RADIO AGE

The Magazine of the Hour

JANUARY 1924

In This Number

Construction of wave trap to make receiver selective.

A Good Neutrodyne Receiver.

How to make a Junior Heterodyne.

Simple Experiments in radio control.

What the Broadcasters are doing.

Complete corrected list of Broadcasting stations.

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May, 1922

—How to make a simple Crystal Set for $6.

June, 1922

—How to make a Receiving Transformer.
—Aerials under ground and under water.
—Electric light wires as auxiliary to radio.

September, 1922

—How to construct the Reinartz Receiver.
—Federal Act regulating radio.

October, 1922

—How to make a Tube Unit for $23 to $37.
—How to make an Audio Frequency Amplifying Transformer.

November, 1922

—Photo-electric Detector Tubes.
—Design of a portable short-wave radio wavemeter.

December, 1922

—Home-made battery charger for $3.00.
—Principles of radio receiving equipment.

January, 1923

—How to make a sharp-tuning Crystal Detector.
—Fixed condensers in home-made receiving sets.
—Description of loading coil for simple sets.

March, 1923

—Layout and drilling for Reinartz Tuner, with amplification.
—How to make the Crystal Set do long distance work.
—How to make an Audio Frequency amplifier.
—Symbols used in radio diagrams.

April, 1923

—The Kopprasch circuit.
—How to make a one-tube loop aerial set.
—A two-circuit Crystal Set.

May, 1923

—How to make the Erla single-tube reflex receiver.
—How to make a portable Reinartz set for summer use.

June, 1923

—How to build the new Kaufman receiver.
—What about your antenna?

July, 1923

—The Grimes inverse duplex system.
—How to read and follow symbols.
—Proper antenna for tuning.

August, 1923

—Construction of the Cockaday four-circuit tuner.
—An efficient two-stage amplifier.
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September, 1923

—How to load your set to receive new wave lengths.
—Simple Radio Frequency Receiver.

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—The Four-Tube Neutrodyne.
—Your First Tube Set.

November, 1923

—The Super-Heterodyne.
—A Three-Circuit Tuner.
—How to Learn Code.

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—Building the Haynes Receiver.
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RADIO AGE

The Magazine of the Hour

(Established March, 1922)

Volume 3 *JANUARY, 1924* *Number 1*

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Radio Age is published monthly by
RADIO AGE, Inc.

Publication office, Mount Morris, Ill.
Editorial and Advertising Offices, Boyce Building,
500 N. Dearborn St., Chicago

FREDERICK SMITH, *Editor*
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First National Bank Building, Chicago

Eastern Representatives
E. V. HEVEY & COMPANY
17 West 42nd Street, New York City
Telephone, Longacre 1698

Advertising forms close on the 15th of the month preceding date of issue

Issued monthly. Vol. 3, No. 1. Subscription price $2.50 a year.
Entered as second-class matter September 15, 1922, at the post office at Mount Morris, Illinois, under the Act of March 3, 1879

Our Unique Record

WITH this issue our magazine enters its third calendar year. We established it in the early spring of 1922 with a firm belief in the steadfastness of public interest in radio and results have amply justified our faith. We have attained a substantial prosperity and as you readers have been partners in our enterprise, we believe it not out of place to tell you just how we accomplished it.

In the first place we regarded the selling of advertising space as of secondary importance. The primary object was to print a magazine that radio fans would actually need in their home experimentation and in the construction of receiving sets and accessories on their own work benches. Our growth from 10,000 to present figures with subscriptions and sales increasing rapidly from month to month, proves that our idea—service to readers first—was a sound one.

No inconsiderable financial burden is involved in the writing, editing, illustrating, printing and distribution of 50,000 forty-eight page magazines every thirty days. Outside of printing costs, white paper bills, administration expenses, engraving costs, express and postage there are scores of incidental items to swell the monthly total. Yet, like the Miller of the Dee, we owe no man a penny and our bankers greet us with a daily smile. Fans throughout Canada and the United States have built up RADIO AGE and they are adding to the structure every day. It is a readers' book.

It is inevitable, with such a showing for this publication, that advertisers will want increasing space in which to convey their message to our 100% circulation. That brings us up to the most important point we wanted to make. With new advertising, additional pages will be added to the magazine so that the present generous allotment of space for readers will increase rather than diminish. We never had an ambition to edit or publish a catalogue.

Wishing you a happy and prosperous New Year—

Frederick Smith

—Editor, RADIO AGE

"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"

Radio has moved from the laboratory and amateur's work-table out into the refined surroundings of the family living room. In keeping with this new companionship we offer this reliable, long-lived Eveready "B" Battery, in an attractive, new metal case, worthy to stand beside the rich cabinets of fine radio sets.

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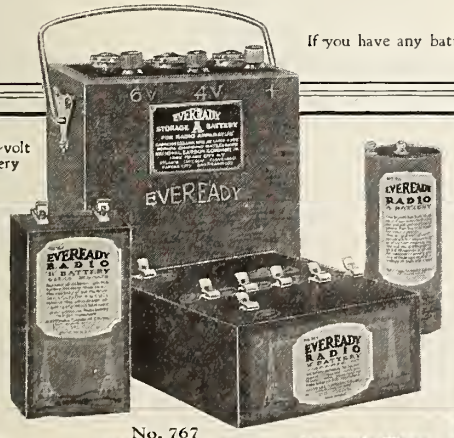

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You Cannot Keep Radio Secrets from the Women

At the top is Miss Rachel M. Thompson, of Boston. She is a graduate of a radio school and lectures to boys on radio subjects. (Keystone Foto). At the bottom is Miss Catherine Jay Moore, first American girl to pick up English broadcasting stations. (Kadel & Herbert Foto). At the right is another picture of Miss Moore. She is adjusting the aerial on the roof of her New York home.

RADIO AGE
"The Magazine of the Hour"
M. B. SMITH, PUBLISHER
PUBLISHED MONTHLY
FREDERICK SMITH, EDITOR

Tuning Out Interference

By FELIX ANDERSON

Technical Assistant, Radio Age

INTERFERENCE is the bugaboo of the radio pastime. Every time the average listener turns on the filaments of his radio set, he has to contend with this difficult element in the course of his enjoying the delightful programs and entertainment provided by the great institution of broadcasting, and not infrequently has he turned away from the receiving set with some savage invective concerning the inefficiency of his receiver or the inadequate system of wave allocations.

The entire broadcasting system is based upon the assigning of waves as widely different as possible to stations in close proximity, in order to maintain a well balanced system of wavelengths to keep the disorder caused by the clashing of undesired frequencies down to a minimum. In large cities where more than one powerful station is operated, the popular method seems to be an agreement between the various broadcasters as to the division of the periods of the day when certain stations are permitted to broadcast.

This system usually is efficient as far as local broadcast listening is concerned, but to some fans, the thing seems a poor arrangement, due to the fact that he has no chance to listen to programs from distant transmitting stations. Many cities provide a specified night for the reception of out-of-town stations. In Chicago, this "silent night" has proven a popular evening among owners of high-powered receivers who are assured of programs from many directions.

But the average BCL is not satisfied with only one night a week to listen to out-of-town programs, and in spite of the powerful interference created by his local station, will endeavor to reach out-of-town stations almost any time he operates his set.

If his set is one of close tuning properties, the feat can easily be accomplished, but more often it happens to be one of the single circuit type, a type very popular with the newly initiated due to its extreme simplicity of tuning, construction and the exceptional volume it affords, and the result is a bad perspective on the merits of radio listening. With a single circuit set operated in close proximity to a powerful broadcasting station, the business of tuning is likely to be a farce. The signal of the local station can usually be heard over the entire tuning range of the set, and even if a distant station can be tuned in, it is usually so badly distorted and intermingled with noises and squawks from the local station that its entertaining value is lost.

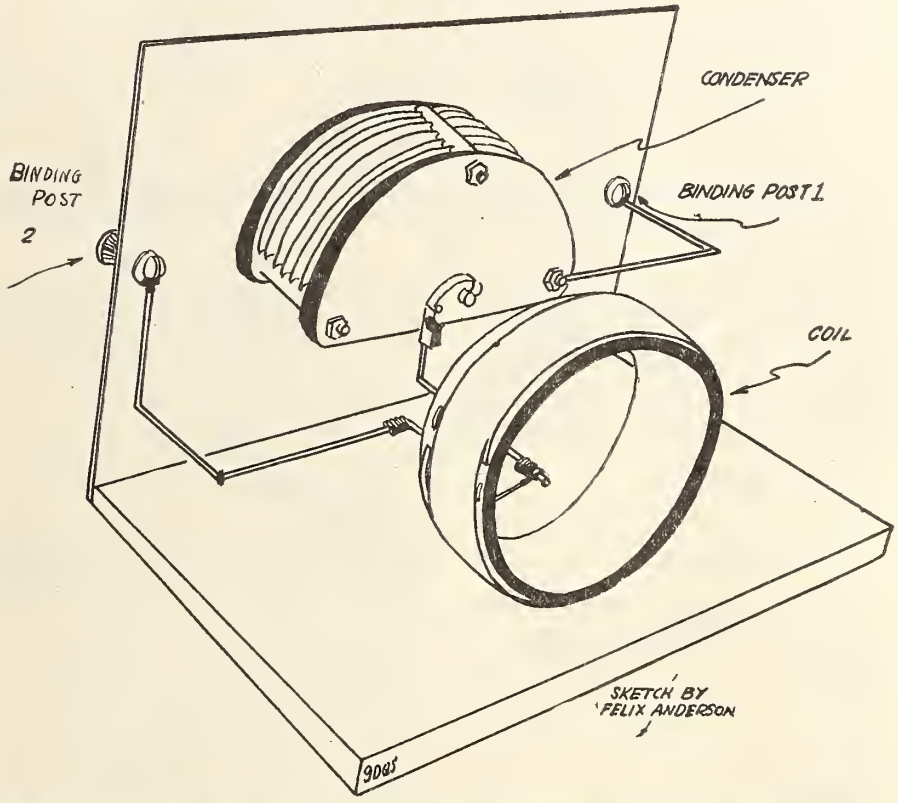


Figure 1. Isometric sketch of the Simple Series Eliminator. The condenser is a 23-plate, and the coil has 40 turns of No. 28 DCC wire wound on a three-inch cardboard tube A filter of this type is useful in assisting to tune out interference from nearby stations.

With the intention of alleviating the nuisance of interference to a minimum, the writer has compiled the following data to be applied to specified forms of interference, squawks, noises, howls, etc., and sincerely hopes that it may be the solution of the problem for many readers.

Antennae

Under first consideration comes our old friend, the antenna. For those who live at a reasonable distance from broadcasting stations and who are using tuners of either the single circuit or four circuit or any other type of set which tunes moderately closely, and who experience only little or occasional interference, it is recommended that they merely cut down on the length of their antennas.

At a slight sacrifice in signal strength, the antenna may be reduced to eighty-five or ninety feet, including lead in, and the selectivity of the set increased materially. This applies to any type of receiver. With a two variometer variocoupler (three circuit) receiver, the operator can then tune out any station at will, providing the interference is not on the same wave as the one to which he is tuning. Usually this slight change will solve the problem for the average BCL who fortunately has been accorded with a location where he may listen to programs from any such stations as he may care to tune.

On the other hand, we have the fellow who lives about two blocks from a five-

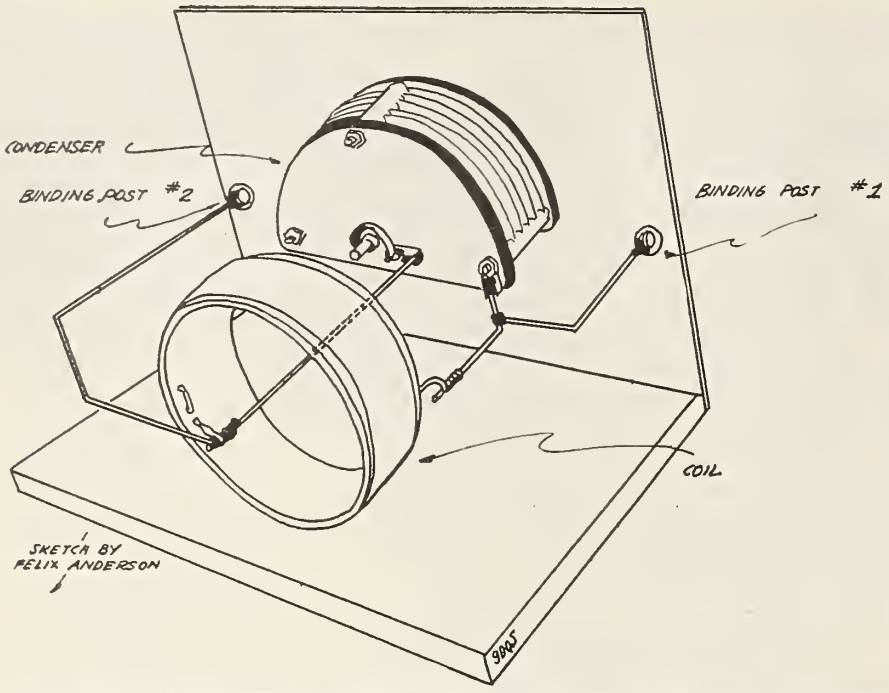


Figure 3. An isometric sketch of the wave trap, showing the method of connecting and arranging the apparatus. The wave trap is a useful instrument for tuning out many kinds of interference.

hundred watt broadcasting station, with resultant harmonics from the guy-wires of the station, the transmitter itself, and from signals reradiated by his neighbors' receivers. His problem is "a horse of a different color," but can usually be taken care of by using what is known as a

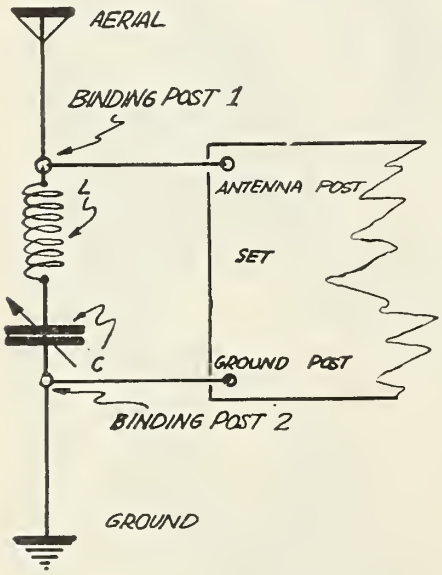


Figure 2. The electrical connections of the Simple Series Eliminator.

Simple Series Eliminator

The simple series eliminator, consisting of a filter or a series capacity-inductance circuit, connected across the antenna and ground posts of the receiving set, is of material assistance where a broadcasting or spark station is strong enough to render the tube inoperative. It is also useful in assisting to tune out spark stations on waves materially longer or shorter than the desired frequency.

This simple unit is composed of a good twenty-three plate condenser, preferably with a vernier, and a one microhenry inductance coil. The coil may be home made by winding about forty turns of No. 28 DCC wire on a cardboard tube, three inches in diameter.

The action of this type of filter is to provide a path whereby the interfering signals may be shunted off to the ground and not enter the receiving set. A filter of this type is not exceptionally close tuning, but will help matters along greatly as stated in the aforementioned cases.

The connections of this type of filter are shown isometrically in Figure 1, and the electrical connections to the receiving set in Figure 2. The binding post shown numbered as Binding Post 1 should be connected to the antenna, and then to the antenna post of the receiver, while number two should be connected to the ground post of the receiver.

Care should be taken in the construction of this unit, as careless construction

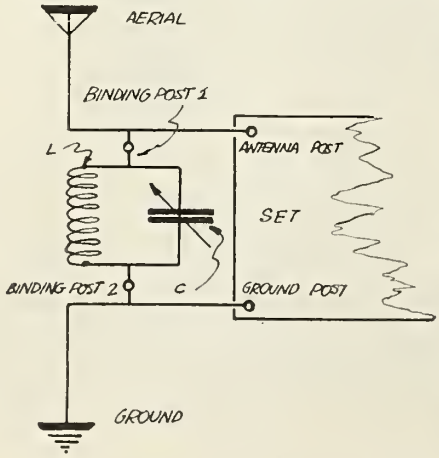


Figure 5. This shows another method of connecting the wave trap to the receiving set.

may result in losses which may offset the merits of the filtering action.

The Wave Trap

The wave trap, sometimes called an "anti-resonant circuit," also is useful in tuning out undesirable signals of the broadcasting type.

The apparata used in this unit are: one twenty-three plate venier condenser, one coil of 42 turns, wound on a three-inch untreated cardboard tube, a panel, cabinet and binding posts.

The apparatus is arranged on the panel as shown in Figure 3, and should be connected to the set as shown in Figure 4. Binding Post 1 is connected directly to the antenna, while No. 2 is connected to the antenna post on the receiving set.

This unit instead of being tuned to the frequency of the desired signal is tuned to the wave of the interfering signal. It will be noted that when the condenser of the trap is turned, the signal will diminish in strength until it disappears and then gradually increase again until it is restored to normal value.

The trap should be adjusted to the point where no signal from the interfering station is heard. The receiver is then tuned to any other wave except

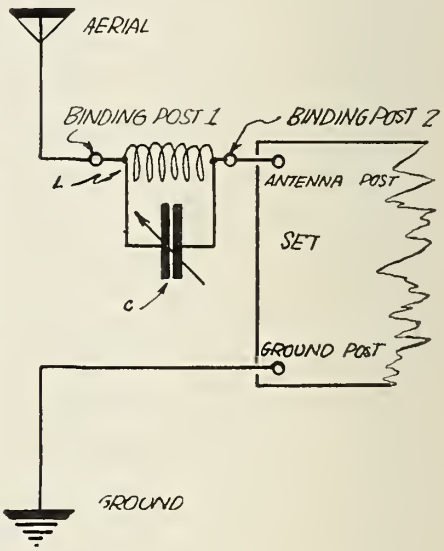


Figure 4. The wave trap is connected in series with the aerial and set as shown herewith. The construction of this unit is described in detail in the accompanying article.

the one to which the wave trap is adjusted.

The action of a filter of this type is that when it is tuned to resonance with the interfering signal, a local current flows around it, setting up a potential across its terminals almost strong enough to counteract the incoming wave from the interfering station. This action virtually obliterates any current of the interfering wave, and very little of it gets into the receiving set. If the station is exceptionally strong, one or more of this type of trap may be placed in the antenna lead, and tuned to the same wave or to separate waves which are causing interference.

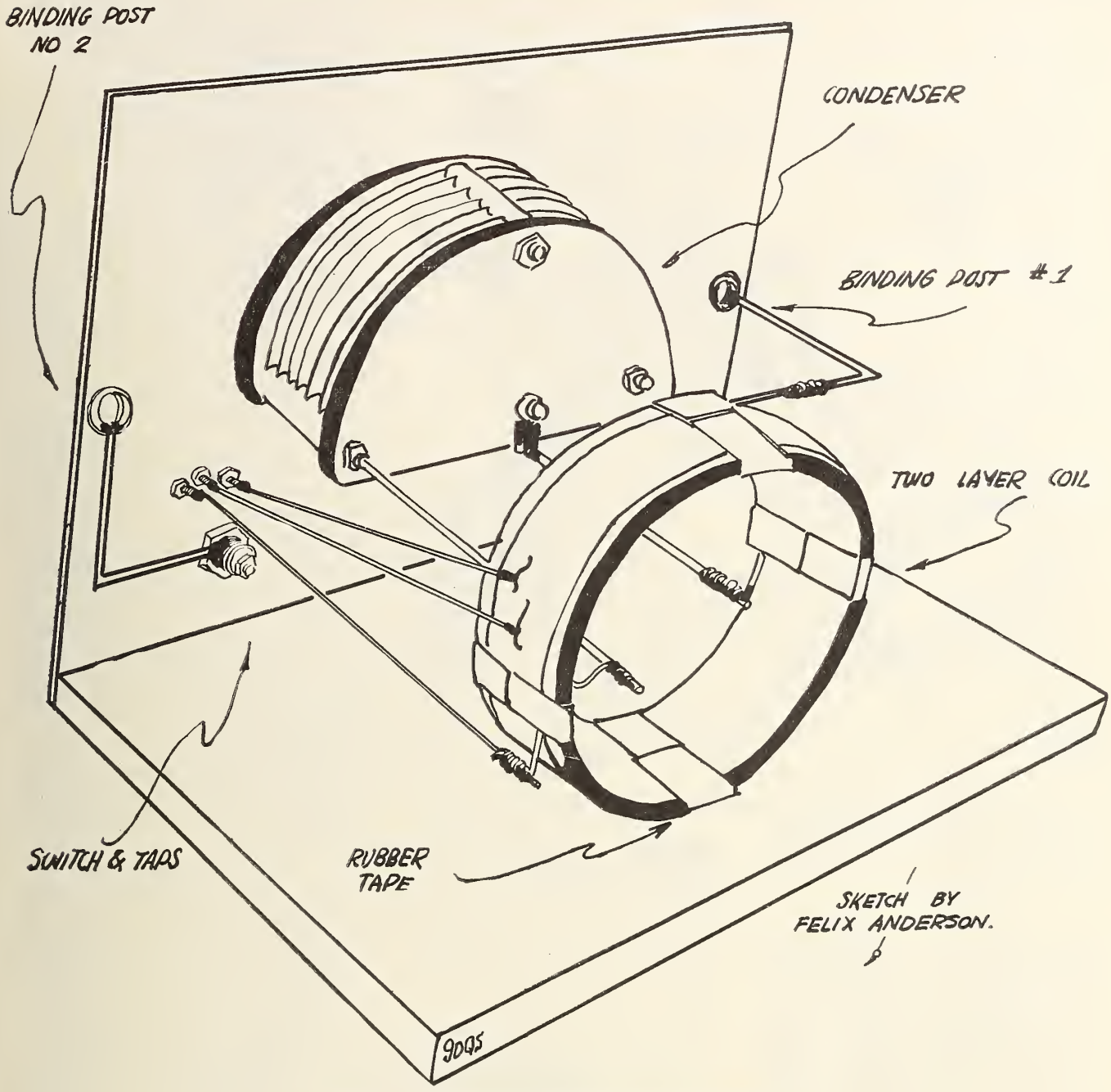


Figure 6. The isometric arrangement of the Eliminator.

The extreme flexibility of this type of filter makes it a popular type of arrangement used to eliminate interference. When connected to the antenna in this manner, however, it is of little use in tuning out spark stations and to gain this additional advantage the filter must be connected into the circuit as shown in Figure 5. The Binding posts, numbered 1 and 2, are connected to the antenna and ground posts of the receiver, respectively. The filter or trap then becomes an acceptor, and shunts the signal, to which it is tuned, off to the ground, allowing the signal we want to pass on to the remainder of the set where it is amplified, rectified, distorted, etc. However, the usefulness of the wave trap is limited to the eliminating interference of stations or signals which are separated by a rather wide band of waves, and cannot be used efficiently where only a few meters discrepancy exists between the interfering and the desired signal. This type of interference is a rather difficult problem, but can readily be handled by a filter of the coupled inductance type.

The filter illustrated isometrically in Figure 6 is about the most efficient possible arrangement available for tuning out interference from broadcasting stations or other stations using continuous wave transmitters. It really weeds out signals not wanted to a degree where tuning may be accomplished to within wavelengths differing by about one per cent of the desired signal, and therefore we will call it an "eliminator."

The Eliminator

The eliminator has many advantages over the other types of filters. Instead of placing the filter directly in the antenna circuit it is coupled to the aerial circuit on the same principle of the variocoupler. The aerial is inductively coupled to the filter with a small coil of wire wound directly outside of the filter coil. The inductive relation between the two coils and the capacity (condenser) are the components used to trap the interfering signal.

The apparatus required in the course of construction of this type of filter are as follows: one twenty-three-plate variable condenser with vernier; one bakelite panel; two binding posts; one switch lever; three switch taps; two feet of rubber insulating tape; one cardboard tube about three inches diameter and three inches long; about seventy feet of No. 28 DCC wire; about eight feet of No. 24 or 26 DCC wire; empire cloth

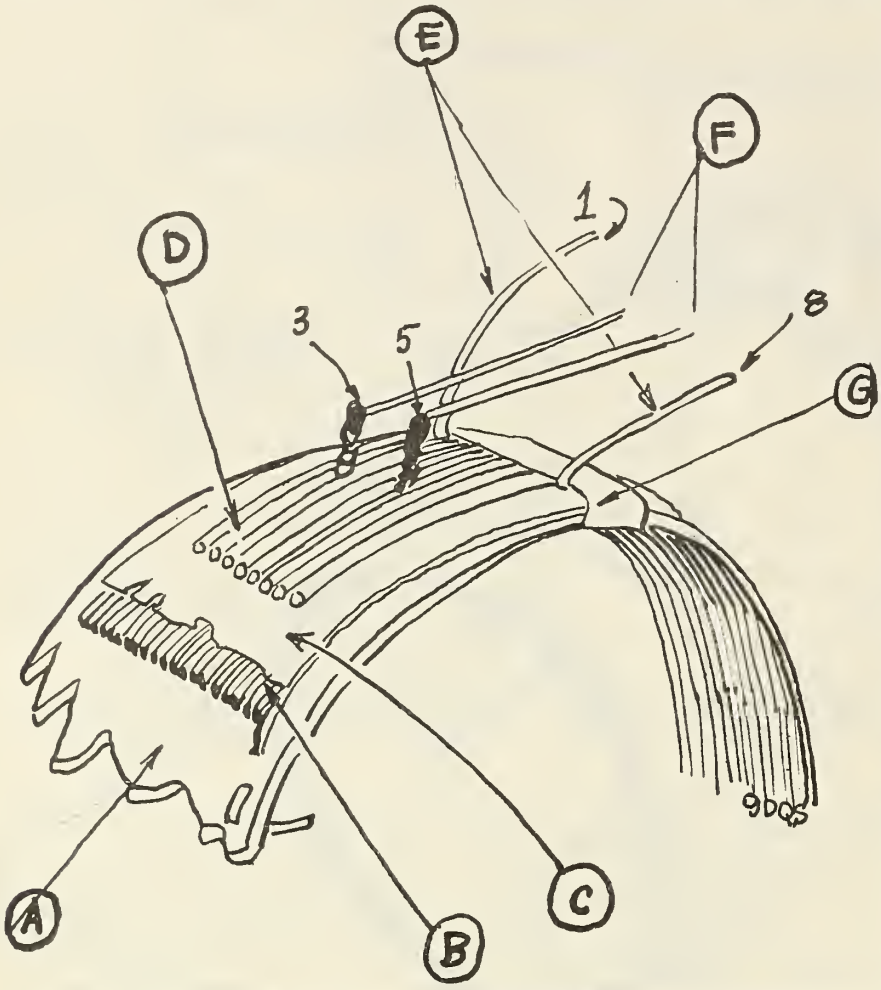


Figure 7. This shows the method of winding the inductances used in the Eliminator. Full details in accompanying article.

or dry writing paper; busbar, solder and other accessories.

Construction

The construction of a filter of this type is a little more difficult than any of the ones described in the preceding paragraphs, but at best, the Eliminator is a simple piece of apparatus.

The cardboard tube on which to wind the coils should be thoroughly dried and some moisture-proof compound should be applied. Soaking the tube in hot paraffine is good, as is shellac or collodion (airplane wing dope).

Punch two holes about three-fourths of an inch from the side of the tube and wind about 40 turns of the No. 28 DCC wire running the finishing end through two more holes punched near the finish edge of the coil. Over this wrap three or four turns of the empire cloth or writing paper and then start winding the primary (antenna) coil.

The antenna coil consists of eight turns of the No. 24 or 26 DCC wire. Wind three full turns, and then bring out a small loop for a tap, wind two more and twist another tap, and then finish the coil by winding the remaining three turns, leaving ends at both the start and finish of the coil for connecting purposes. The taps three and five and the finish end of the coil are connected to the three switchtaps on the panel. Figure 7 shows the winding of the coil in cross section, with the following legend applying to the letters. A is the cardboard tuning, B the 40 turns of No. 28 DCC, C is the layer of writing paper or other insulation, D is the antenna coil, E the first and eighth turns on the antenna coil, and G is a strip of insulating rubber tape used to bind the coil together. Three and five are the taps brought out to the switchtaps.

Connect the forty turn coil ends to the condenser terminals as shown in Figure 6. After making sure that the coils are wound in the same direction, connect the first turn to Binding post 1 and the third, fifth and eighth turns to the switch taps in order. The switch lever is then soldered to Binding post 2. This completes the wiring of the Eliminator. Simple, isn't it?

How to Use the Eliminator

If you are having trouble with broadcast interference, fasten Binding post No. 1 to the antenna, and Binding post No. 2 to the set, and tune the filter to the interfering wave, in the same manner as described for the wave trap. Then let it alone and forget it for the rest of the evening. Connections illustrated in Figure 8.

If you experience trouble with spark, *AC hum*, or *arc light* interference, connect the Eliminator as shown in Figure 9, and notice how much better the set tunes. When using the Eliminator in this way, it will usually entirely squelch the interference caused by a broad spark set.

A combination of the two arrangements may be used as shown in Figure 10, and if it still leaks through, there is something radically wrong with the adjustment of the transmitting stations wave.

General Suggestions

The secret of these filters lies in constructing them carefully, with low loss apparatus. In choosing a condenser, it would be wise to acquire one that has the rotary plates connected to the end mounting, and having but little insulating dielectric which is so placed to assure but little leakage. Verniers of the friction type or gear type are to be desired over those having separate vernier plates.

Above all, do not dope the wire of the

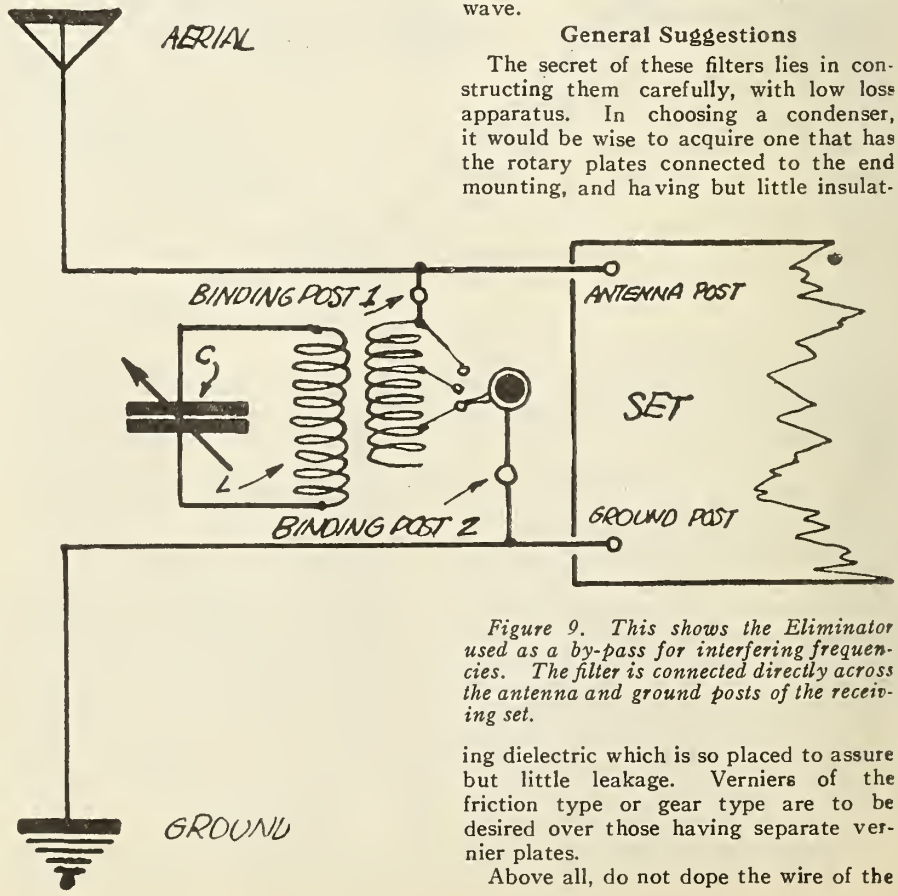


Figure 9. This shows the Eliminator used as a by-pass for interfering frequencies. The filter is connected directly across the antenna and ground posts of the receiving set.

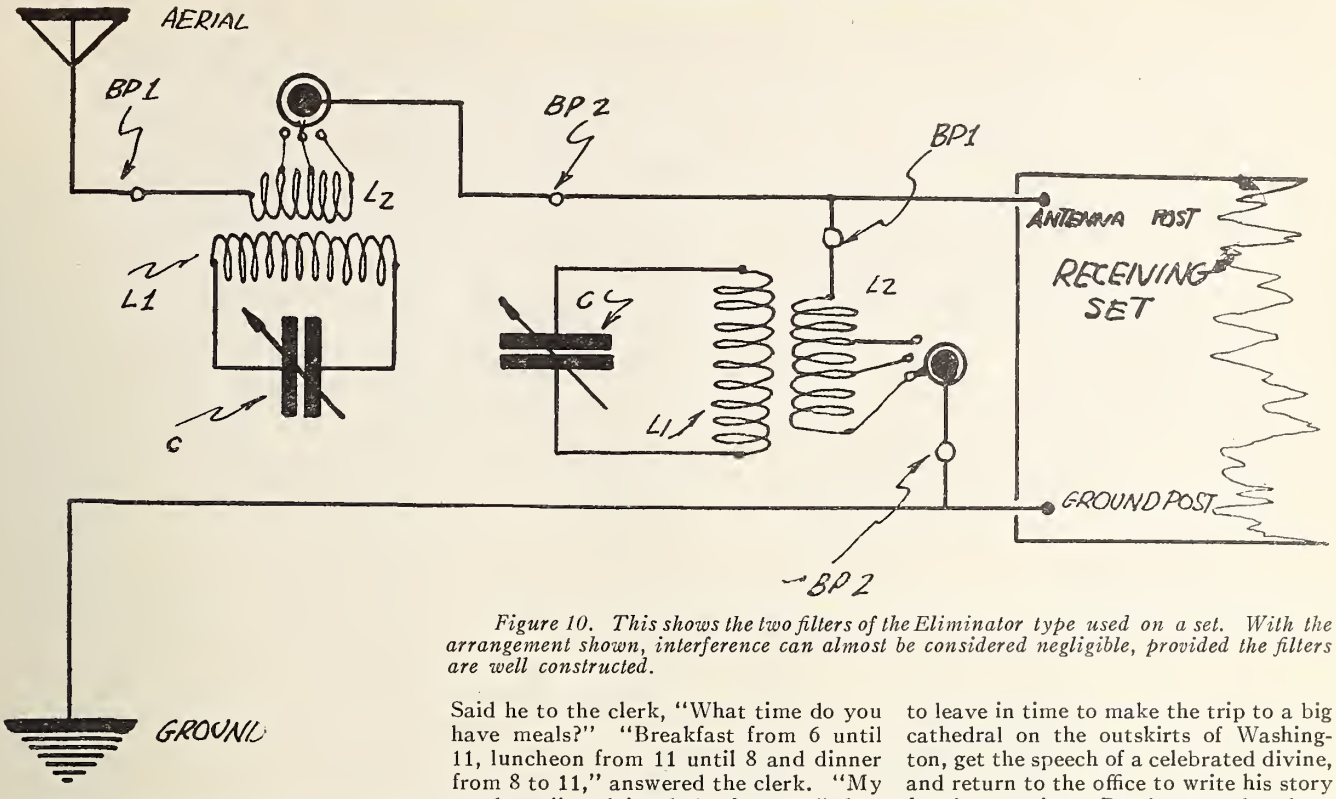


Figure 10. This shows the two filters of the Eliminator type used on a set. With the arrangement shown, interference can almost be considered negligible, provided the filters are well constructed.

coils, and make all connections solid with solder and flux, cleaning the contact points well to cut down the high frequency resistance of the entire unit.

These little details may not be noticeable if you make them one at a time, but counting them together, probably will make a great difference in the tuning qualities of the filter as a whole.

Remember that no man can tune out a station if it happens to be plop on the wave you are listening on. If station ABC is transmitting on the same wave as XYZ at the same time, there is no receiver that will efficiently tune either of them out.

Intelligent operation of these units and familiarization with their various traits is necessary just as much as patience is necessary in the process of learning to tune a new receiving set.

The writer would be pleased to hear from readers who construct any of these types of interference preventers.

Radio Widowers

WEAF has received a number of letters of complaint from anxious husbands who find that their wives are neglecting their household duties because of the radio. One radio listener wrote requesting WEAF's schedule to be changed so that broadcasting only take place on alternate evenings in order that she have ample opportunity to catch up with her regular duties. It is understood that no one is compelled to listen to WEAF but those who do so may gain sufficient profit from the Thursday morning programs especially arranged for women to make up for the time lost on other hours of the schedule.

"An old farmer inherited some money." wrote one of WEAF'S listeners, "and went to the Waldorf to spend some of it." Said he to the clerk, "What time do you have meals?" "Breakfast from 6 until 11, luncheon from 11 until 8 and dinner from 8 to 11," answered the clerk. "My goodness," exclaimed the farmer, "when do you expect me to see the city?"

And then the writer went on to say: "The point is, if WEAF gives such wonderful programs all day and half the night, when am I going to do my housework and shopping? It is all too good to miss!"

Radio Saves Reporter

A somewhat tardy reporter, although it must be admitted, one with initiative, saved himself from being scooped on a local Capital story, through using his head and radio. He may have saved his head also.

It was Sunday. He had tickets to an entertaining matinee. He went intending to leave in time to make the trip to a big cathedral on the outskirts of Washington, get the speech of a celebrated divine, and return to the office to write his story for the morning. But he stayed so long at the theatre, he could not get to the cathedral in time, even with a taxi or an airplane.

Suddenly he recalled that WCAP was broadcasting the ceremonies and that there was a receiving set at the Press Club. He was saved. Rushing to the club, he tuned in, and leisurely made notes during the discourse of the speaker. Later at the office he pounded out a neat half column and went home; saved by the radio—if the city editor doesn't find it out.

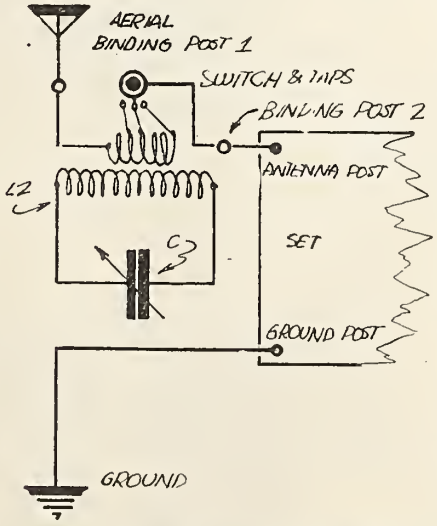


Figure 8. This shows the method of connecting the Eliminator to the receiving set. The Eliminator is the best all-around unit known as yet to tune out interference from any source.

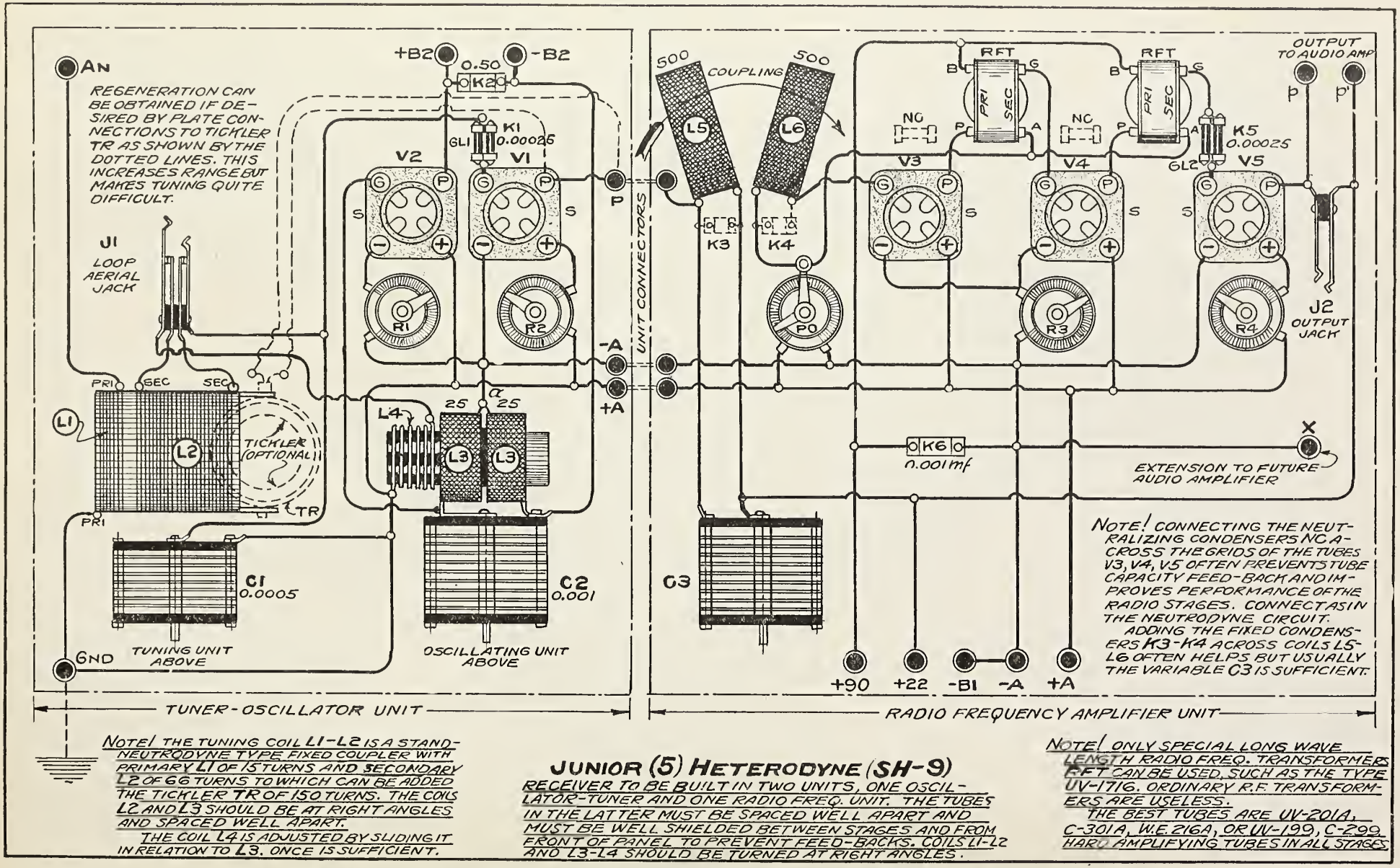
Panel Treatment

For the old panel that you have grown tired of looking at—for the new panel that you know will soon become thumb-printed and for the rest of them, try this stunt to treat the surface and get in return, that dull finish and one that is easier kept neat and clean and something out of the ordinary.

For the first treating, secure very fine sandpaper or emery cloth and rub down until the entire finish is removed. Carefully brush all the dust off after this and with a soft cloth, apply thin oil and rub until it has disappeared.

After this comes the finishing coat which must be applied in only one direction and that, the lengthwise of the panel. Fine steel wool rubbed the long ways of the panel gives or rather leaves the grained finish yet a dull lustre appears. One's own judgment must be used when the panel has been sufficiently polished in this manner.

This application is especially recommended for the amateur who scratches up the panel in boring out the holes for the radio parts. This will cover up a multitude of sins in that direction and must always be done when the panel is unmounted.



NOTE! THE TUNING COIL L1-L2 IS A STANDARD NEUTRODYNE TYPE FIXED COUPLER WITH PRIMARY L1 OF 15 TURNS AND SECONDARY L2 OF 66 TURNS TO WHICH CAN BE ADDED THE TICKLER TR OF 150 TURNS. THE COILS L2 AND L3 SHOULD BE AT RIGHT ANGLES AND SPACED WELL APART.

THE COIL L4 IS ADJUSTED BY SLIDING IT IN RELATION TO L3. ONCE IS SUFFICIENT.

JUNIOR (5) HETERODYNE (SH-9)

RECEIVER TO BE BUILT IN TWO UNITS, ONE OSCILLATOR-TUNER AND ONE RADIO FREQ. UNIT. THE TUBES IN THE LATTER MUST BE SPACED WELL APART AND MUST BE WELL SHIELDED BETWEEN STAGES AND FROM FRONT OF PANEL TO PREVENT FEED-BACKS. COILS L1-L2 AND L3-L4 SHOULD BE TURNED AT RIGHT ANGLES.

NOTE! ONLY SPECIAL LONG WAVE LENGTH RADIO FREQ. TRANSFORMERS RFT CAN BE USED, SUCH AS THE TYPE UV-1716. ORDINARY R.F. TRANSFORMERS ARE USELESS.

THE BEST TUBES ARE UV-201A, C-301A, W.E. 216A, OR UV-199, C-299 HARD AMPLIFYING TUBES IN ALL STAGES.

DIAGRAM FOR WIRING AND ASSEMBLING THE JUNIOR HETERODYNE

A Junior Super-Heterodyne

By JOHN B. RATHBUN

DURING the past twelve months we have witnessed a number of rapid and radical changes in radio fashions, particularly in the design of high power multi-tube sets, and from all present indications we are getting all set for still another radical departure —the super-heterodyne circuit. During last December (1922), the majority of the radio experimentalists were busily employed in tinkering with straight radio frequency or with the Armstrong super-regenerative circuits. The "super" circuits in most cases did not live up to expectations and by the first of the year all interest in this receiver had practically died out. The straight radio frequency circuits of that period were far from satisfactory. Hence, when the reflex circuit was announced, the tinkersmiths went at the new problem with great enthusiasm.

After "reflexing" all spring and part of the early summer, and after we were getting up to the point where we could show some real results with the reflex receiver, up popped Hazeltine's neutrodyne. At last we had found a solution for our former difficulties with the straight radio frequency hook-ups and the neutrodyne went merrily on, and in fact is with us today as one of the most prominent of hook-ups. While the neutrodyne proved a far more satisfactory circuit for the beginner than the R. F., or reflex type, yet there was something lacking that discounted it in the eyes of the more advanced students of radio. We soon found that the neutrodyne had very certain limitations and therefore determined to go farther afield to find the ideal in the super-heterodyne. Whether the latter will prove as practicable and popular as the neutrodyne is still a question, but there is one thing certain, and that is, no other existing circuit can hope to equal it in efficiency and performance.

Strictly speaking, the super-heterodyne is far from being a new circuit, but owing to the complication and expense of building it in its original form, it was so seldom spoken of that it is a decided novelty to the radio novice. The very mention of it was sufficient to send goose pimples down the spine of the unitiated until about a month ago when the first real attempts were made at the simplification of the circuit. Very possibly it will be as familiar to the novice within the next month or so as the straight regenerative or reflex circuits—there is no real reason why this should not be the case. At any rate, the super-heterodyne is the new star on the radio horizon and it will therefore be well for us to become acquainted with the general principles of the receiver and its simpler practical forms.

Formerly, when one spoke of the "Rolls-Royce of radio" it brought visions of long vistas of tubes and control knobs—

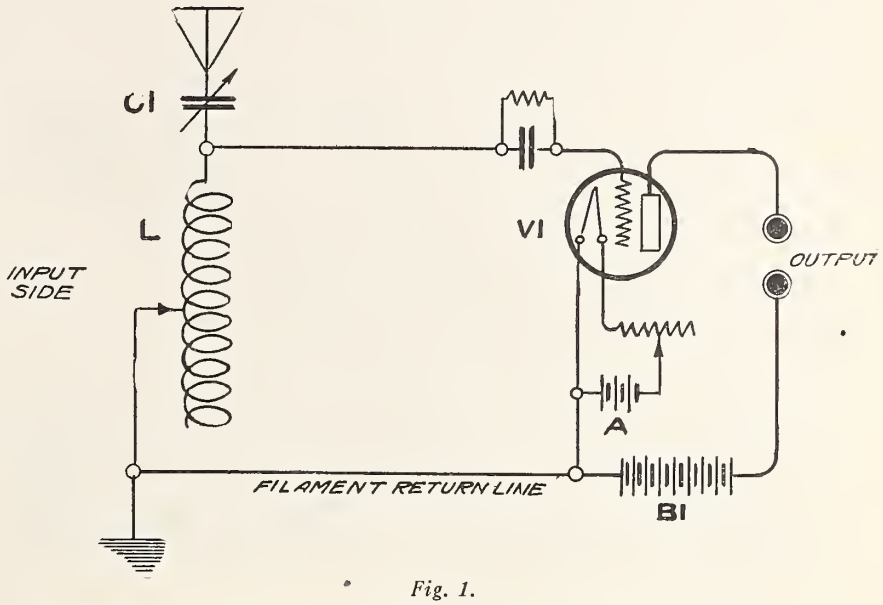


Fig. 1.

a veritable tube exhibit of the first degree. Actually, however, this need not be the case, for the elementary circuit can be made nearly as simple in construction and as easy to control as the more common straight regenerative and at the same time, retain a considerable proportion of its inherent high power of amplification and range. Tube for tube, it will be found far superior to any of the popular high power circuits yet devised, both in regard to signal strength and range. Further, it is not particularly critical or hard to tune, and its great selectivity alone should put it in popular favor even though its other virtues were of the ordinary order.

General Principles

It has long been known that far greater amplification is possible with long wave lengths bordering on 5,000 meters than with the ordinary short broadcasting waves lengths reaching a maximum at about 600 meters. In other words, far greater amplification is attained with a radio frequency receiver on long wave lengths than with short wavelengths. Further, there is one definite wave length on which amplification reaches a maximum in a given circuit, and if the wavelength is above or below this critical value, the amplification will suffer accordingly. This means that the ideal receiver would be confined to one definite wavelength and that a long one when compared with that of the ordinary broadcasting station.

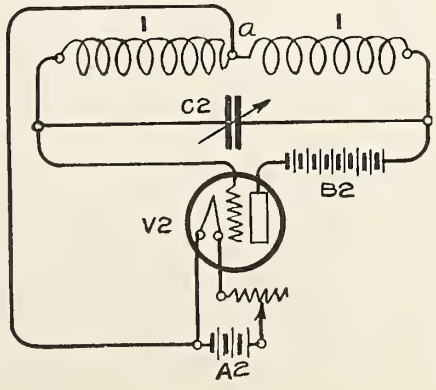


Fig. 2.

With these facts in mind it is at once evident that we must provide some means for converting the various short broadcasting waves into a long wave of constant length before the radio energy enters the amplifying circuit if we are to attain the greatest benefit from our apparatus. In other words we must provide a "frequency changer" for converting the 300 meters of Station X, and the 550 meters of Station Y, into one constant wavelength in the order of 5,000 meters. When this conversion has been performed, the converted radio waves pass to the radio frequency amplifying stages for intensification, thence through the usual detector tube and then through the audio amplification stages, should audio amplification be considered necessary. Back of the frequency changer, we have a circuit which is identical with that of the ordinary radio amplification set. We may have as many radio or audio stages as we desire, or rather as many as we can afford. Even one radio stage, detector and one audio stage are possible.

Before going further with a description of the circuit, we wish to call the readers' attention to the relation between "wavelength" and "frequency." The wavelength of a radio wave is the distance between the peaks of the radio wave measured in meters. The frequency of the wave is the number of complete reversals taking place in the wave per second; that is, the number of times that the wave surges back and forth (two trips) per second. Since the radio wave

progresses at a constant speed forward, approximately 186,000 miles or 300,000,000 meters per second, it will be seen that the wavelength must bear a definite relation to the frequency. In short, the velocity of the wave in meters per second, divided by the wavelength in meters, gives the frequency in "cycles per second" or the number of complete reversals per second. In the description that follows, it is much simpler to speak in terms of the frequency than in terms of the more commonly used "wavelength," but in any event the total result will be the same.

For example, a wavelength of 360 meters corresponds exactly with a frequency of 833,333 cycles per second, 429 meters wavelength corresponds to 700,000 cycles per second, and so on. The longer the wavelength the less will be the frequency in cycles per second, the shorter the wavelength the greater will be the cycles per second. One increases as the other decreases, in direct proportion.

Heterodyning

As before explained, we must first reduce the frequency of the rapid broadcasting wave to a frequency of approximately 60,000 cycles per second (5,000 meters wavelength), before passing the energy to the radio amplifying tubes of the super-heterodyne circuit. Thus, if the station is broadcasting on 429 meters wavelength, we must reduce the station frequency of 700,000 cycles per second to a frequency of 60,000 cycles in the amplifier circuit. This is performed by what is known as the "heterodyne method" in which an interference is produced between the incoming radio waves and the waves or oscillations set up by the "oscillating tube" in the receiving circuit.

By allowing the tube to oscillate at a certain frequency, and combining these oscillations with those of the incoming radio waves (at another frequency) we can obtain a resultant frequency equal to that required in the amplifier circuit. For example, let us say that the incoming waves from the station have a frequency of 600,000 cycles per second, and that the oscillations set up in the circuit by the oscillator tube is equal to 500,000 cycles per second. The resulting oscillations of the combined waves will be equal to the difference of the two frequencies or: 600,000 − 500,000 = 100,000 cycles per second. This means that the oscillations have been reduced from 600,000 to 100,000 cycles per second in the amplifier circuit. By adjusting the oscillator tube by means of a variable condenser any desired resultant frequency can be obtained in the same way.

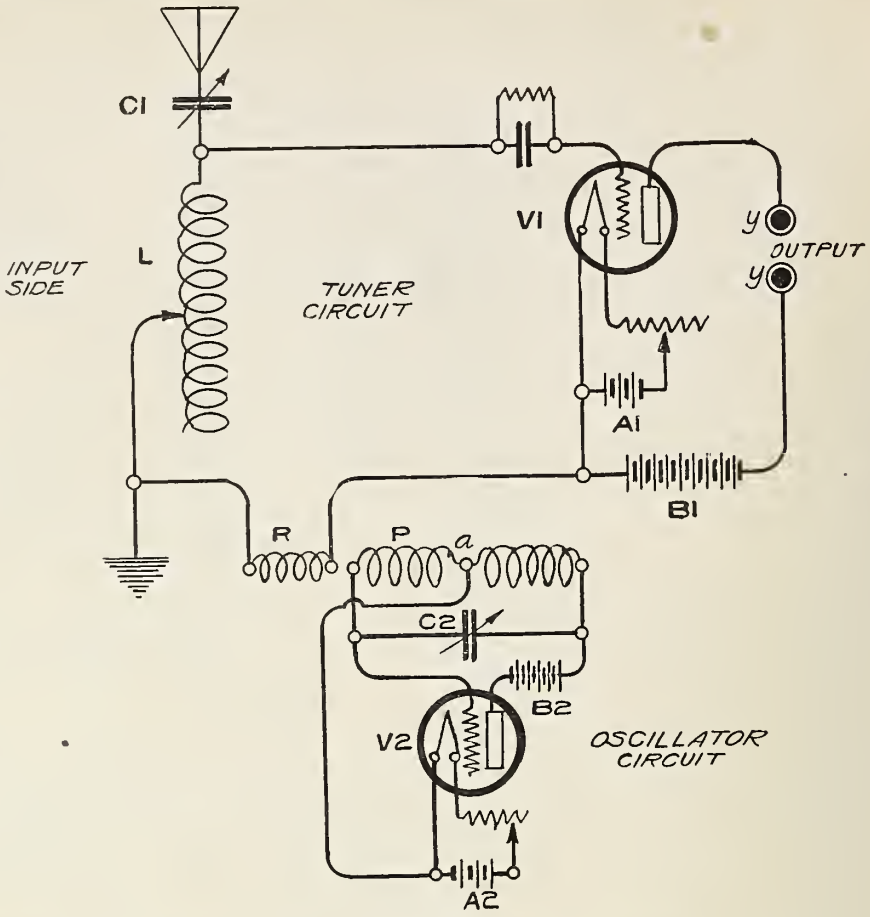


Fig. 3.

The oscillator circuit is the distinguishing feature of the super-heterodyne and is an essential part of the system. Electrically, the oscillator is quite simple as it consists of an inductance coil, an ordinary amplifier tube and a variable condenser, all of which are inductively connected to the usual tuning circuit through a few turns of wire somewhat like a fixed condenser. Varying the capacity of the circuit by means of the variable condenser varies the oscillation frequency of the tube. We now have two principal controls, (1) The tuning devices of the usual type, and (2) The control of the oscillator circuit or of the amplifier frequency.

Simple Oscillator-Tuner Circuit

An ordinary simple tube receiving circuit is shown by Figure 1 where (L) is a simple slide tuning inductance, (C1) is the primary tuning condenser and (V1) is the detector tube. You have seen this typical circuit hundreds of times if you have read RADIO AGE regularly. It is just an old-fashioned nonregenerative circuit first shown alone so that further developments can be more easily followed. This is the "tuning circuit," which of course can be modified by the substitution of a variocoupler for the inductance (L).

In Figure 2 we have the "oscillator circuit" drawn out alone where (I) is the inductance coil, with a connection (a) to the mid-point of the winding. The oscillator tube is (V2), and the variable condenser used for controlling the frequency of the oscillations is at (C2). So far—so simple. The oscillator tube is supplied with the "B" battery (B2) which is entirely independent of the battery (B1) in Figure 1.

Since the oscillations of the tube (V2) must be impressed on the tuning circuit, we show the combined tuning and oscillator circuit in simple form by Figure 3. Here the old tuning circuit of Figure 1 and the oscillator of Figure 2 are coupled together inductively by the coils (P) and (R). This is the fundamental circuit of the super-heterodyne shown in its simplest form. The output (y-y) leads directly to the transformers and tubes of the radio frequency amplifier division, and from this point on the rest of the circuit is almost identical with an ordinary radio frequency receiver. We can have any reasonable number of radio frequency stages from this point on, ranging from one stage to five. A second detector tube follows the radio stages, and then comes the audio amplification stages. It should be noted that

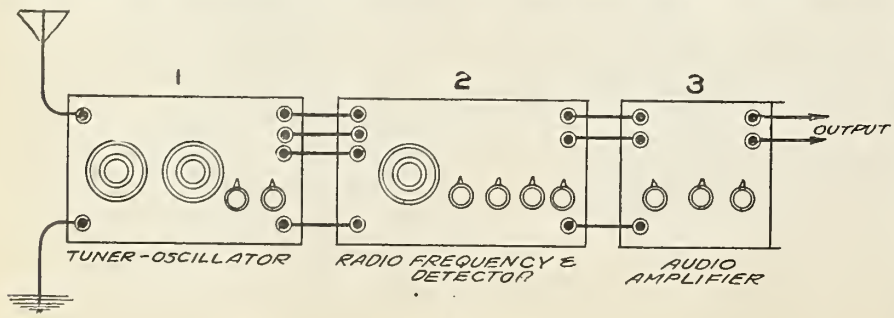


Fig. 4.

the super-heterodyne uses two detector tubes, one in the tuning circuit and one placed after the R. F. stages.

A schematic view of the complete super-heterodyne assembly is given by Figure 4, it being assumed that each of the three principal divisions is contained in a separate cabinet for convenience. In the first cabinet (1) are the oscillator and first detector tubes which give this division the name of the "Tuner-Oscillator Unit." The output of (1) is connected to the input of the "Radio-Frequency Unit" marked (2). Here the radio waves are amplified on the long wave length produced by the first unit, and are then rectified by the second detector tube which is ordinarily placed in (2). The output of (2) is then connected to the input of the "Audio Amplifying Unit" marked (3) where the volume of the sound is augmented by familiar means. The output of (3) then goes to the loud speaker.

It should be particularly noted that almost any type of tuner circuit can be used, either with an outdoor aerial, indoor aerial or loop aerial. Owing to the great powers of amplification possessed by this circuit, the loud speaker can be operated with good volume on stations several thousand miles distance, the exact volume of course depending upon the number of amplifying stages used. For convenience we have shown the ordinary flat-top outdoor aerial in the illustrations.

Radio Frequency Unit

Almost any type of radio frequency hook-up can be worked at (2), resistance coupling, transformer coupling or by tuned impedances. Probably, the transformer connected type with special long wave length transformers is the most common type, but not necessarily the most effective. However, no matter what class of stage coupling is used, there is one thing that we must keep in mind from first to last, and that is, that we are dealing with wavelengths in the nature of 5,000 meters in this circuit and that the ordinary short wavelength transformers and impedances are therefore absolutely useless with the super-heterodyne. The R. F. transformers used in reflex circuits and designed for wavelengths ranging from 200 to 600 meters are a hindrance rather than a help.

Outline of the "Junior"

In presenting the "Junior" super-heterodyne circuit the principal objective is simplicity and economy, with flexibility in regard to future expansion a close second. Starting with five or six tubes as a basis of operations, this being the smallest number of tubes which will insure the performance characteristic of the super-heterodyne, we can afterwards add more radio or audio stages as we may desire without tearing up the tuner-oscillator unit. As with any other circuit, the greater the number of amplifying stages, the greater will be the range and volume, and we can carry this up to ten or twelve tubes if our pockets will bear the traffic.

However, we have assumed that there are but few millionaires among our readers and therefore have confined ourselves to a five tube set, oscillator tube, frequency changer tube, two stages of radio amplification, and detector. If more volume is required, then two stages of audio can be added to the output in the usual manner. As the audio stages are ordinarily installed in a separate cabinet, the addition of these stages will in no way affect the Tuner-oscillator or the radio stages. Regeneration in the tuner circuit undoubtedly increases the effectiveness of the set, but in return makes it very difficult to tune. Every time that the tickler coil is moved, it upsets the rest of the circuit and we must then make a second or third trip over the dials to bring the circuit back into resonance. This feature can be added later if desired, after the builder becomes more familiar with the action of the circuit.

A unit construction has been adopted which makes the set simple to build and makes it much more compact than with the ordinary type of construction. Insofar as possible, the inductances have been mounted directly upon the variable condensers a la neutrodyne. In the near future it is likely that such units can be purchased ready built upon the open market, thus adding to the ease and certainty of construction.

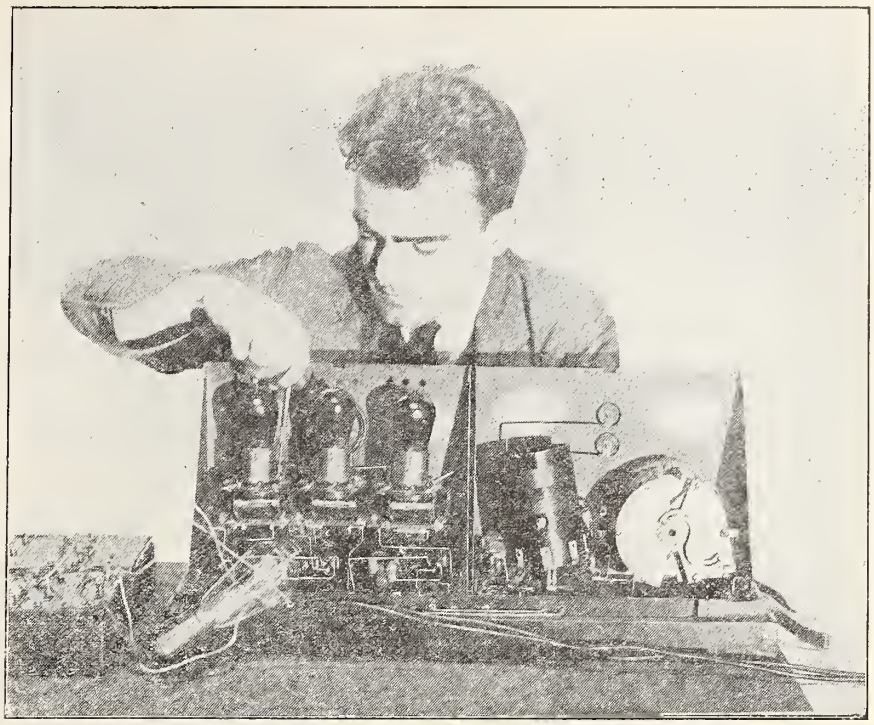
Tuning Circuit

Figure 5 gives the complete circuit diagram of the "Junior" super-heterodyne, and it will be noted that the tuner oscillator unit and radio frequency unit are boxed off in dot and dash lines to indicate the separate cabinets in which the apparatus is installed.

The first circuit to demand our attention is the tuning circuit, and this will be seen to consist of a fixed coupler (L1-L2) of the neutrodyne type which is tuned in the secondary circuit by the variable condenser (C1). The neutrodyne fixed coupler has often been described, but we may say that the primary coil (L1) consists of 15 turns of No. 20 D. C. C. wire wound on one end of a three-inch tube, while the secondary coil (L2) is wound on a 3 1-2 inch tube and consists of 66 turns of the same size wire. The primary winding is now placed inside the tube containing the secondary, and the relation between the coils is fixed by securely fastening the two tubes together at their ends. The tuning condenser is a variable vernier type with a capacity of 0.0005 m. f., and is the only tuning element used.

A UV-201A or a C-301A tube is preferred for the first detector tube (V1). We do not advise the use of dry cell tubes for this purpose. The grid condenser (K1) is the conventional 0.00025 m. f. with a variable grid leak (GL) of the lead pencil mark type. The plate voltage is 22.5 volts.

A two circuit jack (J1) normally connects the coupler into the circuit, but when the loop plug is inserted the coupler is cut out and the loop aerial is automatically connected directly across the condenser (C1). With this arrangement it is a simple matter to change from outdoor aerial to loop and vice versa. For



SAFETY FIRST

Many an amateur radiophan has learned to his dismay that 90 volts "B" battery accidently connected across the filament of the tubes is an expensive mistake. An excellent method for testing, etc. is to hook a 110 volt, regular house lighting bulb in series with the minus lead of the B battery. The bulb acts as a safety valve, allowing the current to pass freely to the tubes on the plate, but should the connection be wrong, only six volts will fill the tube, the excess current being absorbed by the bulb,—result $5 to $40 saved for Mr. Experimenter (Foto Topics).

simplicity, the jack can of course be omitted.

The tuning unit or coupler (L1-L2) can be a commercial neutrodyne coupler, but if home made it is strongly recommended that the coupler be attached permanently to condenser by brass brackets as is done with the neutrodyne sets. This gives compactness which is most desirable in a circuit of this kind.

Oscillator Circuit

Here we get into the distinguishing feature of the circuit, the circuit which produces the oscillations for the heterodyne effect. The inductance (L3) consists of two 25-turn honeycomb coils placed close together with a tap (a) running out from the mid-connection between the coils. They are connected in series and care must be taken that the turns run in the same direction so that they act together and do not "buck." Across the outer ends of the two coils is the variable vernier condenser (C2) with a capacity of 0.001 m. f. (43 plate). One of the outer ends of the inductance is connected to the fixed condenser (K2) which has a capacity equal to 0.5 m. f. or slightly greater.

The tube (V2) is an amplifier tube of the UV-201A type, or even better, a Western Electric 216A. A separate "B" battery (B2) is used for this circuit with a voltage approximating 67 to 90 volts. This battery must be entirely independent of the rest of the circuit, hence is one of the reasons for the high cost of heterodyning.

At one side of the oscillator inductances is the coil (L4) which couples the oscillator circuit to the tuning circuit. It is a coil of about six turns of No. 20 D. C. C. magnet wire, and of course is in inductive relation with the coils (L3). Both sets of coils are supported on a single fiber tube, and the coils (L3) are connected rigidly to the variable condenser (C2) by brass brackets as with the neutrodyne coils. This makes a self-contained and compact unit which requires little space and which is easy to wire.

Radio Frequency Circuit

Coupled to the plate (P) of the first detector tube (V1) are two stages of radio amplification. The two radio frequency transformers are of the special long wave type already mentioned and should have a rated wave length of from 5,000 to 15,000 meters. As these transformers operate constantly on one wave length the requirements are not the same as with ordinary types of transformers, since the latter are designed to cover as large a range of wave lengths as possible. The narrower the band of wave lengths, the greater will be the amplification of the transformers, and without doubt special transformers will soon be on the market which have this most desirable characteristic. The radio frequency amplifying tubes (V3-V4) may be UV-201A or C-301A, and should be provided with rheostats of sufficient resistance to permit of operation on a six volt storage battery. A potentiometer (PO) controls the grid potential of (V3)

It will be noted that the radio stages are coupled to the first detector tube (V1) through tuned coils (L5) and (L6), these coils being so arranged that the distance between them can be varied. Both (L5) and (L6) are 500 turn honeycombs, mounted in a two coil mounting for convenience in varying the degree of coupling. Across each of these coils are the two fixed condensers (K3) and (K4) which have a capacity of 0.0005 m. f. each. These condensers, which should be of the mica dielectric type and accurately calibrated to the specified capacity, can be mounted directly on the coil mounting. This adjustment of the coils is not critical and is easily performed.

The secondary of the last radio frequency transformer is connected in the usual manner to the second detector tube (V5) through the grid condenser (K5) of 0.00025 m. f. capacity and the grid leak (GL2). The plate of this second detector tube is connected to the output jack (J2) and the output binding posts(p-p'). The latter affords a means of connecting a loud speaker into circuit or for hooking on one or two stages of audio amplification as may be desired. It was considered advisable to discontinue the set before the audio stages were added for these can be installed at any time and by conventional audio amplification circuits. We believe, however, that the average constructor will have many thrills with the set the way it is shown before he thinks of adding more stages.

Precautions and Advice

As with every other radio frequency circuit, there is a strong tendency to feed back between stages and to start oscillations in the radio frequency tubes which will not only reduce their efficiency but which may even entirely prevent the functioning of the tubes. For this reason the transformers should be well separated, and as a further precaution the axis of the transformers should be turned at right angles to one another to prevent inductive feed backs through stray fields. For the same reason, the tubes should be well separated from one another and from the transformers as well. Placing well grounded metal shields between the transformers and between the transformers and tubes will minimize such troubles.

It is suggested that the grid neutralizing stunt of the neutrodyne be experimented with on the two R. F. tubes and the second condenser; that is, two of the small "micro-mikes" used for neutralizing the grid should be connected between the grids of tubes (V3), (V4) and (V5). I have not yet tried this arrangement but I believe that it would prove helpful even though it might not be quite so effective as on the shorter wavelengths. In this event we would have a "neutrodyne-super-heterodyne", surely enough name to pull it through if nothing else. The proposed neutralizing condensers are indicated by dotted lines and are given the symbols (NC).

It is of great importance to keep all wires well separated and to prevent running wires parallel to one another for any distance. The sockets should be raised well above the base board to prevent leakage strays from taking place, and if possible, the sockets should rest on a bakelite slab rather than on wood.

We must next be sure that the coils (L3) do not buck each other; or in other words, that the turns on both coils run in the same direction so that the effect is that of a single coil. Coil (L4) can be moved back and forth until the maximum effect is had, and when once this adjustment is had it can be left without further adjustment.

Government Regulation

Radio, which for the first time carried to the continent at large and perhaps Europe and Central America, the President's message, also carried his recommendations for remedial legislation on radio. Echoing Secretary Hoover's request that the laws affecting radio administration enacted in 1912 be revised, the President personally told congress that new legislation regulating radio interference is needed. At present, Secretary Hoover is operating under a sort of "gentlemen's agreement" between commercial, governmental, private and amateur interests, reached last spring during the second National Radio Conference.

Secretary Hoover stated recently that Representative White, who fathered the bill which bore his name last session. will introduce a simplified radio bill this session. The old bill, it is understood, has been reduced to first terms so as to permit of proper interpretation with the development of the art and to give the Secretary of Commerce and his advisory committee liberal and more or less elastic authority over the control of national radio problems. A recent conference between representatives of the government departments was successful in eliminating such points of disagreement as existed heretofore, and the resultant bill was ready to be introduced in the house before the end of this month.

According to Secretary Hoover, the radio interference situation today is far better than it was at the time the original White Bill passed the house last year, due chiefly to the elimination of interference through the voluntary co-operation of the several interests. There is now little interference between the existing broadcasting stations, which are decreasing in numbers.

In general, the President also indorsed the enactment into law of the approved plan of the Joint Committee on the reorganization of the government departments, which places radio under the direction of an Assistant Secretary of Communications, who would have charge of telephone and telegraphs. The post office and the radio section of the Bureau of Navigation of the Department of Commerce would become a part of the Department of Communications, according to the present plan of the Joint Committee.

Before the reorganization is effected, however, all phases of the radio question will probably have been threshed out and its administration may or may not be taken away from the Department of Commerce. The proposed bill, it is understood, carries no suggestion of a transfer of radio to the new Communication Department.

Construction of the Push Pull Amplifier

By FRANK D. PEARNE

THE use of the third step of audio frequency amplification in most any of the standard sets in use today results in distortion of the signal and considerable noise, so much noise, in fact, that the added volume to the signal is of little or no value. These noises are caused usually by the ordinary tube noises in the detector being amplified at the same time the signal is amplified. Even the second stage will sometimes magnify these tube noises to such an extent that they are extremely disagreeable.

If, however, the user would get away from the conventional idea that a transformer of high ratio should be used in the first step, this effect would be considerably reduced. In code reception, more or less distortion does not interfere much with the reception, but when listening to a good musical selection it makes all the difference in the world. It is a well-known fact that the lower the ratio of the transformers used in audio frequency amplification, the less will be the distortion. As each succeeding stage amplifies everything which precedes it, it is only reasonable to expect that if the first stage has a high ratio of amplification and some distortion, that distortion is bound to be amplified in each succeeding stage.

Reversing the Ratios

Therefore, the order of things should be reversed, using the low ratio transformers in the first stages and the higher ratio in the last. This arrangement would cause the first stages to be amplified without distortion, after which it could be stepped up in the higher ratio, with only the distortion of the last stage affecting the loud speaker.

To eliminate the distortion in the last stage and at the same time increase the volume to such an extent that it may be heard two or three city blocks from the receiver, the "push pull" amplifier should be used in the last stage. Until recently, this type of amplification was out of the reach of the broadcast listener, because the special transformers required in its construction were not available. However, during the last month or two, transformer manufacturers have discovered that there is a great field for this product, and it is now possible to get these special transformers made by most all of the reliable manufacturers.

This type of amplifier will produce undistorted signals of enormous volume, providing that the signals presented to it are of good intensity and are clear. It is generally used as a third stage, but owing to its great amplifying power it can be used quite successfully in the second stage if desired.

Connection With Phones

By looking over the accompanying drawing one will notice that the direct current of the plate battery is not applied to the phones, as the secondary of the output transformer is directly connected to them. This greatly aids in obtaining clear reception, as the plate battery noises are eliminated in the phone circuit. The parts may be either mounted in a cabinet, or on a bakelite panel which will lie flat upon the table. The latter arrangement can be made into a very neat appearing outfit, if carefully wired with the parts properly located.

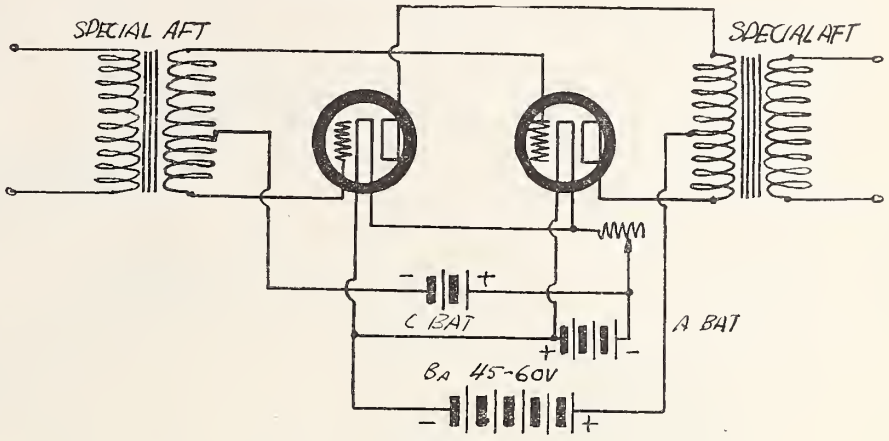


Figure 2.

The material required for its construction consists of the following parts, two push pull transformers, one rheostat, two sockets, two amplifying tubes, one C battery, twelve feet of bus bar tinned copper wire, No. 14, eight binding posts, one bakelite panel, 7 by 10 by 3-16 inches, and four rubber feet.

The resistance of the rheostat will depend upon the type of tubes used. The best tubes for the purpose are the W. E. 216 A and if these are used the rheostat resistance should be approximately 6 1-2 ohms. These tubes are, however, hard to get. The UV-201-A tubes may be substituted in which case, a 25 ohm rheostat should be used.

Making the C Battery

The C battery may be made of flashlight battery cells and the voltage required will depend upon the plate battery voltage used. The pressure of one of these flashlight cells is about 1 1-2 volts and for a 90-volt plate battery, three cells will be sufficient, but if more pressure is used in the plate circuit, the number of cells in the C battery should be increased.

In connecting the C battery in the circuit, care must be used to see that the negative terminal of the cells is connected to the center tap, or the extra binding post on the input transformer. This puts a negative bias on the grids of the two tubes and if the connections are reversed, the amplifier will not work. The No. 14 tinned copper wire is to be used in wiring up the set and any connections which are not made on the binding posts direct, should be carefully soldered to insure perfect contact.

All parts may be fastened to the panel by means of small brass machine screws and nuts and the rubber feet are to be fastened, one under each corner, so that the panel will be raised slightly from the table and the entire weight of the amplifier will come on the rubber feet.

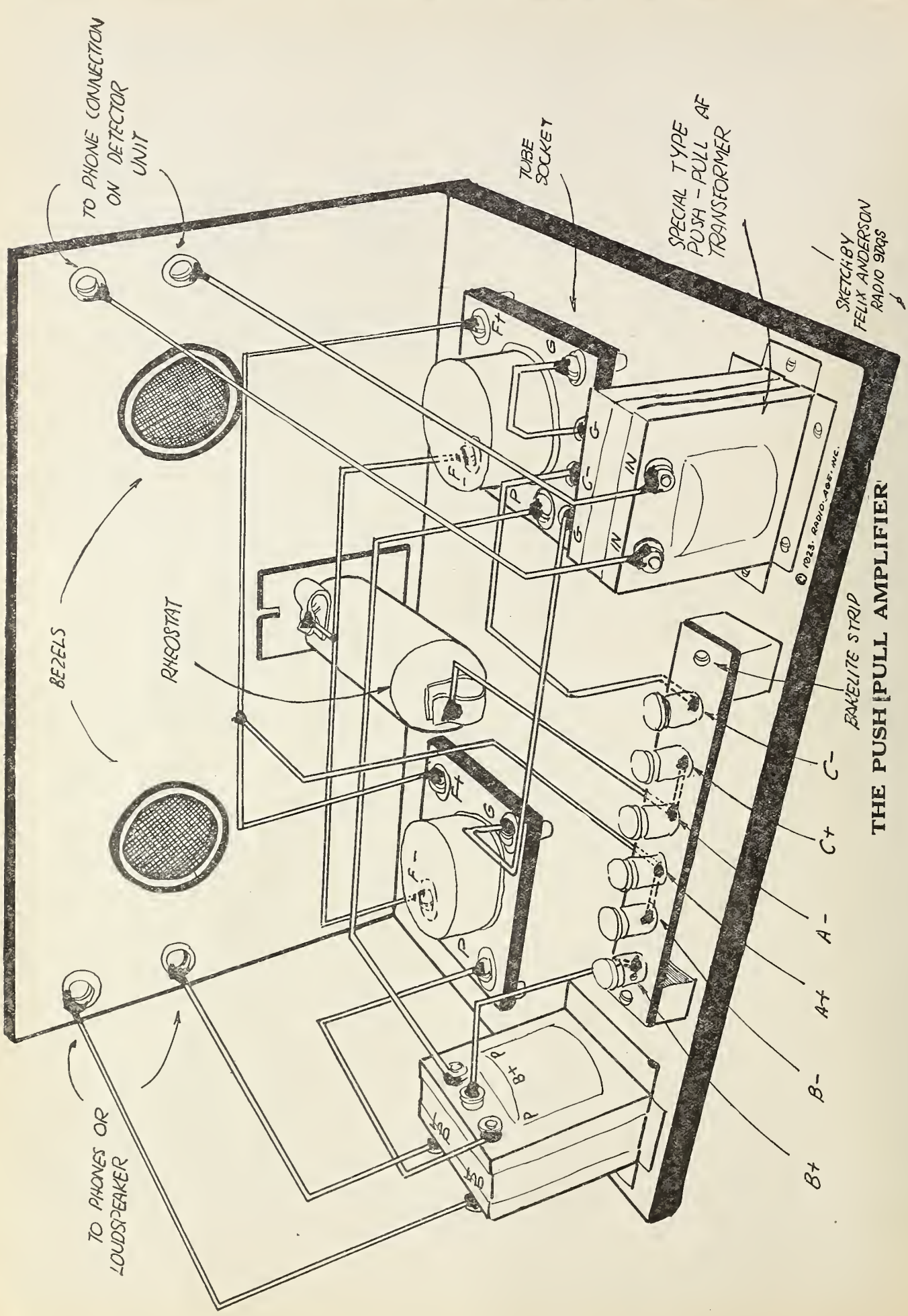
The greatest care must also be exercised in the wiring. The radio frequency wires which are the plate and grid wires must be widely separated and, in fact, it is a good idea to keep the grid wiring as far as possible from any of the other conductors. If this is not done, there may be an audio frequency feed back to the grids, by induction between the wires, which will cause the amplifier to howl.

Results Are Surprising

If these instructions are carefully followed, the result of this addition to any set will be surprising. It may be found that using it as a third stage will give entirely too much volume in the ordinary home, as it will be almost deafening, but will still retain the quality which is found in the lower stages. In this case it can be substituted for the second stage. Even if the push pull is used as a first stage amplifier, the results will be much better than the ordinary one stage amplifier and the music will come in so clear and distinct that one would almost believe the player was in the same room.

After using such an arrangement it will be hard to ever go back to the ordinary method of audio frequency amplification. It must be understood, however, that this type of amplifier will not remedy poor reception, that is, if the receiver does not bring in clear, distinct signals, the amplifier will only repeat what is fed into the input transformer, but with a good receiver, nothing can compare with the results obtained by using this arrangement.

On the next page will be found an isometric drawing, showing in detail the method of assembling the Push Pull amplifier. Readers write to us saying these picture diagrams are more easily read than photographic illustrations.—The Editor.



THE PUSH PULL AMPLIFIER

The Rosenbloom Circuit

By FRANK D. PEARNE

ONE of the greatest difficulties in the construction of a radio set which some beginners encounter, is the soldering of the connections and for those who cannot do a good job of soldering, the Rosenbloom circuit offers an easy way out. This arrangement was designed by William Rosenbloom, of Revere, Mass., and has so few connections that practically all of them can be made on the binding posts alone. It is very efficient and has very few controls compared to most of the other good sets in use today.

Comments on the circuit, made by those who have used it, are quite favorable, some claiming that for selectivity and sensitiveness, especially when using a UV-200 detector tube, it can not be excelled. Because of the few parts used in its construction, one man was able to assemble a test circuit and had it working in less than one hour. No variocoupler is used which, of course, will dispense with many soldered joints on the necessary contacts and the substitution of a variometer in the primary circuit in combination with a fixed condenser gives extremely sharp tuning with only one control.

The two variometers should be of the basket-ball type to get the closest tuning, although any of the standard wood, or bakelite variometers will work, but the builder is advised to select those having the least distributed capacity.

Condenser

The condenser used in the aerial circuit is a fixed Micon condenser having a capacity of .0005 M. F. which is equal to that of a 23-plate variable, although not adjustable. The variable is not needed here because of the fine tuning qualities of the variocoupler in this particular part of the circuit. In some cases a small 3-plate variable has been shunted across the terminals of this condenser to give a vernier effect, but this is not necessary under ordinary conditions.

It will be noticed that the drawing shows a potentiometer connected across the filament battery leads. The lever of this potentiometer is connected in series with the phones and the plate battery for the purpose of adjusting the voltage in the plate circuit. This also may be eliminated if desired, but when tuning in a weak wave coming from a long distance, it is wonderfully effective, and as Mr. Rosenbloom says, "if anyone doubts its value, he should use the receiver for awhile, with the potentiometer, and then attempt to do long-distance work without it.

Perhaps one of the reasons that some amateurs are so successful in getting long-distance reception and others are not, is due to the fact that some use the potentiometer and others do not. It is one of the most important controls on any receiver, because there is one certain voltage at which the plate circuit will function best, although some results may

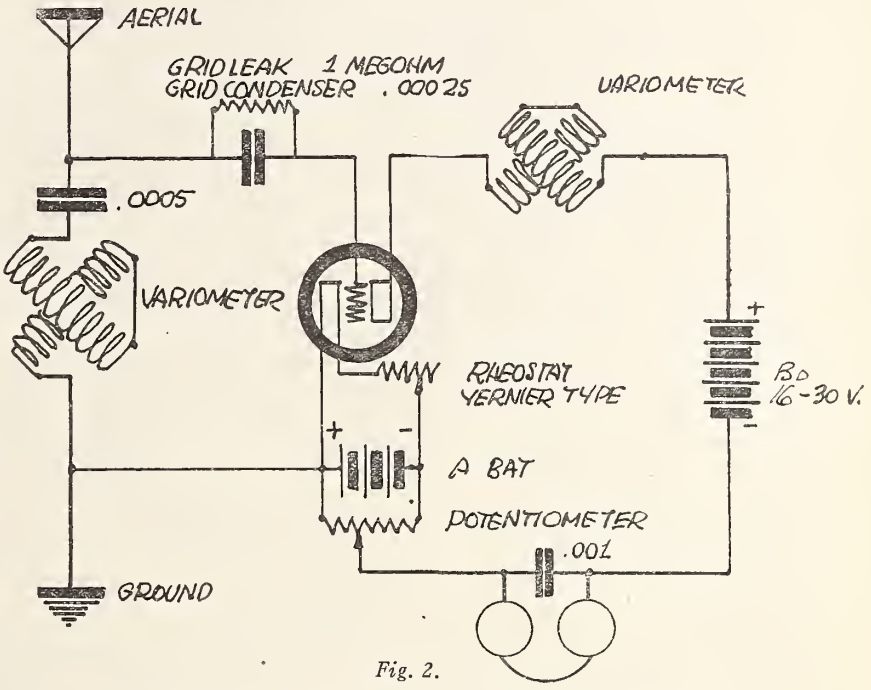


Fig. 2.

be obtained with voltages somewhere near this critical point, but for the ideal reception, it should be exact and the potentiometer furnishes the means of getting this fine adjustment.

The other variometer serves to tune the plate circuit, thus making the circuit regenerative. This regeneration takes place through the tube itself, the plate and grid, acting as a small condenser, through which any change in the plate circuit will react upon the grid, building up the charge upon it, causing the original charge to be sustained for a longer period and giving considerable additional amplification to the signal. The fine gradations of control made possible by the potentiometer are especially evident when the gassy UV-200 detector tube is used.

Old Favorites

Fans who have been experimenting with various circuits have begun to show a definite trend back to hook-ups which they tried out months ago and then laid them aside to try something "new." This suggests the comment that there are only a limited number of fundamental radio hook-ups and that changes in these circuits are often changes for the worse. One of the interesting circuits that did well for those who tried it some months ago is the Rosenbloom. A full page isometric drawing is printed on the next page, showing how to assemble this receiver.—The Editor.

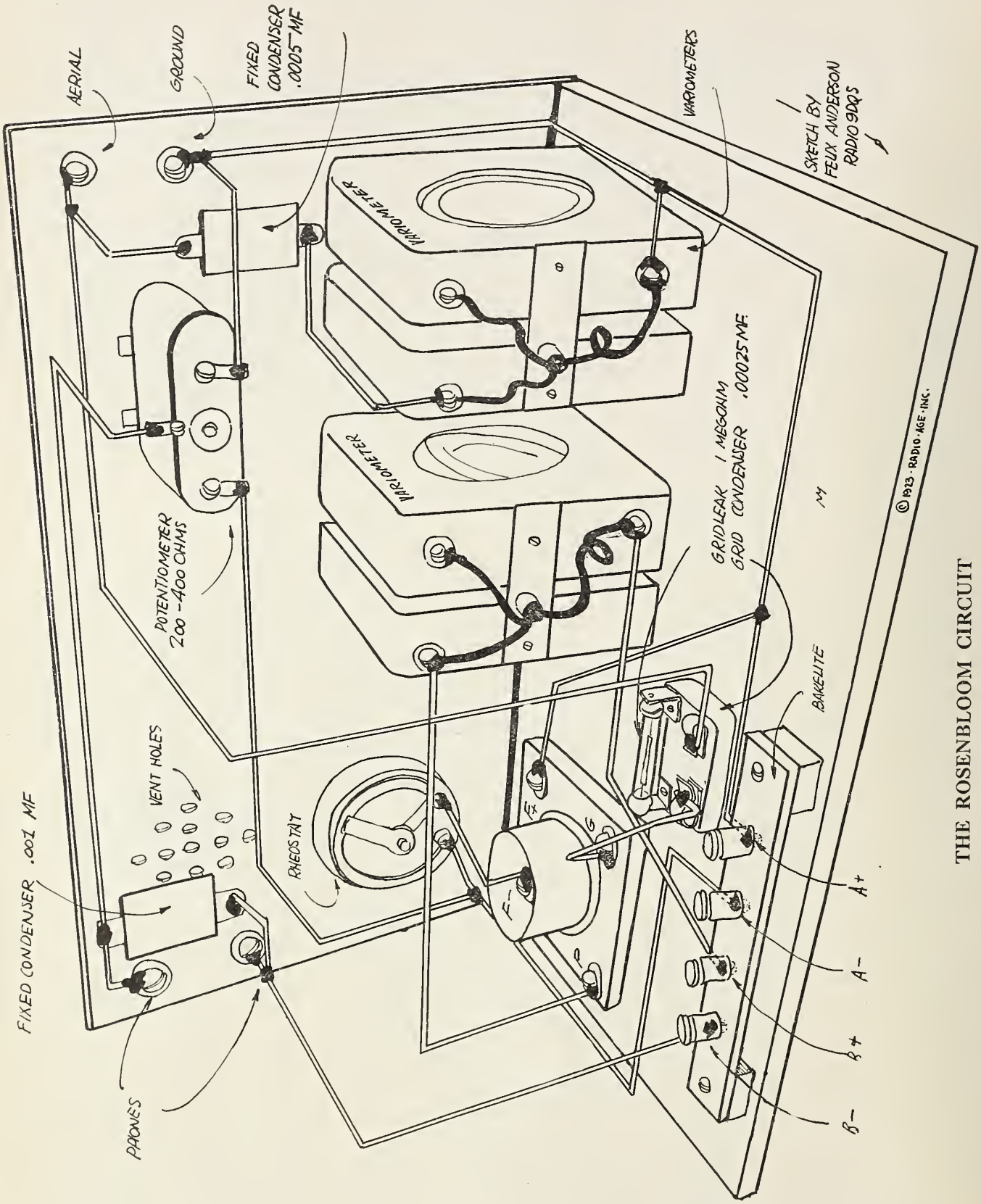
Ground Wire

When the parts are mounted on the panel as shown in the drawing, one should make sure to so connect the variometer which is used in the primary, in such a way that the ground wire will be connected to the end of the rotor shaft which extends through the panels, as this will greatly reduce the body capacity effect. The plate battery should be of the variable type having taps at different voltages, so that any voltage from 16 to 22 1-2 may be obtained.

The condenser which is shown connected across the phones is a mica type fixed condenser having a capacity of .001 M. F. Some arrangement for switching off the filament battery should be used, as the potentiometer, which although having a high resistance of 200 ohms will run the battery down in time, for the reason that a very small amount of current will flow through it all the time, whether the set is in use or not, if some switch is not used in the battery circuit, to open it when the set is not in use. The same end, however, may be accomplished by disconnecting one of the battery terminals when the set is not in use.

The rheostat used is the standard 6 1-2 ohm type, which is always used with the UV-200 tube. The grid leak has a resistance of from 1 to 1 1-2 megohms and the grid condenser has a capacity of .00025 M. F. If any tube other than the UV-200 is used, the grid leak should be variable.

The amateur will find this circuit to be one of the most simple arrangements that can be constructed and he will not be disappointed with the results if the instructions are carefully followed.



THE ROSENBLOOM CIRCUIT

Pickups by Readers

WITH this issue we leave behind us a year's accumulation of new reception records, and challenges, and enter upon an effort to pile up the best record for the new year.

As we look over the mass of letters from the many Pickup fans while reverently filing them away, we are filled with a feeling of satisfaction that our radio brothers have accomplished much, and turning our thoughts toward the future, we wonder what the many readers of this department will accomplish in the coming year. We wonder what kind of receiver will do the most consistent work in getting the DX stations, and we wonder when the Pickup fans will stop breaking records.

We know, fellows, we are in for some keen surprises, and we know that this is going to be one of the big departments of RADIO AGE. Half the fun in radio is building a set from clear instructions, and the other half is telling the other fellow about what the set can do.

If you want to tell it to a real bunch of radio fans, send in the dope to the Pickups By Readers department, and you may be sure that it gets before the kind of fellows who appreciate it.

C'mon BCL's, we're off on a flying start to set new records, and as we fire the starting gun, we simultaneously wish you a HAPPY AND LONG-DISTANCE BREAKING NEW YEAR!

THE PICKUPS EDITOR.

It looks pretty much like the Kopprasch fans have a flying start on the rest of the contenders from the appearance of the letters following:

1305 Dayton Ave.
Springfield, Ohio.

RADIO AGE,
Pickups Department,
Gentlemen:

I am writing you to let you know as to the nature of results I am getting from the Kopprasch circuit published in the April issue of RADIO AGE.

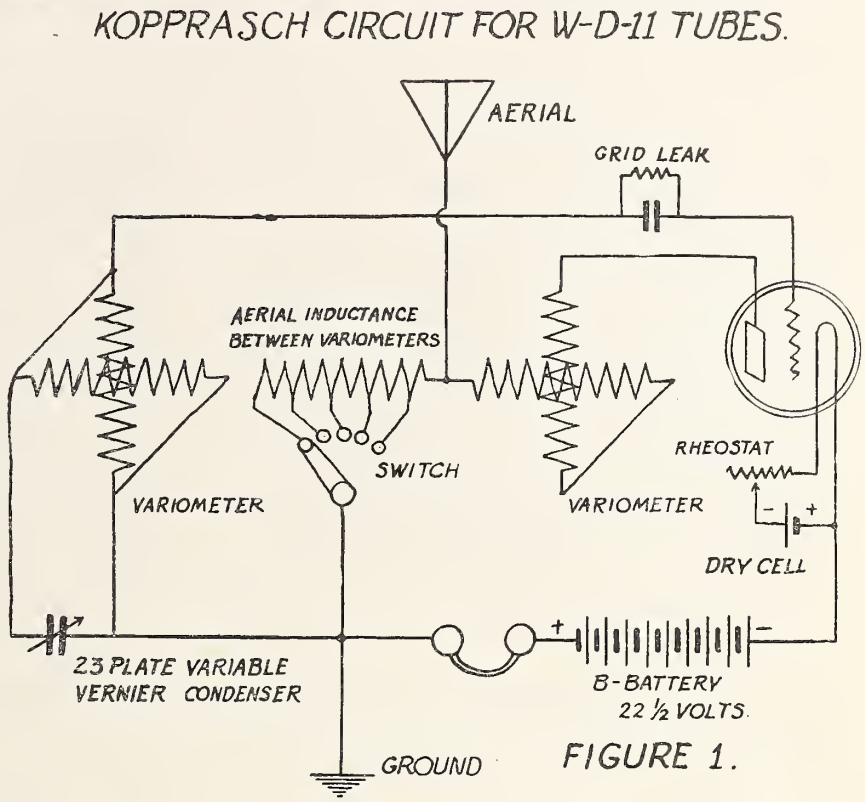
It is, and is doing all you claim for it. We have stations here within a radius of fifty to seventy miles, but they don't come in as strong as the stations two hundred to one thousand miles distant.

I held WGY last Thursday night for three hours and forty-five minutes without one bit of fading, and can pick up WOR, WFAA, WBAP, NAA, KSD, CFCA, WDAJ and many other stations at will. It is the best circuit I have ever tried out, and I speak from costly experience, having had twenty-one of them. The Kopprasch is the bearcat of them all. Long distance stations come in good and strong, and I think considering that my location is one far from favorable, that I have been getting results.

For reception, my antenna is between two tall chimneys and only two wires thirty-six feet long. Tell Mr. Kopprasch that his circuit is certainly a humdinger.

CHARLES H. MOORE.

Mr. Moore uses a one-tube set. His letter really calls for no comment, but will probably arouse the interest of many other BCL's who are using other circuits.



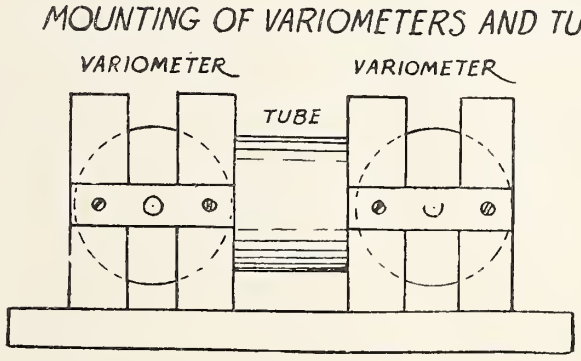


Figure 1. This shows the Kopprasch circuit and the method of mounting the inductance between the two variometers. The inductance consists of forty turns of No. 22 DCC, with taps at every eighth turn, and is wound in opposite direction to the stators of the variometers. Care should be observed that the stators are wound in the same direction. Full details concerning this set appeared in the April 1923 issue of Radio Age.

Hear number two from another fan using a Kopprasch:

2111 St. Paul Street
Baltimore, Md.

RADIO AGE,
Pickups Department,
Gentlemen:

In answer to G. W. Jeffers, of New Jersey, in the November Pickups Department, I would venture that if Mr. Jeffers keeps going at the rate he has been traveling, he can open the window, and get CHILE. And he did it with his little Kopprasch. Let me explain.

With my Kopprasch, built last April, with the WD11 tube using 16½ volts on the plate, I have been able to pile up the following record, some of the work being done during violent electrical storms.

I have twenty-eight stations to my credit, with letters in each case to prove it. I hold as the following my best reception: WOS, WOC, WDAP, and I respectfully beg to ask you to remember that Baltimore is considered a *dead* spot for radio signals, so you will please take this into consideration. I am almost afraid to venture to say what it will do with two stages of AF! My best distance may only be 800 miles, but I don't believe that any other circuit could do even that much in this town.

I hear MacMillan getting messages from WJAZ regularly, as Chicago is one of our standbys. Put me down as a Kopprasch booster.

Very truly yours,
JOHN J. DRECHSLER.

The Kopprasch circuit seems to have a queer habit of working in long jumps. breaking rules regarding dead spots,

The foregoing letters speak pretty well for this circuit. In a postscript, Mr. Drechsler says, "I can tune anything out that I want to." You fellows who have been having trouble with your sets, dig up that April issue and get posted on this circuit.

The users of Cockaday sets are by no means back-numbers this month. Those using this circuit are getting a great kick out of the long distance range it affords as the following will explain:

Madison, Wis.

RADIO AGE,
Pickups Department,
Gentlemen:

I have read several numbers of your journal with considerable interest. I am the enthusiastic owner of a Cockaday Four Circuit Tuner and have read the letters in your last issue as sent by others using the set. Last year I used a regular Armstrong regenerative set with a variocoupler and two variometers. During my vacation last summer I had time to read up on the newer circuits in the radio journals and read the description of the set in RADIO AGE and how to build it. Have had it working since September 16. I can heartily endorse all other users have said about the set and think I have some pretty good records myself.

My set was constructed from parts in the old set with the necessary additional parts. It has the regular arrangement with two stages of audio frequency amplification. Last year I had 137 stations on my map of North America and since setting up the Cockaday set have added thirty-five making 172 that have been heard in less than twelve months as I put in my last year's set at Christmas time. I have heard about 125 of the 172 stations this fall with the Cockaday set and can get easily fifteen to twenty stations any evening if I want to stay with it. The best record I have made was on October 20, when I heard the following stations from 7:30 until 11:20 p. m.:

WOC	Davenport, Iowa
WHA	Madison, Wis.
KFIC	Fond du Lac, Wis.
WDAP	Chicago, Ill.
WDAF	Kansas City, Mo.
WBAP	Fort Worth, Texas
WDAO	Dallas, Texas
WMAQ	Chicago, Ill.
KYW	Chicago, Ill.
WHAS	Louisville, Ky.
KDKA	East Pittsburgh, Pa.
WGR	Buffalo, N. Y.
WEAH	Wichita, Kans.
WOQ	Kansas City, Mo.
WHN	Ridgewood, N. Y.
WTAM	Cleveland, Ohio
WLAG	Minneapolis, Minn.
WOAW	Omaha, Neb.
WSB	Atlanta, Ga.
WBAK	Harrisburg, Pa.
WSAI	Cincinnati, Ohio
9XM	Madison, Wis.
KFKB	Milford, Kan.
KFI	Los Angeles, Calif.
KGO	Altadena, Calif.

The above list of twenty-five stations covers almost the entire length of wave ranges, except KSD, and I have heard them often so the set has plenty of range, and covers most of the United States and Canada, as I have heard six Canadian stations from Calgary to Montreal.

Its freedom from body capacity, sharp tuning and loudness are a joy to every one. My set brings in all of the stations of 500 watts and over on a loud speaker in my 500 mile radius, and KDKA, WGY, WOR, WJZ, WSB, WFAA, WBAP and KLZ as well.

The letters from the fans with the different sets are very interesting. KEEP IT UP.

Yours very truly,
WILLIAM H. WRIGHT.
Associate Professor of Agricultural Bacteriology, University of Wisconsin.

There "ain't" no bacteria on the Cockaday, is there, professor? The fellow who puts in a Cockaday gets blisters on his fingers from holding the pencil in his hand all the time to log the many stations he hears. And what's more, the fellow who uses a four-circuit tuner doesn't let any grass grow under his feet when it comes to getting the long distance stuff.

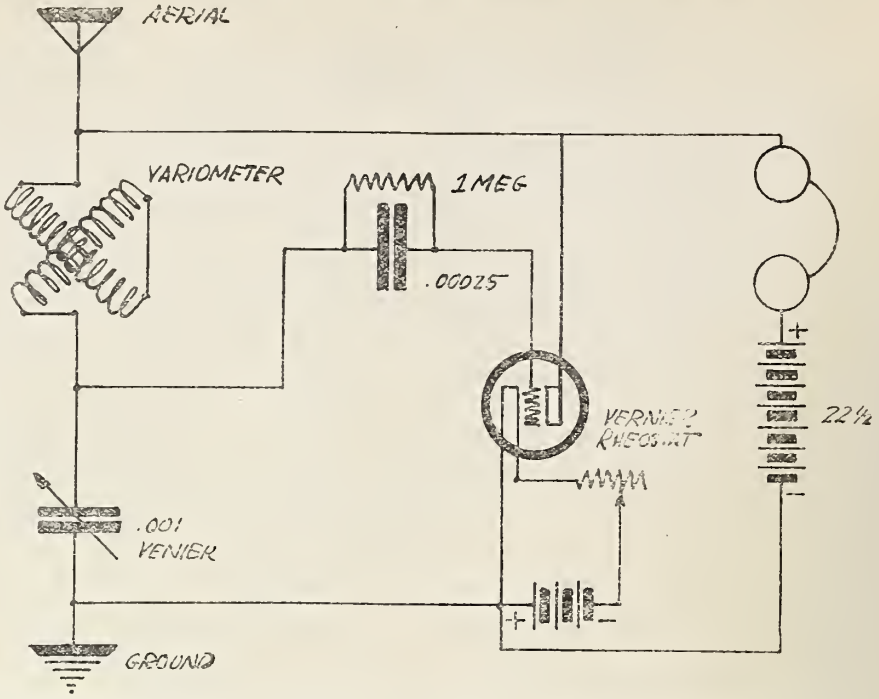


Figure 2. This shows the connections of the first tube set, with which several of our readers have accomplished long distance records.

Memphis, Tenn.

RADIO AGE,
Pickups Department,
Gentlemen:

Just a little line to let you know that on the evening of November 27 I picked up WTAS, Elgin, Ill., and WCAS, Minneapolis, Minn., over a friend's Cockaday. I believe that this is a record for a station of small power, with WMC, my local station, going full blast.

Very truly yours,
JAMES P. COOPER.

The above letter is just one of many we receive, praising the selectivity of the Cockaday set.

The following communication is just another reason why we said that the Kopprasch fellows have a flying start:

242 Vine Street, Council Bluffs, Iowa.
RADIO AGE,
Pickups By Readers Department.
Gentlemen:

I noticed in your reference to Mr. Fleckenstein's list of stations in your November issue, that you want to know how about the Kopprasch fellows. Well, here is from one of them and I kind of think I have him beat. Here is my list for November only: Stations WJAZ WHB, WLAN, WGY, WAAG, WDAF, WOS, WDAG, WSAP, WLAG, PWX, WDAP, WFAA, KPO, WAAF, WOAI, WCK, WHAS, WSB, WCAS, WCAH, KSD, KDKA, WPAL, WLW, WOAA, KLZ, KFI, WAAK, WWJ, WJAX, KYW, WPAD, WWI, WKY, WTAM, WEAH, WOC, WLAJ, WJAD, WOO, KWH, WGR, WMAQ, WEAF, KHJ, WBAH, WHA, WSAI, WJAS, WRM, WGAY, WCX, WMC, WKAA, WCAM, KFKA, WFY, WPAH, WBAP, WCBD, CKCK, KGW, WTAS, KSS, WNAP. The above list was logged just as received, and does not include our local stations WOAW and WAAW, two very powerful stations which I succeeded in tuning out a number of times, and when you can tune out either one of them, you are going some, as they are only four miles off. While I am writing this, I am listening to a very nice concert from WDAP, Chicago.

It may help some of the Kopprasch boys if they will add a 43-plate variable condenser in series with the antenna, hook up stator to antenna and rotor to antenna binding post on set; find it helps a great deal with my three WD11 tube Kopprasch receiver. From the other lists that have been published, I think the Kopprasch is holding its own pretty well; one station I overlooked in my list is CFCN, Calgary, Alberta, Canada. I had them for a short time but was cut out by another station.

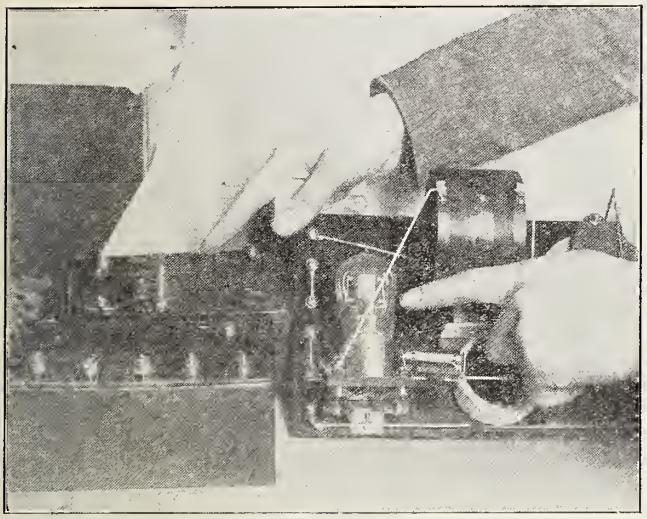
Respectfully,
R. L. SHEWARD.

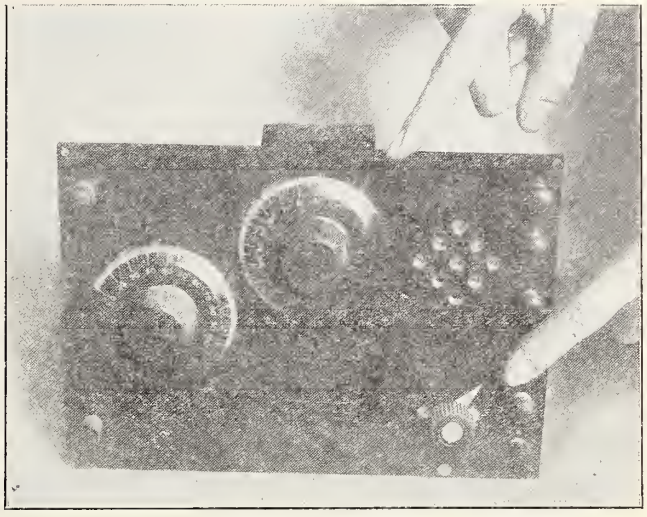
It looks like we misjudged these Kopprasch fellows! While the other fellows were busy writing about how many long distance stations their sets could receive, the Kopprasch users were evidently busy tuning in a few extra ones to make their lists overlap the rest. That's SOME list, if you ask us.

R. R. O. Box 118, Indianapolis.
RADIO AGE,
Pickups by Readers Department.

(*Continued on page 44.*)

Little Things That Help





DON'T ANNOY YOUR NEIGHBORS

Photo at left shows that you should not put too high a plate voltage on the detector tube. If you do, it not only spoils the quality of the radio music but it also makes it impossible to tune your set without causing squeals.

Photo on right shows that you should not turn the rheostat that controls your tube on too full. This will distort the music and cause squeals. It will also greatly shorten the life of your vacuum tube. Don't turn the dial that controls regeneration around too far. The proper place to stop is just before the squealing point. If you go beyond that point the squeals that you will hear will also be heard by everyone in your neighborhood. (Kadel & Herbert Fotos.)

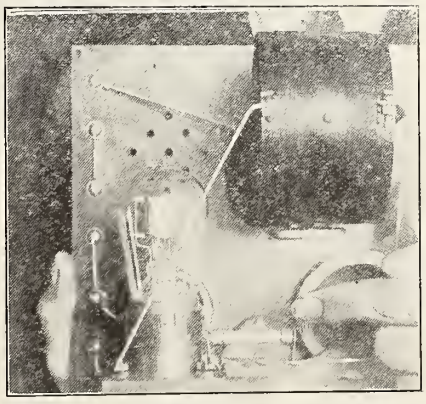
Cause of Fading

When radio first was used for long distance communication it was noticed that signals were not transmitted as far during the day as during the night time. It has also been observed that at night radio signals on the higher radio frequencies or shorter wave lengths vary greatly in intensity from minute to minute. Persons who receive broadcast concerts from distant stations have occasion to notice this variation in intensity of received signals since loud signals may be received from a given distant station at one moment only to disappear entirely for a few minutes and then recover their original intensity.

This and related phenomena have been recorded from time to time and various hypotheses have been brought forward in an attempt to explain them. The phenomena are dependent upon a large number of variable quantities such as the weather conditions, the nature of the country over which transmission occurs, the surroundings of the transmitting and receiving stations, and the method of handling the receiving apparatus. Only by a statistical study in which the results obtained simultaneously at a large number of receiving stations are collected and tabulated, may reliable averages be obtained.

In an attempt to secure some worthwhile statistics of this kind, a co-operative study of radio signal fading was made by the Bureau of Standards and the American Radio Relay League during 1920 and 1921. In these tests from five to ten radio stations transmitted signals in succession on certain nights, according to prearranged schedules. The signals were received simultaneously by about one hundred receiving stations whose operators were provided with forms for recording the variations in the intensity of the signals as received.

The paper gives summary tables pointing out possible relationships between weather conditions and the fading and intensity of radio signals and the prevalence of strays or atmospheric disturbances. On account of the limited number of observations and the large number of factors which influence transmission, the statistical results can be considered as only tentative.



The squeals and howls being sent through the air every night by owners of single circuit regenerative sets and other trick circuits is fast making it impossible to enjoy listening to radio concerts. If the owners of radio sets that cause squeals would operate their sets correctly they would not be spoiling their neighbors' concerts every night. Photo shows proper type grid leak. This is very important. (Kadel & Herbert Foto.)

The general result of these tests, however, substantiates the theory that the sources or causes of fading are intimately associated with the conditions at the Heaviside surface, which is a conducting surface some sixty miles above the earth. Daytime transmission is largely carried on by means of waves moving along the ground, while night transmission, especially for great distances and short waves is by means of waves transmitted along the Heaviside surface. Waves at night are thus free from the absorption encountered in the daytime but are subject to great variations caused by irregularities of the ionized air at or near the Heaviside surface. These variations probably account for fading.

The results of these tests are embodied in Scientific Paper No. 476 of the Bureau of Standards. Copies can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. The price is ten cents, cash.

New St. Paul Studio

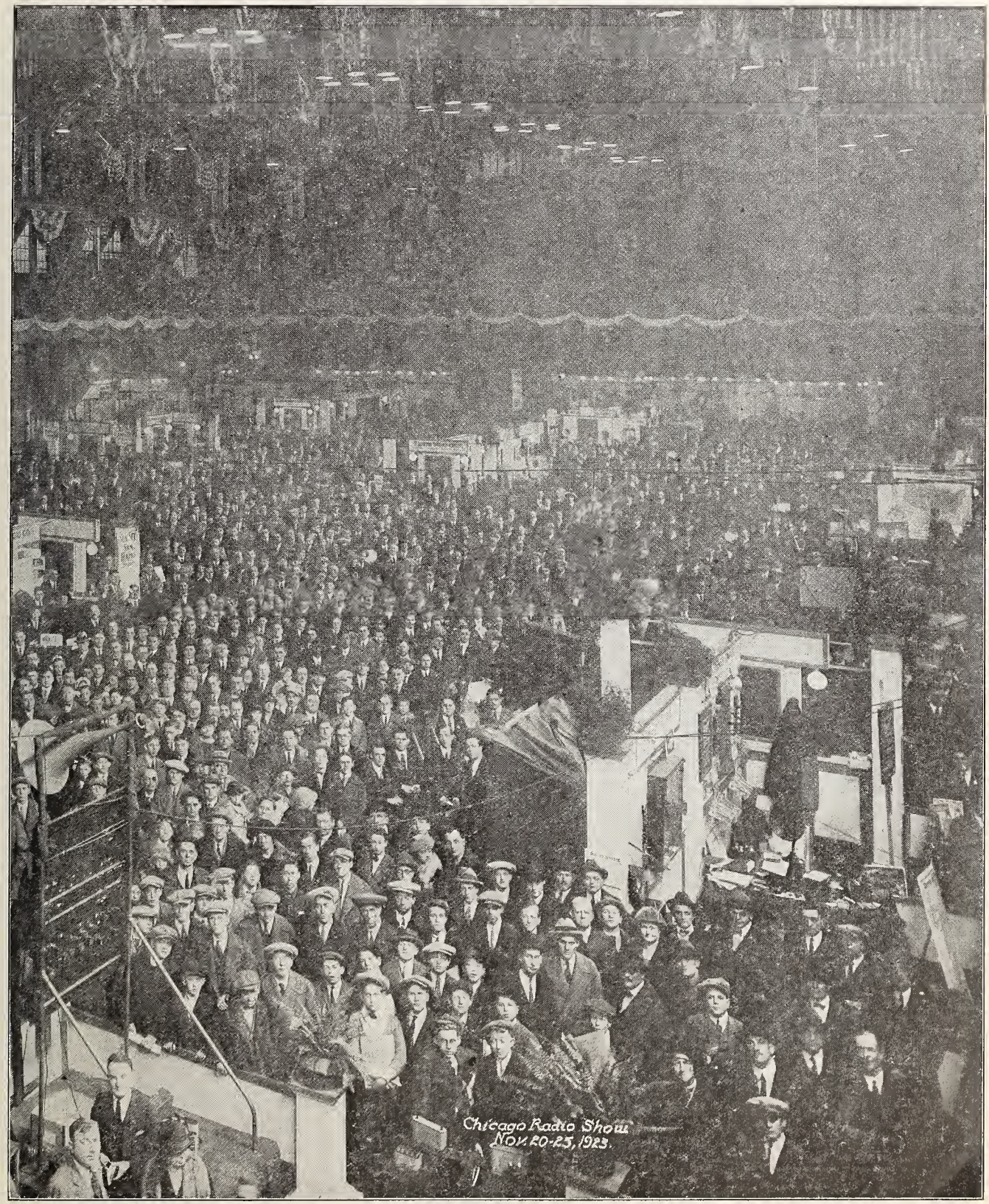
St. Paul made its debut as a permanent radio broadcasting station on December 12 with the initial program from the new studio just completed in the St. Paul Athletic Club.

Regular programs are broadcast alternately with those from Minneapolis over WLAG, the Twin City Radio Central, operated by the Cutting & Washington Radio Corp., in Minneapolis, the St. Paul studio becoming a permanent unit of WLAG.

Radio's Great Future Forecast

Two points impressed themselves upon observers at the second annual Chicago Radio Show, held in the Chicago Coliseum, November 20 to 25. One was the tremendous attendance and the other was the eagerness of the throngs to get radio information.

At Chicago's Recent Exhibition



The 1922 radio show crowd was about sixty per cent boys. The 1923 crowd was much greater and was only about twenty per cent juveniles. The older people have taken up the art in earnest and that is one of the reasons for the increasing stability of the industry.

Simple Experiments With Radio Control

By CARL MASSON

THOUGH the Scientists of the world have presented us with many wonders in connection with radio, the speed at which new inventions are appearing, reveals that there are still greater wonders in store for us, pertaining to this branch of science.

Manless vehicles, boats, airships, etc., made possible by radio, have recently startled the world. Radio control will, no doubt, be an important factor, in the near future.

Bearing this in mind, the author presents a group of interesting experiments for the amateur. Realizing that the average amateur has but a scanty workshop, the author has endeavored to make these experiments as simple as possible.

In radio control, it is necessary to have some sort of a relay which will respond to radio waves, at the will of the operator. Recently, much has been done to develop such a relay, but due to complicated parts involved in them, amateur experimenters have left this use for radio untouched.

Fig 1. The Receiver.

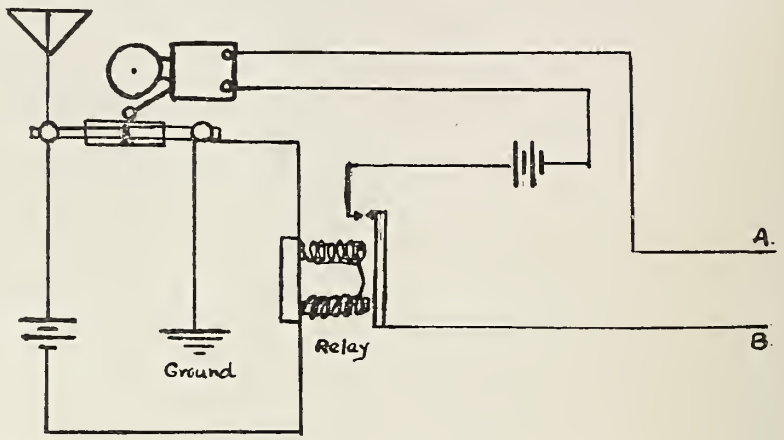
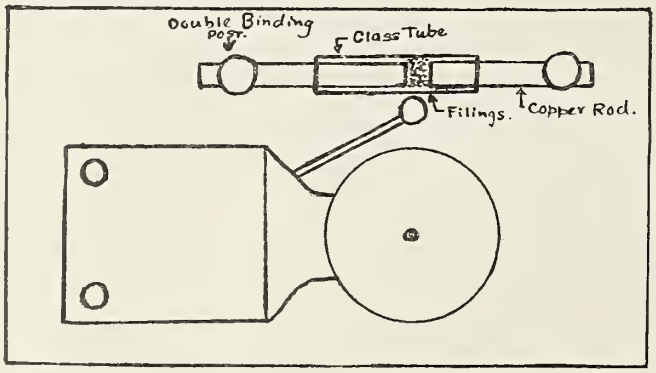


Fig. 2. Assembly of Coherer and decoherer.



Recalling the pioneer days of "wireless" (as it was then called) Marconi's coherer and decoherer suggests a simple relay circuit which might be applied to experiments with radio control.

Fig. 1 shows such a circuit. Since coherers and decoherers have entirely disappeared from the market, perhaps it would be best to describe how to construct them.

To make the coherer, get a piece of glass tubing, 2" long, and about 1/4" in diameter, also 2 double binding posts, and 2 pieces of copper or brass bar about 2 1/2" long and which will fit the glass tube quite snugly. Fig. 2 shows the assembly which is self-explanatory. Between the copper bars, which slip within the glass tube, is a quantity of metal filings, (preferably silver) filling the gap, which should be about 1/8 inch.

Now, when the radio waves pass through the coherer, they cause the filings to cohere—that is, stick together, allowing the current to pass and operating the relay. But when once the filings have cohered, they will remain so, unless some means is provided to decohere them. Hence an electric bell is placed in the circuit as shown in Fig. 1. When the relay allows the current to pass, the bell will ring, and the hammer will tap the glass tube, causing the filings to decohere. An ordinary telegraph relay is used.

Since these experiments are conducted indoors, a small single wire antenna, about 8 feet long, is sufficient. Gas or water pipes serve as grounds.

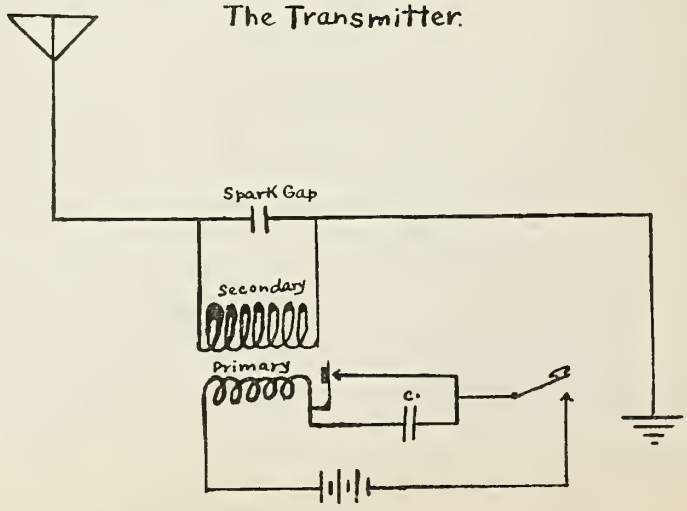
Now for the transmitter by which the control is possible. The circuit is nothing other than that of a simple spark coil sending set. A 1/8 inch coil is sufficient. Fig. 3 shows the circuit. An antenna of about 8 feet is also used in the transmitter.

For the first experiment, connect a toy electric motor in the receiving circuit

(Continued on page 36.)

Fig. 3

The Transmitter.



Substitution of a Tube for a Crystal in a Selective Crystal Detector Circuit

By J. A. CALLANAN

THE construction of a circuit using a crystal detector, as offered in the December issue of RADIO AGE, forms the basis of a progressive circuit in which we are now showing a tube detector.

The tube is going to be a much more sensitive detector and will for that reason afford a far greater receiving range. Our tuning apparatus must be more selective to permit of discriminating reception among the many broadcast stations.

It is presumed that the construction of variocoupler already given has your consideration, although any standard type will serve.

Coupler Modification

An additional winding is indicated. The form can be a cardboard tube 2 1-2 inches long and four inches in diameter for variocoupler of our previous description, or to equal that of whatever size is used. Taking No. 24 double covered, cotton wire begin winding at 1-4 inch from the end of form, having first punched two small holes spaced at 1-4 inch in parallel to anchor wire by lacing through them.

Wind forty turns firmly and terminate with a similar anchorage, leaving leads for making connections. Do not coat this secondary winding with anything. This acts as a deterrent to sharp tuning necessary in the secondary circuit (this is not an important matter in the primary circuit).

This completed coil is then placed end to end against the rotor of the variocoupler and made secure by means of four brass sheet strips cut 1-4 inch wide by 1-2 inch long which are used as connectors, being bolted to the two forms, on the inner side for appearance sake. This will leave a 3-4 inch space bare between the two coils, the tickler coil shaft and bearings being in this free space and the rotor (tickler) free to revolve inside the completed coil.

Mounting Unit

The completed unit is mounted in a horizontal position and supported by three wood blocks as illustrated in diagram B. These are placed at either end of the unit and between the two coils. The unit is mounted 1-2 inch behind the panel to avoid body capacity.

Connections

Proper connections are of vital importance to avoid necessity of shielding resulting in an appreciable loss of energy. We must have as much of the wiring as possible at ground potential.

Connect the antenna lead to the end of the primary nearest the secondary winding and the grid lead to the end of secondary nearest the primary winding.

The terminal of the rotor (tickler) which connects to the plate of the detector tube should be nearest the primary at the maximum dial reading and at right angles at zero reading. As this is a revolution of only ninety degrees the dial need only be graduated through one fourth of its circumference. In revolving from zero to maximum the tickler coil is rotated in a clockwise direction.

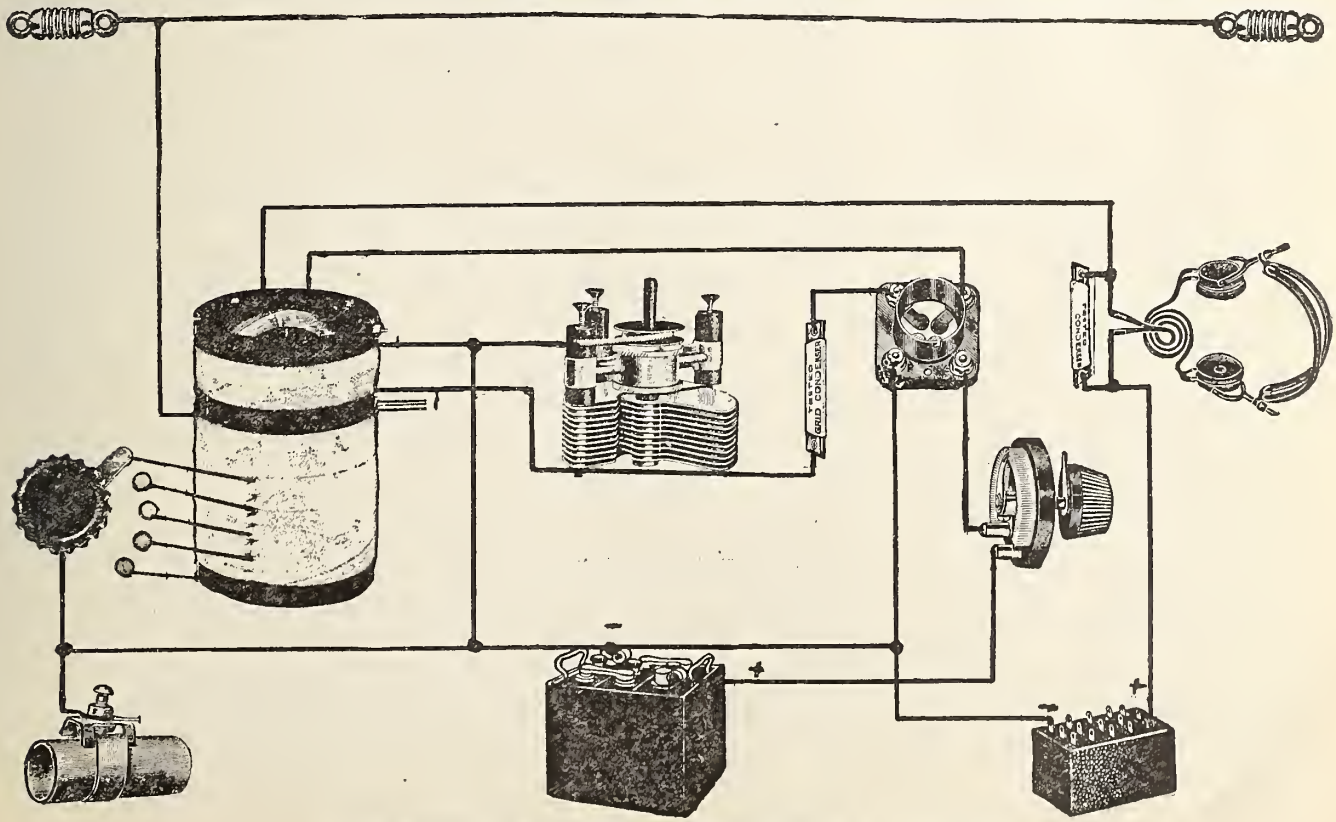
Detector Tube

The detector tube is the heart of the circuit; the greater its sensitivity the greater the possibilities in receiving range. A good, six volt detector tube often affords reception more satisfactory from the standpoint of signal volume and receiving range than a peanut tube (toy tube) with one stage of amplification.

The U V 200 tube with a storage battery for filament supply gives the best results. However, if the expense of storage A battery is at first prohibitive, the U V 201A can be operated on dry cells, eight connected in series of four, two sets in parallel, with much satisfaction. Twenty-two and one half volts plate potential can be employed with either tube, and a maximum of 45 volts with the U V 201A.

A .00025mfd fixed grid condenser (mica) and a two megohm fixed grid leak will serve for either tube cited and should be mounted directly to the tube socket,

(Continued on page 28.)



Picture diagram showing the electrical connections of the Tube Units

How Receiving Tuners Work

By JOHN V. L. HOGAN

IN THE fifth of his series of radio talks delivered through WEAF, John V. L. Hogan, consulting engineer and former president of the Institute of Radio Engineers, discussed the subject of "How Your Receiving Tuner Works."

His presentations have been given most enthusiastic response because of his clear and simple presentation. In the course of his remarks on December 7, Mr. Hogan said:

"The interval that interests us most is from 550 to 1040 kilocycles, for the stations using the wave frequencies between those limits are powerful enough to be heard a good many hundred miles. The fifty individual wave frequencies in this range were chosen at separations of ten kilocycles because any two waves whose frequencies differ from each other by that amount should not overlap or produce direct interference with each other in a good radio receiver. To understand just why this is so we must think for a few moments about what goes on inside a radio receiving tuner.

"Let us begin by noting that at this very moment there are two powerful broadcasting stations in New York City sending out streams of radio waves. One of these is WEAF, where I am talking, and the other is WJZ. The waves from WEAF are of 610 kilocycles frequency; when they reach your receiving aerial, a tiny fraction of a second after they leave here, they generate electromotive forces of 610 kilocycles frequency on your receiving aerial wires. Those electromotive forces, as you would have guessed from their name if you did not already know, are simply forces that tend to move electrons (or electric current) in the circuit where they are generated. Thus, whenever WEAF is sending, its radio waves are doing their best to produce electric currents of 610 kilocycles frequency in your receiving antenna system. In the same way, the waves from station WJZ are trying to generate electric currents of 660 kilocycles frequency in your receiver, for 660 kilocycles is the wave frequency of that station.

"Now suppose that you are anxious to hear the transmission from this station, WEAF, without hearing anything whatever from WJZ. What must you do? The answer is perfectly simple; it is only necessary for you to permit the WEAF waves to produce a strong 610 kilocycle current in your receiver while at the same time preventing the WJZ waves from generating any appreciable current in your set. To hear WJZ without interference from WEAF you would do the opposite of that, or develop the greatest 660 kilocycle current you could while suppressing the 610 kilocycle currents.

"Of course, this raises another question. How can you encourage waves of one frequency to generate strong currents in your aerial-to-ground or your loop antenna circuit and at the same time discourage the waves of all other frequencies? The answer to that lies in electrical tuning, and our next job is to get some idea of how tuning is done.

"You know that practically all receiving sets contain condensers and coils of wire. Sometimes the condensers are of a certain fixed size, and sometimes they are variable, but without some sort of condenser a radio receiving set won't do much in the way of tuning or selecting between waves of different frequencies. So, too, with the coils of wire. These are generally called inductances, or (to speak correctly) inductors. Sometimes the inductors are fixed in size and position; sometimes they are variable by means of switches or as in variometers, so that their effective values may be changed at will.

"Did you ever wonder why these condensers and inductors are used in radio receivers? It is because an electrical circuit that is made up of such a coil and a condenser is capable of being tuned to resonate to or select alternating currents of any particular frequency one may desire. Electric condensers possess the electrical property called capacitance; inductors have the electrical property called inductance. An electrical circuit that contains both capacitance and inductance always is capable of passing more electric current of some one frequency than of any other frequency, for the same amount of generating or electro-motive force. What particular frequency in cycles or in kilocycles per second get through best, depends upon the amount of capacitance and inductance in the circuit. Thus, by changing the amount of capacitance (as you can do by means of a variable condenser) or the amount of inductance (as you can with a tapped coil or a variometer) you can change the frequency to which the circuit is most responsive. This is what you do when you adjust the control knobs of your receiver. The act of tuning is simply making the inductance and capacitance (or the coil and condenser) values of your receiving circuit correct for the production of the greatest amount of current of the frequency you desire to receive. Right now your receiving sets are adjusted to respond strongly to the 610 kilocycle currents generated by the 610 kilocycle waves that WEAF sends out.

"Perhaps this will be still clearer to you if we consider for a moment how very much radio tuning is like musical tuning. A piano string has a certain mass, which in mechanics is very much like inductance in electricity. The string also has a certain flexibility or flimsiness or looseness, which is mechanically the analogue of capacitance in electrical circuits. If we vary the mass or the flexibility of a piano string, we change its pitch of vibration. In a piano, the mass of each piano string is fixed when the instrument is made, but the tension of each one can be varied at any time. If you look inside a piano you will see that the heaviest strings are tuned to the lowest notes and the tightest strings (of any certain size) the highest frequencies.

So it is in radio; among circuits of the same capacitance, those that have the most inductance will respond to the lowest frequencies. If the inductance remains constant, the circuits that have the least capacitance will be tuned to the highest frequencies. Piano tuning is nothing but tightening and loosening the strings until their pitches of frequencies are correctly spaced along the musical scale. Radio tuning is nothing but adjusting the condensers or inductors of a circuit until its best electrical vibration frequency is correctly in agreement with the frequency of the particular wave (in the scale of radio frequencies) that it is desired to receive.

"Now you are perhaps thinking that piano tuning is very different from radio tuning, after all, because a piano string is tuned to send out a note of a certain frequency, whereas a radio receiver is tuned to select an arriving wave of a certain frequency. In my next talk I will tell you how those two apparently opposite properties really go hand in hand. Until then, just bear in mind that when you want to hear WEAF without interference you must let your receiver build up currents of 610 kilocycles frequency and at the same time oppose the building up of currents of all other frequencies."

On December 14, Mr. Hogan said from WEAF: "The coils and condensers in a radio receiver are used to get the effects of electrical tuning, so that the signals arriving at some desired wave frequency can be selected from interfering signals carried by waves of other frequencies. By properly adjusting a variable condenser or a variable inductor (which is the engineering name for a coil) you can cause its circuit to become an easy path for currents produced by the WEAF waves of 610 kilocycles frequency, for example, and at the same time a hard road for currents of other frequencies to traverse. A different setting of the condenser or inductor dial or switch will permit currents of WOR's frequency, 740 kilocycles, to flow easily; and similarly other adjustments correspond to the wave frequencies of other stations.

"The variation of condensers and inductors in a radio set corresponds fairly well to changing the tension and weight of a piano string. Such an adjustment by changing the tuning, changes what is called the "natural frequency" of the radio tuner or the musical string. This natural frequency is the rate of vibration which is the easiest for the tuned system. If we tune a piano string to the frequency of 256 cycles per second, which is the pitch of middle C, it will give off a note of that frequency whenever it is disturbed or struck. That happens because

tuning the string to 256 cycles is nothing more than making its natural frequency 256 cycles, so that its easiest or natural rate of vibration is 256 cycles per second.

"The most interesting thing about this adjusting of natural frequencies is that it works both ways. Not only does a musical string give off a note of its natural frequency when it is strongly struck or plucked, but it will pick up and start vibrating in resonance with a separately-produced sound of its natural frequency. If you tune two strings of a guitar to the same note, that is, so that they have the same natural frequency, you can make a simple experiment to demonstrate this. Pluck one of the two strings and immediately stop it from vibrating by putting your finger on it; you will then find that the second string has picked up the vibrations of the first and is carrying them on, as you can readily prove by touching the second string with your finger and noting that the sound stops. If you try this experiment with the second string a little out of tune from the first, that is what a somewhat different natural frequency, you will find that the second string does not pick up the vibrations of the first. Of course, that is because the natural frequency of the second or "receiving" string is then not the same as the sound frequency of the first or "sending" string.

"You may wonder what this has to do with radio. It is not hard to see how the first string may be compared to a radio sending station, and how the sound waves which the string gives off are in one sense like the radio waves sent out by the radio transmitter. In this same sense, then, the second guitar string is like a tuned radio receiver. This analogy may be clearer to you if we trace it step by step, so let us consider the sound waves first.

"When the first guitar string is plucked, it vibrates at its natural frequency and produces sound waves of that same frequency. The sound vibrations travel to the second string; if this second string is tuned to the original frequency the arriving waves will set it into resonant vibration at their own frequency. If the natural frequency of the second string is not the same as that of the arriving waves, it will respond relatively feebly or not at all.

"Now for the analogous radio case: When the radio transmitter is operated, it oscillates at its characteristic frequency and produces radio waves of that same frequency. The radio waves travel to the radio receiver; if the receiver is tuned to the original frequency the arriving waves will set it into resonant vibration at their own frequency. If the natural or tuned frequency of the receiver is not the same as that of the arriving waves, it will respond relatively feebly or not at all.

"Thus we have a simple acoustic or musical example of what tuning is and how it can be used to select wave-vibrations of any desired frequency. The principles are the same as those that underlie radio tuning, the only differences being in the details. Sound waves are mechanical and usually occur in air; they are of audible frequencies, or say between sixteen cycles and 16,000 cycles a second. Radio waves are electrical and travel through space, not requiring even air to carry them. Their frequencies are ordinarily so high that they cannot be heard directly, or say from ten or fifteen kilocycles on up to thousands of kilocycles.

"The question that naturally comes up now is why, if the musical string will respond resonantly only to a wave of its own frequency, a radio receiver will respond to waves of frequencies different from the one to which it is tuned. We all know that the unfortunate fact is that many radio receivers do bring in interference; a good many of you who are listening to me now are at the same time hearing interfering signals that are carried to you on waves having frequencies quite different from WEAF's value of 610 kilocycles. Yet is is fair to assume that all your receivers are tuned to 610 kilocycles.

"The answer to that question lies in what I called the "pitch sense" or selectivity of the receiver. Some receivers are capable of selecting a relatively narrow group of wave frequencies centering about a single definite value; others let in many wave frequencies in addition to the one which is desired. For instance, a good receiver tuned to 610 kilocycles will admit practically nothing from waves of 600 kilocycles or 620 kilocycles (which are respectively ten kilocycles below and above the central or resonant value of 610 kilocycles). On the other hand, a poorly selective receiver that is tuned to 610 kilocycles may also admit current from waves as much as 100 kilocycles below and above the resonant value or from 510 to 710 kilocycles. As you can easily see, such a receiver when tuned to WEAF might also pick up signals from WJZ on 660 kilocycles although it would probably exclude interference from WOR on 740 kilocycles.

"What causes such a great difference in receiver selectivity? That is a question that bothers very many radio listeners. The answer is that receivers in which there is a comparatively large waste or loss of electrical energy are poorly selective. Receivers that have well designed circuits and component parts and which therefore waste relatively little energy, are highly selective. The most common causes of poor tuning, are (1) bad aerial or ground connections, (2) incorrectly connected crystals, (3) poor tuning coils and (4) badly designed or badly built variable condensers. All of these are easy to remedy, and some attention to them will usually improve the selectiveness of any poorly-operating tuner. Sometimes none of these items is defective, however, and still the receiving set will not tune properly. In such cases there is usually something radically wrong with the circuit arrangement or the layout of the parts."

Denmark Hears Us

Enthusiastic radio amateurs in Denmark are always endeavoring to catch broadcasting from the United States, even though this country lies in a somewhat more unfavorable position to receive American radio messages than other European countries, Consul-General Letcher reports from Copenhagen.

Some of the Danish radio amateurs have made it a practice to "listen in" for Americans at about 3 or 4 o'clock in the morning. Recently several of these amateurs reported "getting" different broadcasting stations in the United States. One station mentioned particularly was "Schenectady" with the call signal, WGY. Orchestra music, soloists and speeches were plainly heard.

Interest in radio continues to increase in Denmark, the general says, and it is estimated that there are now approximately 10,000 radio amateurs in the country.

WRC Listens In

Out of thousands who listen in on WRC, few know that WRC, as well as all broadcasters near the coasts, also listens in constantly, not on its own "stuff," speaking informally, but for ships. As the law requires every hour of the day while the big Class B stations of the radio corporation in Washington is on the air, one operator is listening in on 600 meters, the ship emergency wave, for S O S calls. When one comes in, broadcasting is shut down until the air is cleared, usually by some coastal naval station.

One Friday during the midnight show, the operator on watch at WRC heard an S O S from a ship off the coast of New York, and immediately pulled the switch, cutting off the power in the midst of a number by a local orchestra. Later, when NAH and NAO, naval stations at New York and Charleston, reported "all OK," WRC went on with her show. This was the third S O S call heard while the station was broadcasting, and shows the necessity of keeping a watch on the 600 meter wave. If broadcasting kept up during the transmission of distress calls, it is doubtful if the calls would get through or whether aid would be brought to the ship; the law requires, however, that coastal stations cease operation when an S O S call is heard.

Station WJY Reopens

After a brief period of silence, during which time extensive research and experimental work has been in progress, WJY, the twin station of WJZ at the Radio Corporation of America's dual broadcasting station Radio Broadcast Central located in the Aeolian Building, New York City, has resumed broadcasting during its former periods on Tuesdays, Thursdays, Fridays and Sundays on 405 meter wave-length.

The reopening of the 405 meter channel re-establishes the unique dual broadcasting installation which is an exclusive feature of Broadcast Central, permitting two distinct programs to be broadcast on different wave-lengths from closely associated antennas. The programs from station WJY are of the same high standard which has characterized station WJZ, including symphonic, classical, and popular music, noteworthy speeches and dinners, and events of major interest to the public.

Amateurs Exchange Messages With France

HARTFORD, CONN.—Reliable two-way communication between amateur radio operators in North America and Europe has been carried on frequently since the first two-way contact was made by F. H. Schnell, traffic manager of the American Radio Relay League of this city and Monsieur Leon Deloy of Nice, France, the night before Thanksgiving eve. This proves that international citizen radio communication across the Atlantic is now practicable. One of the thousands of amateur transmitting stations in the United States, using a wave length of 100 meters, can pick out and communicate direct with one of the many hundreds in France and England—this while the ether is humming with the medley of thousands of CW transmitters and broadcast stations are hurling DX music across the continent on other waves.

Two-way short wave radio conversations have been carried on not only between Deloy's F8AB and those operated by Schnell and John Reinartz of South Manchester, Conn. 1MO and 1XAM respectively, but also three other Eastern amateur stations, 1XAQ, operated by S. Kruse and Boyd Phelps of this city, 2CQZ by Robert M. Morris and 2CFB by Floyd M. Weise, both of Elizabeth, N. J. Deloy reported last night by radio that he had heard 9ZT, operated by Donald C. Wallace of Minneapolis, Minn., but that he could not work the American station. He also stated that the signals of 1MO came in stronger than the high power commercial station WSO.

In reply to the first amateur radio message across the Atlantic on 100 meters, General Ferrié, director of telegraphs for the French government sent the following radio to the A. R. R. L. Headquarters: "Many thanks and most hearty congratulations on the results obtained with 100 meter wave, which have permitted the establishment of a new bond between France and the United States." The message was sent by way of Monsieur Deloy's station and was received at amateur station 1MO here.

It is impossible to describe fittingly the great amount of detail, the careful recording of time schedule, the exact precision in the tuning of respective sets that made it possible for the French amateur to transmit on his key the brief "GM, OM," meaning "Good Morning, Old Man" in answer to the clear call, "8AB fu 1MO," that came from America. It was early morning in France when that message was heard though it was exactly 10:30, eastern standard time, in Connecticut.

The receipt of that simple greeting from the darkness out over the ocean to the point where it was nearing daylight on the other continent carried with it a feeling that only an amateur could appreciate and only a ham, that was used to "boiled owl" practices that keep him at his key through long anxious hours, could adequately express for it meant realization of the dreams of all short wave radio fans.

This brings us to the scene at amateur station 1MO, at Hartford, which marked the beginning of the transmission tests with Europe on that night after Mr. Schnell had obtained the sanction of the Radio Inspector of the first district to transmit on 100 meters.

For two nights in succession Schnell had listened to the peculiar note of 8AB like a string of r's run together and just the suggestion of an h like r-h-r-r-r-r-h-r-r- in steady beat and on the previous night he had copied two complete messages so that his fingers fairly ached to grasp the key and hurl 1MO's shrill note in the air. He sat down in front of the transmitter and ran his fingers nimbly over the set tuning it down to the proper 100 meter wave length.

This at 9:25 and he listened for fully fifteen minutes before he heard the French amateur's note calling "A1MO (the prefix A being for America) de F8AB, GM, OM, here messages." Number 3 read:

"Your cable establishing midnight schedule received this morning. I consider it as cancelled by your agreement to my message No. 2, sig. F8AB." At 9:38 this message was ended and Deloy sent:

"No. 4 A1MO, Tomorrow will not be on at this time, pse listen at 0500 and transmit at 0515 sig. F8AB." The figures given represent the transmitting time schedule in Greenwich Mean Time. Not knowing of course whether these messages had been received in the United States, Deloy went on and repeated both of them over a second time, after which he stood by for about ten minutes and repeated them a third time. At exactly 10:27 he signed off calling A1MO, A2BY, CQ de F8AB.

At the moment that the lid went off the amateur quiet period for the benefit of broadcasting at 10:30, Schnell threw over his antenna switch and grasped the key to test the result of many months of planning. Thousands of amateurs could understand his emotion.

"8AB fu 1MO" clicked out into the air and traveled across to France where it struck and vibrated at Deloy's receiving antenna at Nice.

"RRR," he went on "messages received signals QSA." He called and repeated until 10:37 and a moment later the silence broke with:

"A1MO de F8AB rr QRK Your signals QSA vy one foot from phones on Grebe. FB OM Hearty Congratulations.

Two-way communication between the continents had been established but to the great surprise of both operators it was not for a brief second or two, giving them credit for the accomplishment and nothing more but steady and reliable communication that was continued for two hours.

"This is a fine day" called Deloy joyously, it appeared. "Pse QSL No. 1 and No. 2."

"O. K. FB QSA QTC QRV? (Meaning signals loud) I have messages. Are you ready to receive them?"

This was 10:50 and the French amateur came back. "Sure, go ahead with messages, words twice." As he was signing off, Schnell heard him call A1XAM, the station operated by John Reinartz at South Manchester, Conn., only a few miles away saying: "Pse QRX until after A1MO."

Substituting Tube for Crystal

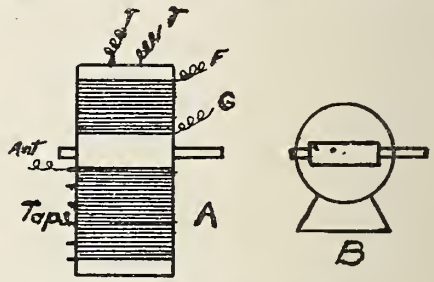
(*Continued from page 25.*)

the socket being placed 2 inches behind the panel.

A .001mfd fixed mica condenser is essential across the phones to by-pass radio frequency as otherwise circuit will not, usually, oscillate.

Wiring

All connections are to be made with either No. 16 or No. 18 tinned copper wire which should not touch panel or base except at points where connection



to binding posts make it necessary. If attention be given to these details the set will be so stable that its controls can be touched without acting as the least deterrent to long range reception.

Tuning

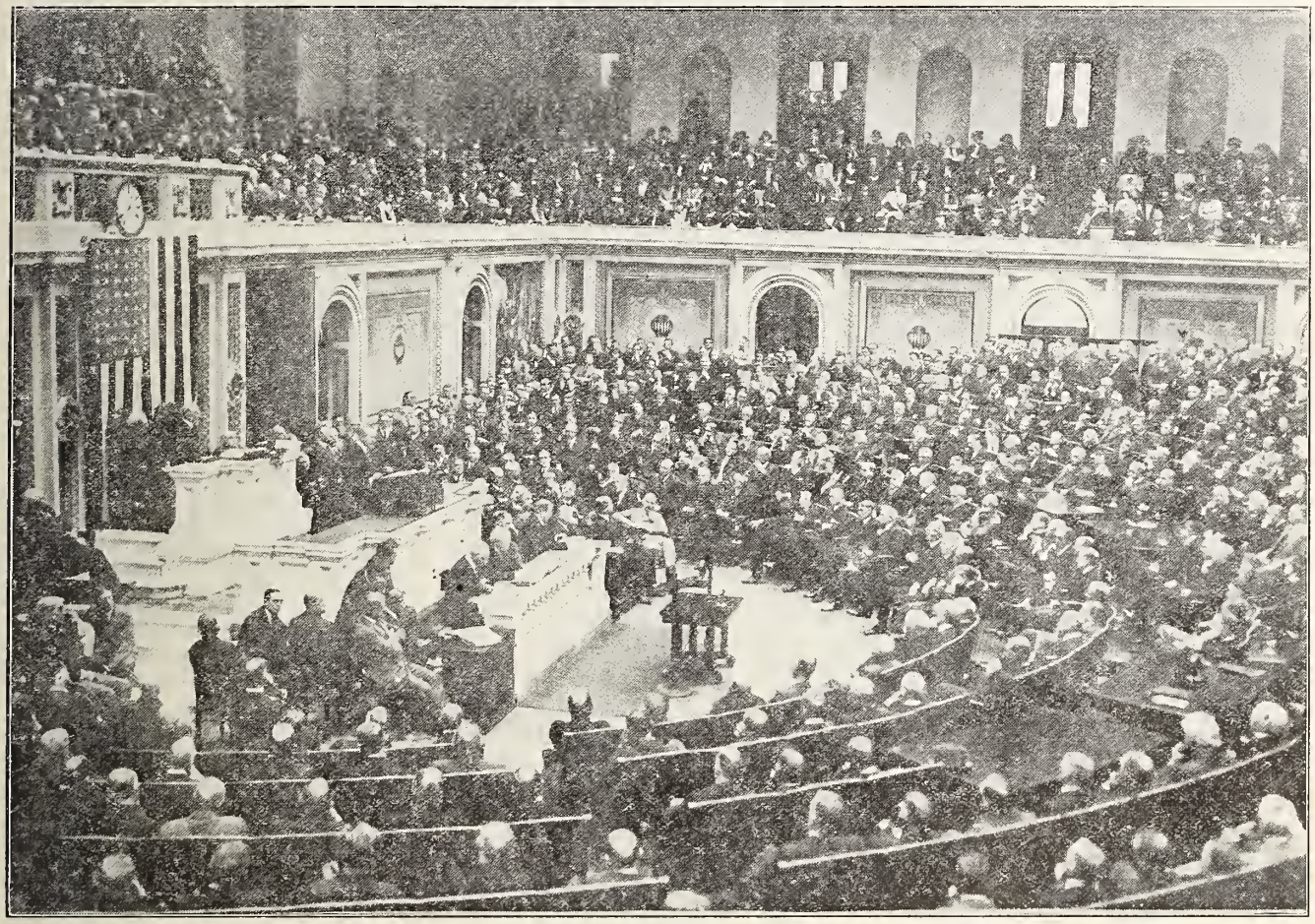
While we have four controls, it is necessary to tune with two, only. To tune: turn all controls to zero. Turn detector tube on until, with a U V 200 tube, a hiss like that of escaping steam is heard (a vernier rheostat is not necessary to make adjustment). Now turn down rheostat until the hiss ceases and set is quiet. Turn switch to the third contact (with a one hundred foot antenna), or to the fourth or fifth contact for a shorter system.

Note that by turning tickler coil to maximum a click will be heard in the phones and if completely turned to maximum a howl will be encountered. Return to zero and increase wave length by turning in condenser plates until a station is received. Volume is then increased by rotating tickler. After having received a station and determined its wave length observation of condenser dial position will show the wave length to which you are tuned.

For long range reception the condenser and tickler are worked together because the point of most sensitive and loud reception is that at which the click in phones is heard and the position changes with the wave length. Never turn the tickler further than to this critical point. To do so merely distorts signal, decreases audibility, and makes havoc with your neighbors reception.

What the Broadcasters are Doing

(News for this department is solicited from all stations)



SPEAKING TO 25,000,000

President Coolidge delivering his first message to congress in the presence of a throng of national notables. For the first time in the history of the United States millions of Americans from coast to coast heard a President delivering his message. His voice was clearly broadcast by radio from local stations and relayed across the continent. Several of the microphones that picked up the President's voice for transmission by telephone to various broadcasting stations are seen in the photo. (Kadel & Herbert.)

WHEN President Coolidge addressed Congress on December 6 his words were heard all over the United States in cities and hamlets and on farms, on the borders of the wilderness and in isolated mountain homes. Radio did this. It made history that day, for it established the efficacy of this means of enabling a President to address the whole people.

The message was broadcast by WCAP at Washington and was relayed by various other stations to the far corners of the United States.

An interesting comment on this achievement was written by Oswald Schuette, editorial writer on the staff of the Chicago Herald and Examiner, which, by the way, is the Chicago morning newspaper that has given its support whole-heartedly and enthusiastically to promotion of radio. We republish the editorial:

TWICE in five days the voice of the President of the United States has been broadcast across the continent by the marvel of the radio.

It is estimated that 25,000,000 people heard each of the addresses. The first was his first message to Congress, delivered last Thursday. The second was his memorial speech for the late President Harding on Monday.

Even in these days, when science finds it difficult to surprise a world accustomed to surprises, there is something miraculous in the thought that the frail human voice of the President at Washington should be carried through the air to the corners of this vast continent.

But there is a far more important aspect to this achievement. That is its effect on the unity of our national life.

When the United States was established among the nations of the world, the greatest peril which its founders feared was the clash of opposing inter-

ests. New York and Virginia, though but a few hundred miles apart, were so widely separated in the social and economic lives of their inhabitants that there was every reason to fear the new Union would be endangered by this divergence. When President Washington delivered his first message to the first Congress at New York in 1789, it took weeks, and even months, before the printed copies of that address could reach the remote hamlets of Virginia, to say nothing of the farflung boundaries of Massachusetts and Georgia.

What would the fathers of the nation have said if they could have looked into the future to the day when the Constitution they framed would have to stand the strain of the diverging interests of Maine and California, of Florida and Alaska? And what would they have said if, looking into that future, they could have seen the President at Washington speaking, not to an assembled handful of congressmen, but speaking, with his own voice, to 25,000,000 of his countrymen?

From Washington's inaugural to President Coolidge's first address to Congress, 134 years have passed into the crowded history of the United States. From thirteen struggling colonies on the narrow coast of the Atlantic, the nation has grown across mountains and rivers and oceans until it is today the greatest republic in the world. But it is more united today, in all its vast expanse, than it was in its confined limits nearly seven score years ago. It owes that union to many contributing causes.

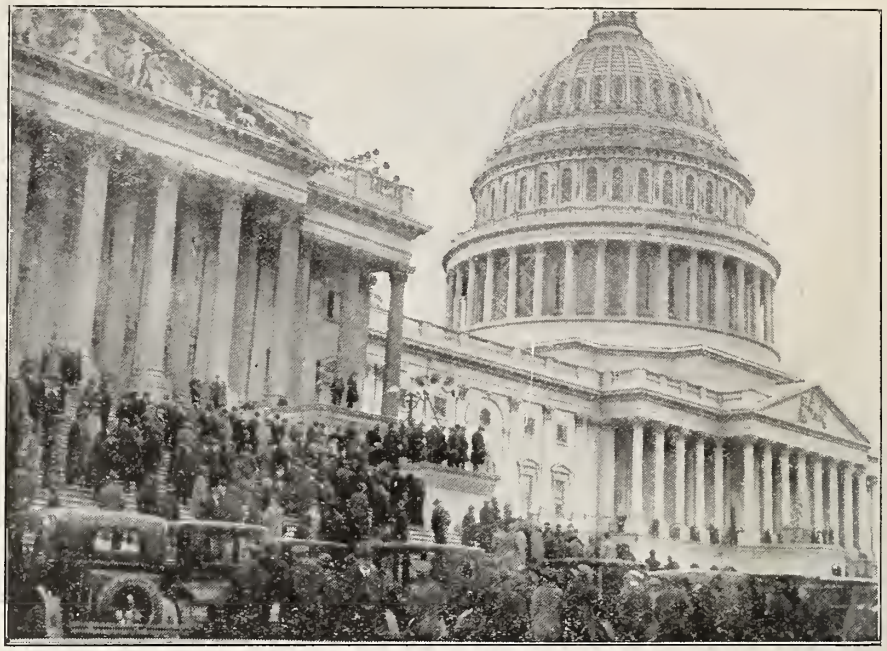
And the latest of these is the Wonder of the Radio.

33 Broadcasters Quit

WASHINGTON, D. C.—Less than 500 broadcasting stations will be in operation with the advent of 1924, officials of the Department of Commerce predict. These stations will be the best and most popular in the country, and will be more than enough to serve their communities; in some instances there will still be several in a single city.

The deletion of broadcasting stations during the past six months has been quite rapid; the total reaching 149, whereas only 107 opened, showing a loss of forty-two stations. During the past month thirty-three stations fell by the wayside, so to speak, and only fifteen new ones entered the field.

Apparently, as in many lines of endeavor, it is to be a survival of the fittest race. On December 1, there were 549 broadcasting stations still serving the public; forty-seven were the more powerful Class B stations; 281 were in class A; 219 in class C, and two were listed as Class D, or development stations. Officials hope that the 219 class C stations, all of which are operating on the single wave length of 360 meters, will qualify as class B stations, transfer to class A or quit, thus eliminating considerable existing interference chiefly among themselves. The result would be a group of about 100 big stations with distinctive wave lengths, and approximately 350 smaller stations with exclusive district waves.



A RADIO CLOSE-UP

Large crowds heard every word of the President's address to congress with the aid of radio amplifiers installed outside of the capitol. (Kadel & Herbert Foto.)

The broadcasting service in this country, which is of course privately owned and operated, and also leads the world in number of stations, is still holding public interest, the Department of Commerce believes. Moreover, its permanency is assured. Its real value, however, has not yet been fully realized, and will not be until there has been a wider distribution of receiving sets suitable for the reception of varied programs from several stations, permitting the listener to select at will the class of service of greatest interest and value.

The recent changes in wave lengths grouped weaker stations between 220 and 280 meters and gave the more powerful stations the wave lengths between 280 and 546 meters. In this class, the longer waves usually are assigned to the more popular stations. It is only natural that the more powerful stations are the most popular since listeners-in naturally tune in on accustomed channels where they get the big stations with no interference. These stations all broadcast good programs and have a transmitting power which cannot be approached by Class A or C stations. When fans try for smaller stations on the lower wave lengths, unless they have very selective receivers, they immediately get interference from the larger stations and the volume is appreciably less.

The weaker stations are out of luck, so to speak, in another line; they find that the larger stations come into their territory if not their actual stations and get the best talent together with their following. The cost of maintenance is tremendous, besides the initial cost averaging about $125,000 and few small operating companies can keep up the pace. The big electric-manufacturing companies are exempt, of course, as well as some other interests which got off with an early start, expecting no return. These include some big department stores, large municipal daily papers, some national organizations and manufacturing companies, such as comprise the present forty-seven Class B stations. For the small concerns, the maintenance for good operation is a steady drain on the exchequer which they cannot meet and the advertising is not of sufficient value.

Students of the situation today declare there is no need for smaller broadcasters in cities where there are one or two large stations in constant service. The craze to broadcast, which was at first a popular fad, is now established on a positive operating basis, serving a practical need in almost every big community.

While some minor stations may continue in smaller districts where farmers are served, others, such as more prosperous papers, may function despite the cost, just for the intangible goodwill, and some churches and hotels may operate to extend their scope and advertising. Many believe our broadcasters will eventually be reduced to one-half the total today.

Broadcast Program Analysis

A RECENT vote of broadcast listeners taken by three Chicago stations has aided tremendously in arriving at a definite idea of what kind of programs the fans prefer. One of the most interesting disclosures of the vote was the vast size of the listening audience. Another was the fact that only 1.7% of the listeners want grand opera. In view of the almost desperate efforts one station has made recently to take over unto itself the control of opera broadcasts, the latter figure is rather humorous. Two-thirds of the 263,000 who mailed in their votes were men. Almost one-fourth of them wanted classical music and only .2% wanted to hear male quartets.

Believing that an analysis of the vote

would be equally interesting to broadcasters and broadcast listeners Radio Age requested such an analysis from E. F. McDonald, Jr., and he has supplied the following information:

"For a period of twelve days, three Chicago broadcasting stations made the same announcement. These three stations were the Westinghouse Electric and Manufacturing Company, station KYW, the Chicago Board of Trade, station WDAP, and the Zenith-Edgewater Beach Hotel Broadcasting station, WJAZ. Each of these stations asked its listening audience what it desired to hear most. We asked them whether they preferred to hear classical, popular, jazz, instrumental, vocal, religious, political, educational talks or what. We told them that their desire would have a great influence on the future of radio broadcasting. We also announced that each listener could have only one vote and that if more than one vote were sent in, or if the same person sent votes to two of the stations, neither one of them would be counted. We have found no duplication.

"The three stations received in these twelve days a total of 263,410 pieces of mail. KYW brought in 37,900 of these, WDAP 54,811 and WJAZ 170,699. Conservative advertising men estimate that not more than one in fifty of our listeners will respond regardless of what the inducement offered is. This indicates a listening audience of 13,170,500. Taking the figures of the Zenith-Edgewater Beach Hotel Station of 170,699, this represents a listening audience on this one station alone of 8,534,950. Station WJAZ in one day received 20,152 pieces of mail, representing an audience of over a million for a single night.

"I am enclosing herewith a list of the responses received by WJAZ divided into states up to the time we had received a total of 122,000. After this time the responses were coming so rapidly that we could not sort them into states rapidly enough. An analysis of the desires of the listening audience shows us that:

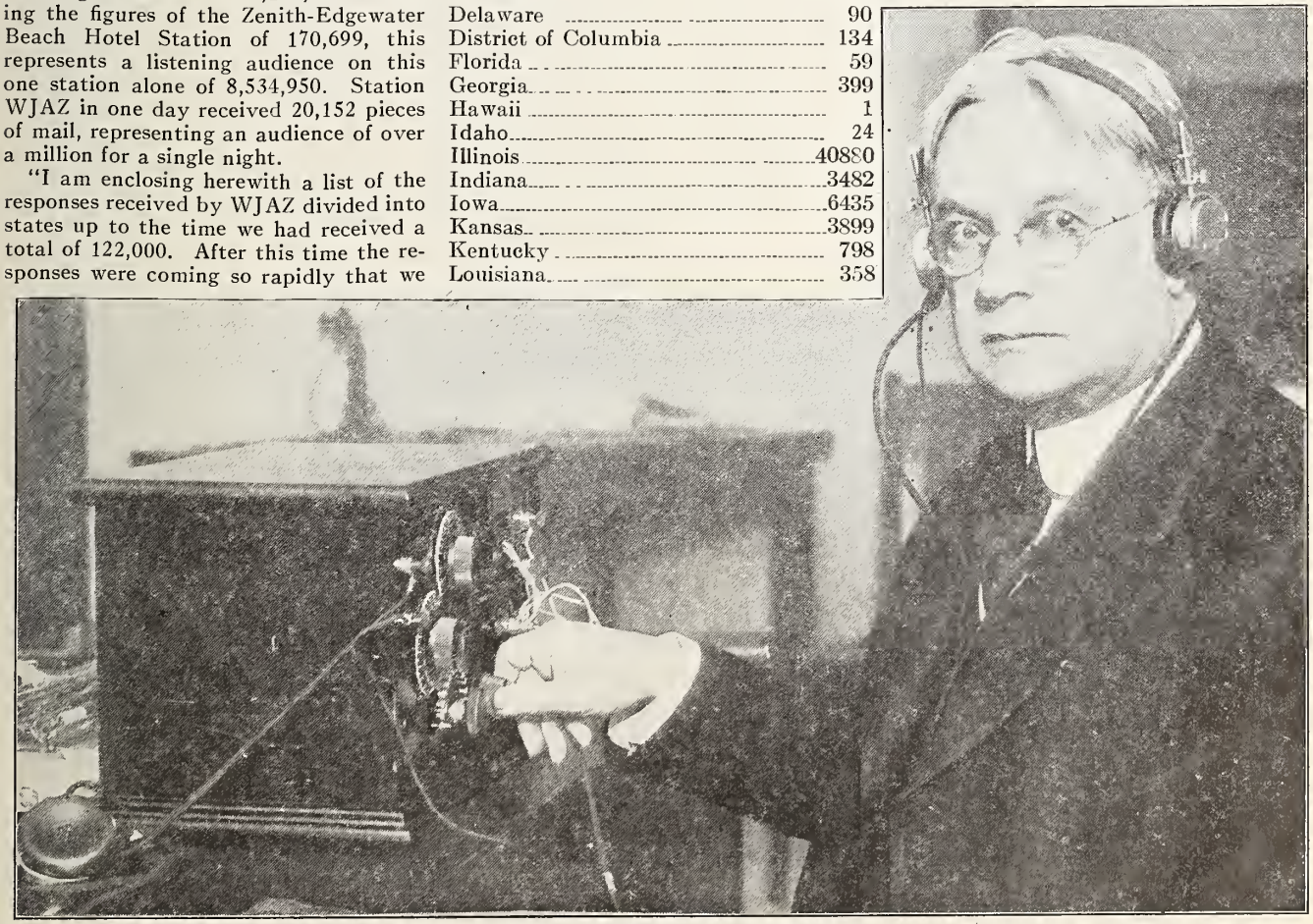
2.7% desire band music.
24.7% desire classical music.
2.9% desire dance music.
.3% desire dramatic music.
1.0% desire Hawaiian music.
18.4% desire jazz.
.3% desire Mexican music.
.3% desire male solos.
5.7% desire old-time songs.
1.7% desire grand Opera.
.9% desire orchestra.
.5% desire pipe organ.
29.0% desire popular music.
.3% desire quartet instrumental.
.2% desire male quartette.
.8% desire mixed quartettes.
.5% desire religious music.
2.1% desire sacred music.
.7% desire saxaphone.
.6% desire symphony music.
2.1% desire vocal selections.

"Of the responses received 32.5% were from women and 67.4% were from men."

Following is a table of the votes by states:

United States

Alabama	425
Alaska	3
Arizona	38
Arkansas	1004
California	315
Colorado	1172
Connecticut	635
Delaware	90
District of Columbia	134
Florida	59
Georgia	399
Hawaii	1
Idaho	24
Illinois	40880
Indiana	3482
Iowa	6435
Kansas	3899
Kentucky	798
Louisiana	358
Maine	123
Maryland	457
Massachusetts	1323
Michigan	3707
Minnesota	4421
Mississippi	416
Missouri	3677
Montana	524
Nebraska	3146
Nevada	12
New Hampshire	148
New Jersey	983
New Mexico	128
New York	6245
North Carolina	271
North Dakota	3429
Ohio	6861
Oklahoma	1992
Oregon	62
Pennsylvania	5964
Rhode Island	98
South Carolina	193
South Dakota	1642
Tennessee	1138
Texas	2971
Utah	6
Vermont	220
Virginia	403
Canada	4076
Miscellaneous	2021
Mexico	12
Cuba	3
Central America	1
Bermuda	1



HIRAM LISTENS TO CALVIN

Senator Hiram Johnson is pictured at his New York campaign headquarters as he listened over the radio to President Coolidge's first message to congress, which was broadcast over the country on December 6. Senator Johnson went to the east to consult with Frank H. Hitchcock, national manager, concerning his campaign for the republication nomination for president. (Kadel & Herbert.)

What is Radio's Future?

An era of simplification of radio broadcasting, with larger and more powerful distributing stations but with few new additions to the "science of radio," was forecast by Bowden Washington, builder of the world's most powerful marine stations and United States naval equipment, in an address broadcast over the North American continent from the National Radio Show at Chicago.

Mr. Washington's speech, delivered from the Cutting & Washington booth, was picked up and relayed by WDAP, Chicago; WLAG, Minneapolis; WJAZ, Chicago; a Cleveland station and Canadian stations.

"I rather think we will have fewer broadcasting stations of higher power, better programs and more powerful receivers," said Mr. Washington.

"The small, independently operated station is doomed. They cannot get programs of the quality obtainable by the large stations, and since the novelty of radio has worn off, people are no longer interested in listening to scratchy phonograph records. The dry cell tube has done a great deal to make the multi-tube set available to a great many more people than ever before; not only by saving the price of storage batteries, charger, etc., but by making tube sets available to those in isolated districts where no means of charging storage batteries is at hand. I also believe that loud speaker operation will be demanded from all but the very cheapest sets, as will the self-contained feature.

"People, for the thrill of a new thing, will put up with a mess of wires, cords and batteries, but I feel that the radio receiver will soon be as necessary as the phonograph in the home, and this mess will not be tolerated. The demand will range from the simple cabinet model to the beautiful period console, an ornament to any living room.

"People who are putting off buying a set, or a better set, because they are waiting for some new and startling development which is coming out next month, or possibly even next week, are in error. Do you realize that there is no violent or radical difference between the radio telephone receiver of 1913 and the broadcast receiver of 1923?

"Radio, like any other engineering art, progresses slowly and logically, with a gradual improvement.

"I have been following radio for twenty years. In 1913 I had a station-spark coil transmitter and coherer receiver—things most of you have probably never heard of. I have been following the art ever since, as amateur student and professional. I have yet to see anything absolutely revolutionary occur.

"The vacuum tube is probably the greatest invention of the last half century. Until I became interested in home radio a few months ago, I was chief engineer of a company operating the radio of 900 merchant ships. A large number of these ships are still doing good work with crystal detectors, and the vacuum tube was disclosed in 1907.

"We read in every column of new circuits—in the newspapers and in every radio magazine—the so-and-so circuit—the something-or-other. To my knowledge, there have been since 1910 but two radically new and useful circuits—the Armstrong regenerative and the Armstrong super-heterodyne. Most of these alleged new circuits are the products of so-called radio experts.

"The present regenerative three-tube set is practically identical with a navy radio compass receiver of 1917—therefore, do not wait for the revolution. Enjoy radio now.

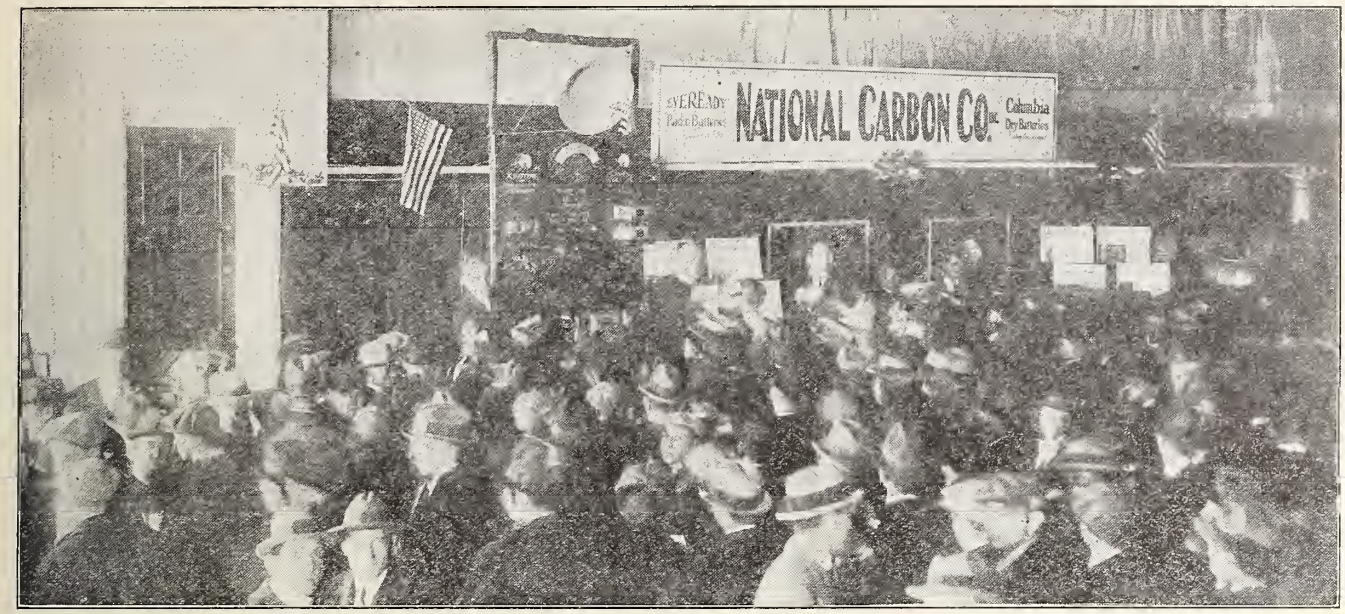
"Another thing that I would like to mention, is the single circuit versus the double circuit receiver. This seems a bitter controversy, yet each has its uses. The single is easy to tune, having two major controls instead of three.

BOWDEN, Washington, radio engineer and designer, is the designer of seven large commercial radio stations in the United States, including WSA (East Hampton, L. I.), the most powerful spark marine radio station in the world, with a maximum radius of 11,000 miles. He was a designer of U. S. Naval equipment during the war, and also of ALLIED army and navy equipment.

The speech printed herewith predicts the future of radio. We believe it may be of interest from that and other standpoints.

RADIO SHOW IN PARIS

A general view of the first great radio show held in Paris. Many exhibits from America and other countries were shown. (Kadel & Herbert Foto.)



Radio fans listening to demonstration of "B" battery practice at the Philadelphia Radio Show. Near the demonstration board the fans may be seen grabbing for copies of the booklet, "How to Get the Most Out of Your 'B' Battery," of which they took 20,000 during the five days of the show.

With the Manufacturers

Phonographs and Radio

In an interview, Mr. H. L. Willson, president of the Columbia Graphophone Company, explained the position of the phonograph industry in relation to radio broadcasting.

"A happy relation is rapidly being established between the radio broadcasting interests and the phonograph industry. In some quarters, when radio first sprang into prominence, there was a feeling that the phonograph industry would be unfavorably affected, but the experience of more than two years has proven that radio may become a great aid to the phonograph industry. In the end, anything that helps to increase the popularity of music helps the sale of phonograph records. Radio serves to popularize music but as soon as a number is rendered at a radio broadcasting studio, no record of it remains. The radio audience is not satisfied with one reproduction. This is indicated by the many request programs which are arranged in an attempt to meet the demand for a permanent record of successful numbers. Famous orchestras sometimes receive as many as 500 telephone requests for certain numbers. Only a phonograph record personally selected can suit the indivudual tastes of this diversified audience.

"Realizing that radio broadcasting is an effective way of bringing new musical numbers to the attention of the public, just as the phonograph is the only successful way to permanently record them, the Columbia Graphophone Company has made arrangements with the American Telephone and Telegraph Company to broadcast through WEAF selections by the same artists who are recorded on phonograph records at our studios. The selections by radio will be played exactly as they are reproduced on Columbia New Process Records. As a result of these arrangements, the radio audience gains excellent program matter while the phonograph industry profits in creating a demand for permanent reproductions of the radio programs."

A New "B" Battery

A new type of "B" battery constructed on the skyscraper principle, so that most of its bulk is raised vertically instead of occupying valuable horizontal space, is now available to radio fans whose table area is limited. The new battery is No. 764 of the National Carbon Company. It gives 22 1-2 volts, and is only 3 1-8 inches wide. Its height is 5 5-8 inches.

It has been the practice of many radio users to install in their home sets the small "B" battery designed for portable sets, in situations where the saving of space or in the first cost were considerations. Some set manufacturers, to provide cabinet space, have done the same thing. Although the small "B" battery is necessary for portable use, its small size gives so short a life that it is properly used only where small space and light weight are of first importance.

The new battery has twice the life of the portable battery, while standing on practically the same size base, and the cost is only about one-fourth more than the cost of the small one. It was developed after months of experimentation by engineers of the National Carbon Company, who knew that many radio users were increasing their battery operating cost in order to economize on space or to save in first cost. The new battery gives much lower operating cost without appreciable sacrifice in table space.

Cascade Regeneration

A radio receiver set which, with a dishpan for an antenna, catches broadcasts from a 500 Watt Station 1,400 miles away, has been developed by Bowden Washington, it is announced by the Cutting & Washington Radio Corporation, Minneapolis.

The receiver, the result of two and a half years of laboratory efforts, works on a somewhat new principle termed cascade regeneration, which renders extremely small antennae highly effective.

With four UV-199's and a dishpan on a chair for an antenna, and another on the floor directly beneath it for a "counterpoise," signals from a 500-watt Western Electric transmitter in Dallas, Texas, were heard 1,400 miles distant on a loud speaker with such intensity as to be unpleasant. The receiver works equally well with a fly screen, a 6-foot wire, a magnavox horn or any small body of metal for an antenna, the announcement said. The receiver is also extremely selective.

Vernier Control

Radio Units, Inc., Webester Bldg., Chicago, has attractive folders describing the "Tiny-Turn," a vernier control which has a high gear ratio and makes tuning easy. They also offer the Duo-Spiral, a loop aerial with long handle and dial to regulate direction. The same company makes a binding post of black and nickel finish which improves appearance of the panel.

Bradley Switch

The Allen-Bradley Co., Milwaukee, Wisconsin, have added a fourth item to their list of radio products, known as the Bradley switch. This is a very com-

The How and Why of the Neutrodyne

By ARTHUR B. McCULLAH

THE ideal condition for amplifying at radio frequencies is to have the grid circuit tuned to the incoming signal that is to be amplified; also to have the plate circuit tuned to the same value that the grid or secondary circuit is tuned to. That is, the greatest efficiency is obtained when both grid and plate circuits are tuned to the same wave length.

One of the properties of a vacuum tube is to oscillate when the grid and plate circuits are tuned to the same value, which is due to the capacity coupling, furnished by the elements of the tube. The tube can be made to stop oscillating by biasing the grid. This can be done with a potentiometer, but this method has not proved satisfactory.

It can be readily seen that if a tube is oscillating at the frequency of the incoming signal, the oscillations from the tube will "buck" the incoming signal, and produce nothing but howling and distorted music.

The method to tune such an outfit, is to detune the plate circuit, so that the tube will not oscillate; that is, to detune the plate circuit, to a point just before the point where the tube will oscillate. With this method of tuning, the signal is relayed from the antenna to the detector, for a loss as the voltage across the tuning circuit in the plate circuit falls off very rapidly. By actual comparison it has been found that the three circuit regenerative system gives by far louder signals than the radio frequency amplifier of this type.

Prof. L. A. Hazeltine surmounted all of the difficulties by neutralizing the inherent capacity of the tube that is so objectionable. The balancing or neutralization of the capacity feedback between the grid and plate circuits is done with a small condenser in the neighborhood of .000015 mfd.

In this system the grid and plate circuits are tuned to the same wavelength, thus the maximum voltage will be across the tuned circuit in the plate circuit of the radio frequency amplifier. The tuning of such a set is not so critical as the tuning of a set that oscillates.

The neutrodyne condenser probably gives more trouble than anything else in a neutrodyne set. A large share of the neutralizing condensers on the market are too small. This makes it impossible to neutralize the capacity feedback; also the full benefit can not be derived from such a set.

A neutralizing condenser can be made that is the right size and will be just as efficient as the ready-made condenser. All that is necessary is two copper plates two inches square, soldered to the ends of two copper bus bar wires, one piece of bakelite 8 1-2 inches by 3 inches by 3-16 inches, two long binding posts (see Figure 1).

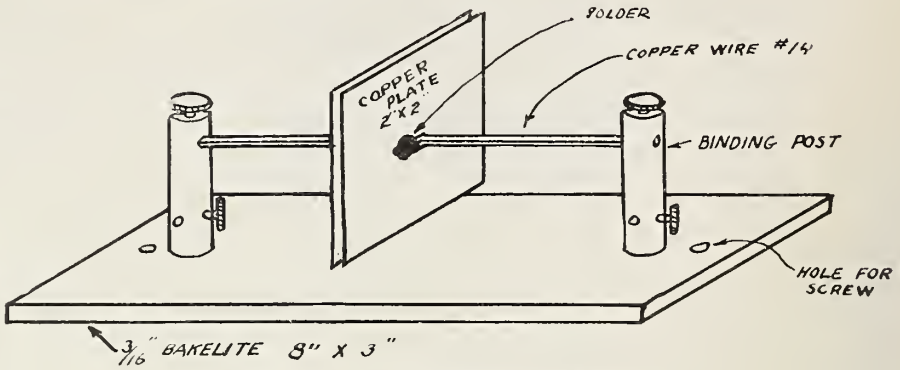


Figure 1. The Neutrodyne Condenser.

Editor's Note: Comprehensive instructions on how to build the four-tube neutrodyne receiver, illustrated with a full page isometric drawing, was published in the October RADIO AGE. Back copies are available at the regular rate of thirty cents for back numbers.

With the Manufacturers

(Continued from page 33.)

pact, completely enclosed, single-pole switch for opening battery circuits. It is mounted by drilling a hole in the radio panel and securing the switch by means of a knurled nut. The switch is operated by pulling or pushing the switch button.

The Bradley switch is nickel-plated and the button is polished black, thus conforming with the standard finish used for radio equipment. The switch will retail for sixty cents.

Rogers Radiometer

A device for tuning out interference is offered by the Rogers Radio Co., Pittsburgh. It is called the Rogers Receiving Radiometer and sells for $3, list. Some of the merits of this radiometer are that it is devoid of self-capacity; its inductance is progressively variable; it occupies small space; it is of moulded condensite; easy to mount and is substantially constructed. Tested and approved by Radio Age Institute.

Combined Battery and Charger

The Philadelphia Storage Battery Company announces a big demand for the $20.20 Philco Charger-Battery combination. It is a charger for "A" and "B" batteries and a genuine "Philco" 50-ampere radio battery, big enough to operate as many as five tubes. Further inquiry may be made of J. N. North, manager of the radio department, Philadelphia Storage Battery Co., 1621 S. Michigan Ave., Chicago.

Battery Demonstrations

A demonstration board which graphically illustrated the factors affecting "B" Battery current drain attracted attention at the Philadelphia Radio Show, which closed November 17. The same board was moved to Chicago for the show there, and went on to Boston for the Boston Show, December 3 to 8. The board was part of the exhibit of the National Carbon Company, and was manipulated by F. T. Bowditch, physicist, the associated company of the Union Carbide and Carbon Research Laboratories, Inc.

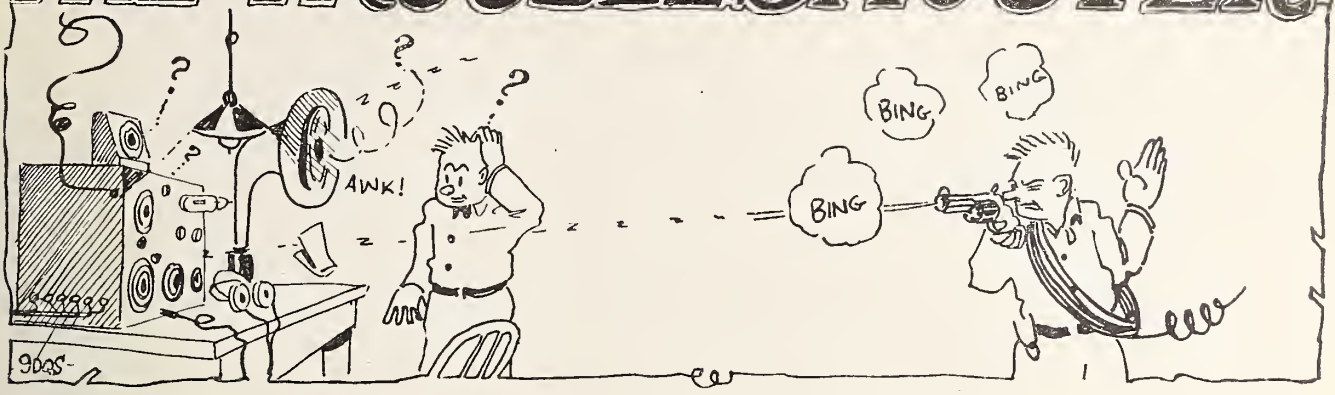
Just how much interest was shown in this battery demonstration may be imagined from the fact that the radio fans took away with them 20,000 National Carbon Company booklets describing battery operation, during the time the show was on. And the fans literally took them as the photograph shows. Each demonstration closed with the announcement that the new booklet, "How to Get the Most Out of Your 'B' Battery," might be had for the asking. Fans at once surged forward toward the booth, seizing the booklets the instant they came within arm's reach. One of these onslaughts is shown in the photograph, made during one evening at the show. The booklets rehearsed the information given by Mr. Bowditch during his talk and demonstration.

The demonstration board stood at one side of the booth and was constructed with a huge ammeter running across the top. As Mr. Bowditch explained the effects on battery life of the number of tubes, "B" battery voltage, use of a "C" battery, etc., the needle of the ammeter swung backward and forward across the dial, clearly visible to the farthest corner of the crowd. The demonstrator was able to talk in a natural voice by means of a unit of the Western Electric public address system in front of the board.

Besides the demonstration board, the National Carbon booth contained two large display stands which carried all the different types of Eveready radio batteries, with large lettered cards explaining the use of each in different radio installations.

In addition to Mr. Bowditch, the National Carbon Company was represented by G. C. Furness, manager of the radio department; A. M. Joralemon, sales manager, radio department; E. E. Horine, radio engineer; and E. Harold Boudwin, Philadelphia representative.

THE TROUBLESHOOTER



THE Troubleshooter Department of RADIO AGE has become a popular section of this magazine due to the fact that fans may write and receive answers to their inquiries with a minimum of delay.

In order that we may keep up the standard of this department and assure our fellow readers prompt service, it has become necessary for us to ask fans who write this department to observe certain rules, in order that prompt replies and concise answers may be sent out.

Non-subscribers may avail themselves of this service if they enclose fifty cents with each letter of inquiry. Do not ask us to answer your inquiries if you do not remit, saying that you are a regular reader, as we cannot do this in justice to our regular subscribers.

When writing, write on one side of the paper only, and do not forget to enclose a stamped, addressed envelope if you desire a personal reply.

Before writing this department, search through your back numbers of RADIO AGE to see if the desired information is not printed therein. It will save you both time and money to do this, because if the information has already appeared in some past number, this department will only call your attention to the issue in which the desired information appeared.

Questions pertaining to hookups of manufactured sets can not be answered. Write the manufacturer for this information.

Do not ask the Troubleshooter department to send you a list of the best apparatus to use in a set. We can advise the type of apparatus in a general way, but cannot specify any particular piece of apparatus. If it is absolutely necessary to specify an instrument vitally necessary in the circuit without intention of advertisement, it will be done.

When writing, don't put down every question you can think of—stick to the particular subject you are asking about as much as possible. If it is a set, tell about how it functions, whether good, bad or indifferent. If you possibly can, enclose a diagram of the circuit you are asking about, as it becomes very perplexing when a fan does not make clear what type of circuit he uses.

Questions are answered in the order they are received, and if your letter is delayed, exercise a little patience. Many letters command special attention requiring reference to our files, and looking up information.

This important service is carried out by our Technical Assistant, Felix Anderson, under the supervision of Frank D. Pearne, Technical Editor of RADIO AGE.

In an effort to start the year right, and settle for once and always the rubber stamp variety of question, we are printing this month questions of general and interesting nature. For the benefit of those who are just starting, we print the following general information:

Antennas:

Most preferred and popular type, is a single wire from 100 to 125 feet in length, including lead-in. For further information see June, 1923, issue.

Grounds:

Use waterpipe, or iron stake driven into ground. SOLDER the connection.

Instruments:

Use instruments that are strong, and well built. Do not expect results from cheap apparatus. Condensers should have positive connections and a gearing adjustment is preferred over any other type of vernier due to its lower losses. Choose a condenser which has the rotary plates connected to the end mounting, and has a minimum of insulation so placed with respect to electrostatic field that its losses are small. Friction verniers are also good.

Selectivity of Sets:

Depends upon the type of set, the location it is operated in, the proficiency of the operator, and the length of antenna.

Tubes:

Dry cell tubes will not give the volume that can be gotten from storage battery tubes.

H. F. H., Jamestown, N. Y.

Question: Kindly inform me where I can obtain a copy of the diagram of the Cockaday Four Circuit Tuner. I have read with considerable interest the comment of your readers on this circuit.

Answer: Full instructions relative to the construction of the above circuit appeared in the August, 1923, issue of RADIO AGE.

A. C. H., Chicago, Ill.

Question: Last week I built my first tube set from the isometric sketch showing back panel arrangement and wiring as given in the October issue of RADIO AGE. To say that it is a good hookup is putting it mildly. I wired my set as per your sketch and was able to get KDKA, WOS, WDAF, and WDAO the first silent night, and I have since brought in KDKA through local stations. It is my desire to build two steps of audio amplification with jacks so that I may use one or two steps and as I do not understand the circuit drawings, I am wondering if you could supply me with an isometric sketch showing arrangement and connections of parts. With many thanks for the help you have already accorded me, I await your further information.

Answer: The August issue of RADIO AGE contained detailed information on the construction and operation of a two-stage audio frequency amplifier with jacks. Inasmuch as the article is illustrated isometrically, you should have no trouble in connecting the set.

E. W. R., Orlando, Fla.

Question: Kindly inform me in what issue details concerning the construction of a battery charger were printed. I note in your questions and answers department you refer to a charger that can be operated from the 100 volt lighting circuit.

Answer: The information you desire was printed in the December, 1922, issue of RADIO AGE, and refers to an electrolytic type of battery charger.

G. A. J., Joliet, Ill.

Question: I am a beginner in the radio game and in the course of my trying to get acquainted with the particulars concerning sets, I have acquired a number of radio parts of which I am enclosing a list. I would appreciate your giving me a circuit which would use these pieces of apparatus and which would really tune in long distance stations.

Answer: In the October, 1923, issue of RADIO AGE you will find a circuit applicable to the apparatus you list and which will do consistent and long distance work. The December, 1923, issue

shows how to add two stages of audio frequency amplification to a set of this kind.

G. W., Hailey, Idaho.

Question: Please tell me how the various dry cell tubes compare as to volume and efficiency; also kindly send me a copy of the Kaufmann circuit.

Answer: The dry cell tubes are all efficient as far as current consumption is concerned. I would list them as follows, their efficiency rating in the order named: C 301A, UV 199, WD 11, WD 12, DV 6. Complete description giving detailed information on how to construct and operate the Kaufmann circuit was printed in the June, 1923, issue of RADIO AGE. A diagram of the two stages of amplification appeared in the September, 1923, issue.

R. H., Belleville, Ohio.

Question: Kindly inform me where I can obtain a copy of the three-circuit regenerative set, the type which uses two variometers and a variocoupler. I would like to have if possible the isometric sketch type showing the panel layout.

Answer: A complete description of the Armstrong three-circuit regenerative set appeared in the November, 1923, issue of RADIO AGE. This issue shows the isometric sketch you desire. A diagram of the circuit in connection with a two stage audio frequency amplifier appeared in the September, 1923, issue.

M. S. B., Minneapolis, Minn.

Question: Early last spring I constructed a radio set using the Kopprasch circuit. I am not able to recall in which issue it appeared. This circuit uses two variometers with an inductance between them. The set I made was dismantled by another person and I now want to rebuild it, using the above circuit. Will you kindly oblige me with another copy of the issue in which it appeared?

Answer: The circuit you have in mind appeared in the April, 1923, issue of RADIO AGE. A diagram of the circuit with a two-stage audio frequency amplifier was printed in the same issue.

D. R. C., Logansport, Ind.

Question: I am using a single circuit receiver with two stages of audio frequency amplification. Why is it that I cannot get as good results when I use more than ten volts on my detector and forty volts on my amplification? Please show me if there are any changes in my hookup that would better my results. Please tell me if there are any improvements I can make on my tuning arrangement. The coil consists of 90 turns of bank winding tapped at every ninth turn. This coil is wound on a three and one-half inch tube. The tickler coil has sixty turns of 26 DCC wire on a tube slightly smaller.

Answer: Probably the tube you are using as a detector is defective. If it has too much residual gas remaining, the tube will not function well. Put it on the amplifier stage, and if it turns blue on 45 volts, you can be sure that it is too "soft." You might decrease the number of turns on the tickler, making the coil have about 50 turns. The set should oscillate freely with this number of turns. The other improvement I would suggest is to place your phone condenser across the terminals of the transformer on the first stage of amplification. I am enclosing herewith a diagram showing how this is done. This issue contains information relative to increasing the selectiveness of your receiver.

L. E. D., Kansas City, Mo.

Question: I am a subscriber and wish to get information regarding a Reinartz set I am going to build. In your September issue, on page 5, you show how to load up a Reinartz set. As I look at the connections, it seems to me that when you switch in the loading coil you switch out the other coil and all the other switch points. The drawing does not show any connection between the two coils. Is it possible to wind a Reinartz coil large enough to take care of 600 meters? That is I want to reach this wave and higher without resorting to exterior loading coils. If this can be done, kindly advise me as to the specifications of such a coil.

Answer: We rather prefer the arrangement shown in the September issue to a larger coil, as you will decrease the dead end loss of the additional turns used to bring the wave of the set up to six hundred meters. You might use larger condensers. The arrangement shown in the September issue allows the outer coil to be used independently from the inner coil and when not in use, it is cut out of the circuit entirely. Cutting out the coil in the above manner increases the efficiency of the set to a noticeable degree.

W. K. R., Kennobert, Sask., Can.

Question: Kindly inform me where I can obtain a description of an amplifier to be added to a single tube Reinartz receiver.

Answer: This information can be had from either the August issue of RADIO AGE, or can be obtained from the Reinartz booklet advertised elsewhere in this issue.

G. D. I., Tulsa, Okla.

Question: Please give me a diagram of the circuit and a list of parts necessary to properly assemble the Haynes DX Receiver.

Answer: Detailed information of the construction and operation of the receiver you have in mind appeared in the December, 1923, issue of RADIO AGE. A diagram showing the addition of a two-stage amplifier was also shown in this issue.

A. L. K., Watertown, N. Y.

Question: Have been reading your July number of RADIO AGE, and I find it to be of mighty interest. I haven't been able to get this magazine on our news-stands, so please enter my subscription. I have an Armstrong three-circuit regenerative set at present. but I desire to get away from a regenerative type of receiver. Will I make a mistake in making a Reinartz set as in Figure 1 of your July issue? Would you please advise me something along this line?

Answer: You apparently have the wrong conception of the Reinartz set when you infer that it is not regenerative. The Reinartz is one of the sets which makes use of this regenerative action, due to the plate coil being directly coupled to the antenna through the feedback condenser. If you intend to build a set of the non-regenerative type, we would suggest your constructing one as described in the September issue of RADIO AGE in which the tubes you mention could be used to advantage.

B. W. E., West Burlington, Iowa.

Question: Kindly inform me where I could obtain information relative to the adjustment of a Neutrodyne Receiver. I am using one at present, and I am having trouble in making it work properly.

Answer: Detailed instructions concerning the operation, construction and action of the Neutrodyne Receiver was published in the October issue of RADIO AGE.

Experiments In Radio Control

(Continued from page 24.)

(Fig. 1) at A—B. Then, having set up the transmitter, say 20 feet or so away, press the key. You will find, perhaps after a little adjusting of the coherer, that the motor will operate simultaneously with the transmitter. An electric bulb may be supplemented in place of the motor, if desired.

As an illustration of how explosives can be ignited at a distance by means of radio, here is a novel experiment: Connect a small piece of No. 36 bare German silver wire in the circuit at A—B. To this wire attach the fuse of an ordinary fire-cracker. Press the key of the transmitter, and the German silver wire will heat, and light the fuse, causing the fire-cracker to "go off."

Another interesting experiment is the taking of flashlight photographs, without the presence of any person. Having set the camera as you would for a time exposure, connect the German silver wire in the circuit as in the preceding experiment, allowing it to touch the flash powder. Thus you can take photographs at a distance.

Numerous other experiments which are needless to mention will suggest themselves to the experimenter.

Radio control will some day be commercially practical. Picture in your mind, huge, crewless, liners, laden with freight, sailing the seven seas, bound to a course at the will of the operator in the control station miles away, and this one possibility of radio control, will cause you to realize what it will mean to the progress of our world.

Radio Year Book

Radio, with other forms of communication is included in a general survey of the economic situation of the world, just issued by the Department of Commerce. This review which is known as "The Commerce Yearbook," and is available from the superintendent of documents, was prepared under the direction of D. J. Reagan, of the department. Concerning radio it states:

"The principal developments in international radio during the year 1922 were in the form of concessions secured, plans made and work prosecuted on various stations designed for international traffic. The station at Monte Grande near Buenos Aires, of which the Radio Corporation of America is part owner, was taken over from the German company which had started its construction and the plans were altered to provide direct communications with the United States, as well as with Europe. The concession was secured for a similar high-power station in China, with smaller stations to act as feeders. This latter concession was issued in the name of the Federal Telegraph Company, which made arrangements to work with the Radio Corporation of America. The Radio Corporation secured the contract for the construction of a high-power station in Sweden, and proceeded with the construction of the station at Warsaw for the Polish government. These two stations furnish additional radio circuits direct to New York.

"In Central America and on the Caribbean coast of South America, the Tropical Radio Telegraph Company developed a general plan for a radio network to cover the countries bordering on the Gulf of Mexico and the Caribbean Sea. A new station was erected at Tegucigalpa, and the power of the New Orleans station was increased.

"International radio communication during 1922 showed a large increase in receipts from transoceanic traffic, the Radio Corporation of America reporting gross receipts of $2,914,000 as compared with $2,138,000 in 1921. It is evident from these figures that radio has taken its place beside the ocean cable as a reliable means of international communication. They indicate also the possibility of operating high-power radio circuits at an actual profit—something that has never been accomplished before.

"The most remarkable development in radio, however, was the great increase in the number of radio telephone broadcasting stations and in the number of receiving sets in use by the public. During the summer months of 1922 there was a slackening in the demand for radio apparatus and apparently a period of stagnation in the market. This proved to be only temporary, since, with the advent of the fall, the number of receiving sets in use increased even more rapidly than before and the requests for transmitting station licenses came into the Department of Commerce in even greater numbers. A remarkable increase appears in the gross sales of the radio corporation for 1922—$11,286,000 as compared with $1,468,000 in 1921.

What's What In Radio Industry

THE Federal Trade Commission on December 3 submitted to Congress a report of facts with respect to the radio industry. The report contains the results of the investigation made pursuant to House Resolution 548, Sixty-seventh Congress, fourth session.

An attempt has been made to collate the data with respect to the various phases of the inquiry as outlined by Congress in the resolution. In Chapter I, the facts concerning the development of the industry are presented which include the organization of the Radio Corporation of America, the most important factor in the industry. In Chapter II, the agreements between the various companies, respecting the hundreds of patents covering radio devices and apparatus, are discussed, which agreements are set out in full in the Appendix. In Chapter III are discussed the various traffic agreements respecting international radio communication and which are also set out in full in the Appendix. Chapter IV is devoted to a discussion of the practices relative to the manufacture, sale, and use of radio apparatus and parts. This naturally includes an outline of the sales policy of the Radio Corporation and the facts as to its sale of vacuum tubes, which product has been termed the heart of radio.

The Commission desires to call attention to certain facts disclosed by the investigation which may be summarized as follows:

British Holdings

The Marconi Wireless Telegraph Company of America was the first company in America formed for the purpose of engaging in the transmission of messages by wireless. It was organized November 22, 1899, with a capitalization of $10,000,000, of which about 25 per cent was owned by the Marconi's Wireless Telegraph Company, Ltd., a British Corporation.

In the United States and territories, this concern had the exclusive right to use and exploit the patents controlled by the British Marconi Company, among which were the important Fleming tube patents. The Marconi Company erected high power wireless stations at New Brunswick, N. J., Belmar, N. J., Marion, Mass., Chatham, Mass., Bolinas, Calif., Marshall, Calif., Kahuku, Hawaii and Kokohead, Hawaii. In the ship-to-shore communication business it practically had a monopoly when it was taken over by the Radio Corporation in 1919. Some of the wireless apparatus used was manufactured at its plant at Aldene, New Jersey, where it also manufactured radio parts, which it sold to amateurs and experimenters in radio, while the equipment for its high power stations was purchased from the British Marconi Company.

There were only two other companies in the United States engaged in the operation of a radio communication service, the United Fruit Company and the Federal Telegraph Company. The United Fruit Company, which operates a fleet of vessels in connection with its tropical fruit business between the United States, the West Indies, Central and South America, obtained a few radio patents and a license from the Marconi Company under certain of its patents. Its vessels were equipped with wireless apparatus and stations were erected in Boston, Massachusetts, New Orleans, Louisiana, and a few points in Central America from which a commercial service was maintained. The Federal Telegraph Company of California was organized in 1911 and operated a ship-to-ship and ship-to-shore service on the Pacific Coast.

Prior to the war, broadcasting for entertainment purposes had not been developed and the radio apparatus required in receiving and transmitting sets were sold to the concerns engaged in the communication field, the United States Government, and amateurs and experimenters in the radio art. The principal manufacturers of apparatus and parts were the Marconi Company of America, Federal Telegraph Company, DeForest Radio, Telephone & Telegraph Company, and the Wireless Specialty Apparatus Company, a subsidiary of the United Fruit Company. None of these concerns manufactured what is now termed the modern vacuum tube and which is considered so essential by the industry. Only the Marconi and DeForest Companies manufactured vacuum tubes which because of certain defects were not considered of much importance.

The DeForest Company manufactured tubes for only a short time since it was infringing the Fleming tube patents of the Marconi Company. The device then used for rectifying purposes was the crystal. Crystals and crystal receiving sets, efficient for short communication, were manufactured chiefly by the Wireless Specialty Apparatus Company. The Federal Telegraph Company manufactured the Poulsen arc, which is used in high power stations, for its own use and sale to ship owners and the Government. The three important manufacturers of electrical apparatus, the General Electric Company, and the Westinghouse Electric & Manufacturing Company, prior to the war did not sell radio apparatus, although they had done considerable research and development work. Some of the apparatus manufactured, however, was adapted for both radio and general electrical purposes.

Radio Corporation

Although engaged primarily in the manufacture of electrical machinery and apparatus, the subject of radio was of interest to the General Electric Company since many of its patents were also adapted to the radio art. Among its developments is the Alexanderson alternator, which is a machine for generating high frequency current, useful especially in long-distance communications. The first of these machines was installed in 1917 at the New Brunswick, N. J., station of the Marconi Company. Shortly thereafter the British Marconi Company commenced negotiations for the exclusive rights to the machine but because of the war negotiations were suspended. After the signing of the armistice, negotiations were resumed but were practically concluded after a conference in April, 1919, between Rear Admiral Bullard, Director of Communication of the Navy, Commander S. C. Hooper, of Bureau of Engineering of the Navy Department, and officials of the General Electric Company. The officials of the Navy Department suggested that an American radio corporation be formed to which the rights in the machine be sold and thus enable it to compete with British interests. A contract was proposed which provided for the organization of a company in such a man ner that the control thereof would re main in the control of American citizens At a conference in May, 1919, with officials of the General Electric Company, Secretary Daniels stated (1) that he was in favor of government ownership of radio, which he intended to urge upon Congress, and (2) that he doubted his power to execute such a contract except with the consent of Congress. No such

authority was granted so the contract never became effective. The General Electric Company, therefore, began negotiations for the purchase of the British Marconi Company's holdings in the Marconi Wireless Telegraph Company of America with a view of organizing a new company to carry on the radio business.

The Radio Corporation of America was caused to be organized by the General Electric Company, October 17, 1919. Its original capital stock was $1,000 but at the first meeting of the stockholders was increased to $25,000,000. On December 31, 1922, there was outstanding 3,955,974 shares, preferred stock, par value $5.00 per share, and 5,734,000 shares common stock, no par value. Of this amount, the the General Electric Company owns 1,875,000 shares, common, and 620,800 shares, preferred; the Westinghouse Electric & Manufacturing Company, 1,000,000 shares, common and 1,000,000 shares, preferred; and the United Fruit Company 160,000 shares, common, and 200,000 shares, preferred. The remainder is held largely by the former stockholders of the American Marconi Company. The companies mentioned are represented on the Board of Directors with the Exception of the American Telephone & Telegraph Company.

On November 20, 1919, the Radio Corporation entered into an agreement with the Marconi Wireless Telegraph Company of America, whereby the Radio Corporation issued to the Marconi Company 2,000,000 shares of its preferred stock in exchange for the physical properties, patents, licenses and good will of the Marconi Company.

License Agreements

The Radio Corporation has entered into agreements with the various companies which own or control practically all patents covering radio devices considered of importance to the art. The number of patents involved approximates two thousand. Agreements of this character have been entered into with the General Electric Company, Marconi's Wireless Telegraph Company, Ltd., American Telephone & Telegraph Company and its subsidiary, the Western Electric Company, the United Fruit Company and its subsidiary, the Wireless Specialty Apparatus Company, The International Radio Telegraph Company, the Westinghouse Electric & Manufacturing Company, and the Radio Engineering Company of New York. With certain minor limitations, the Radio Corporation under these agreements has secured an exclusive divisible right to sell and use the radio devices covered by the patents involved or by patents which these companies may acquire before the termination of the agreements. The agreements with the American Telephone & Telegraph Company and the Western Electric Company are to terminate in 1930 while the remainder are to terminate in 1945. Provision is made for the mutual exchange of information relating to radio, and, in most instances the Radio Corporation has granted to the other company a license under its patents to make and use devices in the particular

field in which the other company is interested.

The Radio Corporation, under these agreements, is made the selling company for practically all radio devices to be sold the public under the hundreds of patents involved. The General Electric Company and the Westinghouse Electric & Manufacturing Company are to manufacture and to sell to the Radio Corporation only, these devices and apparatus, the Radio Corporation agreeing that sixty per cent of its annual requirements would be purchased from the General Electric Company and forty per cent from the Westinghouse Company. Until the expiration of the Fleming patents in 1922, the Radio Corporation had an absolute monopoly in the sale of vacuum tubes. On the expiration of these patents, the DeForest Radio, Telephone & Telegraph Company which had retained a right to manufacture and sell, commenced the sale of such tubes to the general public. In the sale of receiving sets, the Radio Corporation has competition from seventeen concerns licensed under the Armstrong patents, although their sale of sets for use in conjunction with tubes is being contested in the courts at the present time.

It is contended that their sale and use under the present patent situation constitutes an infringement of the tube patents of the Radio Corporation which, if upheld by the courts, will prevent all competition in the sale of complete sets, since the Western Electric Company is manufacturing and selling only transmitting apparatus for commercial purposes.

Ship-to-Shore

In communication by radio between ships at sea and the shore, the Radio Corporation is the dominant factor. Its chief competitors are the independent Wireless Telegraph Company, Ship Owners' Radio Service Company, Wireless Company of Port Arthur, and Gulf Radio Service operating on the Atlantic Coast and the Federal Telegraph & Telephone Company and the Kilbourne and Clark operating on the Pacific Coast. The question as to the right to use tubes, the patents to which are under the control of the Radio Corporation, in apparatus furnished the ships and land stations is also involved in litigation, suit having been instituted by the Radio Corporation against the Independent Wireless Telegraph Company on this ground. The U. S. District Court for the Southern District of New York recently dismissed this bill for lack of parties since the DeForest Company, the owner of the patents involved and which had retained a personal license to make and sell, was a party to the proceeding in name only. If the contention of the Radio Corporation should finally prevail, competition from the other ship-to-shore service companies will be eliminated until there is a change in the patent situation. The Tropical Radio Telegraph Company, a subsidiary of the United Fruit Company, is also engaged in a ship-to-shore service in the Carribean Sea, but is affiliated with the Radio Corporation.

Overseas Communication

The Radio Corporation is the only concern now engaged in transmitting and receiving radio messages between the United States and foreign countries and contends that in order to function properly it must of necessity secure a monopoly in this field. The company has secured a virtual monopoly and controls all the high power stations with the exception of those owed by the Government. In addition, it has entered into traffic agreements with the various foreign Governments and radio companies, the majority of these agreements providing that all messages intended for the United States shall be transmitted only through the facilities owned by the Radio Corporation of America. Agreements of this character have been made with Marconi's Wireless Telegraph Company, Ltd., covering the British possessions, and the Governments of Norway, Germany, France, Poland, Sweden and the Netherlands. An agreement of a similar character between the Marconi Company and the Japanese Government was assumed by the Radio Corporation when it purchased the assets of the Marconi Wireless Telegraph Company of America and traffic by radio between the countries established.

In 1921, the Radio Corporation entered into an agreement with Marconi's Wireless Telegraph Company, Ltd., a British concern, the Compagnie Generale de Telegraphie sans fil, a French concern, and the Gesellschaft Fuer Drahtlose Telegraphie m. b. H., a German concern, respecting radio traffic from South American countries which was afterwards extended to Central American countries. Steps have been taken to establish service between Brazil, Argentina, Columbia, Venezuela and the United States. This agreement was made subject to the rights of the United Fruit Company in Cuba, Colombia, the Panama Canal Zone and Central America, and its agreement with the Radio Corporation whereby it agreed not to establish or operate stations for wireless communication outside the allotted territory.

The Federal Telegraph Company of California, which is engaged in a ship-to-shore communication service on the Pacific Coast, in 1921 entered into a partnership agreement with the Chinese Government providing for the erection of stations in China and the establishment of a transoceanic service. This agreement was assumed by the Federal Telegraph Company of Delaware, which was organized by the old Federal Company and the Radio Corporation. An agreement between the various companies holding concessions in China was also proposed. The agreement was apparently not executed and the correspondence with the Navy Department shows that the department would oppose any agreements of this character unless they were first approved by the respective governments. In a letter to the Secretary of State dated December 16, 1921, Mr. Denby, Secretary of the Navy, emphasizes the importance of maintaining competition in radio communication to and from China. The possibility of a monopoly in other fields than that of service is also pointed out, as is shown by the following excerpt from the letter:

"The Navy Department fears that any commitment on the part of the Government to an arrangement favorable to a monopoly by a single commerical company, though limited to a particular service, would but lend a means towards extending monopoly to other services such as development and distribution of apparatus in general, and this is considered absolutely undesirable, particularly in the field of supply and service to ships."

At the present time, the Radio Corporation has in operation communication circuits with Great Britain, Norway, France, Germany, Poland, Italy and Japan. It is expected that the station in Sweden will be completed and ready for operation within the next six months and that the station near Buenos Aires, in the Argentine, will be completed in the near future.

Because of the provisions in these various agreements providing for service through the facilities of the Radio Corporation exclusively, it is not believed that it will be possible for any other company in the United States to conduct an efficient transoceanic service. In fact, a group of newspaper publishers in the United States who sought to erect a station for the receipt of radio messages, after conducting experiments in this country, eventually built such a station at Dartmouth, Nova Scotia. This station is now being operated, its service being supplemented by virtue of an arrangement with the British Post Office. The following are members of the association operating such service:

The Chicago Tribune.
The New York Times.
The New York World.
The New York Herald.
The New York Tribune.
The Philadelphia Public Ledger.
United Press Association of America.
International News Service.
Universal Service.

The association is not exclusive and business for other newspapers is conducted at a charge of one cent per word.

Sale of Apparatus

The refusal to sell or lease apparatus to competitors for international communication purposes is included in the well defined policy of the Radio Corporation of America. It also affixes to the apparatus sold a license notice, the object of which is to restrict the purchaser's use of the device to amateur and experimental purposes. In supplying ships with apparatus, devices and appliances, the ship owners are required to execute an agreement which provides that the apparatus, etc., furnished by the Radio Corporation is licensed only for use on board ships and aircraft in communications destined to or originating on such ships or aircraft.

The Radio Corporation distributes its products chiefly through wholesale concerns handling electrical supplies. In order for a distributor to handle these goods it must furnish evidence that it has the facilities for conducting a wholesale business and give an initial order amounting to not less than $25,000. Independent manufacturers of sets are not sold vacuum tubes and other patented devices for re-

sale in connection with sets manufactured by them. This was a hardship, particularly when there was a shortage of tubes, as the dealers were unwilling to furnish them with tubes. The investigation shows that the shortage in tubes was confined to three of the six types manufactured and prevailed during 1922 and first few months of 1923. There was a marked increase in the demand for tubes as the industry developed as is shown by the orders received by the Radio Corporation which were as follows: 1921, 112,500; 1922, 1,583,021; and for the first nine months of 1923, 2,931,262 tubes. Although the officials of the Radio Corporation admit that they do not carry dealers who confine their orders to tubes exclusively, there is little evidence that the Radio Corporation required dealers to handle their goods exclusively or favored such dealers, in the supply of tubes, as compared with dealers who also handled apparatus manufactured by others.

The DeForest Radio, Telephone & Telegraph Company which is now engaged in the manufacture and sale of a modern vacuum tube, also a ffixes to its product notices with respect to use similar to those used by the Radio Corporation. This company has recently adopted the policy of making the distributors of its products, agents.

The Commission submits no conclusions in this report as to whether the facts disclosed constitute a violation of the anti-trust laws, as the House resolution under which the report was prepared called only for the facts and data "as in the opinion of the Commission may aid the House of Representatives in determining whether . . . the anti-trust statutes of the United States have been, or now are, being violated . . . ; and such other facts as in the opinion of the Commission may aid the House in determining what further legislation may be advisable."

Mooseheart Heroes

Matthew P. Adams, superintendent of Mooseheart, Ill., is the premier bachelor daddy. His brood comprises 1,200 youngsters of assorted ages, races, creeds and sizes, but just as if the number were two or three and he the honest-to-goodness daddy who comes home with a surprise bag of gumdrops or puzzlebook hidden in his pocket, so he is always planning something new and thrilling for his flock of 1,200.

Thomas Mulligan and Thomas Burgess, two important cogs on the Mooseheart lightweight foot ball team, each of whom suffered a broken leg in a game at Morris, Ill., were removed to an Aurora hospital, both feeling fit as Punch but with heavy casts keeping them confined to their beds. After the fractures were reduced all they would have to do for six weeks would be to lie in bed—and on their backs.

Superintendent Adams surprised the two lads when he had a radio receiving outfit installed in their room at the hospital. It is equipped with a quieting device so that other patients will not be disturbed, but the two Mooseheart boys have earpieces so that they get news, music and entertainment going on in the world without even turning over in bed.

Every night they get scores of athletic contests, news of the day, concerts from all parts of the country and then the bed-time story and their red letter days were when university football games were broadcast, play by play. They need pay no attention to "lights out" or other usual hospital rules, for they get radio messages until the early hours of the morning unless they go to sleep.

Mooseheart is the academic and vocational school of the Loyal Order of Moose for dependent children of deceased members.

CLASSIFIED ADVERTISEMENTS

Six cents per word per insertion, in advance. Name and address must be counted. Each initial counts as one word. Copy must be received by the 15th of month for succeeding month's issue.

HELP WANTED

Steady work. No strikes. No layoffs. Commence $133 month. Raise to $192 monthly. Become U. S. Government Railway Postal Clerks. Pleasant work. Traveling constantly. See your country on Government time. Vacation with pay. Common education sufficient. List positions free. Men—boys, 18 up, write immediately, now Franklin Institute, Dept. F 115, Rochester, N. Y.

FREE HOOKUP

Sixty-thousand miles on Home-made Receiver. Twenty-six hundred mile range. Hundred-station log and Hookup free. Spencer Roach, 2905 Columbia Avenue, Philadelphia, Pa.

BOOKS

If you have not bought your Reinartz Book, fully illustrated with hook-ups and clear description of how to make this popular circuit, send $2.00 in money order or currency and we will send you the booklet "Reinartz Radio" and place you on the subscription list of Radio Age for one year. Address Radio Age, 500 N Dearborn Street, Chicago, Ill.

If your newsdealer has sold out his supply of RADIO AGE you are likely to miss just the hook-up that you have been looking for. To avoid any such chance fill out the coupon in this issue and send in your subscription. Then you will be safe. And don't forget that with each subscription at the special price of $2.00 a year, or $1.00 for six months, we send you free the popular Reinartz Radio booklet FREE. Address Radio Age, 500 N. Dearborn Street, Chicago, Ill.

Turning on Our Loud Speaker

SAY, Mr. Radio Bugg, are you a regular reader of RADIO AGE? Before you file this copy of RADIO AGE, stop a minute and think over what you found in it. Have you ever read articles as clear as the ones you just finished? Did you ever see drawings and circuits more clearly portrayed? Perhaps you have once or twice—but here's your opportunity to be assured of real practical information right along.

Read over the following extracts and letters from our readers, who know and appreciate first-hand radio information; *real* practical radio. Here's a shining example of just what RADIO AGE has done for one of our readers and it shows how we can help you:

RADIO AGE,
Gentlemen:

Being an admirer of RADIO AGE, I just built the three circuit receiving set designed by Felix Anderson as it was published in the November, 1923, issue of your publication.

I have built nine different sets from supers to various other types of sets, published in other radio journals, and they turned out to be jokes. I won't mention the names of the other magazines but I will say that the sets I built came out of every radio journal I could buy, and I think I got them all. I was almost heartbroken, as it cost a pretty penny to be fooled like that.

So I resolved I would try one more and I did, which was the above mentioned set, and while I am writing this I feel like jumping up and down and hollering.

You may publish this letter if you wish, as I think your readers would enjoy knowing that it is a feeling of great joy to know that at last one can get radio from a reliable source, and get information that is straight.

This is the only way I know of expressing my appreciation for such a book.

Very truly yours,
B. R. THOMPSON,
731 West Congress Street, Chicago, Ill.

Ronald Cox, of Beach Haven, N. J., built one of the simple tubes sets described in RADIO AGE, writes as he encloses a record breaking list of stations (see the Pickups section of this issue).

"Your magazine is the best I have ever seen."

Just read over this little extract from a letter of A. E. McElroy of Columbia, Mo.

"I have been reading your magazine for the past several months, and I have been particularly attracted by the exceptionally good, clear, and concise hookups you print."

James P. Cooper of Memphis, Tenn., says:

"I am proud to be a subscriber to your valued and instructive paper."

John J. Drechsler of 2111 St. Paul Street, Baltimore, Maryland, writes us:

"I have RADIO AGE to thank for the many days of pleasure I derived from my Kopprasch set. Gentlemen, kindly accept my humble thanks for your untiring labors."

It's rather pleasant to believe that readers of RADIO AGE are as appreciative as that!

James E. Chandler of Belvidere, Ill., says:

"I am a regular reader of your good magazine, RADIO AGE, and I want to tell you that I find it most instructive and helpful."

George Rollisson of 418 West Elm Street, Hanford, Calif., writes:

"I have read nearly all the different radio journals and am proud to say that RADIO AGE beats them all when it comes to hookups and material."

We get letters from fellows who have just started to read RADIO AGE which run something like this excerpt from the letter of F. M. Swissher of Meadowbrook, W. Va.:

"If you keep making your issues like the November issue, then it is without doubt the best radio book ever published. Keep up the good work."

There is no doubt about keeping up the good work. This month new writers appear on the staff of RADIO AGE, to furnish our interested fans with more and more first rate information. It's pretty hard to find a more capable staff of workers than Frank D. Pearne, Felix Anderson, Carl Masson, Arthur B. McCullagh, Carl Butman, John B. Rathbun, J. A. Callanan, all doing their level best to supply you with first rate radio.

The following is just another reason why you should be a regular RADIO AGE booster. Philip G. Shermerhorn of 67 West 52d Street, New York City, N. Y., tells us:

"May I say that I send in my subscription, partly because of the excellent material composing your magazine, and partly because of the list of broadcasting stations, since this list is an absolute necessity to DX listeners."

Perhaps as you glanced through the magazine you have noticed that we feature a list of broadcasting stations

But our list is different—it is not only a list of stations—it is a *corrected* list, which is kept to date for each issue by special service and news bureaus, and by the watchful eye of our Washington correspondent.

We hope you will pardon us for taking so much of your time, but we know that if we don't tell you about RADIO AGE, in this way, you'll probably never get to hear about it, because the average RADIO AGE reader is so busy copying long distance signals on a set made according to RADIO AGE instructions that he will just point to a magazine on his work bench, and mumble "LET THEIR HOOKUPS BE YOUR GUIDE."

A Public Chat

WJAZ, the Zenith-Edgewater Beach Hotel broadcasting station, was rebroadcasting an outside station the other night, the operator forgot to close his transmitter and a queer thing happened. Some one called him up on the phone and had quite a conversation with him. Thousands of fans thought that they were hearing two broadcasting stations carrying on a conversation. The caller's voice was just as clear as the operator's due to some freak of inductance.

Complete Corrected List of U. S. and Canadian Broadcasting Stations

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers and broadcasters.

			Wave length
KDKA	Weatinghouse Electric & Mfg. Co.	East Pittsburgh	326
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270
KDPT	Southern Electrical Co.	San Diego, Calif.	244
KDYL	Telegram Publishing Co.	Salt Lake City, Utah	360
KDYM	Savoy Theatre	San Diego, Calif.	252
KDYQ	Oregon Institute of Technology	Portland, Oreg.	360
KDYS	The Tribune	Great Falls, Mont.	360
KDYW	Smith Hughes & Co.	Phoenix, Ariz.	360
KDYX	Star Bulletin	Honolulu, Hawaii	360
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZE	The Rhodes Co.	Seattle, Wash.	456
KDZF	Automobile Club of Southern California	Los Angeles, Calif.	278
KDZI	Electric Supply Co.	Wenatchee, Wash.	360
KDZK	Nevada Machinery & Electric Co.	Reno, Nev.	360
KDZQ	Nichols Academy of Dancing	Denver, Colo.	360
KDZR	Bellingham Publishing Co.	Bellingham, Wash.	261
KDZT	Seattle Radio Assn.	Seattle, Wash.	360
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	360
KFAE	State College of Washington	Pullman, Wash.	360
KFAF	Western Radio Corp.	Denver, Colo.	360
KFAJ	University of Colorado	Boulder, Colo.	360
KFAN	The Electric Shop	Moscow, Idaho	360
KFAP	Standard Publishing Co.	Butte, Mont.	360
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif.	280
KFAU	Independent School District of Boise City, Boise High School, Boise, Idaho		270
KFAV	Abbot Kinney Co.	Venice, Calif.	224
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280
KFAY	W. J. Virgin	Medford, Oreg.	283
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Azbill	San Diego, Calif.	278
KFBE	Reuben H. Horn	San Luis Obispo, Calif.	360
KFBG	First Presbyterian Church	Tacoma, Wash.	360
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and the Chronicle News	Trinidad, Colo.	360
KFBU	The Cathedral (Bishop N. S. Thomas)	Laramie, Wyo.	283
KFCB	Nielsen Radio Supply Co.	Phoenix, Ariz.	236
KFCD	Salem Electric Co. (F. S. Barton)	Salem, Oreg.	360
KFCF	Frank A. Moore	Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)	Billings, Mont.	360
KFCK	Colorado Springs Radio Co.	Colorado Springs, Colo.	258
KFCM	Richmond Radio Shop (Frank T. Doeing)	Richmond, Calif.	360
KFCP	Ralph W. Flygare	Ogden, Utah	360
KFCV	Fred Mahaffey, Jr.	Houston, Tex.	360
KFCY	Western Union College	LeMara, Iowa	252
KFCZ	Omaha Central High School	Omaha, Nebr.	258
KFDA	Adler's Music Store	Baker, Oreg.	380
KFDD	St. Michaels Catbedral	Boise, Idaho	252
KFDH	University of Arizona	Tucson, Ariz.	360
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	360
KFDL	Knight-Campbell Music Co.	Denver, Colo.	360
KFDO	H. Everett Cutting	Bozeman, Mont.	248
KFDR	Bullock's Hardware & Sporting Goods (Robert G. Bullock). York, Nebr		360
KFDU	Nebraska Radio Electric Co.	Lincoln, Nebr.	240
KFDV	Gilbrech & Stinson	Fayetteville, Ark.	380
KFDX	First Baptist Church	Shreveport, La.	360
KFDY	South Dakota State College of Agriculture and Mechanic Arts,	Brookings, S. Dak.	360
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank Co.	Portland, Oreg.	360
KFEJ	Guy Greason	Tacoma, Wash.	360
KFEL	Winner Radio Corp.	Denver, Colo.	360
KFEP	Radio Equipment Co. (Joseph L. Turre)	Denver, Colo.	240
KFEQ	J. L. Scroggin	Oak, Nebr.	360
KFER	Auto Electric Service Co.	Fort Dodge, Iowa	231
KFEV	Radio Electric Shop	Douglas, Wyo.	263
KFEX	Augsburg Seminary	Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Concentrating Co.	Kellogg, Idaho	360
KFEZ	American Society of Mechanical Engineers (F. H. Schubert,)	St. Louis, Mo.	360
KFFB	Jenkins Furniture Co.	Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.	Pendleton, Oreg.	360
KFFO	Dr. E. H. Smith	Hillsboro, Oreg.	229
KFFQ	Marksheffel Motor Co.	Colorado Springs, Colo.	360
KFFR	Nevada State Journal (Jim Kirk)	Sparks, Nev.	226
KFFV	Graceland College	Lamoni, Iowa	360
KFFX	McGraw Co.	Omaha, Nebr.	278
KFFY	Pincus & Murphy	Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.	Dallas, Tex. (portable)	228
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	360
KFGJ	Missouri National Guard, 138th Infantry	St. Louis, Mo.	268
KFGL	Arlington Garage	Arlington, Oreg.	234
KFGQ	Crary Hardware Co.	Boone, Iowa	228
KFGV	Heidbreder Radio Supply Co.	Utica, Nebr.	224
KFGX	First Presbyterian Church	Orange, Tex.	250
KFGZ	Emmanuel Missionary College	Berrien Springs, Mich.	268
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHB	Rialto Theater (P. L. Beardwell)	Hood River, Oreg.	280
KFHD	Utz Electric Shop Co.	St. Joseph, Mo.	226
KFHF	Central Christian Church	Shreveport, La.	268
KFHH	Ambrose A. McCue	Neah Bay, Wash.	283
KFHJ	Fallon & Co.	Santa Barbara, Calif.	360
KFHQ	Curtis Brothers Hardware Store (Alfred E. Fowler)	Los Gatos, Calif.	242
KFHR	Star Electric & Radio Co.	Seattle, Wash.	270
KFHS	Clifford J. Dow	Lihue, Hawaii	275
KFHU	M. G. Sateren	Msyville, N. Dak.	261
KFHX	Robert W. Nelson	Hutchinson, Kans.	229
KFI	Earle C. Anthony (Inc.)	Los Angeles, Calif.	469
KFIB	Franklin W. Jenkins	St. Louis, Mo.	244
KFID	Ross Arbuckle's Garage	Iola, Kans.	246
KFIF	Benson Polytechnic Institute	Portland, Oreg.	360
KFIK	Gladbrook Electrical Co.	Gladbrook, Iowa	234
KFIL	Windisch Electric Farm Equipment Co.	Louisburg, Kans.	234
KFIO	North Central High School	Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association	Yakima, Wash.	224
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIV	V. H. Broyles	Pittsburg, Kans.	240
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	240
KFIY	Brott Laboratories	Seattle, Wash.	256
KFIZ	Daily Commonwealth and Oscar A. Huelsman	Fond du Lac, Wis.	273
KFJA	Central Power Co.	Grand Island, Nebr	244
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	Seattle Post Intelligencer	Seattle, Wash.	233
KFJD	Weld County Printing & Publishing Co.	Greeley, Colo.	238
KFJF	National Radio Manufacturing Co.	Oklaboma City, Okla.	252
KFJH	"The Sugar Bowl" (H. R. Shaw)	Selma, Calif.	273
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg.	252
KFJJ	Carrollton Radio Shop	Carrollton, Mo.	238
KFJK	Delano Radio and Electric Co.	Bristow, Okla.	233
KFJL	Hardsaeg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	229
KFJR	Ashley C. Dixon & Son	Stevensville, Mont. (near)	250
KFJU	Central Power Co.	Kearney, Nebr.	234
KFJV	Thomas H. Warren	Dexter, Iowa	224
KFJW	Le Grand Radio Co.	Towanda, Kans.	226
KFJX	Iowa State Teachers' College	Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	246
KFJZ	Texas National Guard, One hundred and twelfth Cavalry Fort Worth, Tex.		254
KFKA	Colorado State Teachers College	Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association	Milford, Kans.	286
KFKH	Denver Park & Amusement Co.	Lakeside, Colo.	228
KFKQ	Conway Radio Laboratoriea (Ben H. Woodruff)	Conway, Ark.	224
KFKV	F. F. Gray	Butte, Mont.	283
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	280
KFKZ	Nassour Bros. Radio Co.	Colorado Springs, Colo.	234
KFLA	Abner R. Willson	Butte, Mont	283
KFLB	Signal Electric Manufacturing Co.	Menominee, Mich.	248
KFLD	Paul E. Greenlaw	Franklinton, La.	234
KFLE	National Educational Service	Denver, Colo.	268
KFLH	Erickson Radio Co.	Salt Lake City, Utah	281
KFLP	Everette M. Foster	Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop	Little Rock, Ark.	261
KFLR	University of New Mexico	Albuquerque, N. Mex.	254
KFLU	Rio Grande Radio Supply House	San Benito, Texas	230
KFLV	Rev. A. T. Frykman	Rockford, Ill.	229
KFLW	Missoula Electric Supply Co.	Missoula, Mont.	234
KFLZ	Atlantic Automobile Co.	Atlantic, Ia.	273
KFMQ	University of Arkansas	Fayetteville, Ark.	263
KFMR	Morningside College	Sioux City, Iowa	261
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service	Portland, Oreg.	380
KGN	Northwestern Radio Mfg. Co.	Portland, Oreg.	380
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach.	360
KGW	Portland Morning Oregonian	Portland, Oreg.	492
KGY	St. Martins College (Rev. Sebastian Ruth)	Lacy Wash.	258
KHJ	Times-Mirror Co.	Los Angeles, Calif.	395
KHQ	Louis Wasmer,	Seattle, Wash.	380
KJQ	C. O. Gould	Stockton, Calif.	360
KJR	Northwest Radio Service Co.	Seattle, Wash.	270
KJS	Bible Institute of Los Angeles	Los Angeles, Calif.	360
KLN	Monterey Electric Shop	Monterey, Calif.	281
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	380
KLX	Tribune Publishing Co.	Oakland, Calif.	360
KLZ	Reynolds Radio Co.	Denver, Colo.	380
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif.	273
KMO	Love Electric Co.	Tacoma, Wash.	360
KNT	Grays Harbor Rsdio Co. (Walter Hemrich)	Aberdeen, Wash.	263
KNV	Rsdio Supply Co.	Los Angeles, Cslif.	258
KNX	Electric Lighting Supply Co.	Los Angeles, Calif.	380
KOB	New Mexico College of Agriculture & Mechanic Arts	State College, N. Mex.	360
KOP	Detroit Police Department	Detroit, Mich.	288
KPO	Hale Bros.	San Francisco, Calif.	423
KQI	University of California	Berkeley, Cslif.	360
KQP	Apple City Radio Club	Hood River, Oreg.	380
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	360
KQW	Charles D. Herrold	San Jose, Calif.	360
KRE	Berkeley Daily Gazette	Berkeley, Calif.	278
KSD	Post Dispatch (Pulitzer Pub. Co.)	St. Louis, Mo.	540
KSS	Prest & Dean Radio Co. and Radio Research Society of Long Beach, Calif.	Long Beach, Calif.	360
KTW	First Presbyterian Church	Seattle, Wash.	384
KUO	Examiner Printing Co.	San Francisco, Cslif.	380
KUS	City Dye Works & Laundry Co.	Los Angeles, Calif.	660
KUY	Coast Radio Co.	El Monte, Cslif.	256
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	360
KWH	Los Angeles Examiner	Los Angeles, Calif.	360
KXD	Modesto Herald Publishing Co.	Modesto, Calif.	252
KYQ	Electric Shop	Honolulu, Hawaii	360
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	536
KZM	Preston D. Allen	Oakland, Calif.	380
KZN	The Deseret News	Salt Lake City, Utah	360
KZV	Wenatchee Battery & Motor Co.	Wenatchee, Wash.	380
WAAB	Valdemar Jensen	New Orleans, La.	286
WAAC	Tulane University	New Orleans, La.	368
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	280
WAAK	Gimbel Brothers	Milwaukee, Wis.	280
WAAM	I. R. Nelson Co.	Newark, N. J.	283
WAAN	University of Missouri	Columbia, Mo.	254
WAAW	Omaha Grain Exchange	Omaha, Nebr.	360
WAAZ	Hollister-Miller Motor Co.	Emporia, Kans.	600
WABA	Lake Forest College	Lake Forest, Ill.	360
WABB	Dr. John R. Lawrence	Harrisburg, Pa.	268
WABC	Fulwider-Grimes Battery Co.	Anderson, Ind.	229
WABD	Parker High School	Dayton, Ohio	283
WABE	Young Men's Christian Association	Washington, D. C.	283
WABF	Mount Vernon Register-News Co.	Mount Vernon, Ill.	234
WABG	Arnold Edwards Piano Co.	Jacksonville, Fla.	248
WABH	Lake Shore Tire Co.	Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co.	Bangor, Me.	240
WABJ	The Radio Laboratories	South Bend, Ind.	240
WABK	First Baptist Church	Worcester, Mass.	252
WABL	Connecticut Agricultural College	Storrs, Conn.	283
WABM	F. E. Doherty Automotive and Radio Equipment Co.	Saginaw, Mich.	254
WABO	Waldo C. Grover	La Crosse, Wis.	244
WABO	Lake Avenue Baptist Church	Rochester, N. Y.	252
WABP	Robert F. Weinig	Dover, Ohio	288
WART	Holiday-Hall, Radio Engineers	Washington, Pa.	252
WARU	Victor Talking Machine Co.	Camden, N. J.	226
WARV	John H. DeWitt, Jr.,	Nashville, Tenn.	263
WRAA	Purdue University	West Layayette, Ind.	360
WBAD	Sterling Electric Co.	Minneapolis, Minn.	360

Pickups by Readers

(Continued from page 20.)

Gentlemen:

In this November RADIO AGE you have a letter sent in by Frank A. Fleckenstein, Memphis. According to his record he has heard twenty-two stations in nine days with his Cockaday. You ask if his record can be beaten in the same period of time. Here is my record, and let me state now that I keep two pairs of receivers hooked up to my set, and when I get a distant station I have my mother or a visitor to listen in on them long enough to prove that I am getting them. For practically all these stations I have such proof.

I have a single circuit set using the two-variometer hookup of the Aeriola portable set, and *I have only the detector.* From the twenty-seventh of October to the seventh of November I used my set nine nights (closed down on November 3, 4 and 5 on account of discharged A battery). Here is the list; a total of forty-seven stations:

KDKA, Pittsburgh, KFKB, Melford, Kan.; KSD, St. Louis; KOP, Detroit; KYW, Chicago; WAAP, Wichita, Kan.; WBAP, Fort Worth; WDAF, Kansas City; WDAP, Chicago; WFAA, Dallas, Texas; WGY, Schenectady; WHAS, Louisville, WHAZ, Troy, N. Y.; WLW, Cincinnati; WMC, Memphis; WOC, Davenport; WSB, Atlanta; WWJ, Detroit; WSY, Montgomery, Ala.; WJAR, Providence, R. I.; 2XI, (?); 9CD, Chicago, Ill. WJAZ, Chicago; WCAP, Washington, D. C.; WOAW, Omaha; WGR, Buffalo; (?), Erie, Pennsylvania; WBAH, Minneapolis; WOR, Newark; (?), Columbus, Ohio; WSAI, Cincinnati; (?), Illinois University; WJAN, Peoria, Ill.; WOAI, San Antonio, Texas; WHAM, Rochester; WHB, Kansas City; WJAX, Cleveland; WIAS, Burlington, La.; WMAQ, Chicago; KHJ, Los Anegles, (heard for nearly one-half hour on three successive nights); CHBC, Calgary, Canada; WHN, Brooklyn; WTAM, Cleveland; WLAG, Minneapolis; WOS, Jefferson City, Mo.; WDAR, Philadelphia; WJAK, Greentown, Ind.

These stations were received on a tuner wound on an oats box, a well-known and widely used article in rado construction with a UV200 detector tube and 2,000 ohm phones. Practically all my listening has been done between the hours of eight and midnight. Mr. Jeffers, in the letter following Mr. Fleckenstein's, says he finished at 3:20 a. m. I got KHJ all three times between ten-thirty and eleven, although I have heard that one must wait until everything else has closed for the night before trying for the western coast.

Very truly yours,
LLOYD E. FOLTZ.

It looks like you were getting the raspberry, Mr. Fleckenstein. Mr. Foltz certainly has a mean way of snatching the long distance stations out of the air.

And say, fellows—do you know that our little "first tube set" described by Mr. Anderson in the October issue has enabled beginners to get into the real DX game! That little set is doing some real work.

Read for yourself:

Beach Haven, N. J.

RADIO AGE,
Pickups Department.
Gentlemen:

I made a set according to your description in the October RADIO AGE. It's a one-tube set described in "How to make your first tube set," and I want to say that it works fine.

The first two nights I had it working I received the following stations:

WHAS, Louisville, Ky., WSB, Atlanta, Ga., WGY, Schenectady, N. Y., WJAX, Cleveland, O., KSD, St. Louis, Mo., KYW, Chicago, Ill., 6KW, Cuba, PWX, Havanna, Cuba, WIP, Philadelphia, Pa., WCAP, Washington, D. C., WHB, Kansas City, Mo., WNAC, Boston, Mass., WJAN, Peoria, Ill., WGR, Buffalo, N. Y., WJZ, New York, N. Y., WJAZ, Chicago, Ill., WDAP Chicago, Ill., 8XD, Ohio, WOO Philadelphia, Pa., WBZ, Springfield, Mass., KDKA, Pittsburgh, Pa., WLW, Cincinnati, Ohio, WDAF, Kansas City, Mo., WPAD, Chicago, Ill., WCAE, Pittsburgh, Pa., WEAF, New York City, N. Y. WDAR, Philadelphia, Pa., WOS, Jefferson City, Mo., WWJ, Detroit, Mich., WOC, Davenport, Iowa, WSAI, Cleveland, Ohio, WPAM, Kansas City, Mo., WTAM Cleveland, Ohio. WEAM, Providence, R. I., WNAP, Ohio, WCBD, Zion, Ill., Ill., WDAH, El Paso, Texas, WMAQ, Chicago, Ill., a total of forty stations in two nights.

Yours truly,
RONALD COX.

This looks like a real DX record, and it looks like the best list we have this month! Consider receiving forty stations in two nights with a set composed of about eight or ten pieces or wireless instruments! We'll bet Mr. Cox will be able to hear a fly crawl on the wall down in the Hawaiian Islands broadcasting station when he adds a two-stage amplifier. Considering the type of set this little "flivver" is, we acclaim Mr. Cox the record holder for this month, and dare the rest of you to try and come up to it. By gum! You'd think it was a list taken off the log of a ten-tube superheterodyne. Congratulations, Mr. Cox.

In regard to this little DX getter, George Bindler, of Council Bluffs, Iowa, writes:

"Mr. Anderson's set published in the October issue is certainly a dandy. I built one for my father."

A little set of this type certainly makes a welcome gift, as it is easy to operate, more easy to understand, and least expensive to keep up. Tell your father to let us have his list of stations heard with this little set of his, Mr. Bindler.

Now tune in on this one from the Virginia Hotel, Quincy, Ill.

RADIO AGE,
Pickups Department,
Gentlemen:

In last month's RADIO AGE there was a circuit showing the amateur how to make his first tube set. This circuit looked good to me and I tried it. After assembling everything in shipshape order I tried it out. Did it work? Well, I'll say it did! It brought in the following stations the first three days: WOC, Davenport; WDAP, Chicago; WJAZ, Chicago; KSD, St. Louis; WOAW, Omaha; WGY, Schenectady; KDKA, East Pittsburgh; WOS, Jefferson City; WFAA, Dallas; WABE, Washington, D. C.; WBAP, Fort Worth; WSAI, Cincinnati; WLW, Cincinnati and WSB, Atlanta.

How is that for getting 'em? I'll say it is the best little one-tube set I have ever had and I have had lots of them. It pretty nearly equals the results of my five-tube Reinartz. The Reinartz is a great set for distance and amplification. I don't believe I would trade my old Reinartz for any other set made; that is how I like them.

Yours very truly,
W. L. CARROLL.

F'eaven sake! That little one-tube set must be a whiz if it's good enough to compare its reception records with a five-tube Reinartz! Considering the amount of apparatus used, we'll bet Mr. Carrol is willing to concede that the little one-tube flivver beats his Reinartz! From what we know, the fellows get to love their Reinartz sets like a shipwrecked sailor loves a floating spar! Ask some of the radio widows whose husbands have Reinartz sets.

If the foregoing two letters don't convince you as to the effectiveness of the "first tube set," read this one from 4840 North Lincoln Street, Ravenswood, Chicago, Ill., and weep:

RADIO AGE,
Pickups Department.
Gentlemen:

Just a few words to tell you that I made the hookup given on page five of the October issue into a common little wooden box given me by a druggist, using for the panel nothing else than the wood of one side of the box and connecting all the units of the circuit with common bell wire. There is not a soldered joint in the set. On the road as a traveling man, I am getting all kinds of DX stuff with this set, in hotel rooms at night using sometimes a lighting socket plug, but more often the bed spring for an antenna and ground wire to a common water faucet.

In Wisconsin towns have heard Buffalo, East Pittsburgh, Detroit, Chicago, and many others. Last night had KFKX of Hastings, Nebr., very loud and clear off the bed spring in this hotel. (Jefferson House, Jefferson, Wis.)

No one need hesitate to build this set, for a flivver to carry around. There is not a night that I use it but what I get something satisfactory from some direction, and real DX, using either of the above antenna systems.

Yours very truly,
A. J. BAUMGARDNER.

At this point, the owners of eight and ten-tube reflexes, Reinartzes, Cockadays, Superheterodynes, etc., will plug in

(Continued on page 46.)

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAN	Wireless Phone Corp.	Paterson, N. J.	244
WBAO	James Millikin University	Decatur, Ill.	360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.	Columbus, Ohio	390
WBAW	Marietta College	Marietta, Ohio	246
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.	New York, N. Y.	492
WBBA	Newark Radio Laberateries	Newark, Ohio	240
WBBD	Barbey Battery Service	Reading, Pa.	234
WBL	T & H Radio Co.	Anthony, Kans.	261
WBR	Pennsylvania State Police	Butler, Pa.	286
WBS	D. W. May, Ino	Newark, N. J.	360
WRT	Southern Radio Corp.	Charlotte, N. C.	360
WBZ	Westinghouae Elec. & Mfg. Co.	Springfield, Mass.	337
WCAD	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa.	462
WCAG	Clyde R. Randall	New Orleans, La.	268
WCAH	Enrekin Electric Co.	Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	360
WCAK	Alfred P. Daniel	Houston, Tex.	360
WCAL	St. Olaf College	Northfield, Minn.	360
WCAM	Villanova College	Villanova, Pa.	360
WCAO	Sanders & Stayman Co.	Baltimore, Md.	360
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C.	469
WCAR	Alamo Radio Electric Co.	San Antonio, Tex.	360
WCAS	William Hood Dunwoody Industrial Institute	Minneapolis, Minn.	246
WCAT	South Dakota State School of Mines	Rapid City, S. Dak.	240
WCAU	Durham & Co.	Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co.	Little Rock, Ark.	360
WCAX	University of Vermont	Burlington, Vt.	360
WCAY	Kesselman O'Driscoll Co.	Milwaukee, Wis.	261
WCAZ	Carthage College	Carthage, Ill.	246
WCBA	Charles W. Heimbach	Allentown, Pa.	280
WCBD	Wilbur G. Voliva	Zion, Ill.	345
WCE	Findley Electric Co.	Minneapolis, Minn.	360
WCK	Stix, Baer & Fuller Dry Goods Co.	St. Louis, Mo.	360
WCM	University of Texas	Austin, Tex.	360
WCX	Detroit Free Press	Detroit, Mich.	517
WDAE	Tampa Daily Times	Tampa, Fla.	360
WDAF	Kansas City Star	Kansas City, Mo.	411
WDAG	J. Laurance Martin	Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South)	El Paso, Tex.	268
WDAK	The Courant	Hartford, Conn.	261
WDAL	Florida Times-Union	Jacksonville, Fla.	360
WDAO	Automotive Electric Co.	Dallas, Tex.	360
WDAP	Board of Trade	Chicago, Ill.	360
WDAR	Lit Brothers	Philadelphia, Pa.	395
WDAS	Samuel A. Waite	Worcester, Mass.	360
WDAU	Slocum Kilburn	New Bedford, Mass.	360
WDAX	First National Bank (Appamoose County Farm Bureau)	Centerville, Iowa	360
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	244
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WDM	Church of the Convenant	Washington, D. C.	360
WDT	Ship Owners Radio Service	New York, N. Y.	405
WDZ	James L. Bush	Tuscola, Ill., Star Store Bldg.	278
WEAA	F. D. Failain	Flint, Mich.	280
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	492
WEAH	Wichita Board of Trade	Wichita, Kans.	244
WEAI	Cornell University	Ithaca, N. Y.	286
WEAJ	University of South Dakota	Vermillion, S. Dak.	283
WEAM	Borough of North Plainfield (W. Gibson Buttfield)	North Plainfield, N. J.	252
WEAN	Shepard Co.	Providence, R. I.	273
WEAO	Ohio State University	Columbus, Ohio	360
WEAP	Mobile Radio Co.	Mobile, Ala.	360
WEAR	Baltimore American & News Publishing Co.	Baltimore, Md.	360
WEAS	Hecht Co.	Washington, D. C.	360
WEAU	Davidson Bros. Co.	Sioux City, Iowa	360
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Tex.	360
WEB	Benwood Co.	St. Louis, Mo.	360
WEV	Hurlburt-Still Electrical Co.	Houston, Tex.	360
WEW	St. Louis University	St. Louis, Mo.	261
WFAA	Dallas News & Dallas Journal	Dallas, Tex.	476
WFAB	Carl F. Woese	Syracuse, N. Y.	234
WFAF	H. C. Spratley Radio Co.	Poughkeepsie, N. Y.	360
WFAH	Electric Supply Co.	Port Arthur, Tex.	236
WFAJ	Hi-Grade Wireless Instrument Co.	Asheville, N. C.	360
WFAM	Times Publishing Co.	St. Cloud, Minn.	360
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn.	380
WFAQ	Missouri Wesleyan College	Cameron, Mo.	360
WFAT	Daily Argus-Leader	Sioux Falls, S. Dak.	360
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr.	275
WFI	Strawbridge & Clothier	Philadelphia, Pa.	395
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa.	248
WGAN	Cecil E. Lloyd	Pensacola, Fla.	366
WGAQ	Glenwood Radio Corp. (W. G. Patterson)	Shreveport, La.	360
WGAW	Ernest C. Albright	Altoona, Pa.	261
WGAY	Northwestern Radio Co.	Madison, Wis.	360
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGI	American Radio & Research Corp.	Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett	Philadelphia, Pa.	360
WGR	Federal Telephone & Telegraph Co.	Buffalo, N. Y.	319
WGV	Interstate Electric Co.	New Orleans, La.	360
WGY	General Electric Co.	Schenectady, N. Y.	380
WHA	University of Wisconsin	Madison, Wis.	360
WHAA	State University of Iowa	Iowa City, Iowa	283
WHAB	Clark W. Thompson	Galveston, Tex.	360
WHAC	Cole Bros. Electric Co.	Waterloo, Iowa	360
WHAO	Marquette University	Milwaukee, Wis.	280
WHAG	University of Cincinnati	Cincinnati, Ohio	222
WHAH	Hafer Supply Co.	Joplin, Mo.	283
WHAI	Radio Equipment & Mfg. Co.	Davenport, Iowa	360
WHAK	Roberts Hardware Co.	Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y.	283
WHAP	Otta & Kuhns	Decatur, Ill.	360
WHAR	Paramount Radio & Electric Co. (W. H. A. Pulus)	Atlantic City, N. J.	231
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	380
WHB	Sweeney School Co.	Kansas City, Mo.	411
WHK	Radiovox Co. (Warren R. Cox)	Cleveland, Ohio	360
WHN	George Schubel	New York, N. Y.	360
WIAB	Joslyn Automobile Co.	Rockford, Ill.	252
WIAC	Galveston Tribune	Galveston, Tex.	360
WIAO	Howard R. Miller	Ocean City, N. J.	254
WIAF	Gustav A. DeCortin	New Orleans, La.	234
WIAH	Continental Radio & Mfg. Co.	Newton, Iowa	258
WIAI	Heer Stores Co.	Springfield, Mo.	252
WIAJ	Fox River Valley Radio Supply Co. (Quinn Bros.)	Neenah, Wis.	224
WIAK	Journal-Stockman Co.	Omaha, Nebr.	278
WIAO	School of Engineering of Milwaukee	Milwaukee, Wis.	360
WIAQ	Chronicle Publishing Co.	Marion, Ind.	226
WIAR	Paducah Evening Sun	Paducah, Ky.	360
WIAS	Home Electric Co.	Burlington, Iowa	360
WIAT	Leon T. Noel	Tarkio, Mo.	360
WIAU	American Trust & Savings Bank	Le Mars, Iowa	360
WIK	K. & L. Electric Co. (Herbert F. Kelso and Hunter J. Lohman)	McKeesport, Pa.	234
WIL	Continental Electric Supply Co.	Washington, D. C.	360
WIP	Gimbel Brothers	Philadelphia, Pa.	509
WJAB	American Electric Co.	Lincoln, Nebr.	360
WJAO	Jackson's Radio Engineering Laboratories	Waco, Tex.	380
WJAF	Press Publishing Co.	Muncie, Ind.	360
WJAG	Norfolk Daily News (Huse Pub. Co.)	Norfolk, Nebr.	360
WJAK	Clifford L. White	Greentown, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAN	Peoria Star	Peoria, Ill.	280
WJAQ	Capper Publications	Topeka, Kans.	360
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	360
WJAT	Kelly-Vawter Jewelry Co.	Marshall, Mo.	360
WJAX	Union Trust Co.	Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	448
WJO	Richard H. Howe	Granville, Ohio	229
WJH	W. P. Boyer	Washington, D. C.	273
WJX	Deforest Radio Telephone & Telegraph Co.	New York, N. Y.	360
WJY	R. C. A.	New York, N. Y.	405
WJZ	R. C. A.	New York, N. Y.	455
WKAA	H. F. Paar	Cedar Rapids, Iowa	268
WKAD	Chas. Looff (Crescent Park)	East Providence, R. I.	240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Tex.	360
WKAN	United Battery Service Co.	Montgomery, Ala.	226
WKAP	Dutee W. Flint	Cranston, R. I.	360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	360
WKAR	Michigan Agriculture College	East Lansing, Mich.	280
WKAS	L. E. Lines Music Co.	Springfield, Mo.	388
WKAV	Laconia Radio Club	Laconia, N. H.	254
WKAW	Turner Cycle Co.	Beloit, Wis.	242
WKAY	Brenau College	Gainesville, Ga.	280
WKY	WKY Radio Shop	Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn.	417
WLAH	Samuel Woodworth	Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co.	Waco, Tex.	360
WLAK	Vermont Farm Machine Corp.	Bellows Falls, Vt.	380
WLAL	Naylor Electrical Co.	Tusla, Okla.	360
WLAN	Putnam Hardware Co.	Houlton, Me.	283
WLAP	W. V. Jordon	Louisville, Ky.	380
WLAQ	Arthur E. Schilling	Kalamazoo, Mich	283
WLAT	Radio and Specialty Co.	Burlington, Iowa	360
WLAV	Electric Shop	Pensacola, Fla.	254
WLAW	Police Dept., City of New York	New York, N. Y.	380
WLAX	Putnam Electric Co. (Greencastle Community Broadcasting Station)	Greencastle, Ind.	231
WLB	University of Minnesota	Minneapolis, Minn.	360
WLW	Crosley Manufacturing Co.	Cincinnati, Ohio	309
WMAB	Radio Supply Co.	Oklahoma, Okla.	380
WMAC	J. Edw. Page (Olive B. Meredith)	Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	380
WMAH	General Supply Co.	Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co.	Kansas City, Mo.	275
WMAK	Norton Laboratories	Lockport, N. Y.	360
WMAL	Trenton Hardware Co.	Trenton, N. J.	250
WMAN	First Baptist Church	Columbus, Ohio	266
WMAP	Utility Battery Service	Easton, Pa.	240
WMAQ	Chicago Daily News	Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute	Auburn, Ala.	250
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	280
WMAZ	Mercer University	Macon, Ga.	268
WMC	"Commercial Appeal" (Commercial Publishing Co.)	Memphis, Tenn.	500
WMH	Precision Equipment Co.	Cincinnati, Ohio	248
WMU	Douhieday-Hill Electric Co.	Washington, D. C.	281
WNAC	Shepard Stores	Boston, Mass.	278
WNAD	University of Oklahoma	Norman, Okla.	360
WNAL	R. J. Rockwell	Omaha, Nebr.	242
WNAM	Ideal Apparatus Co.	Evansville, Ind.	360
WNAN	Syracuse Radio Telephone Co.	Syracuse, N. Y.	286
WNAP	Wittenberg College	Springfield, Ohio	231
WNAQ	Charleston Radio Electric Co.	Charleston, S. C.	360
WNAR	C. C. Rhodes	Butler, Mo.	231
WNAS	Texas Radio Corp. & Austin Statesman	Austin, Tex.	380
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa.	360
WNAV	Peoples Telephone & Telegraph Co.	Knoxville, Tenn.	236
WNAW	Peninsular Radio Club (Henry Kunzmann)	Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNJ	Shotton Radio Manufacturing Co.	Albany, N. Y.	360
WOAA	Dr. Walter Hardy	Ardmore, Okla.	380
WOAC	Maus Radio Co	Lima, Ohio	266
WOAD	Friday Battery & Electric Corp.	Sigourney, Iowa	380
WOAE	Midland College	Fremont, Nebr.	360
WOAF	Tyler Commercial College	Tyler, Tex.	380
WOAG	Apollo Theater (Belvidere Amusement Co.)	Belvidere, Ill.	224
WOAH	Palmetto Radio Corp.	Charleston, S. C.	360
WOAI	Southern Equipment Co.	San Antonio, Tex.	385
WOAJ	Ervins Electrical Co.	Parsons, Kans.	258
WOAL	William E. Woods	Webater Groves, Mo.	229
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	360
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	360
WOAP	Kalamazoo College	Kalamazoo, Mich.	240
WOAQ	Portsmouth Kiwanis Club	Portsmouth, Va.	360
WOAR	Henry P. Lundskow	Kenosha, Wis.	229
WOAT	Boyd M. Hamp	Wilmington, Del.	360
WOAV	Pennsylvania National Guard, 2d Battalion, 112th Infantry	Erie, Pa.	242
WOAW	Woodmen of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOI	Iowa State College	Ames, Iowa	360
WOK	Pine Bluff Co.	Pine Bluff, Ark.	380
WOO	John Wanamaker	Philadelphia, Pa.	509
WOQ	Western Radio Co.	Kansas City, Mo.	360
WOR	L. Bamberger & Co.	Newark, N. J.	405
WOS	Missouri State Marketing Bureau	Jefferson City, Mo.	441
WPAB	Pennsylvania State College	State College, Pa.	283
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	380
WPAO	W. A. Wicholdt & Co.	Chicago, Ill.	380
WPAH	Wisconsin Department of Markets	Waupaca, Wis.	360
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College	Agricultural College, N. Dak.	360
WPAL	Superior Radio & Telep. Equipment Co.	Columbus, Ohio	288
WPAM	Auerbach & Guettel	Topeka, Kans.	380
WPAP	Theodore D. Phillips	Winchester, Ky.	380
WPAQ	General Sales & Engineering Co.	Frostburg, Md.	360
WPAR	Ward Battery & Radio Co.	Beloit, Kans.	360
WPAT	St. Patricks Cathedral	El Paso, Tex.	360
WPAU	Concordia College	Moorhead, Minn.	380
WPAZ	John R. Koch (Dr.)	Charleston, W. Va.	273
WPG	Nusawg Poultry Farm	New Lebanon, Ohio	234
WQAA	Horsee A. Beale, jr.	Parkersburg, Pa.	360
WQAC	E. B. Gish	Amarillo, Tex.	380
WQAO	Whitall Electric Co.	Waterhury, Conn.	242
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275

411 So. 18th Street, Mt. Vernon, Ill.
RADIO AGE,
Pickups Department.
Gentlemen:

I am using a single-tube WD11 hookup of the ultra audion type with which I have had such good results that I simply have to tell somebody. In ten days I got the following stations: KSD, WHB, KDKX, KDKA, WHAZ, WHAS, WPAD, WDAJ, WJAZ, WAAF, WMAQ, WDAP, WCBD, WOAW, WOC, WOQ, WOR, WCAP, WTAM, WPA, WEAF, WOS, WDAF, WCK, WCAH, WOAF, WCAE, WSB, WLAP, WLAG, WMC, WEAN, WOK, and WAAW.

St. Louis is eighty miles from here, and Schenectady is 875, but I hear WGY louder than KSD. I'd like to know who can do that with one WD11 tube.

I can get any of the above stations any time they are transmitting, and can tune up as high as 600 meters.

Guess that list ought to hold you for a while, so that will be all for this time.

Yours very truly,
DUANE ROSSELOT.

Duane is another runner-up in the list of high batting averages this month. We are sure that many of the other fans will start to look for the places where losses occur in their sets which prevent them from duplicating this performance.

In a recent letter, George Rallison enclosed the following list of stations heard with one tube: WTAM, WJAZ, WHAS, WLAP, WOC, WAAW, WFAA, WDAF, WHB, WBAP, CKCK, CFAC, CFCN, CHCD, KFAF, KFEL, KLZ, KDZE, KGW, KFEC, KGG, KFAE, KZN, KDYL.

Most of these stations are over 1,000 miles distant, with two of them over two thousand miles!

Mr. Rallison is located at 418 West Elm Street, Hanford, Calif. When one considers that it is necessary to work over the tall Rockies to get these stations, it makes Mr. Rallison's list a feat of unusual merit.

Norwood P. O., Cincinnati, Ohio.
RADIO AGE,
Pickups Department.
Gentlemen:

I am not a subscriber to RADIO AGE, but I buy it at the news-stands and read the Pickups column in every issue. This is my pickup for November 23, 1923, using one U V 200 tube, 22 1-2 volts B battery in a Flewelling hookup, with antenna only:

WOR, WDAR, WJAR, WOO, WIP, WGY, WWJ, WCAE, WEAF, WHAS, WSB, WOAI, WBAP, WFAA, WOS, WJAX, WJAX, WMAD, KYW, WLAG, WDAF, WHB, KHJ, and on the twenty-fifth of November I added to this list the following: KHJ, KFI, KLZ, KWH and CKCK.

Tell the rest of the RADIO AGE family of Pickup readers to compare their lists with this one. I modestly acclaim it as a pretty good accumulation of DX stations.

Very truly yours,
S. MOESCHL.

Listen fellows—! You don't have to be a subscriber to be a pickup fan. If you are a reader of RADIO AGE, and have a list that you think is worthy of consideration among the rest of the Pickup fans, let's have it.

If you'll allow us to comment on your work, Mr. Moeschl, we would add to your last sentence that that sure is some acceleration with a circuit difficult to manage.

Next we have a letter from one of our Monon, Indiana, brothers:

RADIO AGE,
Pickups Department.
Gentlemen:

After seeing several pickup records published in your magazine, I have decided to send in a list of stations tuned in on a loud speaker with detector and two stages of audio frequency amplification and plate voltage of 67 volts.

KSD, St. Louis; WHB, Kansas City; WDAF, Kansas City; WCBD, Zion; WSB, Atlanta; WMC, Memphis; WGR, Buffalo; KHJ, Los Angeles; WOAI, San Antonio; WOC, Davenport; KDKA, Pittsburgh; WCAP, Washington, D. C.; WOS, Jefferson City; WOR, Newark; WOQ, Kansas City; WHAS, Louisville; WPAD, Chicago; WBAK, Harrisburg, Pa.; WBAA, Lafayette, Ind.; KOP, Detroit; KYW, Chicago; WJAZ, Chicago; WMAQ, Chicago; WFAA, Dallas; WOAW, Omaha; WEAF, New York City; WGY, Schenectady; KPO, San Francisco; WLAG, Minneapolis; WWJ, Detroit; WCAE, Pittsburgh; WBAP, Fort Worth; WLW, Cincinnati; WTAM, Cleveland; WTAS, Elgin, Ill.; WDAP, Chicago; WAAP, Wichita, Kan.; WHAZ, Troy, N. Y.; WSAI, Cincinnati; PWX, Havana.

My outfit is home assembled using nothing but the best parts throughout. I also wish to add that these stations are not freak pickups but stations that I can tune in and hear regularly.

Yours very respectfully,
LESLIE E. THOMAS.

This is probably not a record breaking list of stations received, but is a typical example of what a fellow can do with a set that is intelligently constructed and wisely operated. FB, Mr. Thomas.

To conclude the Pickups section for this month, we publish this letter particularly characteristic concerning the Reinartz, The Mighty:

RADIO AGE,
Chicago, Ill.
Gentlemen:

In your columns some months ago you published a letter of mine under "Stations I have heard" and at that time I was very enthusiastic over the Reinartz circuit, and still am. I have seen some very misleading reports concerning this circuit, and I really believe that such glowing reports come from some action in the set that even the maker does not understand. There are a million little things that are hardly noticeable that will make one set from 50 to 100 per cent better than one just like it, to all appearances. I believe about the best way to make enemies for any circuit is to boost it sky high and have a few disappoint-

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WQAF	Sandusky Register	Sandusky, Ohio	240
WQAH	Brock-Anderson Electrical Engineering Co.	Lexington, Ky.	254
WQAL	Coles County Telep. and Teleg. Co.	Mattoon, Ill.	258
WQAM	Electrical Equipment Co.	Miami, Fla.	360
WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	360
WQAQ	Abilene Daily Roporter (West Texas Radio Co.)	Abilene, Tex.	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAV	Huntington & Guerry (Inc.)	Greenville, S. C.	258
WQAW	Catholic University	Washington, D. C.	236
WQAX	Radio Equipment Co.	Peoria, Ill.	360
WRAA	Rice Institute	Houston, Tex.	360
WRAD	Taylor Radio Shop (G. L. Taylor)	Marion, Kans.	248
WRAF	The Radio Club (Inc)	Laporte, Ind.	224
WRAH	Stanley N. Read	Providence, R. I.	231
WRAL	Northern States Power Co.	St. Croix Falls, Wis.	248
WRAM	Lombard College	Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	236
WRAO	Radio Service Co.	St. Louis, Mo.	360
WRAV	Antioch College	Yellow Springs, Ohio	360
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRAY	Radio Sales Corp.	Scranton, Pa.	280
WRAZ	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	233
WRC	Radio Corporation of America	Washington, D. C.	469
WRK	Doron Bros. Electric Co.	Hamilton, Ohio	380
WRL	Union College	Schenectady, N. Y.	380
WRM	University of Illinois	Urbana, Ill.	360
WRR	City of Dallas (police and fire signal department)	Dallas, Tex.	360
WRW	Tarrytown Radio Research Laboratory (Koenig Bros.)	Tarrytown, N. Y.	273
WSAB	Southeast Missouri State Teachers College	Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural College	Clemson College, S. C.	360
WSAD	J. A. Foster Co.	Providence, R. I.	261
WSAG	City of St. Petersburg (Loren V. Davis)	St. Petersburg, Fla.	244
WSAH	A. J. Leonard, jr.	Chicago, Ill.	248
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	309
WSAJ	Grove City College	Grove City, Pa.	360
WSAL	Franklin Electric Co.	Brookville, Ind.	246
WSAN	Allentown Radio Club	Allentown, Pa.	229
WSAP	Seventh Day Adventist Church	New York, N. Y.	380
WSAR	Doughty & Welch Electrical Co.	Fall River, Mass.	254
WSAT	Donohoo-Ware Hardware Co.	Plainview, Tex.	268
WSAW	John J. Long, jr.	Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory	Chicago, Ill.	268
WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	239
WSAZ	Chas Electric Shop	Pomeroy, Ohio	250
WSB	Atlanta Journal	Atlanta, Ga.	429
WSL	J. & M. Electric Co.	Utica, N. Y.	278
WSY	Alabama Power Co.	Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAD	Robert E. Compton and First Presbyterian Church	Carthage, Ill.	220
WTAF	Louis J. Gallo	New Orleans, La.	242
WTAG	Kern Music Co.	Providence, R. I.	258
WTAH	Carmen Ferro	Belvidere, Ill.	236
WTAJ	The Radio Shop	Portland, Me.	236
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAN	Orndorff Radio Shop	Mattoon, Ill.	240
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gorden & Son	Osseo, Wis.	226
WTAR	Reliance Electric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	275
WTAT	Edison Electric Illuminating Co.	Boston, Mass. (portable)	244
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	360
WTAW	Agricultural & Mechanical College of Texas	College Station, Tex.	250
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcasting Station	Oak Park, Ill.	220
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTG	Kansas State Agricultural College	Manhattan, Kans.	486
WWAB	Hoenig, Swern & Co. (John Rasmussen)	Trenton, N. J.	226
WWAC	Sanger Bros.	Waco, Tex.	366
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	Alamo Dance Hall, L. J. Crowley	Joliet, Ill.	227
WWAF	Galvin Radio Supply Co.	Camden, N. J.	230
WWAO	Michigan College of Mines	Hourgton, Mich.	244
WWI	Ford Motor Co.	Dearborn, Mich.	275
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	517
WWL	Loyola University	New Orleans, La.	280

Canadian Stations

CFAC	Western Radio Co., Ltd.,	Calgary, Alta.	430
CFCA	Toronto Star	Toronto, Ont.	400
CFCF	Marconi Co.	Montreal, P. Q.	440
CFCH	Abitibi Power & Paper Co. Ltd.	Iroquois Falls, Ont.	400
CFCI		Vancouver, B. C.	410
CFCJ		Quebec, P. Q.	410
CFCK		Edmonton, Alta	410
CFCL		Victoria, B. C.	400
CFCN	W. W. Grant Radio, Ltd.	Calgary, Alta	440
CFCO		Bellevue, P. Q.	450
CFCW		London, Ont.	420
CFQC		Saskatoon, Sask.	400
CFUC		Montreal, P. Q.	400
CHCB		Calgary Alta.	410
CHCD		Quebec, P. Q.	410
CHCE		Victoria, B. C.	400
CHCL		Vancouver, B. C.	440
CHYC	Canadian Northern Elec.	Montreal, P. Q.	410
CJCA	Edmonton Journal, Ltd.	Edmonton, Alta.	450
CJCD	T. Eaton Co.	Toronto, Ont.	410
CJCE	Vancouver Sun	Vancouver, B. C.	420
CJCI	McLean, Holt & Co., Ltd.	St. John, N. B.	400
CJCN	Simmons, Agnew & Co.	Toronto, Ont.	410
CJCX		Olds, Alta.	400
CJGC	London Free Press	London, Ont.	430
CJSC	Evening Telegram	Toronto, Ont.	430
CKAC	La Presse	Montreal, P. Q.	430
CKCD	Vancouver Daily Province	Vancouver, B. C.	410
CKCE	Can. Ind. Telephone Co.	Toronto, Ont.	450
CKCK	Leader Publishing Co.	Regina, Sask.	420
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	410
CKY		Winnipeg, Manitoba	450

ments among those who attempt to build them.

I read one report, in fact, several pages were devoted to it in a very popular radio magazine telling how the set operated four or five speakers to their full capacity and that programs could be heard at least half a mile from their shop. Anything is possible in radio but such reports are not consistent, as this one set is an exception and it is quite doubtful if it could be duplicated. We have also heard of the long distance crystal sets, and of course there are, but there isn't one in 100,000 that will hear more than forty or fifty miles at the most.

I believe what I have accomplished with the Reinartz is something that anyone with any knowledge of radio can do, and I do not doubt but that many would have much better success than I. I have added four tubes to my set and now have two RF detector and two AF. The consistent distance for this set on a loud speaker is from 800 to 1,000 miles, so for anyone who is centrally located he can feel reasonably sure that he will be able to get anything from the class B stations on his loud speaker. Such stations as WGR, KDKA, WJAZ, WBY, WOAW, WLW, WPAH, WOS, WDAP, we heard night after night regardless of weather conditions and these stations come in with about half the capacity volume of the set, taking the volume with which the local station WLAG comes on.

The set contrary to many reports is quite selective, as I have received a majority of the above stations through our local stations WLAG, WBAH, KFEX and WCAS, without interference.

After adding the RF I found that the volume of the distance stations were increased approximately twice, and I also found that there was a great deal of howling, but am glad to state that this is not permanent as with a little practice one is able to tune in with very little if any noise, but it takes some very fine manipulation to tune in without any noise, such as howling and whistling. I have two of the Day-Fan RF transformers and after I have tuned in on one distant station can get several different ones merely by adjusting the transformers.

I had some little trouble in installing the RF but after making two or three minor changes the set worked wonderfully well. In the Reinartz circuit the positive A and negative B are grounded, but when adding radio frequency this ground connection is not used. A potentiometer is put across the positive of the A to negative of the A battery and the negative of the B battery is connected to the positive of the A battery as before. Then the potentiometer is grounded to the condenser in the grid circuit, this being an 11-plate in my set. The filament connections of the two RF transformers are connected and then this connection is extended to the center or ground connection of the potentiometer, and a .002 condenser is shunted across the negative A battery connection of the potentiometer to the wire making the connection of the transformers to the potentiometer.

Yours very truly,
G. F. McCULLOUGH.

We are very grateful to Mr. McCullough, 1826 Park Avenue, Minneapolis, Minn., for his interesting letter, and are glad to learn that he gets results. One can readily learn from his letter that consistent results come from patient and painstaking design, construction and operation. Remember, that if you make thirty little improvements on a set and each one does not have the property of being noticeable in the phones you feel that not much has been accomplished; on the other hand, if the whole thirty changes and improvements could be made at once, the increase in efficiency would immediately be noticed. Just keep Mr. McCullough's words in mind when working out any new change.

We regret very much the inability to publish all the letters from the many fans who sent in lists in response to our call. However, we wish to acknowledge letters from Messrs. H. Q. Ten Eyck, of 215 W. Goepp Street, Bethlehem, Pa., who says he has a circuit of unusual merit which can be had merely for the writing; James E. Chandler, of Belvidere, Ill.; A. Des Rosius, of Windsor, Ontario, Canada; and from W. O. Halter of 357 South La Salle Street, Aurora, Ill., and others.

Well, fellows, we'll sign off in code this time jes' like a regular amateur station:

"Gess nm nw so best 73's Hppy es Prosperus Nw Yr., SK"

RADIO AGE PICKUPS AND HOOKUPS DEPT.

Kable Band

Many listeners of that sterling station, WOC, Davenport, Iowa, were pleased on the night of November 30 to hear a radio concert given by the Kable Brothers Company band. Kable Brothers print magazines at Mount Morris, Ill., but they mix play with their work and they have organized a musical organization of exceptional merit. RADIO AGE listened in and can commend with authority the performance at Davenport. Furthermore, it is a pleasure to register approval since Kable Brothers Company is our printer.

Miss Anna Leeb, assistant business manager of RADIO AGE, charmed the audience of Station WJAZ a few nights later by singing several songs that proved her to be a vocalist of accomplishment. Miss Leeb has a soprano voice, well suited to such songs as "I Love You Truly" and "Mighty Lak a Rose," both of which she sang, with the result that there were numerous telephone requests for encores.

It was the privilege of the editor of RADIO AGE on one of the Wednesday nights when the Zenith-Edgewater Beach Station talks with Explorer MacMillan to talk to Dr. MacMillan up there near the North Pole, and tell him how interested all radio fans were in the success of his adventure.

Yes, the RADIO AGE family are bugs, like the rest of you.

Best Hook-up Book Ever Printed

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Erla Reflex	Neutrodyne
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Grimes Inverse Duplex	Super-Heterodyne
Two Stage Amplifier	Simple Radio Frequency
Junior Heterodyne	Ultra Audion
One Tube with Loop Aerial	Rosenbloom
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For 1924

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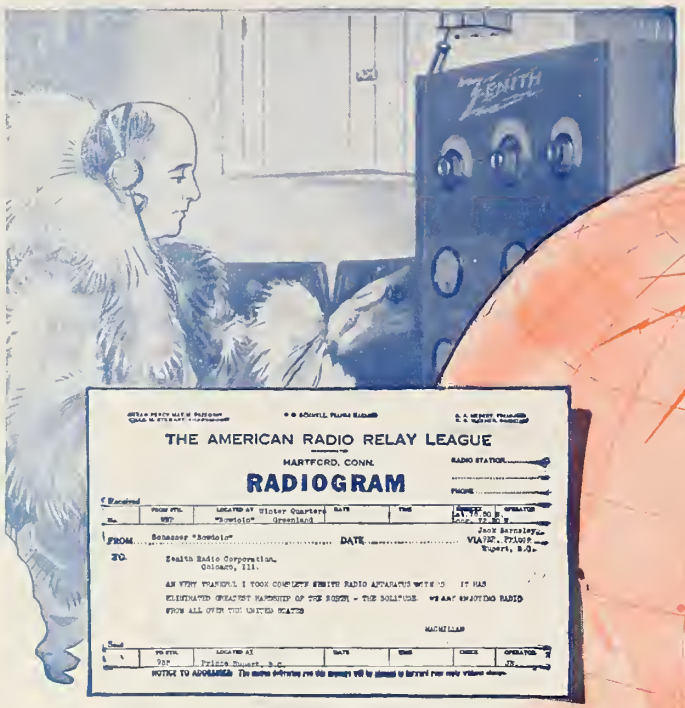

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Inside the Arctic Circle, nine degrees from the North Pole, a little 89-foot schooner is frozen fast in the ice of Smith Sound. Aboard this schooner a group of brave men are enduring, as best they can, the desperate cold of the Arctic—cold that often drops to 60 degrees below zero. Human atoms in a boundless field of ice!

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Model 4R—The new Zenith 4R "Long-Distance" Receiver-Amplifier comprises a complete three-circuit regenerative receiver of the feed-back type. It employs the Zenith regenerative circuit in combination with an ***audion detector*** and ***three-stage*** audio-frequency amplifier, all in one cabinet.

Because of the unique Zenith "selector," unusual selectivity is accomplished without complication of adjustment.

The Zenith 4R may be connected directly to any loud-speaker ***without*** the use of other amplification for full phonograph volume, and reception may be satisfactorily accomplished over distances of more than 2,000 miles **$85**

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RADIO AGE

The Magazine of the Hour

IN THIS NUMBER.

Another device for tuning out interference.

How the antenna actually functions.

How to make a one-tube Heterodyne.

Development of your Reinartz Circuit.

An interesting new tuning unit.

Complete corrected list of Broadcasting stations.

More good hookups.

FEBRUARY

1924

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We have laid aside a limited number of back numbers of Radio Age for you. Below we are listing the hook-ups and circuit diagrams to be found in these magazines. Select the ones you want, enclose 30 cents in stamps for each one desired.

We advise immediate attention to this as the stock of back numbers is diminishing rapidly.

May, 1922

—How to make a simple Crystal Set for $6.

June, 1922

—How to make a Receiving Transformer.
—Aerials under ground and under water.
—Electric light wires as auxiliary to radio.

September, 1922

—How to construct the Reinartz Receiver.
—Federal Act regulating radio.

October, 1922

—How to make a Tube Unit for $23 to $37.
—How to make an Audio Frequency Amplifying Transformer.

November, 1922

—Photo-electric Detector Tubes.
—Design of a portable short-wave radio wavemeter.

December, 1922

—Supply exhausted.

January, 1923

—How to make a sharp-tuning Crystal Detector.
—Fixed condensers in home-made receiving sets.
—Description of loading coil for simple sets.

April, 1923

—The Kopprasch circuit.
—How to make a one-tube loop aerial set.
—A two-circuit Crystal Set.

May, 1923

—How to make the Erla single-tube reflex receiver.
—How to make a portable Reinartz set for summer use.

June, 1923

—How to build the new Kaufman receiver.
—What about your antenna?

July, 1923

—The Grimes inverse duplex system.
—How to read and follow symbols.
—Proper antenna for tuning.

August, 1923

—Construction of the Cockaday four-circuit tuner.
—An efficient two-stage amplifier.
—A simple buzzer transmitting set.

September, 1923

—How to load your set to receive new wave lengths.
—Simple Radio Frequency Receiver.

October, 1923

—The Four-Tube Neutrodyne.
—Your First Tube Set.

November, 1923

—The Super-Heterodyne.
—A Three-Circuit Tuner.
—How to Learn Code.

December, 1923

—Building the Haynes Receiver.
—Combined Amplifier and Loud Speaker.
—A selective Crystal Receiver.

January, 1924

—Tuning Out Interference—Wave Traps—Eliminators—Filters.
The article which was favored with the grateful interest of the radio public after its announcement by Station WJAZ.
—A Junior Super-Heterodyne.
—Push-Pull Amplifier.
—Rosenbloom Circuit.

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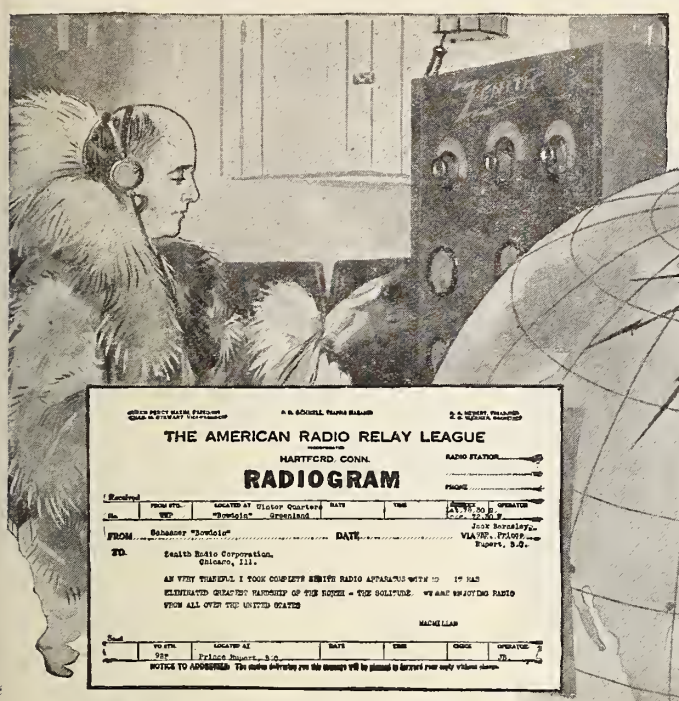

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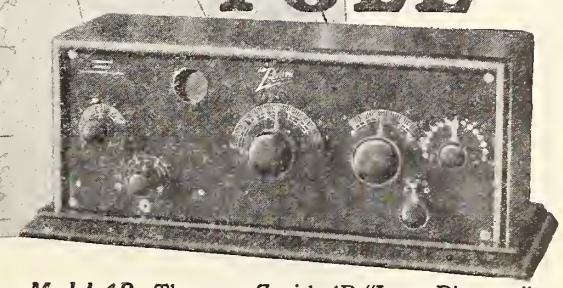

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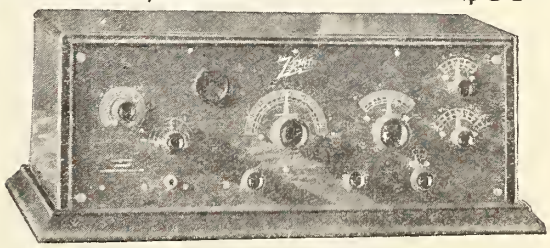

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RADIO AGE

The Magazine of the Hour

(Established March, 1922)

Volume 3 *FEBRUARY, 1924* *Number 2*

CONTENTS

Radio Age is published monthly by
RADIO AGE, Inc.

Publication office, Mount Morris, Ill.
Editorial and Advertising Offices, Boyce Building,
500 N. Dearborn St., Chicago

FREDERICK SMITH, *Editor*
FRANK D. PEARNE, *Technical Editor*
M. B. SMITH, *Business Manager*
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Western Advertising Representatives
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Eastern Representatives
E. V. HEVEY & COMPANY
17 West 42nd Street, New York City
Telephone, Longacre 1698

Advertising forms close on the 15th of the month
preceding date of issue

Issued monthly. Vol. 3, No. 2. Subscription price $2.50 a year.
Entered as second-class matter September 15, 1922, at the post office at Mount Morris, Illinois, under the Act of March 3, 1879

70,000!

AS THE forms for the February issue are about to close it looks as if 70,000 would be the *minimum* press run for this month. Dealers' orders are still coming in as this is written and most of them call for substantial increases over January. We are likely to need 75,000 copies.

One Chicago magazine shop sold out its RADIO AGE supply three times on January 7 and when our distributor reached the store with a fourth consignment of the January issue, thirty customers were waiting for their "Magazine of the Hour." That little loop store sold 900 copies in one day.

"Sold out clean" said a telegram from Montreal, almost immediately after receiving the January issue. Pawtucket, Rhode Island, next came in with a telegram asking that their original order be duplicated. Long distance telephone calls, telegrams, letters and personal visits from dealers steamed things up until the business manager had to telephone the printing house to put the forms all back on the presses for a second run.

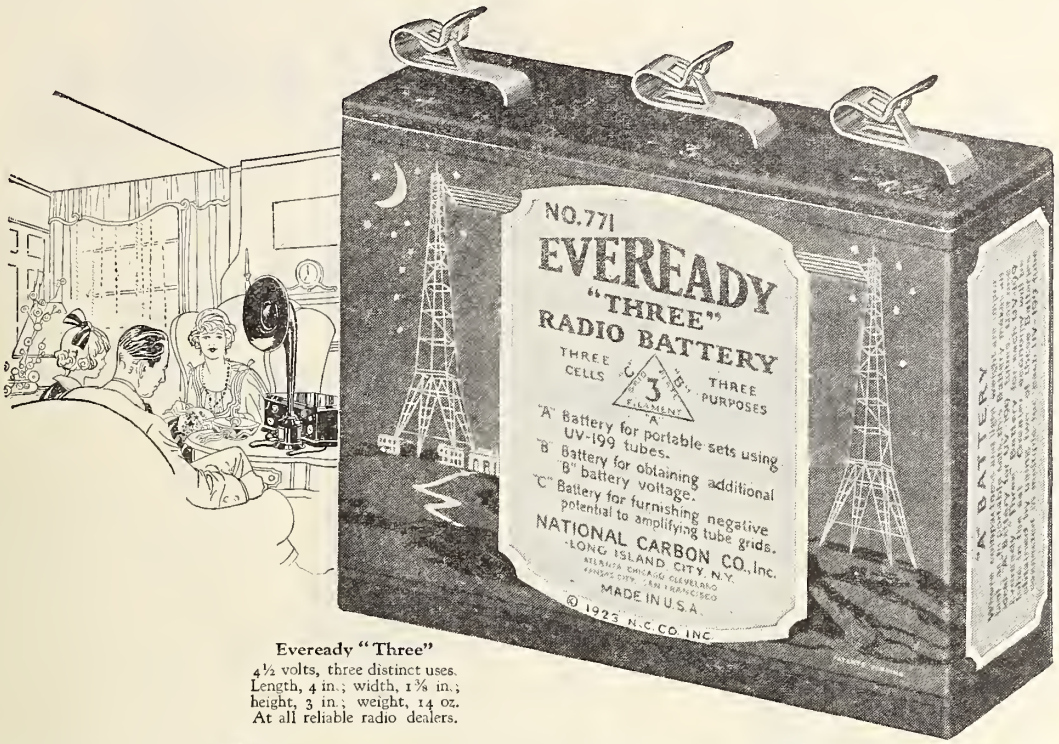
We told you on this page of the January issue that this was distinctively a reader's magazine and we explained how we had attained a prosperous success, practically on circulation alone. Now we are going to tell you what made that January issue sell like peanuts at a circus.

It was the article on "Tuning out Interference." It was the best and most comprehensive article on the subject thus far published. E. F. McDonald, Jr., president of the Zenith Radio Corporation, broadcast some kind words about the article from Zenith-Edgewater Station WJAZ and other stations followed his example. That announcement over the air introduced us to more than 20,000 new readers. Their letters have been coming in —and their subscriptions. We thank the broadcasters and the broadcast listeners. We promise to reciprocate by continuing to do our best to print a good radio magazine.

Frederick Smith

—Editor, RADIO AGE

"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"



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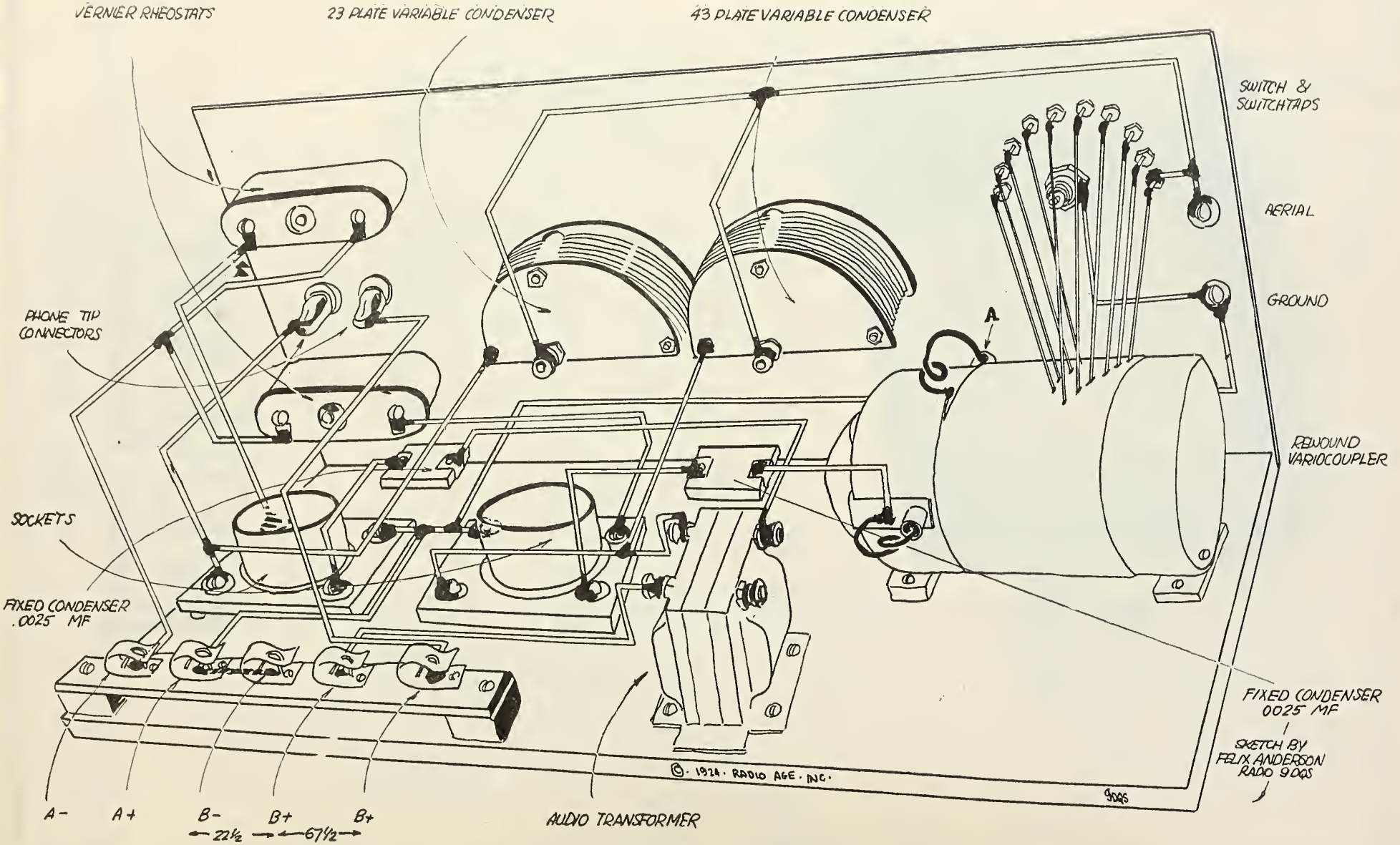


Figure 1. An isometric sketch of the Reinartz Audio Regenerator, described in detail in the accompanying article. The circuit uses a rewound variocoupler as a tuning inductance.

RADIO AGE

"THE MAGAZINE OF THE HOUR"

M. B. Smith
Publisher

A Monthly Publication Devoted to Practical Radio

Frederick A. Smith
Editor

The Reinartz Audio Regenerator

By FELIX ANDERSON

Technical Assistant, Radio Age

HEARKEN 'ye Reinartz followers! Drag out the tool kit, count over the radio budget, and learn how to make a set that will rattle the diaphragms of your telephone receivers.

To make improvements and adaptations on a good circuit is always in order. We are, therefore, presenting to our readers several new circuits and adaptations of the Reinartz circuit which have evolved since the original presentation of this system in June, 1922.

The original Reinartz circuit consists of a spider web coil wound in auto transformer fashion, with a capacity (condenser) shunted across its grid circuit inductance. It is a well known fact that an arrangement of this kind does not deliver as great a voltage variation to the grid of the tube as would an arrangement comprising a large variable inductance, making it unnecessary to use the capacity for tuning purposes.

Acting upon this principle, John Reinartz, originator of the Reinartz circuit, and owner and operator of radio station 1QP—evolved the circuit shown in Figure 2. Instead of tuning the grid circuit with a condenser as was outlined in the September,1922, issue of RADIO AGE by Mr. Pearne, Mr. Reinartz substitutes a large variable inductance to accomplish this purpose.

The originator of this circuit claims it is so much better than the original spider web system, that he advises those using the first system to give this new permutation a trial.

Construction

To construct this set, it will be necessary to rewind a standard variocoupler. This is about the only drawback of the system, but it will be found that no difficulty will be experienced by the average fan who has by this time become familiar with winding coils of all descriptions and sizes in the course of his radio experiments. In purchasing the variocoupler get one in which the tube is not more than three and one-half inches in diameter, and which has a rotor large enough to accommodate fourteen turns of No. 18 SSC insulated wire, on each side of the shaft.

The primary is wound in the following manner. Punch two holes in the cardboard tubing, and start winding, using No. 18 SSC wire. The first ten turns are tapped every turn as shown in the sketch in Figure 1. This winding should start at the end opposite the rotor of the tuner. After the first ten turns are wound, complete the coil by winding 35 turns without taps, leaving an end sufficiently long for connecting purposes.

The rotor should then be rewound as mentioned above, with 28 turns of the same size wire, placing 14 turns on each half of the rotor.

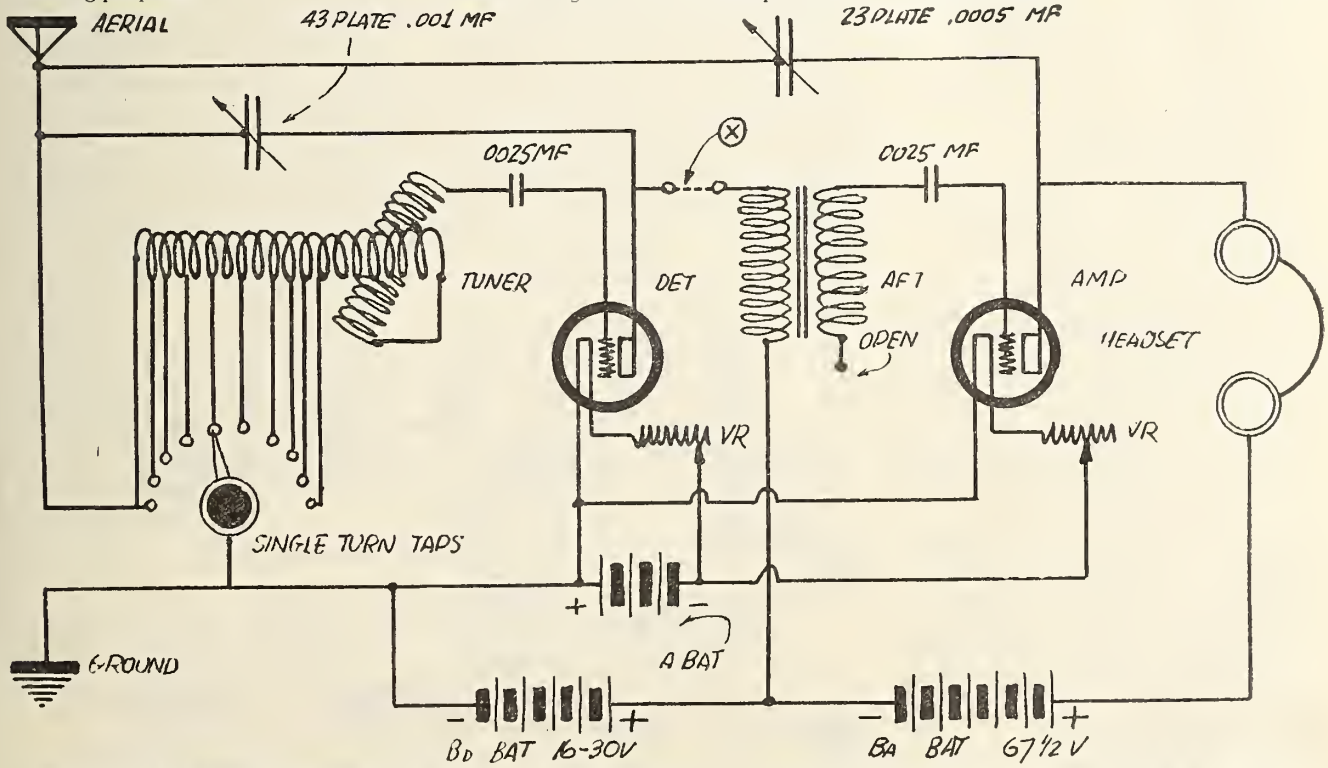


Figure 2—The wiring diagram for the Reinartz Audio Regenerator. If it is found that the tube must be turned on dangerously high to make the set oscillate properly, a choke coil consisting of about six turns of the same size wire as is used on the tuner on a 1-inch tube should be inserted at the point marked X.

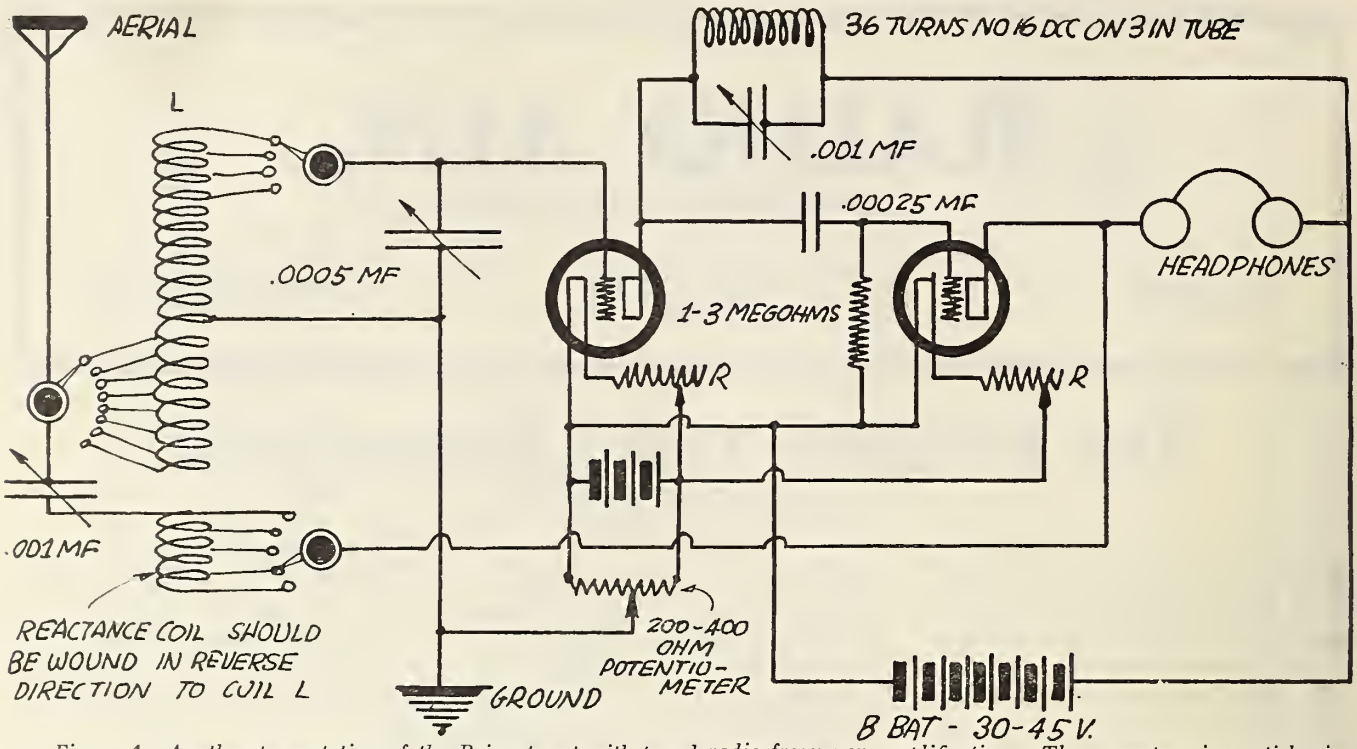


Figure 4—Another permutation of the Reinartz set with tuned radio frequency amplification. The accompanying article gives the necessary constants for building this set.

The 45th turn on the stationary coil is then connected to the first turn on the rotor as shown at "A" on the isometric sketch. This puts the two coils in series, very much like a variometer.

Additional Apparatus

For those who already have Reinartz sets, very few additional parts other than the variocoupler will be necessary, but for those constructing the first set of this type, we are printing a complete list of apparatus necessary. The parts are:

1 43 plate vernier variable condenser.
1 23 plate vernier variable condenser.
2 .0025 or .003 fixed condensers.
2 tube sockets.
2 rheostats, resistance depending on type of tube used.
1 set of phone tip jacks.
1 dozen switchpoints.
1 switch lever.
1 standard 4 or 6 to 1 audio frequency transformer.
5 Fahnstock binding posts.
2 standard binding posts.
1 7x15 inch bakelite or formula panel.
1 variocoupler fulfilling the specifications aforementioned.

Bus bar, mounting board, phones, tubes, batteries and other customary accessories.

After the parts have been acquired, the builder should arrange them on the panel and mounting board as shown in the isometric sketch.

If a single hole is drilled in the back of the cabinet, which should be of the hinged top type, all the battery wires may be run into the set through this hole and connected with ease to the spring type of binding posts as shown in the sketch. The antenna and ground posts are of more attractive design to preserve the general appearance of the set.

Operation

The set makes use of the audio regeneration principle, inasmuch as the condenser connected to the plate of the second tube feeds back capacitatively the audio currents of the second valve, very much in the same manner as the radio frequency is fed back to the antenna from the plate of the first tube. It will be noted that the grid condensers change their capacities from the usual .00025 to .0025 or .003 MF. This, with the open low voltage connection on the audio frequency transformer are practically the only departures from the usual circuits.

Mr. Reinartz claims that this permutation is easily equal to a two stage amplifier if properly constructed and intelligently operated.

The adjustments of the 23 plate condenser control the tone of the signal, and permits reception with unusual clarity. If, however, the condenser mentioned is advanced too far, the signal while terrifically amplified will contain an audible oscillation or tube howl. The condenser should be adjusted to a point where the circuit is so called "triggered off," an intermediate point where the circuit is quiet and clear. The signals are as produced by this triggering action clear, sharp and clean, and without "mush."

The set will function with practically any type of tube, but for the best results, a U V 200 should be used with about 16 or 18 volts on the plate and coupled to the second tube which should be either a WE VT 1 or other amplifying tube by an Acme transformer.

Other Improvements

Through the Technical Office of this magazine, the writer notices many requests for different permutations of the Reinartz circuit with radio frequency amplification of the tuned type. Figure 3 shows one type of circuit which is sometimes effective in this respect. The constants of the circuit are shown on the diagram, and need no comment.

(Continued on page 48)

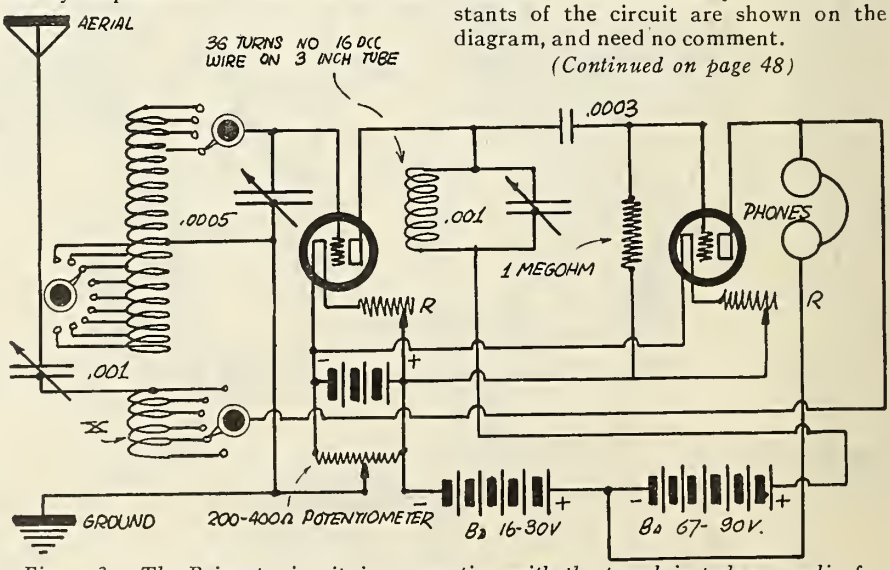


Figure 3. The Reinartz circuit in connection with the tuned impedance radio frequency method of low frequency amplification. This method is highly efficient in tuning over a broad band of waves.

Single Detector Tube Heterodyne

By JOHN B. RATHBUN

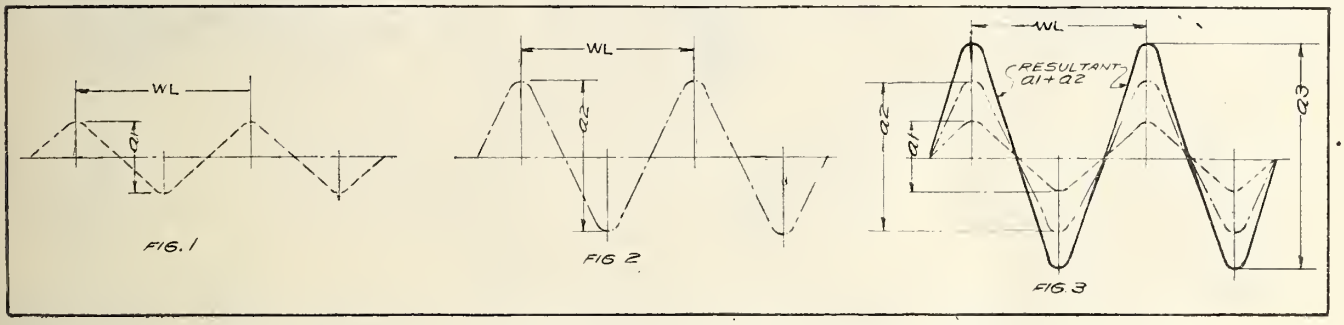
FOR the experimentally inclined this pocket edition heterodyne receiver will prove exceedingly interesting and instructive, and further still can be made the nucleus of a full fledged super-heterodyne set should the builder decide later to add the necessary stages of amplification. Properly constructed and handled, this baby of the heterodyne family is capable of very good results, particularly where there is much interference between local broadcasting stations. Its selectivity is one of its crowning features.

So much has been said of late on the working principles of the heterodyne and super-heterodyne that it seems almost unnecessary to enter into anything more than a brief outline of the heterodyne theory at this point. The purpose of the unit shown here is to adjust the tuning circuit to the frequency of the incoming radio impulses and then to augment these feeble waves by super-imposing other waves from a local oscillating tube upon the tuning circuit. The sum of the wave amplitude or wave intensity in the circuit is then made equal to the sum of the radio wave intensity and the oscillation wave intensity. This in a way is quite similar to the method used in feed back regenerative systems where the plate energy is fed back inductively into the secondary tuner coil except that a separate tube is used for this purpose. In fact, every regenerative circuit is to a certain extent a heterodyne in which the detector tube at once performs the functions of detector, oscillator and amplifier.

Using a separate tube as an oscillator is far more efficient, however, than using the detector tube for this purpose for there is no interference between the three functions when the separate oscillator tube is adjusted to the proper point for maximum oscillation. The proper filament adjustment for oscillations is seldom the best adjustment for detection or amplification, hence the single tube regenerative or "autodyne" cannot be expected to deliver the maximum output when working under all three principles.

Fig. 1 shows the normal oscillations in the detector-tuner circuit of a regenerative set, where (a1) is the "amplitude" or intensity of the radio waves. Fig. 2 shows the amplitude (a2) of the waves created by the local oscillator tube, and by a suitable supply of energy to this tube we can make the amplitude of the artificial oscillations several times greater than the value of the incoming radio waves shown in Fig. 1. The separate local oscillator tube can be adjusted to give any desired wave length so that these oscillations are very close to the frequency of the incoming oscillations.

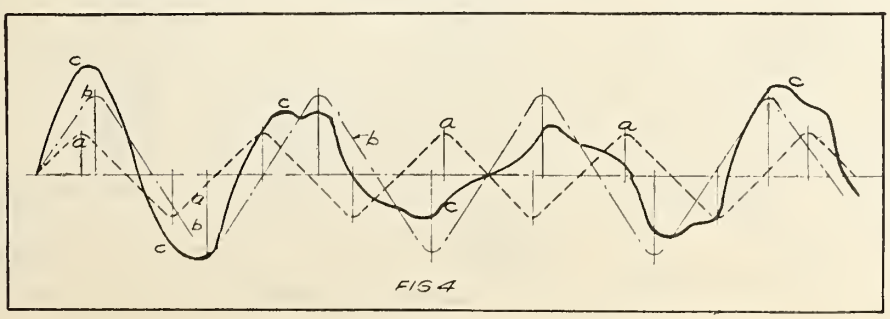
In Fig. 3 we have the oscillations from the oscillator tube impressed on the tuner circuit and so that the radio waves are in phase or in step with the waves of the oscillator tube. The total wave resulting from the two superimposed waves is shown by the heavy full curve and it will be seen that the amplitude of this wave (a3) is equal to the sum of the amplitudes (a1) and (a2) and that the amplification of the original incoming wave can be performed by adding another local wave to it. In the regenerative circuit or "autodyne," the detector tube supplies the wave (a2) and amplification is had to a lesser degree by the "feed-back method." In our present system with the separate heterodyne we can have the increase due to the detector tube plus the further increase due to the super-imposed waves of the oscillator so that the total is much greater than before.



In all these figures we have assumed all of the waves were in step or in "phase," and that they were simple "sinusoidal" waves as delivered by the broadcasting station. This condition is best for the heterodyne having a single detector tube, but in the super-heterodyne where we are to reduce the effective wave length at the output of the detector for amplification in the following radio stages, we have another condition of wave summation. In the super-heterodyne the incoming radio waves from the aerial and the waves from the local oscillator are slightly "out of phase" or out of step in order to gain an interference which is commonly known as the "heterodyne note" or "beat note." It is by this method that we reduce the high frequency radio wave of the broadcasting station to a lower frequency wave.

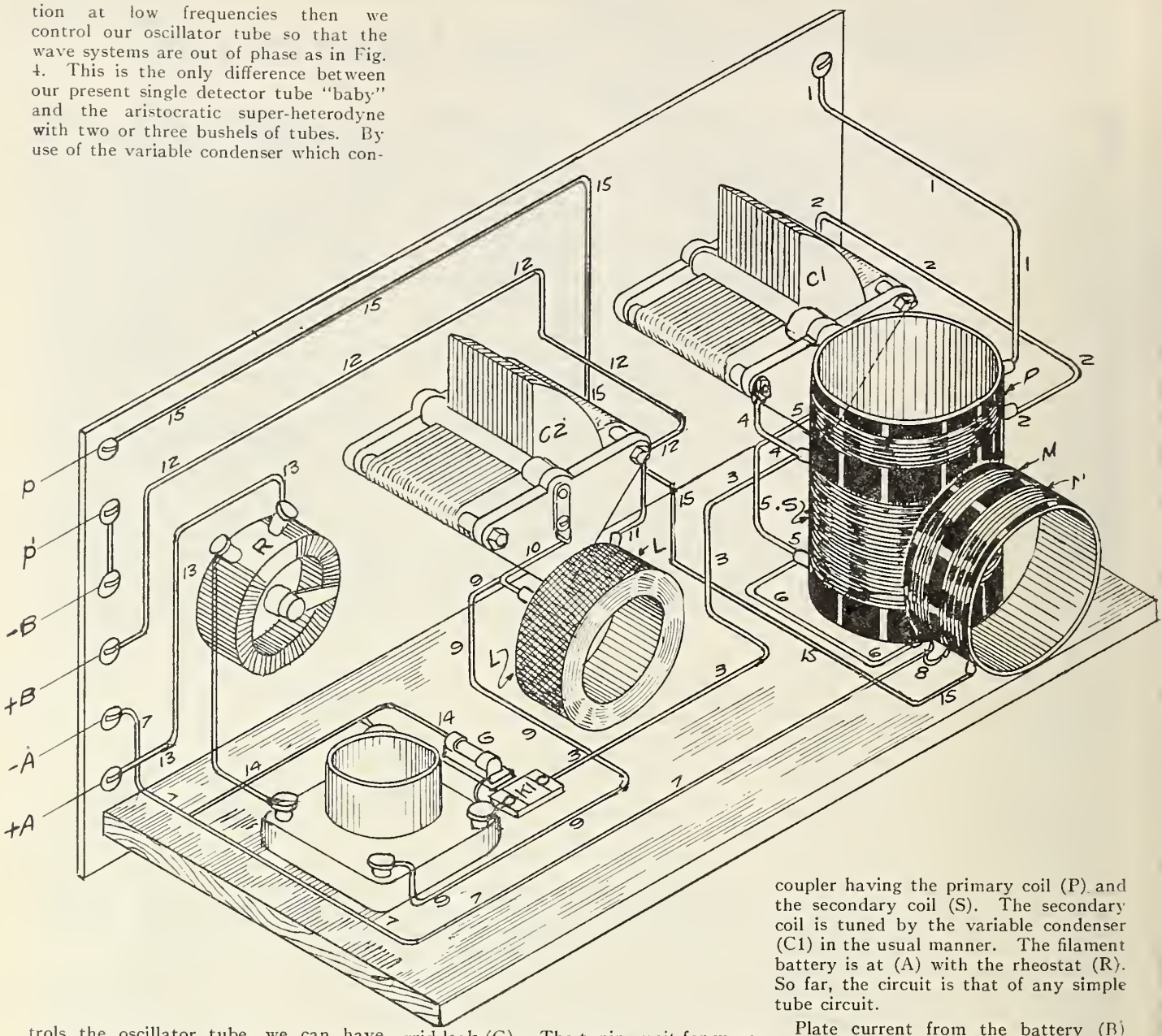
Let us say that our radio amplifying transformers are adjusted for a maximum amplification at a frequency of 100,000 cycles per second, but that the incoming radio waves from the broadcasting station have a frequency of 800,000 cycles per second. This change of frequency from 800,000 to 100,000 cycles can be easily produced by the heterodyne method in which the independent local oscillator tube is made to impress a frequency of 700,000 cycles in the tuning circuit. The total or resultant frequency in this circuit is equal to the difference in the frequency of the radio waves and oscillator waves, or numerically: 800,000 − 700,000 = 100,000 cycles per second in the circuit.

Since the waves must be out of step at the two frequencies of 800,000 and 700,000 cycles, the resultant wave is not exactly equal to the sums of the amplitudes but is somewhat less, and furthermore, the resultant wave of 100,000 cycles is no longer a pure sinusoidal curve but an irregularly shaped curve having several humps or peaks. In Fig. 4 we show the oscillator wave (b) out of phase with the radio wave (a) by just enough to produce the resultant wave (c) of 100,000 cycles. Since the amplitude of the wave (c) is equal to the sums of the other two amplitudes at every point in the length of the curve, we have a badly distorted "harmonic" which has a longer wave length than either of the other two waves.



When operating the single tube circuit we are operating more nearly under the conditions shown by Fig. 3 with all waves in phase or nearly so, but when we use the oscillator on a super-heterodyne having subsequent radio frequency amplifica-

tion at low frequencies then we control our oscillator tube so that the wave systems are out of phase as in Fig. 4. This is the only difference between our present single detector tube "baby" and the aristocratic super-heterodyne with two or three bushels of tubes. By use of the variable condenser which controls the oscillator tube, we can have the wave systems either in phase or out of phase at pleasure, hence we can use the circuit as a plain heterodyne or super-heterodyne at will.



SIMPLE SINGLE TUBE CIRCUIT

A simple single tube heterodyne can be made by introducing certain modifications into the common feed-back regenerative circuit so that the frequency of the plate circuit can be varied in respect to the frequency in the grid circuit. That is, the plate current is fed back inductively into the grid circuit in the usual way but additional means of frequency control are introduced into the plate circuit. A variable inductance such as a variometer may be used in series with the plate circuit or else a "tuned impedance" having an inductance coil and variable condenser can be inserted into the plate circuit. The latter is probably the more effective and will be used in the circuit described.

Fig. 5 contains the amplifier tube (T) with the grid condenser (K1) and grid leak (G). The tuning unit for wave length adjustment consists of a fixed coupler having the primary coil (P) and the secondary coil (S). The secondary coil is tuned by the variable condenser (C1) in the usual manner. The filament battery is at (A) with the rheostat (R). So far, the circuit is that of any simple tube circuit.

Plate current from the battery (B)

(*Continued on page 38.*)

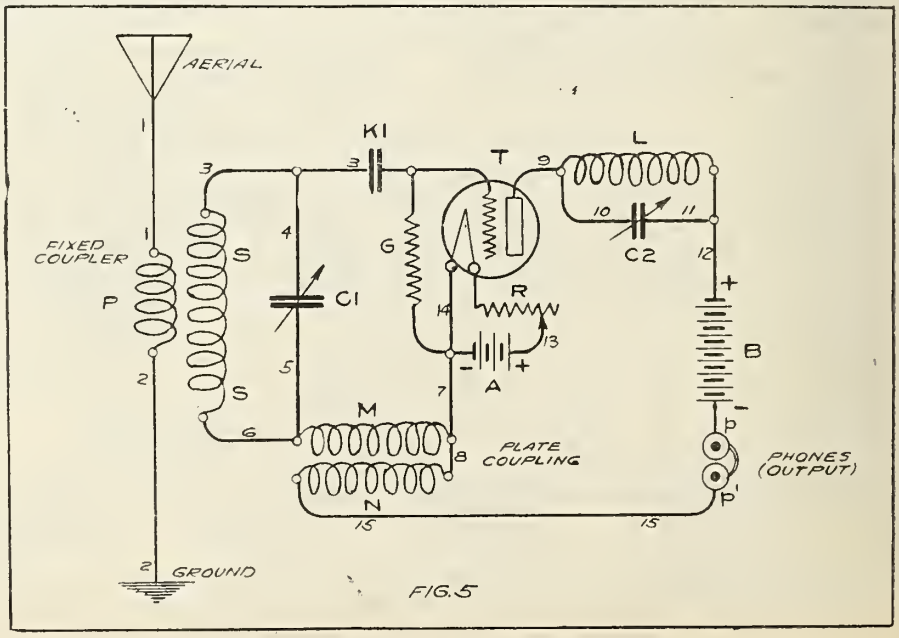


FIG. 5

Analogy of the Receiving Antenna

By FRANK D. PEARNE

JUST how the signals from a broadcasting station are received upon the aerial is somewhat of a mystery to the average radio enthusiast. He knows that the aerial is a very essential part of his receiving set and that almost any conductor strung across the roof, or between any high supports, will bring in the signals.

He will study carefully the different types of receiving sets to make sure that he understands which is the best for his particular needs and after it is constructed, he stretches a wire, or wires, across the roof with hardly any thought other than that of making it as high and as long as possible.

If he really understood just how the energy is received and just what action takes place in this very important part of his apparatus, he might be able to greatly increase the tone and quality of his reception. However, very little information on this subject is available and he can hardly be blamed for following along in the same rut as his fellow fans. It is true, much has been written in regard to long and short, high and low aerials, etc., but very little has been said in regard to how the aerial functions, excepting that it is a collector of electro magnetic waves.

Electrical Currents

The fact is that a current of electricity is set up in the aerial when electromagnetic waves cut through it, but as it is merely a conductor ending in the air, which is an insulator, the question often

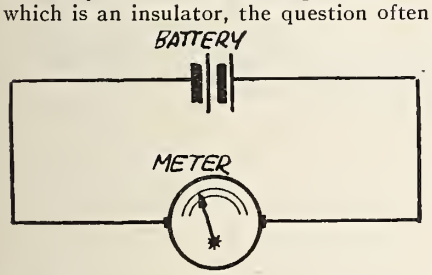


Fig. 1

arises as to how an electric current can flow in an open circuit. It is true (in the case of direct or continuous currents) a complete conducting circuit must be supplied before a current will flow and when such a curciut is established, the amount of current flowing will depend upon the electrical pressure applied and the electrical resistance of the circuit.

Such a circuit is shown in Figure 1. If this circuit is broken at any point, the current will cease to flow until it is again completed.

In Figure 2 we have an ordinary elec-

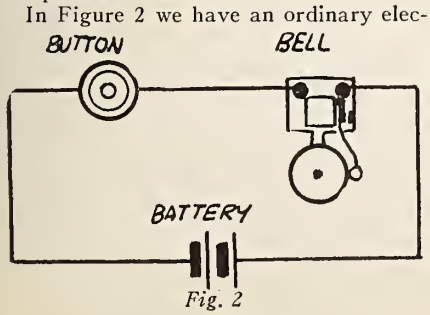


Fig. 2

tric bell circuit, which forms a complete path over which the current can flow, with the exception of the button, at which point it is open. At any time the button is pressed, the circuit is completed, current flows and the bell rings. The air, being an insulator, will not let any current flow until an actual contact is made between the two springs in the button, by pressing on the knob.

Thus it is easily seen that an aerial circuit, with its open end extending into the air, does not supply a complete cir-

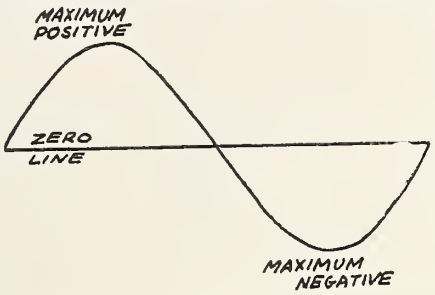


Fig. 3

cuit and consequently a direct current cannot be produced in it.

A direct, or continuous, current can be compared to a stream of water flowing continuously through a pipe. The characteristics of an alternating, or oscillating, current are different. In this case instead of being continuous in one direction it starts at zero pressure, gradually rising to maximum, drops back to zero, reverses in direction, rises to maximum and comes back to zero, as shown in Figure 3. This illustration shows what is known as one cycle and the number of times it occurs in one second determines the frequency. While an alternating and an oscillating current are exactly the same, low frequency currents are usually referred to as alternating currents, while those of extremely high frequency are called oscillating currents.

In radio work, currents of very high frequency are used. For example, the ordinary 360 meter wave used by many broadcasting stations, is produced by a current having a frequency of 833,000 cycles and a 300 meter wave has a frequency of 1,000,000 cycles. Such high frequencies can not be obtained with ordinary alternating current generators and are usually supplied by vacuum tubes, which can be made to oscillate at the necessary high frequencies.

Resistance Governs Currents

Now in alternating current practice, the amount of current which will flow in a circuit is not only determined by the resistance of the circuit and the applied pressure, but two other factors enter into the consideration. These factors are called inductance and capacity. Inductance is caused by the rapid changes taking place in the circuit as the current rises, falls and reverses as shown in Figure 2. The effect of inductance is such as to set up a reactive current in the conductor, which opposes the applied current in direction. This reactive effect will depend upon the frequency of the current flowing through the conductor, being greater for high frequencies than for the lower frequencies. This inductive reaction tends to choke back the applied current, causing the current to lag behind the pressure. In other words it supplies another form of resistance which is not encountered in direct current work.

Capacity may be said to also be another form of resistance to alternating, or oscillating currents, although its effect is negative as compared with inductance and by the proper proportion of each, the effect of both inductance and capacity reactance can be neutralized, or made zero. As the effect of capacity is very essential not only in the aerial, but also in the receiver, the reader should have a very thorough understanding of its cause and nature. If two conductors having considerable surface are placed very close to each other, but not allowed to touch, and direct electrical pressure is applied to them, current will flow for a very small fraction of a second, after which it ceases to flow. This is due to the fact that the large surfaces of the conductors absorb some of the current, although the circuit is not complete. The current, however, will only flow long enough for the conductors to receive a charge equal to the applied pressure, after which no more current can flow, for the pressure in the

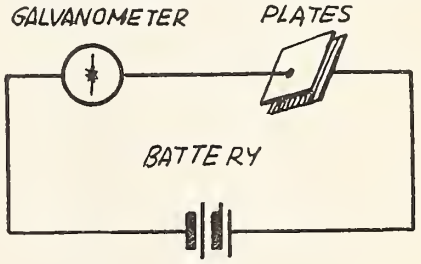


Fig. 4

conductors is then equal to the applied pressure and opposes it.

The size of the conductors, the distance of separation and the quality of the insulating material between them (in this case air) will determine the amount of current which will flow into them and the length of time required for them to receive a charge equal to the applied pressure.

Use of Galvanometer

Figure 4 shows such an arrangement with a battery supplying the pressure and a galvanometer connected in the circuit. At the instant the current is applied, a slight movement of the galvanometer will be noticed, showing that some current has moved in the circuit, although this circuit is open (between the con-

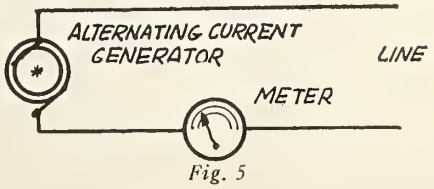


Fig. 5

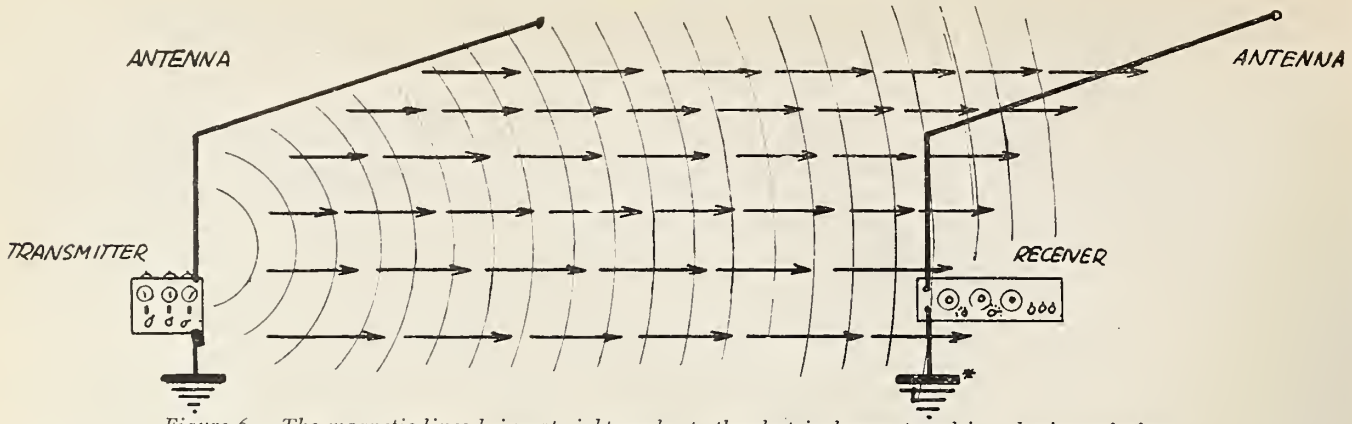


Figure 6. The magnetic lines being at right angles to the electrical wave travel in a horizontal plane.

ductors, or plates). Now if the current is quickly reversed, the pressure stored in the conductors will act with the current of the battery, or applied pressure adding its stored-up pressure to that of the battery and the combined pressure of both will flow through the galvanometer in the opposite direction, until the conductors become charged again. Each time the current is reversed the conductors will be discharged and charged up again in the opposite direction and it will be seen that if an alternating, or oscillating current is applied to the conductors, at each change in direction of current, a slight current will move, although the circuit is open. It is true that it moves for only a small fraction of a second, but it moved and that is the important thing. The galvanometer will show that a slight current flows first in one direction and then the other, as long as these reversals in current take place. This action of the conductors, or plates, is due to the capacity for absorbing a certain amount of current in receiving a charge. Now it will be apparent that the larger the conductors and the closer they are together the more capacity they will have, causing the current to flow longer before they become fully charged.

Figure 5 represents a condition which very often occurs on alternating current circuits. An ampere meter placed in the circuit near the generator will show some current flowing even though the circuit is open at the distant end. This is due to the capacity of the conductors absorbing and discharging current.

Action in Antenna

After this discussion on the subject of capacity, it becomes a simple matter to explain the action of the antenna. The energy supplied to the aerial of the transmitting station produces both electrical and magnetic effects. The electrical wave is in the form of a strain between the aerial and ground which is released at each pulsation carrying with it the tiny magnetic lines of force which eventually reach the receiving aerial and in cutting through it, produce a current of extremely low pressure in the aerial and the primary coil of the receiving set which is included in the circuit.

The principle involved in the production of this current is similar to that of the dynamo, in which the conductors are revolved in a magnetic field and made to cut through the magnetic lines of force. In the case of the aerial the lines of force are made to cut through the conductor. The electrical wave passes out into space in the form of lines from the aerial to the ground as shown in Figure 6. The magnetic lines being at right angles to the electrical wave travel in a horizontal plane, cutting through the receiving aerial as shown. As each cycle of the incoming wave reverses, the lines cut through the receiving aerial, first in one direction and then the other, producing in it, a current of the same frequency as that sent out from the broadcasting station. As each impulse is of extremely short duration, the capacity of the aerial should be enough to allow as great a charge as possible, or in other words, should be enough to allow it to charge completely with each impulse as previously explained, in order that entire antenna circuit may be made to oscillate in unison with it.

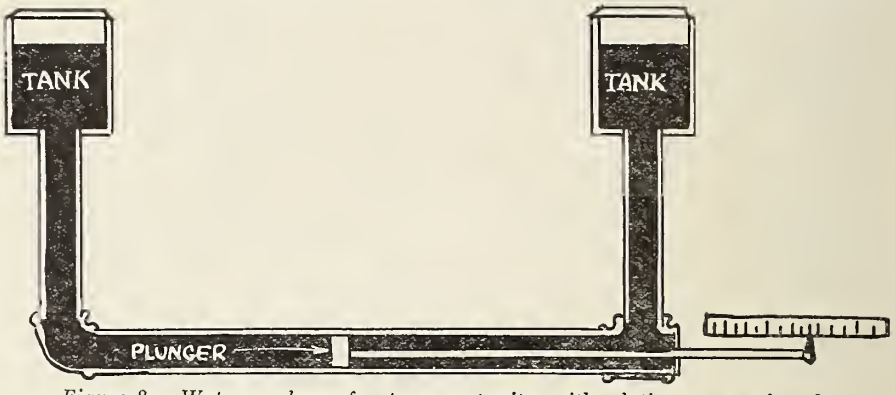


Figure 8. Water analogy of antenna capacity, with relation to wave length.

As the magnetic lines travel in a horizontal plane, most of the cutting takes place in the vertical part, or lead-in of the aerial, the horizontal part on the roof acting more as a capacity than as a receiver. In fact, if the flat part of the aerial is the same height on both ends, no cutting of the lines through it will take place, as the lines travel in the same plane with it, but if the end farthest from the lead-in is slightly elevated, then some cutting of the lines will take place, although the current produced in this part will be slightly out of phase (later, or ahead) with that produced in the vertical part, but it will be in the same direction.

Effect of Height

If, however, the distant end is considerably lower than the lead-in end as shown in Figure 7, then the current produced in this part will be in the opposite direction to that in the vertical part and the result obtained will be the difference

(Continued on page 44.)

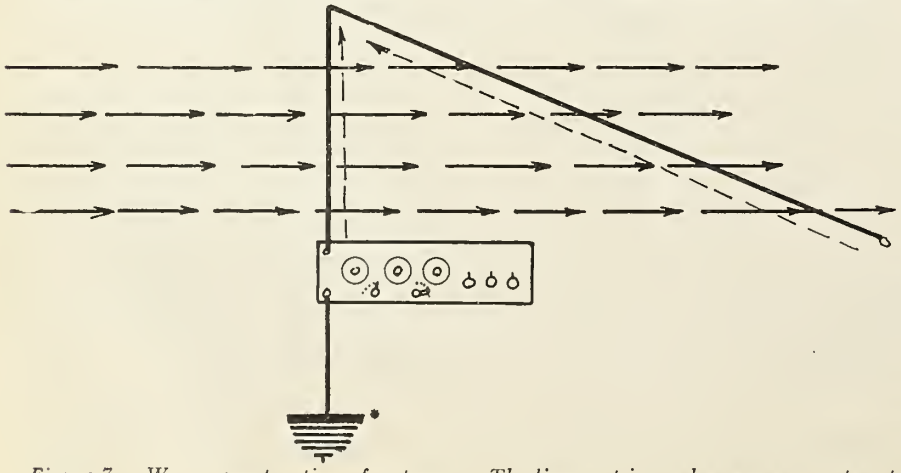


Figure 7. Wrong construction of antenna. The lines cut in such a manner as to set up opposing currents.

Interference Rejectors

By FELIX ANDERSON

Technical Assistant, Radio Age

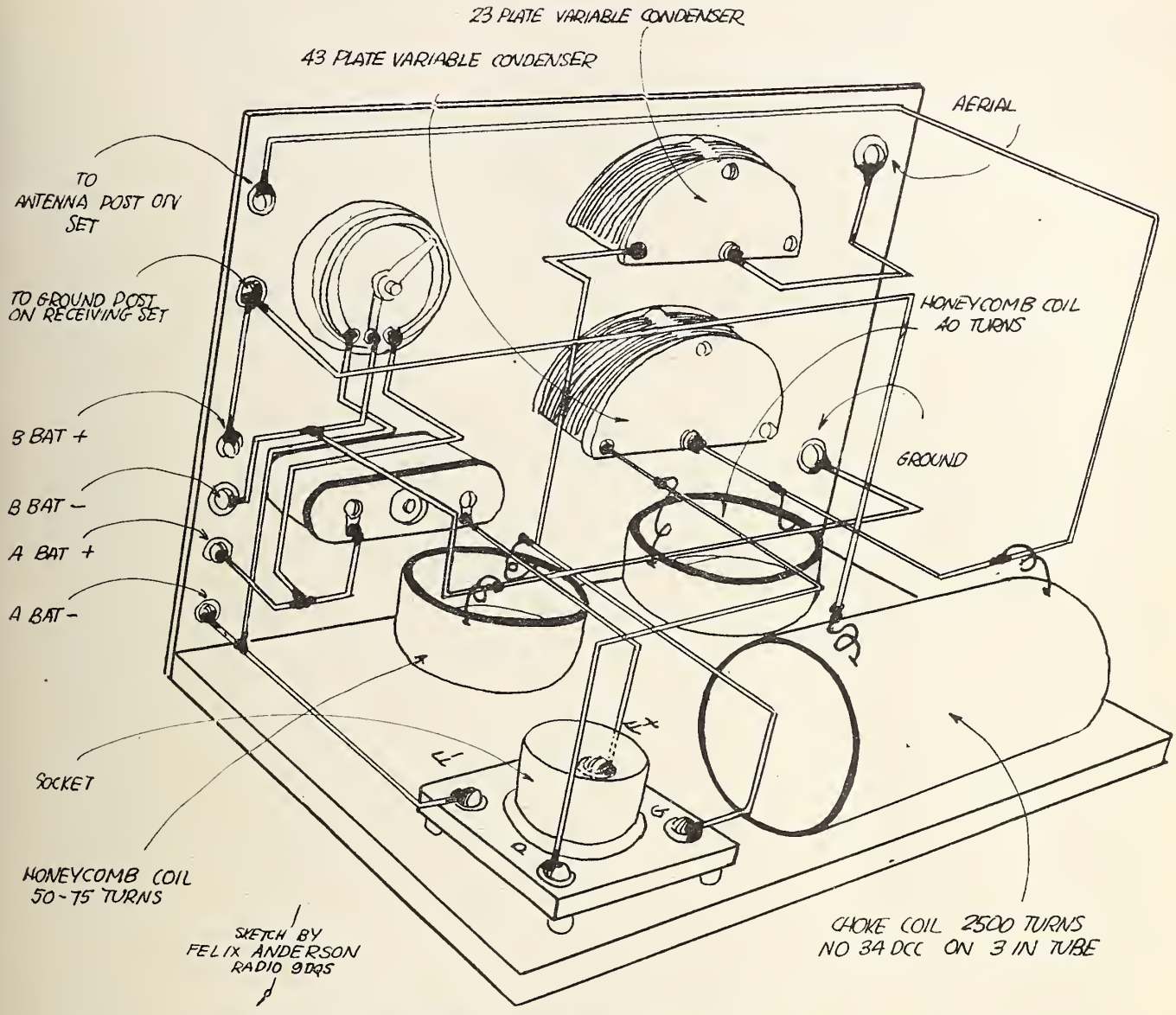


Figure 4—The isometric sketch of the tube rejector, illustrated electrically in figure 3.

IN THE January issue of RADIO AGE, the writer gave some practical hints on the construction of wave traps, and eliminators, useful in tuning out interference from stations and other sources, which met with the approval of many fans. The article, while describing in detail some of the more simple but nevertheless effective types of filters, did not comprise two types which are of great value in eliminating interference, and which are of great help in eliminating signals of disturbing nature.

The writer realizes fully that the average fan will not stop at expense or trouble when it comes to removing this obstacle from his path, and wishes therefore to give detail on the construction of two more elaborate types of so-called rejectors.

The first of these two rejectors is a system widely used by the British Marconi Company for tuning out interference from continuous wave stations. Broadcast stations using tube transmitters are included in the category of modulated continuous wave transmitters, and the rejector shown in Figure 1 is therefore of material assistance in eliminating signals from a station of that type.

The only disadvantage that this type of rejector has, is its cumbersome and clumsy construction, but the relative efficiency of a system of its kind greatly offsets any constructional or mechanical difficulties.

Procure about four feet of very heavy copper wire about the size used for street car trolley wire or larger, four switch levers, eight switch taps, about ten inches of copper strip one thirty-second of an inch thick or heavier, one dozen small nuts and bolts, a piece of brass eight inches long, one-sixteenth of an inch thick and about three-quarters of an inch wide, two binding posts, and four fixed condensers of the mica type of the following capacities: .001 MF, .002 MF, .003 MF, and .005 MF. You will need several feet of bus bar for wiring, a suitable mounting board or panel or other arrangement to fasten this accumulation of apparatus on.

Drill a hole large enough for a shaft to mount the slider in the panel or mounting board as shown in Figure 1. If you can acquire one of those porcelain gas stove handles such as is used on gas burner stop cocks, use it as a knob to vary the slider. Drill holes large enough to fit the small mounting screws to the panel (which by the way should be large enough to accommodate a fifteen inch circle of the heavy wire) at regular intervals along the circumference of a circle of fifteen inches diameter.

The next step is a feat of strength. The heavy wire must be bent into a well rounded circle of 15 inches diameter. After this has been done, it is carefully

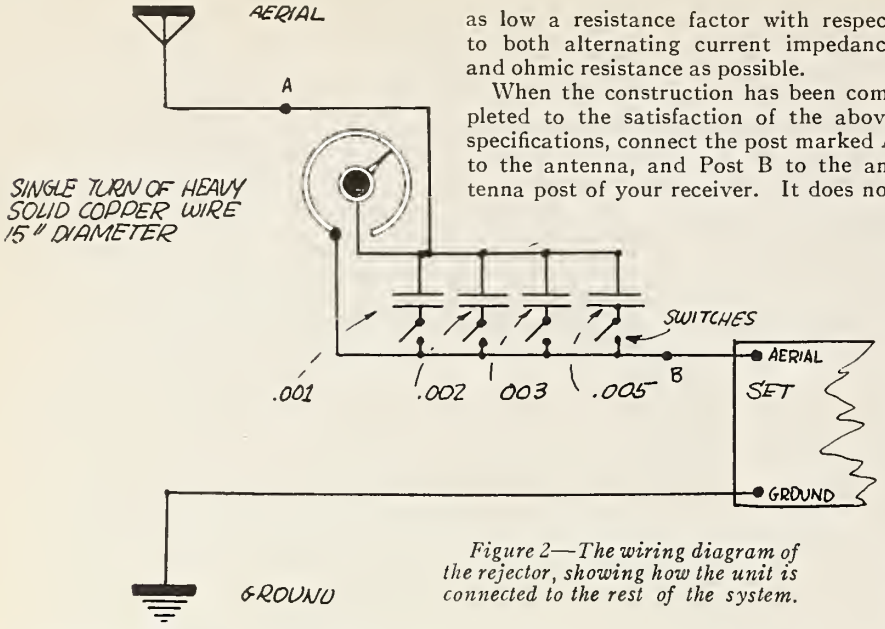


Figure 2—The wiring diagram of the rejector, showing how the unit is connected to the rest of the system.

sandpapered, and soldered rigidly to the copper strips which are cut from the ten inch piece of copper. The illustration shows how this is accomplished. The slider, constructed from the brass strip, should next be drilled and mounted so as to run smoothly over the entire arc. Drill for the mounting of the switch levers, and switch points and make allowance for the two binding posts. Two switchpoints must be used, one to throw the condenser into the circuit and the other out.

When all the apparatus has been mounted either according to the above instructions or to the taste of the builder, the instrument should be wired according to the diagram shown in Figure 2. The isometric sketch of the rejector also portrays clearly the method of wiring up such a unit.

Solder all the connections, and make sure that not a poor connection exists in the set. The secret of the entire rejector lies in the construction to make it possess as low a resistance factor with respect to both alternating current impedance and ohmic resistance as possible.

When the construction has been completed to the satisfaction of the above specifications, connect the post marked A to the antenna, and Post B to the antenna post of your receiver. It does not make a particle of difference what type of circuit you are using so long as it uses an antenna of the open end type. This circuit can be used with loop aerials, but the writer hardly deems it necessary to use an arrangement of this type with a properly constructed loop.

The rejector is tuned very much in the same way as the ordinary wave trap is operated. Different settings of the switches controlling the condensers, and varying of the slider on the inductance will reveal a certain well defined point where the signal of the interfering station is obliterated.

The receiver is then tuned to any wave except that to which the rejector is tuned.

The action of the rejector is the same as that of a wave trap, inasmuch as it consists of a highly selective parallel tuned circuit which is connected in series with the antenna lead. The rejector when properly tuned to the interfering wave by the manipulation of the condenser switches and slider offers a very high impedance to the frequency of that signal, while to other signals on other frequencies, the impedance is negligible. The signal not wanted is dissipated in the wave trap or rejector, while other signals which are not coming in on the same wavelength pass through the rejector without resistance.

The rejector may be connected into the antenna in the manner shown in Figure 5, page 6, of the January, 1924, issue of RADIO AGE, where it performs the same duties as outlined for the wave trap connections of that article.

It may not be amiss to again mention that if results are to be obtained with this type of filter, the condensers must be of low loss construction, the connections should be rigid, and it is even a good plan to wire the rejector up with wire of as great a thickness as mechanical reasonableness will permit. A number 10 or 12 wire is not any too large, and a strip of sheet copper cut into a ribbon about 1–2 inch wide is vastly superior for connecting purposes.

If you can convince yourself that a clumsy affair of the dimensions given is efficient enough to offset the appearance and convictions that radio apparatus should be as small as possible without regard to electrical specifications, we certainly recommend your constructing one of these rejectors.

Vacuum Tube Rejector

The most elaborate of all the interference preventors, selectors and systems to prevent interference as yet outlined in RADIO AGE is the radio frequency amplifier-rejector, which requires more apparatus than the ordinary detector circuits now in use.

A glance at Figure 3 will reveal that the circuit is really nothing more than a simple radio frequency amplifier which can be connected to the antenna and ground posts of any of the conventional receiving sets now in use. The circuit is, however, really more than that, due to the fact that it contains in its plate circuit a highly selective wave trap, which in con-

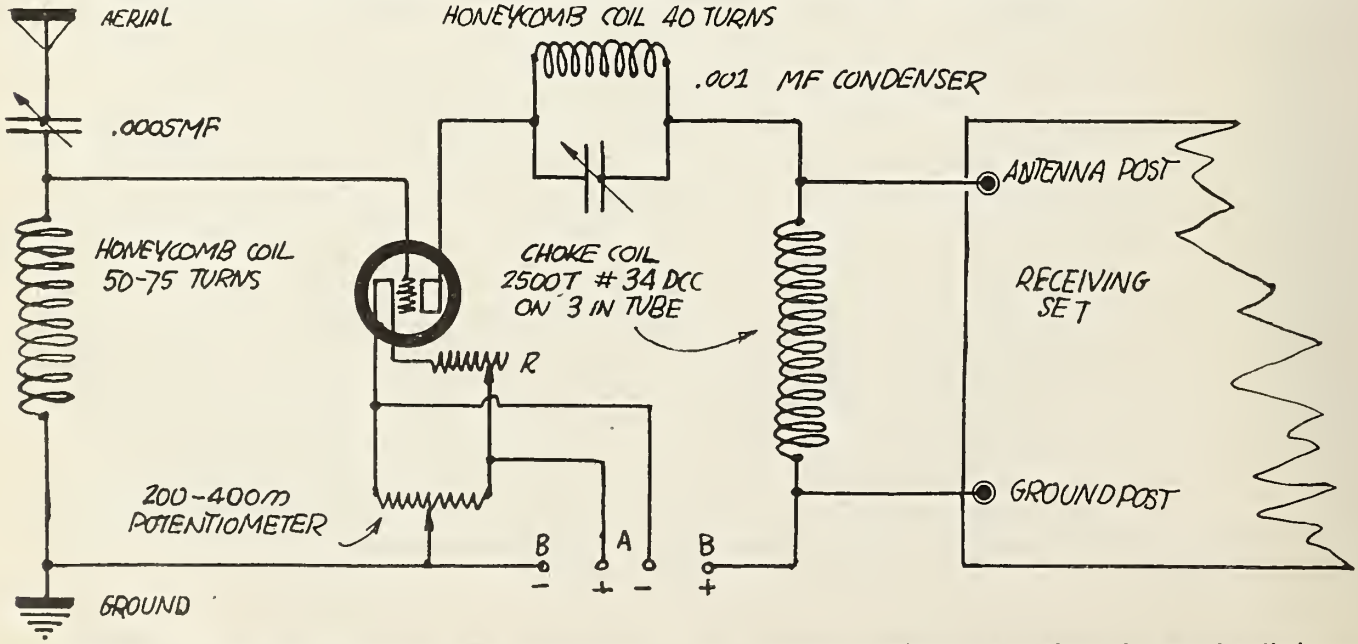
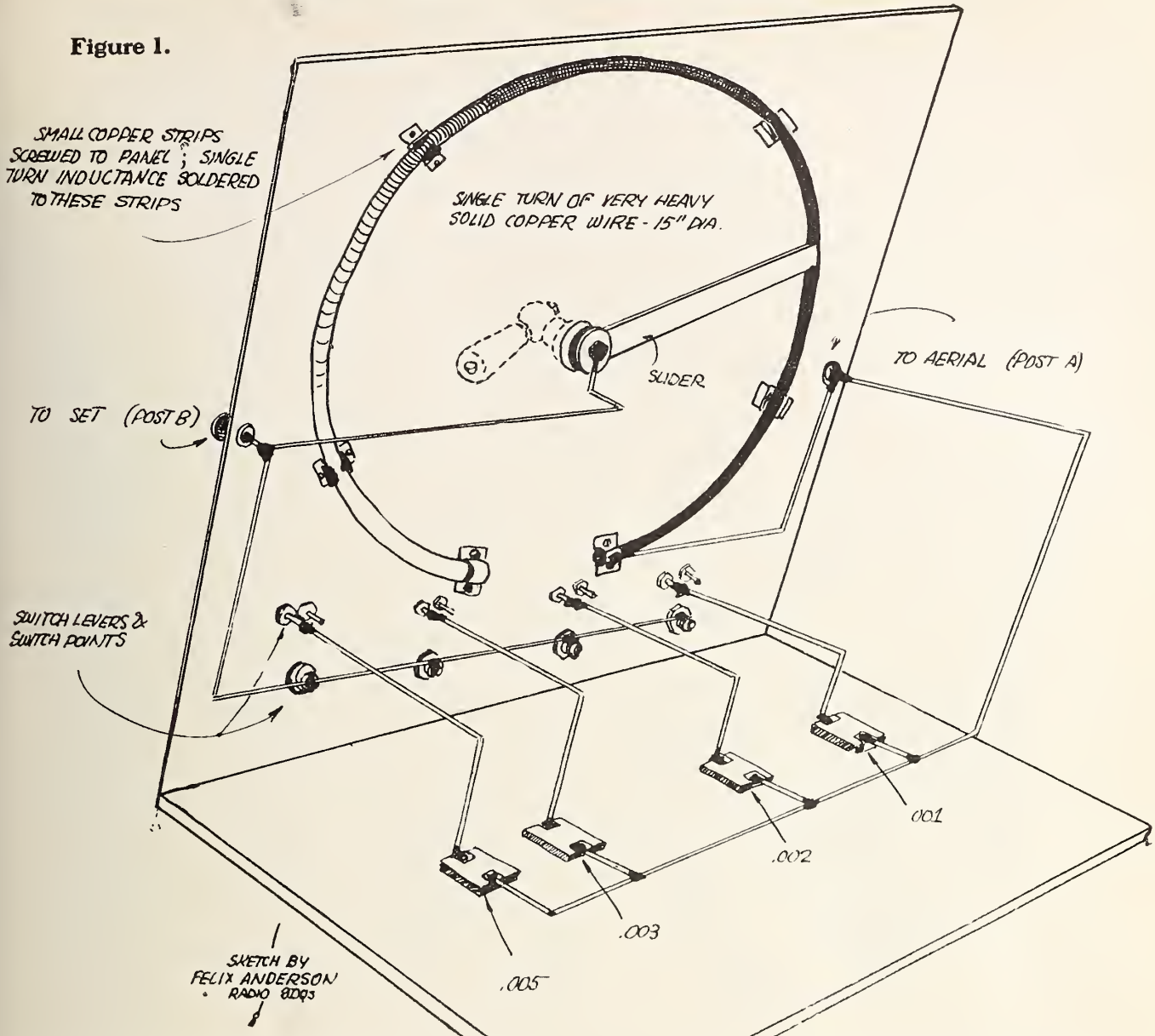


Figure 3—The tube type of rejector is one of unusual merit, and fans who are looking for an elaborate but sure-fire eliminator should try the one described herewith.

Figure 1.



junction with the action of the tube and choke coil, acts as a highly selective tuner, of the finest degree.

The action of the 23 plate condenser in the antenna circuit is a well known factor, inasmuch as many fans are already aware of its value in tuning. This condenser in connection with the honeycomb coil used as an inductance, form a preliminary tuning circuit much similar to the one described under the title of simple series eliminator in the January issue. Together with the action of the tube, which further increases the sharpness of tuning, it is in itself a circuit from which average selectivity may be expected.

The insertion of the forty turn honeycomb coil and 43 plate condenser in the plate circuit further removes the obnoxious interference, which we are trying to eliminate, and this, together with the tuning qualities of an efficient receiver, forms probably the most surefire method to rid one's self of what the amateurs term "QRM."

List of Parts

The necessary parts for the construction of a unit of this type are rather many when one considers that it is merely to be used as an interference preventer, but one should remember that in addition to its being a boon as far as selectivity is concerned, it is a simple radio frequency amplifier of efficient design. The parts necessary are:

1 7x10 inch panel.
1 23 plate condenser vernier type preferred.
1 43 plate condenser vernier type preferred.
1 50-75 turn honeycomb coil.
1 40 turn honeycomb coil.
1 rheostat.
1 200-400 ohm potentiometer.
1 tube socket.
1 radio frequency choke coil wound to specifications.
8 binding posts.
Bus bar, tube (Western-Electric preferred) mounting board and other accessories.

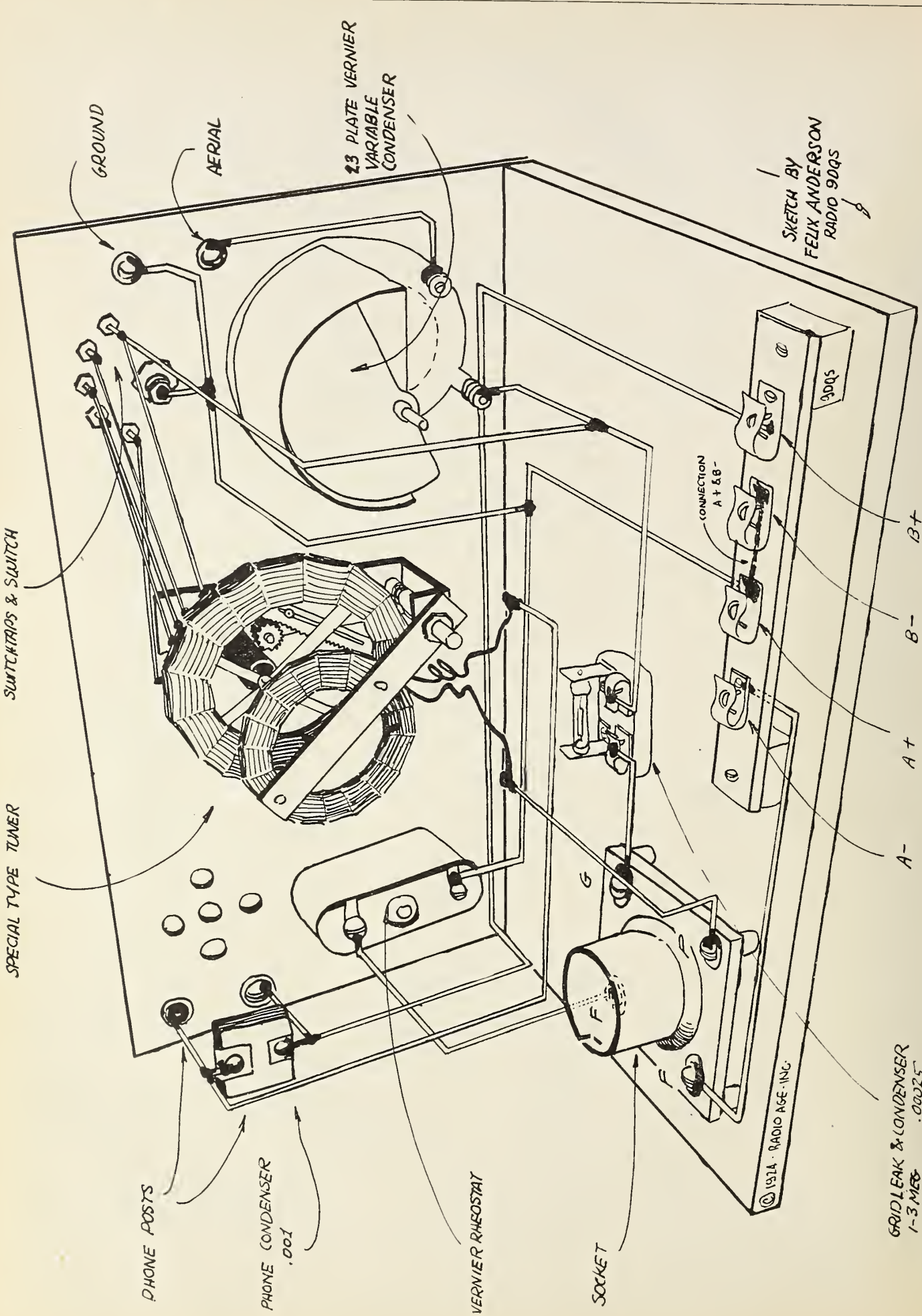
The arrangement shown, while spread apart to illustrate more clearly the connections, can be used if the apparatus is bunched closely, to make sure of short leads, so necessary in the construction of radio frequency apparatus. If the builder desires he may use his own judgment as far as arrangement is concerned so long as he observes carefully the rules regarding the construction of radio frequency units.

The construction is largely a matter of personal choice of apparatus, and knowing that amateurs rarely work to given dimensions, we refrain from printing template instructions or definite measurements.

The size of the honeycomb coil in the antenna circuit is largely dependent upon the size of antenna, and a little experimenting with coils of different sizes will soon determine which is the proper size to use.

The choke coil is probably the only difficult thing to make (here is where the

(*Continued on page 38.*)



An isometric sketch showing the simple, cleancut and effective arrangement of the set described by Mr. Pearne in the accompanying article. This set makes an ideal beginner's receiver.

The Old Reliable Circuit With New Tuning Unit

By FRANK D. PEARNE

MANY of the old time circuits, the ones which we used to build in the old days when broadcasting was hardly known, have proved their value over and over again and if the truth were known many of the supposedly new and intricate circuits of the last year or two are merely additions, or rearrangements of these old-timers. Some of these changes are for the better and some for the worse, but the original basic principles are still there and may be easily recognized if the circuit is carefully analyzed.

One of the most popular improvements was the substitution of the spider web coil instead of the large variable inductances previously used. The principal advantage of such a coil is the reduction of the distributed capacity which is present in straight layer windings. Distributed capacity acts like an extra load connected across the terminals of the coils, using up much of the feeble energy received upon the aerial and anything which tends to reduce it, is sure to improve reception, especially in the reception of signals from distant stations.

However, until recently no very convenient method of adjustment has ever been applied to such coils and the mounting and adjusting arrangement was usually left to the discretion of the builder and as might be expected, most of them were marvelous feats of engineering. Nearly all the adjustments were obtained by swinging one coil away from the other at right angles, the movable coil being mounted on some sort of a hinge which unless very carefully made, would not give the same adjustment two times in succession.

In the circuit shown in the accompanying drawing, the movable coil is made to move in the same plane as the stationary coil, making a coupling between the two with a flat magnetic field and by this method, the lines of force are concentrated, instead of being spread out. Because of this concentration, the lines do not penetrate to the other parts of the set and cause such disturbances as howling, nor will they waste their own energy.

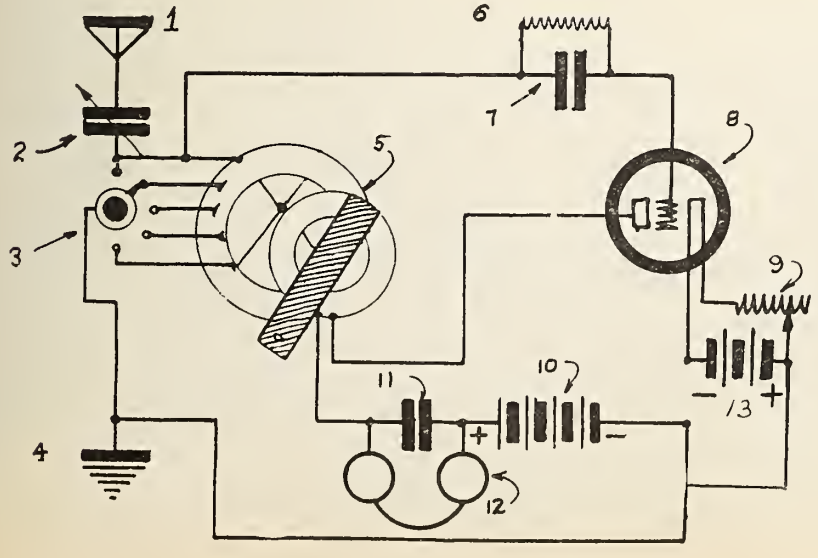
The tuning arrangement shown in the drawing was originally invented by Mr. Carl Pfanstiehl, president and engineer of the Pfanstiehl Radio Service Company, back in the early part of 1923, and as it has proven such a success in thousands of sets produced by him, he has consented to show his method to our readers. This sliding method of adjustment can be adapted to any of the popular circuits where the space is limited and will be found to give very close and sharp tuning.

In the circuit described, the movable coil is included in the plate circuit, and acts as a feedback, making the set regenerative, and as by this method its position can be changed so minutely that the amplification by regeneration can be controlled to a very fine point, which is so necessary in getting long distance reception. The 23 plate condenser in the aerial circuit will also help to a marked degree in bringing in the distance.

While a carbon rheostat is shown on the panel, merely for convenience, any standard rheostat will answer the purpose very nicely. The phone condenser is used to by-pass the radio frequency current, which cannot get through the highly re-active windings on the phones. Any standard detector tube may be used and the filament battery selected will be determined by the type of tube used.

Figure 1 is an isometric drawing showing the panel arrangement and layout of the parts. This can be any convenient size of panel and baseboard to suit the cabinet which the builder can obtain. Figure 2 is a schematic arrangement of the circuit showing a list of the necessary parts and their different values.

This circuit in use in Chicago has been picking up California and all distant points in America. The circuit is not unusual and has been thoroughly tried out and can be depended upon and the total absence of any dielectric material in the magnetic field, eliminates loss of energy through dielectric absorption, and in the reception of distant signals. This point is of the most vital importance.



LEGEND

1 AERIAL
2 23 PLATE VERNIER CONDENSER
3 SWITCH & SWITCH TAPS
4 GROUND
5 TUNING UNIT
6 GRID LEAK—1-3 MEGOHMS
7 GRID CONDENSER .00025 MF.
8 ANY TYPE TUBE
9 VERNIER RHEOSTAT
10 B BATTERY 16-30 V.
11 PHONE CONDENSER .001 MF
12 HEADSET
13 FILAMENT BATTERY

MacMillan's Messages

An absurd newspaper dispatch was published recently to the effect that the Aerial League of America was urging radio operators to check up and try to determine why Dr. Donald B. MacMillan's radio messages "had not been heard in Canada and the United States." One Chicago daily gave the "story" quite a play and other papers in various parts of the country gave it space.

It apparently had escaped the notice of all these editors that practically every newspaper in the country for several months has been publishing items about reception of messages from Dr. MacMillan. Interesting accounts of how Jack Barnsley had received and relayed many messages from Canada to the United States have frequently been printed.

Denial of the Relay League's astonishing suggestion was slow in overtaking the original misstatement. On December 17 Kenneth B. Warner, president of the A. R. R. L. effectually spiked the yarn. President E. F. McDonald, Jr., of the National Association of Broadcasters also sent a statement broadcast, showing that communications had been received regularly in both the United States and Canada.

"NERK!"

WASHINGTON, D. C.—With the materialization of the plans for the polar trip of the naval air cruiser, "Shenandoah," or the ZR-1, it has been decided that her original 300-mile radio equipment first described in these columns last July, is inadequate and a brand new transmitting unit good for a thousand miles has been developed by naval radio engineers.

If, late in July or August, fans pick up the call, NERK, they may shout with glee, for it will be the "Shenandoah" communicating with one of the far-northern radio shore or ship stations.

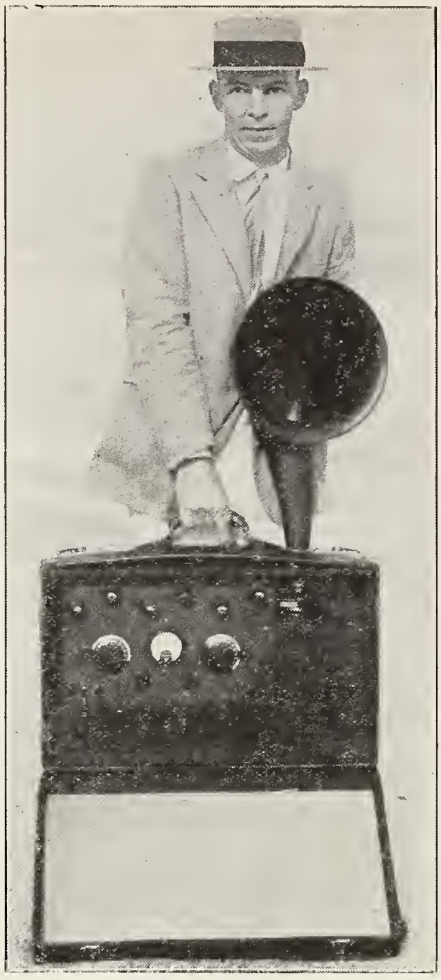
Radio equipment plans for the "Shenandoah" include two transmitting sets, two receiving outfits and a radio compass. The high-powered set which replaces the six fifty-watt tubes, includes two 2-kw tubes, with an input of 4 kw, and an output of 2 kw. With this transmitting set it is believed several northern radio stations such as exist in Iceland, Greenland, Spitzbergen and Russia, or our own Alaskan stations, can be reached. With the powerful receiving sets Annapolis, Cordova, Lafayette, Nauen and other high-powered stations can be copied, or used as points to establish the position of the great airship by means of the radio compass. This instrument is now believed indispensable on this exploration trip from a base at Point Barrow, Alaska, 1,117 miles south of the Pole.

Besides the high-powered transmitting set, an auxiliary medium-range telegraph and telephone set is to be installed aboard the aerial cruiser. The telephone feature will be utilized for communicating with ground stations when landings are being made for the immediate transmission of orders to the ground crew or operators at the mooring masts.

All the radio equipment weighs is 1,023 pounds, which in itself is believed by engineers to be a great accomplishment, giving a transmitting radius of approximately a mile a pound. This is very light in comparison to the radio apparatus carried by surface vessels of the navy. The after-section of the control car will be used as the radio shack. Some difficulty in locating the radio compass where it will be operative and yet not hinder the progress of the airship and interfere with landings is being encountered, but this problem will be solved soon, radio experts declare.

The plans call for the use of two-base ships in the far north, each of which will be outfitted with a mooring mast and carry radio apparatus for communicating with the "Shenandoah" when she is on voyages. One of these remodelled tankers will be sent to Point Barrow, 70° north, and the other will in all probability be dispatched to Spitzbergen, where it is hoped a temporary radio-compass station can be established. Two other portable radio-compass stations will also be erected as far north as they can be pushed. With the two ships, this will give the "Shenandoah" five radio compass stations of her own from which to check her position and progress toward the top of the world, even if she fails to pick up existing radio stations.

As has been pointed out previously, radio will enable the navy to check the position of the airship and if the pole is reached to prove it conclusively by cross bearings made aboard. Her positions could be rechecked later by northern stations having radio compasses. This eliminates faking of a position not attained and is a new feature in polar exploration made possible by radio. Since the Arctic summer is barely two months in length, and daylight is believed a necessary requisite in this venture to the Pole by air, speed in establishing the temporary radio stations in the north is necessary, so that the airship need never be out of touch with main and auxiliary bases.



"Radio Dare-devil"

Major Edward H. Armstrong, of New York, is here shown with a six-bulb suitcase receiver. The major is seen in summer attire because he was snapped at Palm Beach, Fla., where he went for a honeymoon. Mrs. Armstrong was Miss Marian MacInnis, of Merrimac, Mass. It was Major Armstrong who applied the regenerative principle to radio circuits.

AERIALS AND CLOTHESLINES

Picturing the back of a row of tenements near Jackson Avenue, Long Island City, where the tenants are not permitted to string aerials on the roofs. To overcome this objection, a young forest of backyard poles in competition with wash poles serve as aerials for the radio enthusiasts.

Crystal, to Tube, to Loud Speaker

A Two Stage Audio Frequency Amplifier to Use With Selective Receiver Described in January Radio Age

By J. A. CALLAHAN

IN LAST month's description of a selective tube receiver, evolved from our original crystal detector circuit of the December issue, we have considered merely what may be regarded as the essential processes of reception.

The response of all methods of reception can be further improved by straightforward amplification.

We conceive the most simple to be that method which deals with amplification of low frequency currents which is called, for obvious reasons, as previously discussed, audio frequency amplification. Radio frequency currents are by no means as simple of control and the perfection of the type of amplification under discussion is advisable before any attempt at the other is assayed.

The method consists essentially of a series of audion amplifiers arranged electrically so that the amplified output of each tube is passed on successively to the next to be again amplified. Each tube with its passing-on coupling is referred to as a stage, or step in the amplifier.

As magnification of tube and battery noises, and other disturbances of this nature, is proportional to the magnification of the signal received the number of audio frequency stages which are advisable are two, possibly three.

Several methods of linking tubes are possible; resistance, inductance or transformer coupling. We are offering herein the latter method as affording the greatest degree of increased volume.

Transformers

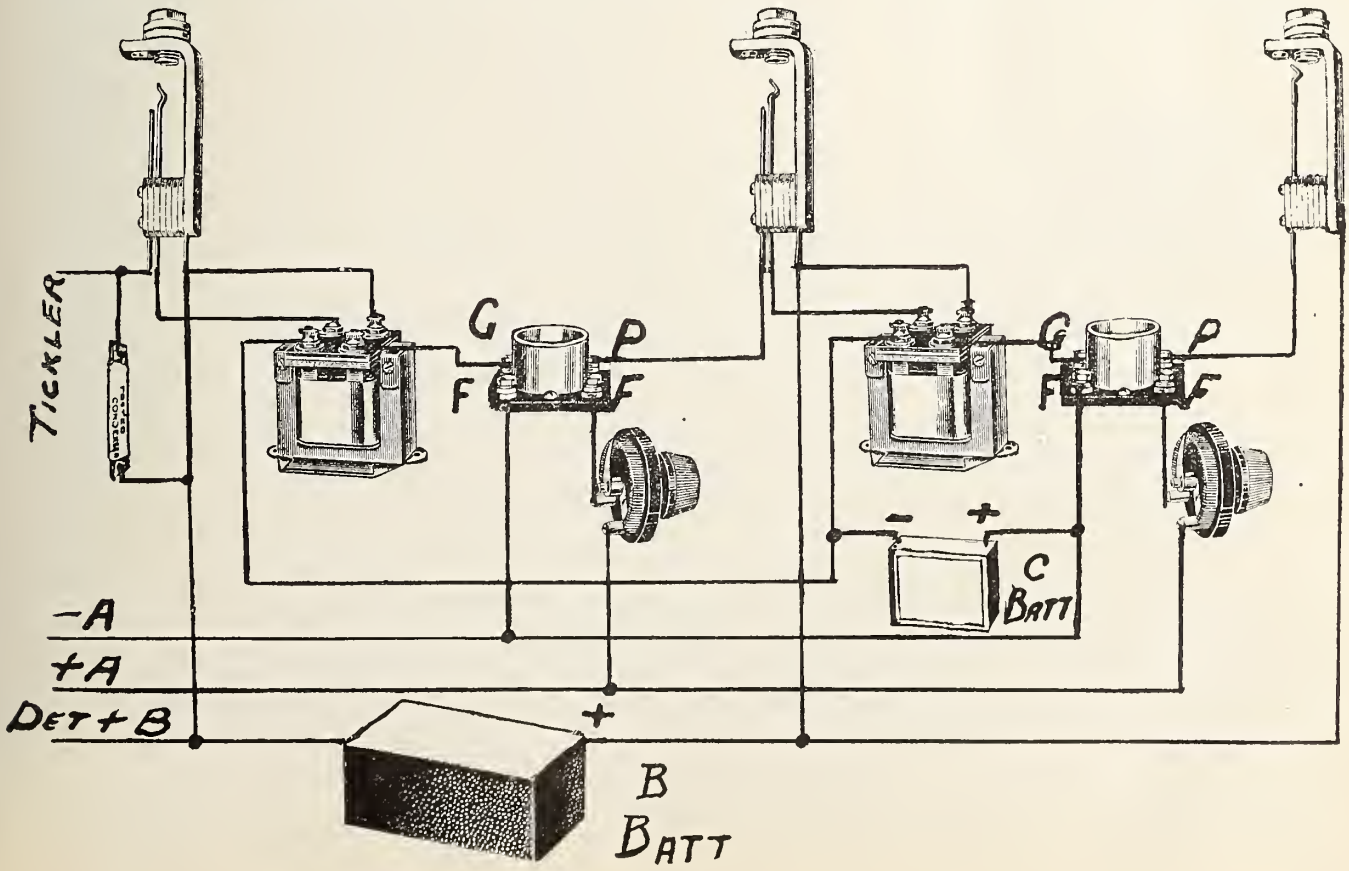
In selection of transformers preference should be given to those types which are shielded. In view of the low cost of these units a discussion for their construction does not seem necessary. The proper ratio is a six to one on first and second stages respectively. It is advantageous to connect the second stage of amplification as a push-pull type. This method was described at length in the January issue of RADIO AGE with a presentation of its virtues.

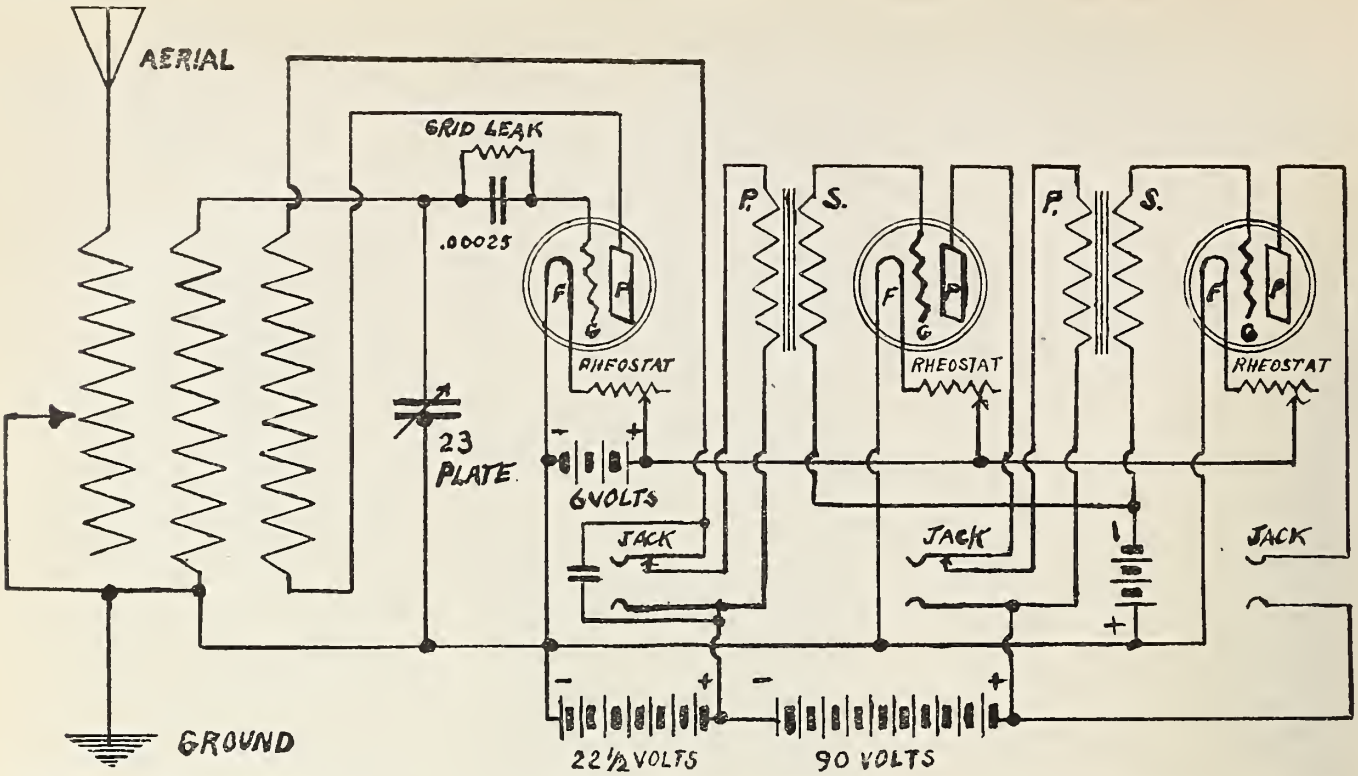
Switches or jacks are usually provided for connecting the telephones either in the plate circuit of the second tube for full amplification or in the plate circuit of the first tube for the use of a single stage. In the diagram pictured, jacks are shown and are of the three-prong type which are preferred by the writer because they are more simple to connect, having one less contact as a source of disorder. This method of jack connection allows one side of primary to remain connected to circuit; however, with audio frequency current there will be no disadvantage of dead end or capacity losses.

If the four-prong jacks are preferred, they can, of course, be employed.

Filament control jacks can be employed and do not differ in construction from other standard types of jacks, with the exception of two additional prongs for filament which act in the nature of a switch contact to connect A battery to filament of tube to be employed. This method relieves the necessity for filament current switches for detector and amplifier tubes. It eliminates switches between amplifiers and between amplifier and detector. It is a saving of filament current which under customary operation is wasted by leaving tubes burning while not in service. It simplifies the operation of the receiver. Pushing in the phone plug connects the receivers to circuit of detector or desired stage of amplification and lights the tube or tubes all in one operation. An added convenience is found in that once the proper adjustment of rheostat is obtained it will remain constant. A diagram showing connection of this type of jacks is offered for your convenience, should they be preferred.

As advised for our detector, or tuning unit, in the January issue we are still adhering to the preference for six-volt tubes in this unit, those known as am-





plifier tubes, which differ somewhat from the detector tube.

Dry Cells

The smaller tubes can be used, with dry cells, without necessitating any change in the circuit, with the possible exception of rheostat resistance.

The U V 201a or C 301a are recommended.

The resistance of rheostat depends upon the tube employed and is rated as given in the accompanying table.

W D 11-12 tube.....6 ohm rheostat
U V 199 and C 299..20 to 30 ohm rheostat
UV 201a and C301A.....
.....15 to 20 ohm rheostat
UV 201, C301 and 216A.....
.....4 to 6 ohm rheostat

A "C" battery is advisable because of the resulting economy of B battery current and is particularly advantageous in increasing volume if the peanut tubes are used. This should be four and one-half volts, regardless of type of tubes in circuit. B battery connection is indicated in diagram and plate potential can be from sixty to 100 volts.

Difficulties may be encountered in perfecting operation of the amplifier. Sometimes transformers are defective, often through being damaged in shipment. A simple test by which condition can be determined is employed by connecting the primary of transformer in series with a 22½ volt B battery and a voltmeter which has a reading of from 25 to 50 volts. Depending upon the make of transformer, the reading of voltmeter should be between ten and eighteen volts. If the meter registers over twenty volts the transformer is shorted. If it does not register at all some connection is broken and in either case the transformer is not serviceable and must be replaced.

The secondary of transformer is tested in the same manner. The volt meter in this testing should read from five to ten volts if effective and if over fifteen volts is registered it is shorted.

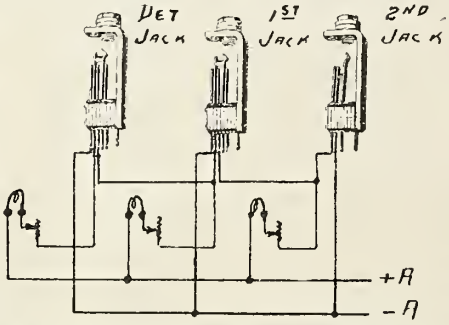
Locating Troubles

If signals are without amplification look for a dead B battery or defective transformer.

If no signal is received look for lack of contact of jack or for disconnected B battery.

Distorted signals result from inoperative C battery or defective transformer.

Now that we have offered you a se-



lective tuner and an efficient amplifier you are going to experience the added joy of general participation in the high quality of entertainment being broadcast, rather than that which is limited to the phone method of reproduction, and there need be no scramble and argument in your generally peaceable family as to "whose turn it is to listen-in" because you are justified in adding a loud speaker to your equipment, knowing that it will afford a highly satisfactory performance.

Tiny Receiver

Harold Lane, one of the Washington correspondents has what is believed to be the simplest complete radio receiver yet assembled. He carries it in his vest pocket, phone and all. When he is near anything which will serve as an antenna, he makes a contact, sometimes only with his hand, often neglecting to make a ground connection, and listens in.

To be sure, he takes what he gets—the nearest and strongest station on the air. The vest-pocket set comprises a single head phone, without leads, and a fixed crystal detector, connected in parallel with the phone by two short copper wires from the telephone terminal. Placing the phone to one ear and making contact with as good an aerial as he can find conveniently by means of his fingers, which of course must touch one of the two terminals, is all he has to do. By this means he has heard NAA time signals and set his watch, and also whiled away odd minutes by listening to WRC or WCAP when they were on the air. One day he picked up KDKA. When convenient he also makes a ground connection at the other phone terminal, but he says it isn't always necessary. The particular crystal he uses is a compact unit about the size of a short thick lead pencil with binding posts at each end convenient for connection with the phone terminals. He used to use a tuner but as this bulky apparatus didn't improve incoming signals he discarded it as he also did his phone leads and wires for connecting with aerial and ground. The result is believed to be the neatest cheapest and smallest portable set in use.

Interesting Combination Receivers

By R. H. LANGLEY

Radio Engineering Dept. General Electric Company

ONE of the most fascinating things about Radio is that it provides such a fruitful field for experiment. The art is young, and there are many questions yet to be answered. The apparatus for the study of these problems is already planted in millions of American homes, and this paper is addressed to those who find pleasure in trying new circuit combinations.

With a small selection of the standard apparatus, it is possible to arrange many interesting new combinations that are not given in the instructions. I shall give now a list of the apparatus needed for the combinations to be described later, and it might be well to make mental note of the items which you do not have.

2—Single circuit regenerative tuners
1—Vacuum tube detector and 2 stage amplifier
1—Three stage radio amplifier
1—Variable air condenser
1—6 Volt storage battery or
6—No. 6 dry cells
4—Blocks of plate battery, 22 1-2 volts each
1—3 cell Flashlight battery for bias, 4 1-2 V
1—Homemade loop antenna
6—Radiotrons, UV 201, UV 201-A or UV-199
—Outdoor antenna and ground connection.

The loop will consist of 8 to 10 turns of almost any kind of copper wire, wound at 3-8 or 1-2 inch spacing on a wood frame 3 or 4 feet square, and arranged so that it may be rotated on a vertical axis.

In all the circuits to be described, a UV 200 soft detector tube may be used, if suitable arrangements are made for obtaining the correct plate voltage.

Eighteen Circuits

With the apparatus just enumerated, there are at least 18 different receiver circuits possible. Some will be very sensitive, some highly selective and some both selective and sensitive. Some will be suitable for use in congested districts, some will function best for nearby stations and some for distant stations. It is not possible of course to give diagrams of these circuits, but we can classify and describe them so that the possibilities of the various combinations may be seen.

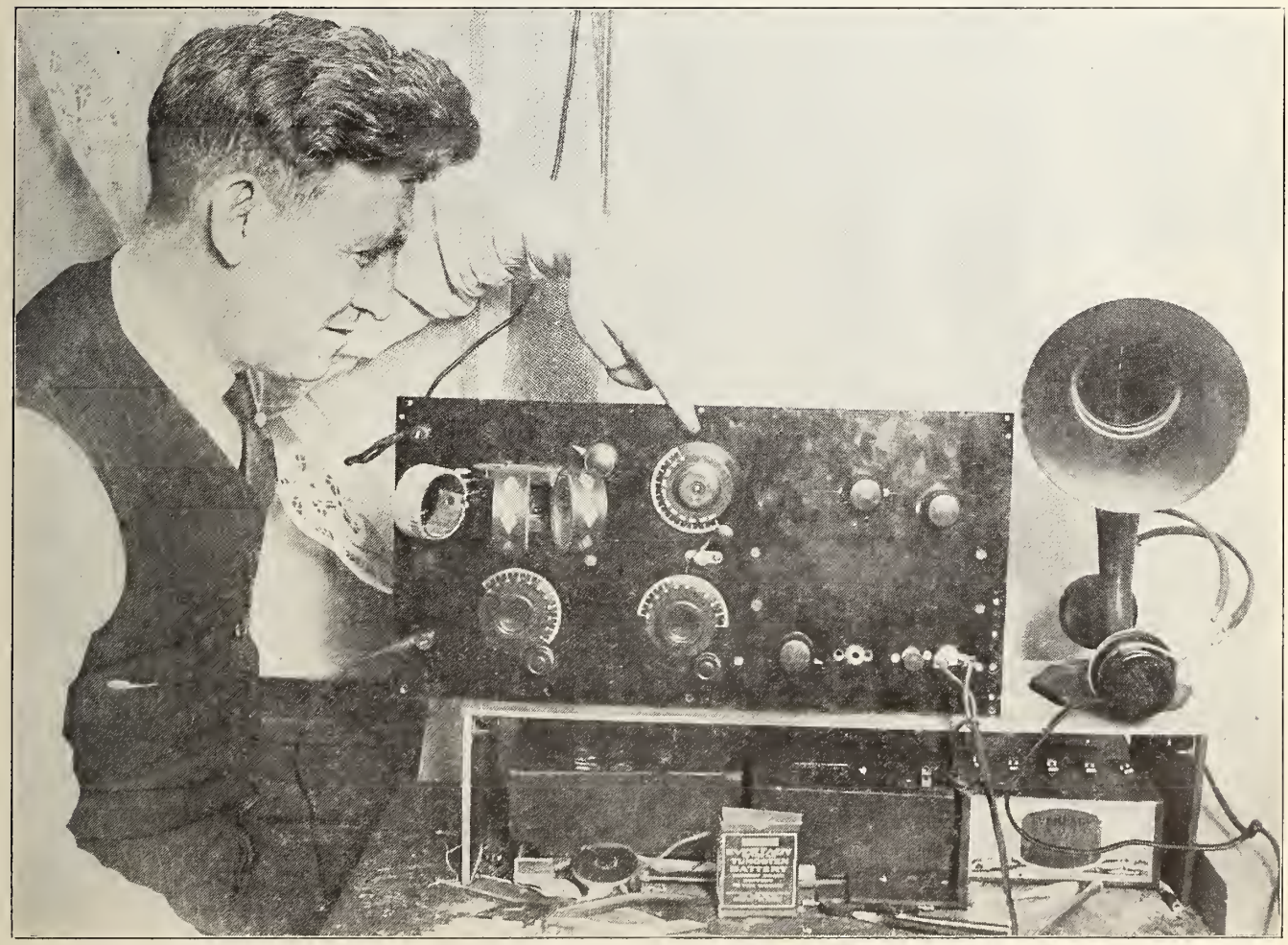
Let us divide the 18 circuits into five classes.

First, on the outdoor antenna without radio amplification.
Second, on the outdoor antenna with radio amplification.
Third, on the loop antenna.
Fourth, using both the outdoor antenna and the loop, and
Fifth, some special arrangements.

In the first class, that is, on the outdoor antenna without radio amplification we can list seven different combinations. Two of these regenerative; the other five circuits are not regenerative. This, of course, means a great deal in signal strength, particularly on the more distant stations, but for the sake of making the list clear and easy to remember we will take them all together.

The seven circuit arrangements possible on the outdoor antenna without radio amplification are as follows:

First, single circuit tuner, using crystal detector.



LONDON AND LOS ANGELES

Mr. Kennedy is here shown pointing out the vernier rheostat on his simple three tube honeycomb regenerative set. He does all his tuning on this rheostat and on the secondary condenser. He gets Los Angeles and London. See photograph on next page. (Kadel & Herbert.)

Second, single circuit tuner with vacuum tube detector amplifier.
Third, single circuit tuner, with detector amplifier and the regenerative connection.
Fourth, using the outside condenser to make a two circuit tuner.
Fifth, using two tuners to make a two circuit tuner.
Sixth, using two tuners to make a three circuit tuner and
Seventh, using two tuners and the external condenser to make a three circuit tuner, with all three circuit tuned.

There are two ways of using the external variable air condenser to make a two circuit tuner. We may connect the variable condenser across the tickler coil to make a secondary circuit or we may connect the condenser in series with the tickler coil to make a primary circuit.

In using two tuners to make a two circuit tuner the tickler coil of the first tuner is used as a coupling coil and connected to the input terminals of the second tuner.

In using two tuners to make a three circuit tuner, the two tickler coils are connected together to form the third or link circuit. If we connect the variable air condenser in series with the two tickler coils, we can then tune this intermediate circuit.

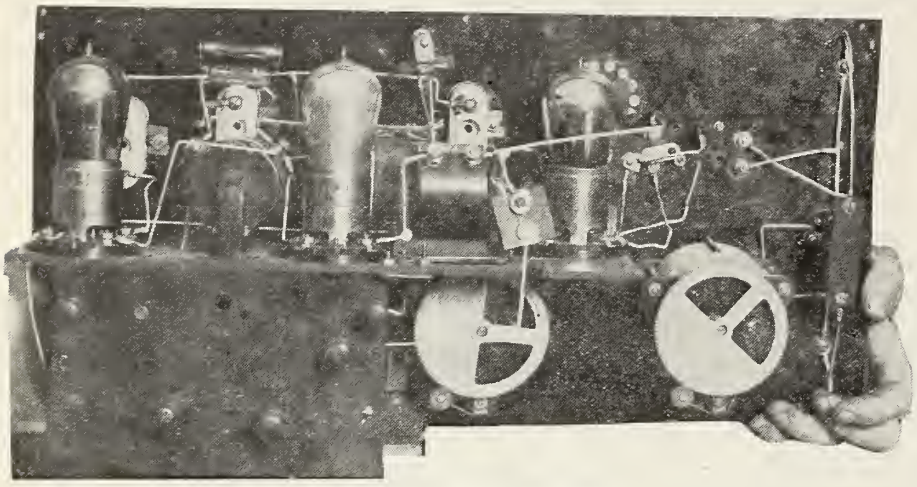
The second class of circuits were those on the outdoor antenna with radio amplification. For these we use our three stage radio amplifier and insert it between the tuning system and the detector amplifier. This may be done on any of the seven combinations which we have just noted except possibly with the crystal detector.

Loop Antennae

In the third class we use the loop antenna. There are several combinations here; let us notice only two. The first is the straight loop circuit where the variable air condenser is connected across the loop and then connected to the three stage radio frequency amplifier and from this to the detector audio amplifier. The second combination, which by the way is a very interesting one, provides a method for using the loop in a regenerative circuit. This uses the loop and one of the single circuit tuners, then the radio frequency amplifier and the detector amplifier.

The fourth class uses the antenna and the loop in combination. There are also several possibilities here. The best one, perhaps, consists in connecting the antenna and ground to one of the single circuit tuners. The loop and variable air condenser are connected to the three stage radio amplifier and the detector amplifier in the usual way. These are two independent circuits, the only connection between them being that the tickler coil in the tuner is connected to the tickler terminal on the detector amplifier. This combination is quite remarkable in performance. The antenna circuit is brought into resonance with the signal by means of the tuner and the loop circuit picks up energy from this tuner antenna circuit. The reactions obtained by the tickler coil connection make it possible to successfully eliminate very loud nearby stations.

In the fifth class, let us notice two stunts. The first one consists in amplifying the signal obtained from the crystal detector, by connecting in such a way that the output of the crystal detector goes thru the primary of the first audio frequency transformer. No batteries are needed in the crystal detector circuit. This is a very fine way of obtaining excellent loud speaker signals from nearby stations. The second stunt, is the use of a grid bias and a higher plate voltage on the amplifier tubes. Open the grid circuit and insert a small Flashlight battery of say 4 1-2 volts between the grid and the filament bus. The negative end of biasing battery should be connected to the grid and the positive end to the filament bus. It is then possible to use very much higher plate voltage on the amplifier tubes, with the result that considerably greater amplification is obtained with the same or even better quality of reproduction. With the UV-201, UV-201-A or UV-199 radiotrons, the plate voltage may be increased to 90 or 110 volts.



A DISTANCE GETTER

Thomas J. Kennedy, 470 West 159th Street, N. Y., regularly receives 2-LO, of London, Eng., and KHJ, Los Angeles, with this simple three-circuit honeycomb regenerative set. He tunes with the secondary condenser and the rheostat of the detector tube, without moving the honeycomb coils or the ground condenser. Note how he uses condensers and grid leaks across the transformer secondaries to clear up signals. (Kadel & Herbert.)

Aerials and Tuning

There are many people who imagine that the loop antenna is a substitute for the big outdoor aerial and that the same results can be obtained from either. This of course is very far from the truth. There is a very fundamental difference. The aerial is a condenser. It is a very large condenser to be sure, so far as its physical dimensions are concerned, but it does not have a very large capacity.

The loop, on the other hand, is an inductance. This means that the method of tuning the aerial is quite different from the method for the loop. The same receiving sets will not work interchangeably on either. The single circuit tuners are suitable for tuning the antenna, but when we used the loop, we used a separate variable air condenser to tune it.

In these experimental combination receivers, it makes very little difference which tube we use. The main difference between the various tubes is in energy consumption in the filament, rather than in performance as detectors or amplifiers. Some are slightly better than others in this respect, but the main purpose of the newer types is to simplify the A battery problem. The UV-200 and the UV-201 require 1 ampere filament current necessitating a storage battery. This is expensive and troublesome and requires frequent charging. The UV-201-A takes only 1-4 of an ampere and can be operated four times as long on one charge of the battery. It may also be operated from dry batteries. The UV-199 tube takes only 6-100 of an ampere and can be operated from dry batteries with great success.

Radio "Help Wanted"

The Government is advertising by radio! But, although direct radio advertising is banned, there are few who will object, since the results achieved seem to indicate that the public is benefited. Every Wednesday night, Mr. Morgan of the Civil Service Commission, broadcasts from NAA, Arlington, openings in government positions and announces examinations to be held for every kind of a job from that of an unskilled laborer to those requiring highly trained scientists, statisticians and executives. Some replies indicate direct results, but as not all applicants state how they learned of the openings, an exact check is impossible.

The recent call for apprentices for the Washington Navy Yard, however, brought several phone calls and mail inquiries from fathers and mothers interested in securing first class training for mechanically inclined sons.

The openings annually announced over the radio phone cover as many as 1,000 different positions, Mr. Morgan states, and he is anxious for those seeking Government work to listen in Wednesday evenings at 7:25 and learn what is available.

CRUSADERS

These radio fans are sure that they can induce others not to interfere with the enjoyment of neighbors by making their regenerative receivers squeal. Miss Helen Dickinson, (seated on table) is getting the signatures of New York neighbors to an anti-squeal pledge. (Kadel & Herbert.)

How to Avoid Interference

By JOHN V. L. HOGAN

The seventh and eighth of this series of radio talks, which have attracted wide attention, were presented through Station WEAF, New York, by Mr. Hogan, consulting engineer and past president of the Institute of Radio Engineers and author of "The Outline of Radio."

IT IS possible to classify the six things that give the most trouble, as follows:

1. Nearby broadcasting stations using wave frequencies close to that which it is desired to receive.
2. Radio telegraph transmitters of the spark type.
3. Oscillating receivers that produce whistling noises.
4. Distant broadcasting transmitters that radiate waves having frequencies within a few kilocycles of the frequency being received.
5. Atmospheric discharges, known as "strays" or "static."
6. Induction from lighting, trolley or power systems.

Of these six kinds of interference, the first, second and third are the most bothersome. Perhaps this interference from nearby broadcasting stations is not so great a difficulty as is interference from spark transmitters, but where it does exist it is practically continuous whereas spark interference at worst is only intermittent. I suppose that accounts for the fact that most of the letters I have received ask, in one way or another, for remedies that will prevent hearing speech or music from one broadcasting transmitter while listening to another. In any event, this kind of interference is wholly or partly spoiling the broadcast reception in many homes today and it is doubtless the first that we should study in detail.

There is one very good thing about this "crosstalk," as we may call it, and that is that it can be very nearly if not entirely eliminated by rearrangement of your own receiving apparatus. Of course, you must be reasonable in what you expect from any radio receiver; it would hardly be fair for a man who lived only a few blocks from WCAE in Pittsburgh to expect his receiver to pick up signals from KDZE in Seattle without interference. That is because WCAE sends out a wave of 650 kilocycles and would be heard very loudly, whereas KDZE sends at 660 kilocycles (only 10 kilocycles higher) and would produce very weak signals at Pittsburgh. On the other hand, this Pittsburgh man might very fairly expect a good receiver to cut out WCAE at 650 kilocycles (even though very near to him) while he listened to WOR in Newark at 740 kilocycles, to WEAF in New York at 610 kilocycles.

In the same way, anyone living anywhere in or around New York may reasonably expect to be able to listen to any one of the four local stations WEAF (610 kc), WJZ (660 kc), WOR (740 kc) or WHN (833 kc) without any interference from any of the other three at any time. Many people living in the middle West Side district of New York have apparatus with which they are unable to hear any stations other than WJY or WJZ when those transmitters are working; but this trouble is not hard to cure, for there is no insuperable difficulty in getting a receiver that will bring in long distance stations such as KDKA in Pittsburgh and WJAZ in Chicago even when installed within only a few blocks of WJY and WJZ.

Depends on Receiver

The whole matter of eliminating interference from one broadcasting station while listening to another comes down to the choice of your receiver. There are two rules to guide this choice, as follows:

1: The nearer your receiver is to any broadcasting station, the more highly selective it must be to prevent interference from that station.

2: The greater the distance you desire to receive, and consequently the more sensitive your receiving apparatus is, the higher its selectiveness must be to prevent interference.

Thus you will see that a receiving set which is perfectly satisfactory in one location or for one service may fail utterly when used in another place for another

purpose. Radio receiving is very emphatically a matter in which one man's meat may be another's poison. It may be helpful, though to consider a list of twelve types of useful radio receivers arranged in the approximate order of their selectiveness, and I will give you such a list tonight. If your receiver is at the bottom of the list, don't let that fact disturb you, for if it is sufficiently selective for your purposes, well and good. But even a receiving set that is rated half-way up the list might not be good enough for some locations, and in such cases the only two remedies are either to pass the set along to someone else who can use it and to get a new outfit of better selectiveness, or else to improve the original receiver. Here, then, are twelve types arranged in the order that I believe puts the most selective outfits at the top and the least selective at the bottom:

1: Superheterodyne with closely tuned intermediate amplifier.
2: Multiple-stage tuned radio frequency amplifier with regeneration and with double-tuned aerial input circuit.
3: Multiple-stage tuned radio frequency amplifier with regeneration and single-tuned aerial-input circuit.
4: Multiple-stage tuned radio frequency amplifier without regeneration but with double-tuned aerial-input circuit.
5: Simple regenerator with double-tuned aerial-input circuit.
6: Multiple-stage tuned radio frequency amplifier without regeneration, with single-tuned aerial-input circuit.
7: Simple regenerator with single-tuned aerial-input circuit.
8: Multiple-stage untuned radio frequency amplifier with regeneration.
9: Non-regenerative audion detector with double-tuned aerial-input circuit.
10: Crystal detector with double-tuned aerial-input circuit.
11: Non-regenerative audion detector with single-tuned aerial-input circuit.
12: Crystal detector with single-tuned aerial-input circuit.

Remember that this list is arranged in the order of *selectiveness*, as it appeals to me. A different list would be required to show the relative sensitiveness and a still different list to indicate the relative ease of adjustment. Still further, bear in mind that to warrant its rating on this list any particular receiver must be well designed and well built; a poorly made superheterodyne may be less selective than a good single-tuned simple regenerator.

Cross-Talk

Cross-talk between broadcasting stations is without doubt breaking up more reception than any other single kind of interference. People who can at one time hear music from some one station, and hear it easily and clearly, find a little later than some other station begins to dominate their receivers and that they cannot "tune it out" sufficiently well to listen to the first. Perhaps they can adjust their receivers so that the interference is no louder than the speech or music that they desire to hear, but it is still there and is intense enough to give all the discomfort of "getting the wires crossed."

If you are experiencing this sort of difficulty—and I know that thousands of you are—make careful note of these two points:

First: The trouble necessarily lies in your receiver, for the wave frequencies of the broadcasting stations are far enough apart to permit reasonable freedom from interference in any location. Such interference is not the fault of any broadcasting station nor of the assignment of wave frequencies.

Second: Either your receiver is of a type which cannot possibly have adequate selectiveness for elimination of the interference in your locality, or it is so designed that its selective power is less than your particular type should have.

60 CENTS
John P. Buckley, scientist with the U. S. Bureau of Standards, completed this crystal detector and he claims they could be made and sold in quantities at sixty cents each. (Fotograms.)

These two points state facts that cannot be controverted, and it is just because of that that we can all afford to be optimistic about cutting out this cross-talk interference. If this trouble did not lie in your receiving sets it might be a hopeless job to get rid of it; since it is necessarily the fault of your receiver, it can be cured right in your own home.

Some of you may be inclined to doubt the possibility of cutting out interferring stations which send on waves close in frequency to the one you want to hear. People have said to me: "I paid $250 for my radio set, and if it won't pick up WCAF while WEAF is sending I don't believe that anything will." The answer to this is that character is what makes a radio receiver good. Dollars have little more to do with it than with the making of a man. People in your own neighborhood, using relatively inexpensive outfits of good design, are cutting right through interference that is troubling other folks whose sets, in spite of their higher cost, are poorly laid out.

Last week I listed twelve general types of radio receivers, in the order of their selective ability. Nearly every set now in use falls into one of these twelve classifications. If your set is low on the list, and if you suffer from cross-talk interference, perhaps you will have to get a more selective type before you can cut it out. The probabilities are, though, that your set is not as good as it should be even in its own type. Therefore your first step should be to make certain that your outfit is of good design.

Spark Transmitters

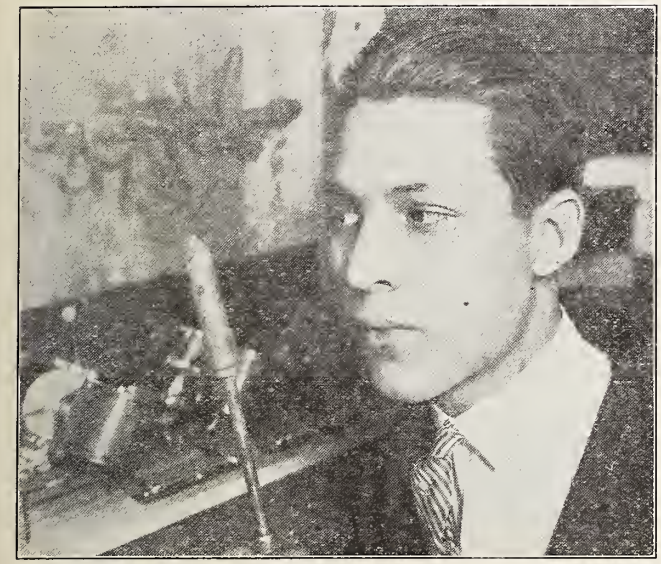
Before we go into the practical things that can be done to improve receiver selectiveness let us give a moment to the second worst kind of program-smasher, which is the spark radio-telegraph transmitter used in ship-and-shore wireless. Those of you who have good receivers may disagree with my rating this spark transmitter as the second worst source of interference, for to you it is by far the most aggravating. But that is because you have already overcome trouble number one (cross-talk); our unfortunate friends whose receivers are so poorly selective that they cannot listen comfortably to any but the nearest or loudest broadcasting station are very numerous, and we must give them first aid.

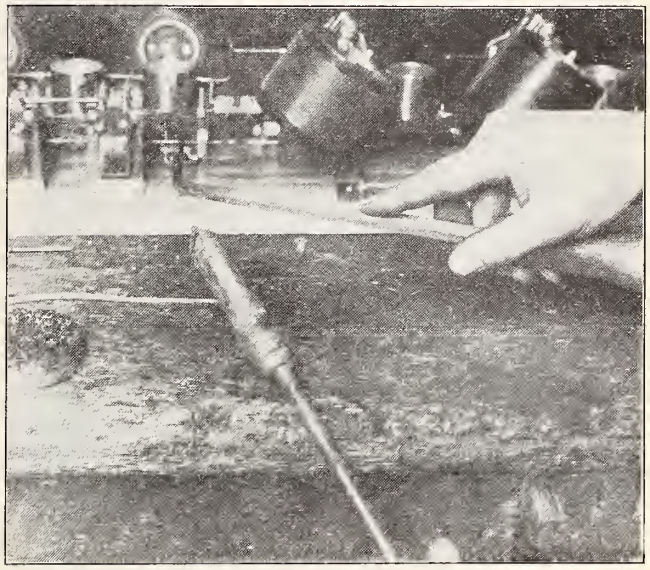
The fact is, however, that by improving the selectiveness of your receivers you will greatly decrease the Morsecode dot-and-dash spark station interference that you now hear. You will never eliminate it completely, however, for spark transmitters will break through and produce disturbances in the most highly selective broadcast receivers that can be built. The only real cure for spark station interference is to eliminate the spark transmitters themselves. That very thing is going on from day to day, so you should all be able to note a continued improvement as progress is made.

Since any increase in receiver selectiveness will aid in reducing both cross-talk and spark interference, let us see what can be done in this direction. First we should consider the last or least selective receiver on the list I gave last week, No. 12, the crystal detector with single tuned aerial circuit. Lots of people are using these outfits, and in some locations they work very well if they are properly put together. If you have one, and if it is not performing to your taste, you can probably improve it by putting a variable condenser in series with your aerial circuit, i. e., between the lead-in of your aerial and the binding post on the set to which the aerial was connected. Then use as much of the tuning coil as you can and do the tuning on the variable condenser. A still greater improvement can usually be made by connecting the crystal detector and telephone side-circuit across

(Continued on page 41.)

Little Things That Help





SOLDERING HINTS

Poor soldering will ruin the best of sets. Picture at the left shows how to make sure your iron is hot enough. Hold it five inches from your face and if you can feel the heat, you are ready. Be sure your iron is clean. It may be cleaned easily with a file, as shown in the picture at the right. (Kadel & Herbert.)

Receiver Essentials

Many radio fans are constructing their own receivers, some of which work well, and some which are tolerated merely because the builder has not the necessary funds to make a new one, says Beverly Dudley, member of the American Radio Relay League. For the construction of a receiver which is to work entirely satisfactorily, a thorough knowledge of radio principles is essential, but one may get on well with a few pointers and his own common sense.

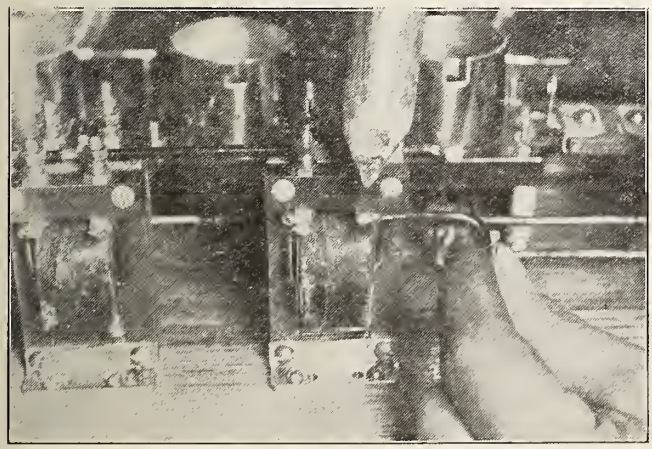
The essentials of a good receiver are: (1) Sensitivity, (2) Selectivity, (3) Ease of control, and (4) Moderate cost. To combine all of these features is not as simple a matter as it may seem.

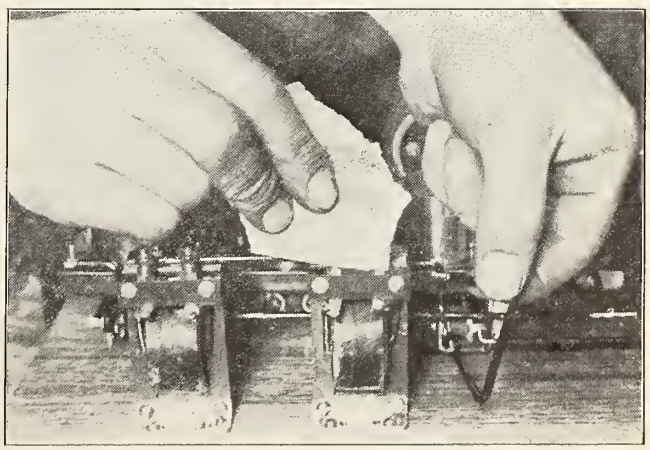
First of all, a receiver must be sensitive. This means the use of vacuum tubes, and radio frequency amplification or regeneration. For a single tube set, regeneration is quite a desirable, almost necessary application. There are numerous regenerative circuits to choose from, but for short wave reception a circuit in which regeneration takes place by use of a tickler is most satisfactory. Regeneration is secured by means of the absorption method, which offers some advantages.

Two Circuit Tuner

For selectivity, a two circuit tuner seems to be the only one worthy of consideration. Tests made last winter showed a single circuit tuner to bring in the stations a trifle louder, but the tuning was so broad that local and loud broadcasts could not be eliminated. Even a few amateurs who work on 200 meters were heard on this tuner, when tuned for the broadcasts. It is of no use to get loud signals, if you cannot pick out the desired stations to the exclusion of the rest. The main objection a radio fan has to a two circuit tuner is the additional control.

Tuners may be made in such a way as to afford the simplicity of the single circuit tuner with the selectivity of the loose coupled tuner, by making the primary of the circuit aperiodic. That is to say that the primary is not tuned at all. This untuned primary consists of from one to five turns of wire wound over the secondary coil, or coupled to it. These turns may be tapped or not.





SOLDERING THAT HOLDS

The picture on the right shows how the point to which the connection is to be made should be cleaned with a piece of sandpaper. On the left picture shows how the iron is used after a little soldering flux has been applied to the contact point. The iron should not have too much solder on it and after the connection is soldered and cooled the connection should be wiped off with a little alcohol and a tooth brush. (Kadel & Herbert.)

The Reinartz tuner uses a tapped but untuned primary. This is a very satisfactory method of coupling the primary and secondary circuits.

Ease of control is very essential, especially to the radio amateur in his traffic work. One cannot tune a receiver all evening merely to hear the bed-time stories from Radioville, two miles away. Don't have seventeen tuning controls on your receiver; three is plenty. A receiver may be—though they usually are not—selective with but one tuning control. Don't however, sacrifice efficiency for ease of control.

As to the cost: buy inexpensive parts if necessary; not cheap parts; there's a difference. The cost of many receivers could be kept down by taking off a lot of the trimmings; a receiver doesn't need voltmeters or bezels mounted on its panel.

Be sure to purchase a good variable condenser. The one with the least parts is all right. One cannot upon merely examining a condenser tell its electrical efficiency. A variable condenser should be mechanically good. Hard rubber is much better for insulation on a condenser than porous, absorbent fiber. Get good mica insulated fixed condensers if you value the quality of the signals you desire from your set. See that the fixed condensers are well made and firmly pressed tight. A fixed condenser the capacity of which varies is worse than nothing.

Amateur Records

Hartford, Conn.—By virtue of recent two-way amateur radio contacts established by Kenneth B. Warner, secretary of the American Radio Relay League, England comes to the forefront among nations of the world that can now communicate across the Atlantic through radio stations operated by citizen amateur radio men. Nine complete messages have been sent across the ocean on a wave length of 100 meters between Mr. Warner operating station 1MO here and J. A. Partridge owner of the English amateur station 2KF situated in London.

There is no question but what amateur two-way transoceanic traffic has opened up a new field of no less importance than the early successes, showing the possibilities of amateur radio, and not a few of the old time hams, whose calls were famous in the old spark days, are bounding back "on the air" to partake in international thrills. The tests are spoken of as the dawn of a world amateur relay.

Kenneth B. Warner, secretary of the League, estimated today that a total of sixty messages had been transmitted across the Atlantic since the first two-way contact was made between amateur stations 1MO in Hartford and 8AB in France the night of Nov. 27. The signals of 8AB have been loud and scores of amateurs are hurriedly bringing their receiver down to the 100 meter wave length.

A radiogram received at League Headquarters stated that amateur station, 9ZT, operated by Donald Wallace, assistant manager of the Dakota division, had been in two-way contact with the French amateur and messages had been exchanged reliably. Deloy is believed to have transmitted a total of thirty-three messages.

9,563 Miles!

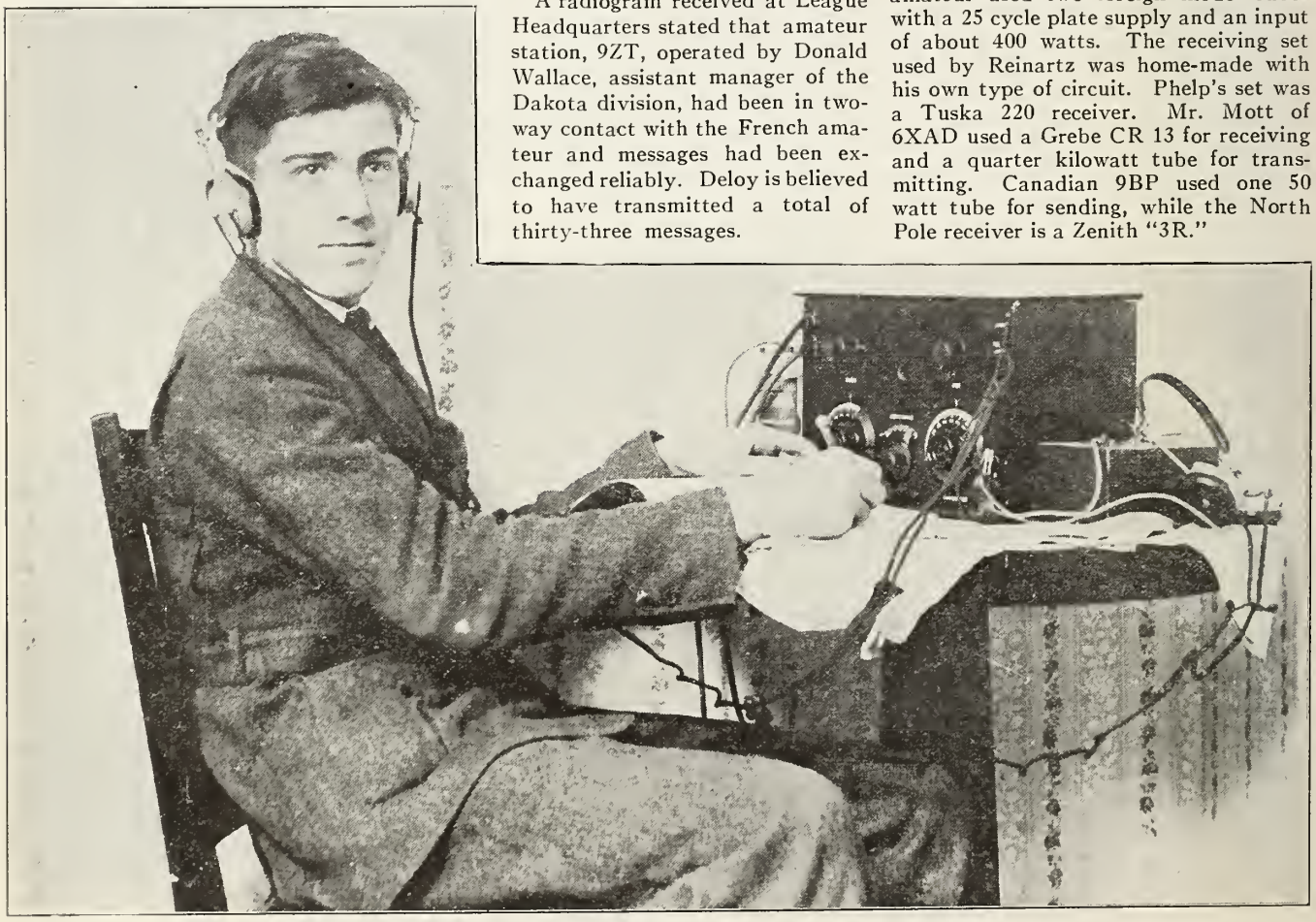
Hartford, Conn.—An amateur radio message from France to the North Pole has covered the farthest distance ever traversed by an amateur relay, arriving safely in the ice-bound cabin of Captain Donald B. MacMillan's schooner "Bowdoin" after a 9,565 miles journey.

The same night after Monsieur Leon Deloy at Nice, France, transmitted a message to the Arctic explorer, a repetition of the dots and dashes came in on the headphones of Donald Mix, radio operator for MacMillan, 11 degrees from the pole and inside the aurora.

In order to reach Refuge Harbor, Greenland, the message took a round about course across the Atlantic to South Manchester, Connecticut, where it was received by John L. Reinartz, operating amateur station IXAM. Reinartz gave the message by telephone to Boyd Phelps of Hartford, who relayed it to 6XAD at Avalon, Catalina Island, off the coast of California. Thence it was sent to Jack Barnsley of 9BP, Prince Rupert, British Columbia, who finished the relay.

The distance covered by each relay was about as follows: Nice to Hartford, 3,500 miles; Hartford to Catalina Island, 2,500 miles; Catalina to Prince Rupert, 1,305 miles, and Prince Rupert to Refuge Harbor, 2,260 miles, making the greatest amateur relay mileage.

In this remarkable record the French amateur used two foreign model tubes with a 25 cycle plate supply and an input of about 400 watts. The receiving set used by Reinartz was home-made with his own type of circuit. Phelp's set was a Tuska 220 receiver. Mr. Mott of 6XAD used a Grebe CR 13 for receiving and a quarter kilowatt tube for transmitting. Canadian 9BP used one 50 watt tube for sending, while the North Pole receiver is a Zenith "3R."



HEARD ENGLAND

Everett L. Battey's friends did not take his little one-tube set very seriously until recently, when he picked up three English stations. Everett's home is at Wollaston, Mass. He logged Bournemouth, Cardiff and London in one day. He uses a dry cell.

The Superdyne Receiver

IN a recent talk, before the American Radio Relay League in Chicago, Mr. C. D. Tuska, President of the C. D. Tuska Company, gave interesting details about the superdyne receiver—a new circuit developed by Robert S. Miner of the Tuska laboratories.

Mr. Miner, known to radio amateurs as IRU, almost a year ago started to work on a receiver that would give results which would surpass the regenerative receiver and the many radio frequency outfits he had tested.

In seeking for this new super circuit, he and his associates investigated all of the latest circuits and every modification of regenerative, radio frequency and other circuits about which they had information. In Mr. Miner's opinion, the only trouble with radio frequency is that it is not possible to get sufficient amplification per stage, and he decided to locate the difficulties and then to overcome them.

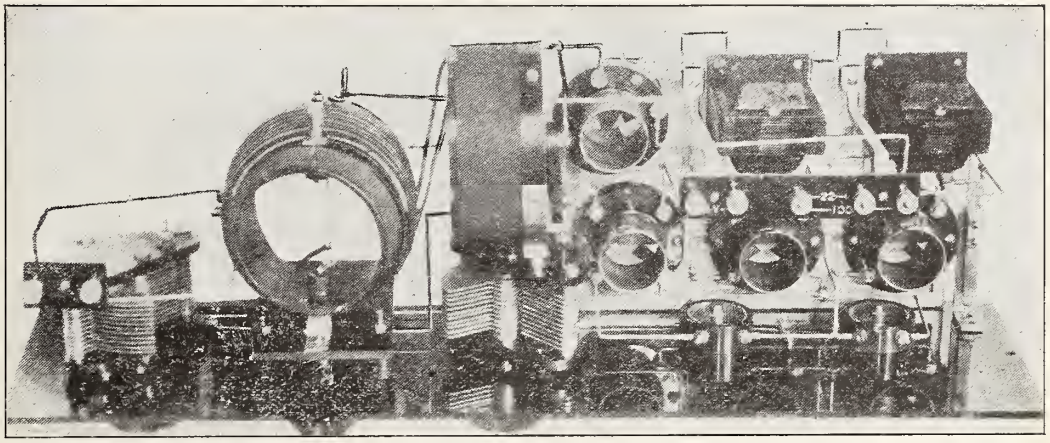
When the superdyne circuit was being perfected it became evident that resonant circuits must be used, but as soon as this was done the tubes started to oscillate and spoiled everything so that the investigators were in what might be called a "vicious circle." The method used to overcome this difficulty was put in the conventional Armstrong feedback *but feed the energy back in the reverse direction or negatively.* The circuit was given just enough feedback to offset the positive capacity feedback of the tube. This stopped oscillation and made it possible to secure absolute resonance between the grid and the plate circuits. Not only was resonance secured, but the maximum impedance in the plate circuit was used which means the biggest voltage impulse which it can be hoped to build up.

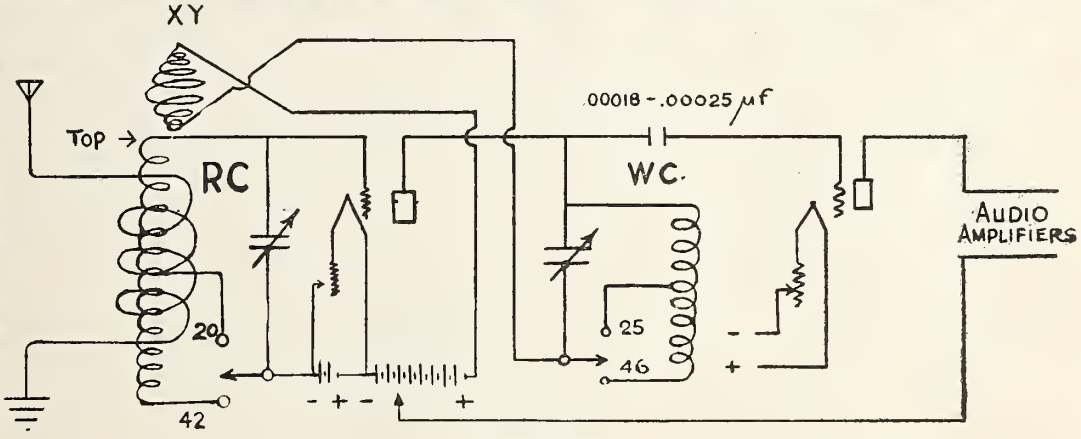
The superdyne circuit is shown in the accompanying illustration. "RC" is the resonant circuit of the grid. "WC" is the resonant circuit of the plate while "XY" is the reverse feedback which stops oscillation. The detector is connected as shown. After it was found what the possibilities were with this circuit, experiments were made to see if it could be improved by changing the constants. All of the stages of increasing capacity and decreasing inductance as well as the reverse, were gone through. Every sort of coupling and every conceivable manner of turns ratio was tried. Hundreds of separate experiments indicated that the successful operation of the circuit depended to an extremely high degree on following dimensions carefully.

Not only does this apply to instructions about sizes of wire and dimensions but in addition care must be taken not to parallel the grid and the plate wires of the radio frequency stage. These wires must be kept at right angles and as far apart as possible. If the reverse feedback coil is coupled too closely to the grid coil the capacity between the grid and plate windings exceeds the negative magnetic feedback and the set will not work. It is extremely important to avoid this trouble so care must be taken to copy exactly the specifications outlined.

The dimensions and constants of the various coils and condensers are shown in the accompanying table. Reception on the detector has not been particularly successful probably due in part to the capacity of the phones on the ungrounded circuit. When operating with a small indoor antenna, the filaments should be grounded and the antenna connected to the grid of the first tube leaving out the antenna coupling turn. With this method, phones on the detector will probably be entirely satisfactory.

The maximum results can be obtained after the operator has learned how to carefully adjust the circuits but it is not possible to get these results until one has had some experience in tuning faint signals.





SUPERDYNE

Photograph of the assembled superdyne and diagram of wiring arrangement of this interesting receiver. As stated in the accompanying article the manufacturers are ready to assist fans in making this set if they desire instructions.

COIL DATA

	Coil Form O. D.	Winding	TURNS	WIRE	TAPS	Micro-henries
Secondary	4"	1¼"	42	No. 22 D.S.C.	0.20.42	273
	Over Sec.	Turns Spaced				
Antenna		¼"	4	No. 22 D.S.C.	0.4	
		Ball				
Tickler	3-⅝"	Motor	18x2—36	No. 22 D.S.C.	0.36	
Plate Reactance	4"	1¼"	46	No. 22 D.S.C.	0.25.46	264

Condenser (Grid) Tuska Type 271 23 Plates Maximum Capacity .000482
Condenser Plate Tuska Type 271 23 Plates Maximum Capacity .000482
Wave Length Range (Approx.) 176-358: 310-660.

The astonishing part about this outfit is that it operates without an antenna and gives signals of sufficient intensity to be heard through the use of a loudspeaker. In Hartford, Connecticut, without the use of an antenna or loop or capacity of any sort, other than the usual ground connection, broadcast has been heard on a loud speaker from Chicago, Davenport, Kansas City, and nearer stations. Havana, Cuba, has been obtained without an outside aerial.

Desiring to compare this set with some of the sensitive sets on the market it was recently taken to Washington and a series of tests made. First, a constant artificial source of power was set up. This was tuned on a regenerative receiver and the audibility measured around 50. With the same power, the same tubes, batteries, etc., the superdyne receiver showed an audibility of over 200. The same two outfits were tried under similar conditions with a broadcasting station as the source of power. Here the regenerative receiver showed audibility of about 60, while corresponding conditions showed the superdyne receiver to have an audibility of 10,000, which was the end of the meter.

The next test was of a more practical nature. Here the superdyne receiver under actual receiving conditions was compared with the naval six-tube universal radio frequency amplifier. The signals with the four-tube superdyne were probably three to four times louder than with the six tubes of the navy amplifier.

The last experiment was the most astonishing of all. In this test the four-tube superdyne was compared with the eight tubes on a super-heterodyne receiver. Some of the signals on the super-heterodyne surpassed this new circuit while in other cases the superdyne exceeded the super-heterodyne. Taken all in all, and being very conservative, Mr. Tuska believed that the best that could be said for the super-heterodyne was that the signals may have been slightly louder using the eight tubes than they were on the superdyne with four tubes.

In operating this circuit it has been found that it is highly desirable to adjust the plate circuit for the wave length to be received, then operate the reverse feedback coil, which has been called a "stabilizer", and the grid circuit in exactly the same manner as a regenerative receiver is operated. By carefully adjusting the reverse feedback against the positive capacity feedback astounding degrees of amplification can be gotten. It has been figured that the voltage amplification per stage probably runs in the neighborhood of 100 times. One tube of radio frequency regeneration of the old style rarely exceeds a voltage amplification of eight or nine times.

In order to simplify the operation the makers have omitted any tuned antenna circuit and simply used four turns of wire which are closely coupled to the grid circuit. This impulse excitation method of tuning seems to be sufficiently selective, probably due to the selectivity of the two resonant circuits.

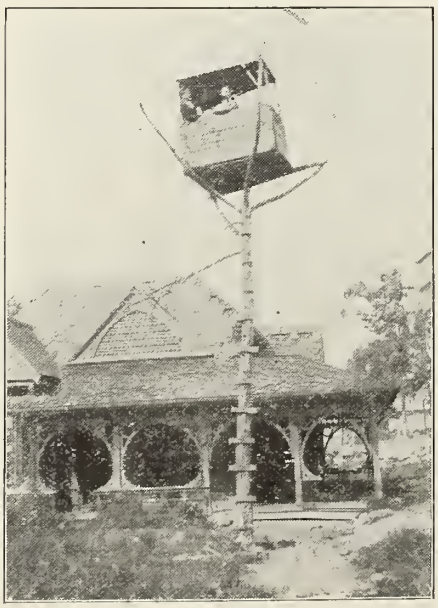
Numerous attempts have been made to simplify the adjustments of the receiver, such as using fixed reverse feedback and gearing the two tuning condensers together, but this method decreases the sensitiveness of the receiver. The closed circuits do not affect each other's wave lengths, but the feedback varies with the wave length received. The reverse feedback has an appreciable effect on the grid circuit tuning. Fortunately, however, the plate circuit remains absolutely constant and may be calibrated in terms of wave lengths.

While the Tuska company expects to market complete superdyne sets, it is willing to assist amateurs building their own sets and will be glad to hear of successful efforts.

The Proposed Radio Legislation

Washington D. C.—There will be no general radio conference in Washington in the near future Secretary Hoover has announced. The Commerce Department is rapidly completing the details of a tentative regulatory radio bill based on the old White Bill he explained. He believes that this can best be done by government officials without further conference. Practically all the suggestions offered by representatives in the several lines of radio work presented at last year's conference will be incorporated the Secretary indicated pointing out that conditions have not changed materially since last year except that the number of transmitting stations has increased.

When it is attempted to draw up legislative recommendations or bills with a large body of diversified interests it usually takes several months. Early action on the new radio bill is necessary.



HIGH LIFE

This experimental radio station was built in a treetop by two Oakland, Calif. boys. They say reception conditions are so good up there that a fellow can almost see the ether waves coming. (Keystone)

A few days ago a delegation of radio interests representing the press clubs, engineers, broadcasters, and amateurs called upon President Coolidge and the Secretary of Commerce urging that a general conference be called in an effort to reduce interference from ships affecting commercial amateur and general broadcasting. The Secretary explained that interference was decreasing due to the voluntary adoption of regulations laid down last year and that the Department was striving to remedy present difficulties through revising the White Bill which was passed by the House last session. Any recommendations which the committee desired to make in writing the Secretary said would be considered by the Department Officials now working out the revisions to the existing radio laws established in 1912.

Officials of the Government point out that many difficult questions arise when regulatory legislation is attempted. Such questions as monopolistic control it is believed should be handled by courts under existing laws and not incorporated in radio legislation.

The prohibition of operation by aliens if injected into radio legislation would tend to handicap American radio development commercially in foreign countries and could be regulated without being covered in a radio bill.

The question of whether or not radio is a public utility is not essentially necessary in a law which should be regulatory it is believed.

Some definite standards of operation and equipment especially in the commercial fields must be included however, it is asserted so that Secretaries of Commerce will have some basis for their decisions as to whether an existing station may continue operation in the event a new company desires to enter the field or whether it must cease operating to permit the opening of another station. The amount of traffic might or might not demand more than one station and efficiency would be questioned.

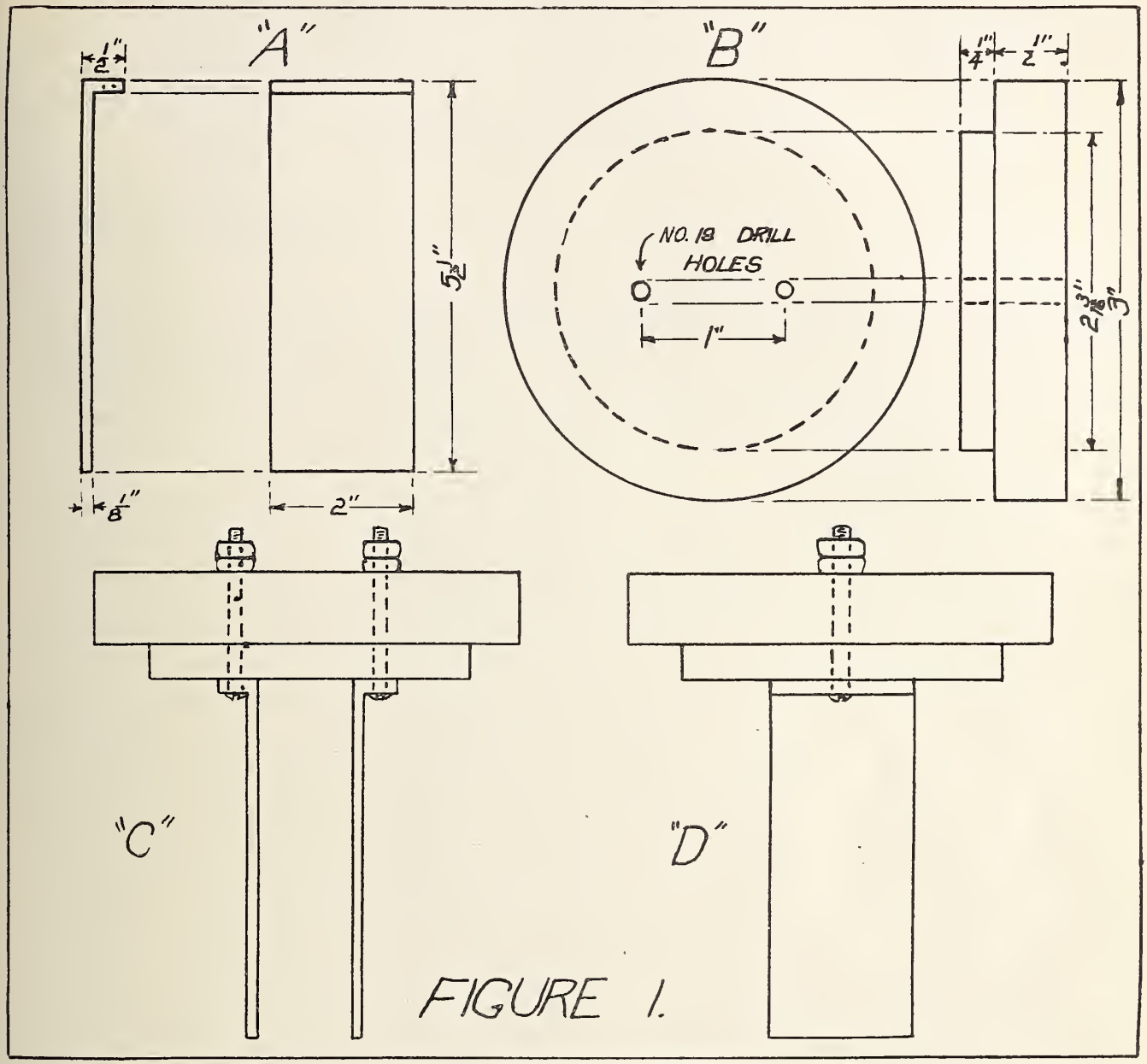
Many phases of development indicate that broad latitude must be granted to the Commerce Department but standards of requirements and service in the public interest should be made clear for the future expansion it is believed.

Recently new interference problems have arisen over which the Department has no control under existing laws. Complaints received report interference from regenerative or re-radiating receiving sets, violet ray machines, electrical precipitating plants, bell-ringing magnetos on telephone lines, and leaking insulation on power transmission lines. Government regulations should it is believed give the Department power to prevent such interference.

After the presentation of the tentative bill in the House and its assignment to the Merchant Marine and Fisheries Committee it is understood that public hearings will be held at which time all interests may appear to present their suggestions and recommendations.

An Inexpensive Homemade Battery Charger

By F. D. PEARNE



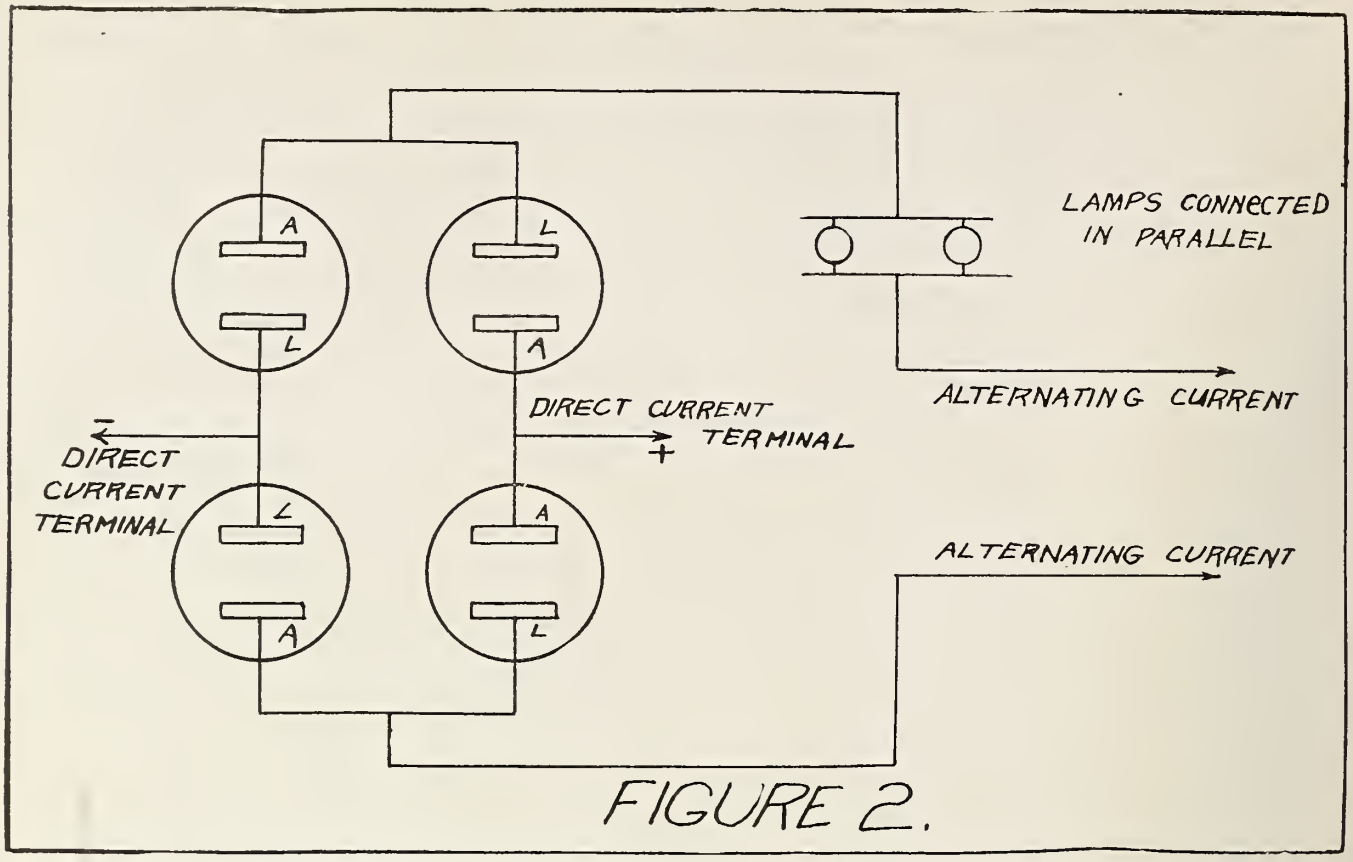
The constructional and assembling details of the Noden Valve Electrolytic Battery charger. This type of rectifier is designed for use in homes where the 110 volt house lighting current of the alternating type is available.

ONE of the most essential requirements of a radio set is some kind of a charging apparatus which will keep the storage battery charged at all times. This is comparatively easy where the electric lighting circuit is of the direct current type, but unfortunately for the radio fan, most lighting circuits use the alternating current and before a battery can be charged with this current, some method of rectification must be used. Various devices for this purpose are now on the market, some of which are sold at reasonable prices, while others are really expensive, and as the average radio fan usually has plenty of outlets for his spare change, I am going to describe a rectifier which any amateur can build at an expense of less than $3.

This outfit is known as the "Noden valve" and will answer the purpose very well and in fact is really better than some of the rectifiers one may buy, for the reason that it rectifies both sides of the alternating current wave, which some of the standard outfits do not do. The materials required consist of four ordinary quart size mason jars, such as are used for putting up preserves; four pieces of sheet aluminum one-eighth of an inch thick; four pieces of sheet lead of the same size and thickness, four wooden tops to cover the jars, a few brass machine screws and nuts, and about two and one-half pounds of phosphate of ammonium.

First cut out four plates of good soft sheet aluminum, six inches long, two inches wide and one-eighth of an inch thick. Bend one end over, one-half inch as shown at "A", Figure 1. Drill a hole through the center of the part which is turned over. This should be drilled with a No. 18 drill which is large enough to allow an 8-32 brass machine screw to pass through it. These plates should be made of soft aluminum for the reason that hard aluminum will crack and break, if bent at a sharp angle. Next cut out four pieces of sheet lead of the same size and shape as the aluminum pieces, and drill holes of the same size in the same place.

The wooden tops for the jars should be turned out of hard wood. The flange should be three inches in diameter and one-half inch thick and the smaller part is two and three-sixteenths inches in diameter and one-quarter inch thick.



The wiring diagram of the jars and the method of connecting the lamps into the circuit to control the charging rate of the rectifier. Full details for the construction and operation of this unit appear herewith.

This small projection is to extend down into the jar and will just fit into the neck of the quart-sized fruit jar. If any other kind of a jar is used, this size should be changed to suit the case. If it is not convenient to turn these tops out in a lathe they can be made of two pieces cut out with a jig saw and fastened together with screws, but these screws must be so located that they do not interfere with the holes which are to be drilled, as shown at "B," Figure 1. Now mount one aluminum plate and one lead plate on each of the tops as shown at "C," Figure 1. These plates are held in place by 8-32 brass machine screws, one and one-half inches long and fastened with a nut on the other side. The nut should be turned up very tight so that the plate is held rigidly in place. Another nut on top of the first one serves as a binding post to which the wires will be connected later.

After all four units are complete the part of the plates which was turned over, as well as the screw heads and the part of the wood which goes down into the neck of the jar should be coated with melted wax, or paraffine to prevent any gas or fumes from the solution corroding the screws, thereby causing a poor joint. Next, make up the solution with which the jars are to be partly filled, make a saturated solution (all the water will dissolve) of distilled water and phosphate of ammonium. It is necessary that the distilled water be used as it will not work if the water contains any impurities.

Fill the jars with this solution to within about one inch of the top, that is, the solution should be within one inch of the top when the plates are in the jars. It is a good plan to measure out enough water to fill the jars three-quarters full and then add the phosphate of ammonium, until no more can be dissolved. In dissolving this chemical, it should not be stirred with a metal spoon; use a piece of glass, so as to make sure that no impurities get into the solution. Figure 2 is a diagram of the circuit, which shows how the connections are made. The aluminum plates are marked "A" and the lead plates are marked "L" respectively. Lamps are connected in the circuit, which allow only a certain amount of current to pass from the alternating current wires to the rectifier. Each lamp added in parallel as shown will allow more current to flow. The direct current is taken off at the junction between the jars as shown. To recharge the battery, connect the positive direct current terminal to the positive terminal on the battery and the negative direct current terminal to the negative terminal of the battery.

The action of this rectifier is based upon the principle that the current will not enter the solution through the aluminum plate. It will enter the solution from the lead plate and flow out through the aluminum, however. Let us for example say that the circuit shown in Figure 2 is connected to a source of alternating current supply. If the first impulse comes in on the side of the circuit in which the lamps are placed, the current will not enter the aluminum plate in the jar on the left side, but will enter the lead plate on the right side, flowing out of the aluminum plate. It cannot enter the cell below it, because of the aluminum plate, but will flow out over the direct current terminal, through the battery and back on the negative direct current terminal, through the lower cell on the left side to the other side of the alternating current.

The next impulse is in the reverse direction and comes to the lower set of cells. The aluminum plate in the left hand cell prevents the current entering so it takes the path through the right hand cell, coming out of the direct current positive wire again, through the battery, back into the negative direct current terminal, through the upper left hand cell, to the other side of the alternating current line. Thus it will be seen that the direct current terminal on the right side of the drawing will always be positive, no matter which way the alternating current flows.

This rectifier will give very good service and will put a good charge in the battery in twenty-four hours. A small hole should be drilled in the wooden tops to allow any gas to escape. As it will be necessary to "form" the plates before the rectifier will function properly, the two direct current posts should be connected together for about ten hours while the alternating current is on, so that perfect rectification will take place when the battery is connected in the circuit. After the plates are once formed, then the battery may be connected on the terminals at any time. A more efficient method is to use a toy transformer, connecting the primary

(*Continued on page 47*)

What the Broadcasters are Doing

Broadcast Records

AMERICAN broadcasting stations are reaching out to such vast distances that it begins to appear that voice-radio communication with points up to 5,000 miles soon will be regarded as commonplace. The recent transatlantic tests called general attention to communication with English stations. But England had heard American broadcasters repeatedly before these tests and American receivers had frequently tuned in and picked up English stations.

To WDAP, the Chicago Board of Trade station, belongs the credit of having entertained an English listener throughout an entire program of several hours. The operator who received this Chicago program was Thomas E. Hamblett, Windle Mount, Hard Lane, St. Helens, Lancaster, England. It may be difficult for Americans to understand how any message, much less a radio, program, could find a Britisher who was hidden behind such a complicated address as that, but Mr. Hamblett was found out not only by WDAP but by KDKA, Pittsburgh. On September 25, Mr. Hamblett was listening to KDKA at 1:57 a. m. He wrote to KDKA saying he tuned out after twenty minutes because the market reports had driven him away. KDKA reached several other English listeners.

Reception of WGY, Schenectady, was so successful in Queenstown, Ireland, during the transatlantic tests on the morning of November 27 that A. N. C. Horne was able to make a fifteen-second log covering the transmission from the opening announcement to the "sign-off."

In his letter to the General Electric Company station, Mr. Horne stated that reception was made on three valves —dectector and two low-frequency, with an aerial twenty-five feet high and 250 feet long, inclosed by tall trees. He explains that he has studied radio for the last ten years and that the highest degree of accuracy was aimed at in recording his observations.

In his log Mr. Horne mentioned that the concluding number of the program, "God Save the King," was "good." That is an odd thing about radio. The patriotic hymn, "America," becomes "God Save the King" in England.

Mr. Horne sent records of WGY for November 22, 23, 24 and 25, indicating that he has little difficulty in picking up the Schenectady station whenever it is

'GENE McDONALD

He is owner of the Zenith-Edgewater Beach Hotel Station WJAZ, president of the Chicago Radio Laboratories, president of the Zenith Radio Corporation and president of the National Association of Broadcasters. He equipped the MacMillan arctic ship with radio receiver and transmitter and talks to MacMillan every Wednesday night from the Chicago station. On the night of Dec. 19 when talking to MacMillan his voice was heard in the Samoan Islands, more than 7,300 miles distant. So far as known this is a world record. Mr. McDonald is a hunter, and a yachtsman. He is leader of the great fight against the American Society of Composers, Authors and Publishers, who tried to force broadcasters to pay large fees for broadcasting popular music. His real name is E. F. McDonald, Jr., and it is a name that is growing bigger and bigger in radio. (Walinger.)

TIME SIGNALS

Each day at noon C. J. Waldron, of Medusa, N. Y., gets the time signal from Station WGY, the General Electric station at Schenectady. Right on the dot he pulls the rope and rings the village churchbell, thereby affording towns folk and farmers with the means of setting clocks and watches.

on the air. Accompanying the WGY records were logs on reception of English broadcasting stations, and it was observable that the WGY transmission faded less than that of the English stations.

Probably the most interesting long distance record made recently by an American broadcasting station was that of the Zenith-Edgewater Beach station WJAZ. On December 19, or early in the morning of December 20, Eugene F. McDonald, Jr., president of the National Association of Broadcasters and owner of the famous Chicago station, was talking to Donald B. MacMillan, ice-locked in his ship near the North Pole. United States Naval radio operators reported three days later that Mr. McDonald's voice had been heard clearly in the Samoan Islands, more than 7,300 miles away.

Away down there in the South Seas, twelve degrees south of equator, the operator of a radio receiving set was "listening in" for any bits that he might pick up from the world abroad.

Doubtless the Samoan operator was interested in the messages that were going out to Dr. MacMillan, but, being a good radio operator, he must have had quite a thrill when he realized that he was making a reception record that probably surpasses any other achievement thus far recorded.

First news of the remarkable incident reached the office of the Zenith Radio Corporation at 332 S. Michigan av., when the United States Naval Radio Station on the Municipal Pier, Chicago, called on the telephone and reported they had a message from Samoa reading as follows:

"YMG reports as follows: Please inform Zenith-Edgewater Hotel Radio Station that Chicago messages and music to MacMillan, North Pole, were received by me at 7:45, Samoa time, December 19.

"ROBERTS."

AMRAD'S RECORD

When two-way communication by voice was established for the first time in the history of radio, Friday evening, November 30, between Amrad WGI, Medford Hillside, Mass., and Station 2-LO, London, England, it was a remarkable coincidence that the first American station to participate successfully in this two-way communication was Amrad WGI, the world's oldest broadcasting station operating today, erected in 1915. It was a further significant coincidence that Mr. H. J. Power, founder and active head of Amrad, who conducted the early broadcasting in 1915 and '16 and now known as the "father of broadcasting," was at the microphone when the successful broadcast was made.

According to the schedule two-way communication was not to be tried until Saturday, December 1; but when 2-LO received the American station November 30, the British amateurs could not refrain from calling back and were heard by many American listeners.

Again on Saturday two-way communication was maintained between Amrad WGI and 2-LO London and complete confirmation followed after an exchange of cablegrams. The achievement was all the more remarkable as the American station used only 150 watts in the antenna.

WTAM's Record

The new high powered broadcasting station, WTAM, in Cleveland, Ohio, was heard in England before any special efforts were made in trans-Atlantic broadcasting.

Mr. Hamblett, from St. Helen's, also wrote that he heard the Willard Company's station quite clearly broadcasting its program on Wednesday evening, November 21.

He picked up WTAM at 3:48 a. m., London time which is five hours earlier than New York time, and heard the remainder of the Willard program with practically no interference until the station signed off at 4:13 a. m., London time. His letter stated that his reception of "The Lost Chord" sung by the Amphion Male Quartette was almost perfect. Hamblett's set is one of his own assembly, using one stage of radio frequency and detector tube. His aerial, according to his letter consists of a single wire antenna 100 feet long and 33 feet high.

A number of other applause letters have been received from foreign countries within the two months this station, operated by the Willard Storage Battery Company of Cleveland has been on the air.

Two Other Records

A. F. Combs, of Enid, Okla., and M. B. Norman, Eureka Center, Wis., reported what are believed to be long-distance receiving records for 3-tube sets.

Using receivers of the same type that were designed and built by Dr. Fulton Cutting and Bowden Washington, Minneapolis, Minn., Combs, at Enid, listened to three numbers—vocal, orchestra and piano—broadcast by 2-LO, London, Eng., and Norman picked up a station at Glasgow, Scotland.

Combs verified his feat through 2-LO's New York office and Dick and Adolph Danielson, of St. Croix Falls, Wis., who were listening in with Norman.

SUNSET STATION

KGO, the Sunset Station, has come on the air with the new year. On the western edge of the United States, at Oakland, California, two steel towers have arisen and from the antenna, on January 8, the new voice vibrated on the air. KGO is the second link in a chain of three super-broadcasting stations planned by the General Electric Company. The first is WGY, at Schenectady, N. Y., now completing two years of popular broadcasting, and the third will be erected at Denver, Colorado.

For the first time an entire building has been constructed to house a great station and its equipment to be used exclusively for popular broadcasting. This indicates that the General Electric Company has faith in the permanence of broadcasting.

The Oakland station in its studio, control-room and power station embodies the latest developments in the art. Its power and antenna systems, a thousand feet away from the studio building, include all the mechanical and technical refinements that have marked the new achievements in broadcasting. By means of KGO the listener in Maine becomes an air neighbor of the folks in California.

The Pacific Coast station is located on East 14th Street, Oakland. It is a two story brick building. On the first floor, near the entrance, is the office of the studio manager who plans programs, selects artists, and co-ordinates the duties of the office and broadcasting staff.

Close at hand is the correspondence room where the business of the station is carried on. Here a staff of assistants attends to the details of program-making, interviews callers, keep logs of every performance and answers and files the letters received from the listeners.

On this floor there is an attractive reception room covered, as is the entrance hall and stairway, with a rich, heavy piled carpet of a beaver taupe color. The woodwork is painted a soft antique ivory and is glazed a Van Dyke brown. The walls are covered with a two tone gray and blue figured tapestry. Draperies of blue and taupe damask enrich the appearance of the room which is furnished with carved walnut furniture of the 18th century period. Adjoining the reception room is the ladies' rest room. On the first floor is also a large room for motor generator sets and storage batteries.

On the second floor are two studios similarly appointed, one large enough to accommodate a chorus or symphony orchestra; the other, a smaller room, for the broadcasting of solos and addresses. The use of the two studios also makes continuous broadcasting possible. The announcer has but to step from one room to the other at the conclusion of a number and find the next performer waiting for the word to begin.

It is in the main studio that the art of the decorator reaches its fullest expression but before the artist began his picture, working with tapestry, carpets and draperies, the engineer had lined the walls with a mesh of insulated wires connecting microphones with control apparatus in an adjoining room. After the wiring was completed exhaustive experiments were made to determine the reverberating qualities that the proper amount of "damping" might be secured to assure maximum musical quality. Walls and ceiling were covered with special sound-proofing material and then the studio was turned over to the artist. The decorator has hidden all evidences of the true purpose of the room.

Adjoining the studios is a "silent" room in which the performer is ushered to remain until summoned to the studio.

On the second floor, but unseen by the performers, is the control room. Here with headphones at ear, operators listen critically to every word and note compensating for differences in tone and volume among the artists and flashing warning through silent electric signals to the studio manager, when it is necessary to alter the position of the singer or instrumentalist in respect to the microphone. The control room has three stages of speech amplification consisting of two 5-watt tubes and four 50-watt tubes. A fourth stage of speech amplification is installed in the power house.

KGO is operated at 1000 watts, but the equipment is designed in excess of that power for purposes of conducting tests. In operating high-powered equipment below normal rating in broadcasting, tubes and rectifiers are not subject to occasional overloads and, as a result, superior quality and greater reliability of transmission is obtained.

The power house and antenna system are 1000 feet from the studio building. Nine motor-generator sets in the power house supply filament and plate current for the oscillator, modulator and kenotron rectifier tubes.

There are six tubes in the kenotron rectifier assembly, one metal plate oscillator tube, and one metal plate modulator. Every part of the equipment in the power house and in the control room is in duplicate, assuring uninterrupted service. If one outfit or part of an outfit breaks down during the operation period another outfit will be ready to be brought into the circuit.

The antenna is of the multiple-tuned type and is strung between two steel towers, each 150 feet high and 250 feet apart. Beneath the antenna is the counterpoise consisting of a network of wires, fourteen feet above the ground, covering an area of 150 by 300 feet. In addition to the power house which is one story high, 71x32 feet, there is a small building for the tuning apparatus

7,300 MILES

Among all the recent distance records recently made by radiophone broadcasting stations by far the most startling is that of WJAZ, the Zenith Edgewater Beach Station, Chicago. E. F. McDonald, Jr., was talking to Dr. Donald B. MacMillan, ice-bound near the North Pole and his message was heard by a radio operator in the Samoan Islands. The South Sea operator's achievement was reported three days later by the U. S. Naval radio station at Chicago, having been relayed back by naval operators.

and the end of the multiple-tuned antenna.

KGO, the Pacific Coast station of the General Electric will not be dependent upon its own studios alone for programs. Located as it is near the great cities of the Pacific Coast, it has a rich field from which to select music and eloquence. By means of broadcasting pick-up circuits, the Sunset Station will be equipped to broadcast the speeches of important public gatherings, the addresses of prominent citizens, sermons by pastors of leading churches, concerts, theatre productions and occasionally, important athletic events like baseball or football games.

The Oakland station will be on the air every Tuesday, Thursday and Saturday nights carrying instruction and entertainment to the great audience of the Pacific Coast and, when atmospheric conditions are favorable, to the fans throughout the country. The wavelength of KGO is 312 meters.

Martin P. Rice, director of broadcasting for the General Electric Company has charge of KGO, the new Oakland station, WGY at Schenectady and the proposed Denver station. J. A. Cranston, Pacific coast manager for the G-E, has direct supervision of KGO.

Portable Station

A SHORT wave radio transmitting set which may be transported to the scene of church services, concerts, dramatic performances or lectures, as easily as a motion picture cameraman is sent on news-weekly assignments, has been introduced as part of the broadcasting equipment of WGY, the Schenectady station of the General Electric Company.

This set is not used to broadcast directly to the listener, but is a radio relay which conveys the program to the broadcasting station. This first radio transmission can not be tuned in on the average radio receiving set.

The portable transmitting set is conveyed to the hall or church from which it is desired to broadcast an entertainment or sermon. Wire connection is established between microphone or pick-up within the hall or church and the transmitter of the portable set outside. The wavelength is too low to interfere with the usual receiving sets or broadcasting stations and it is also so low that there can be no interruption from spark transmitters.

By means of a sensitive receiving set located near WGY, the electrical vibrations into which speech or music has been converted are picked up, amplified and then conveyed to the main transmitting equipment of WGY, from which the program is put on the air on the licensed wavelength of the station, 380 meters.

Prior to the introduction of the radio relay it was customary for WGY to connect church and radio station by wires. Wire installations required considerable preparatory work and because of the time involved in making the necessary installations some programs that might have proved instructive and enjoyable had to be omitted. The small transmitting set is mounted in a covered truck and may be taken to hall, theatre or church, where in a short time the installation will be complete and ready for service.

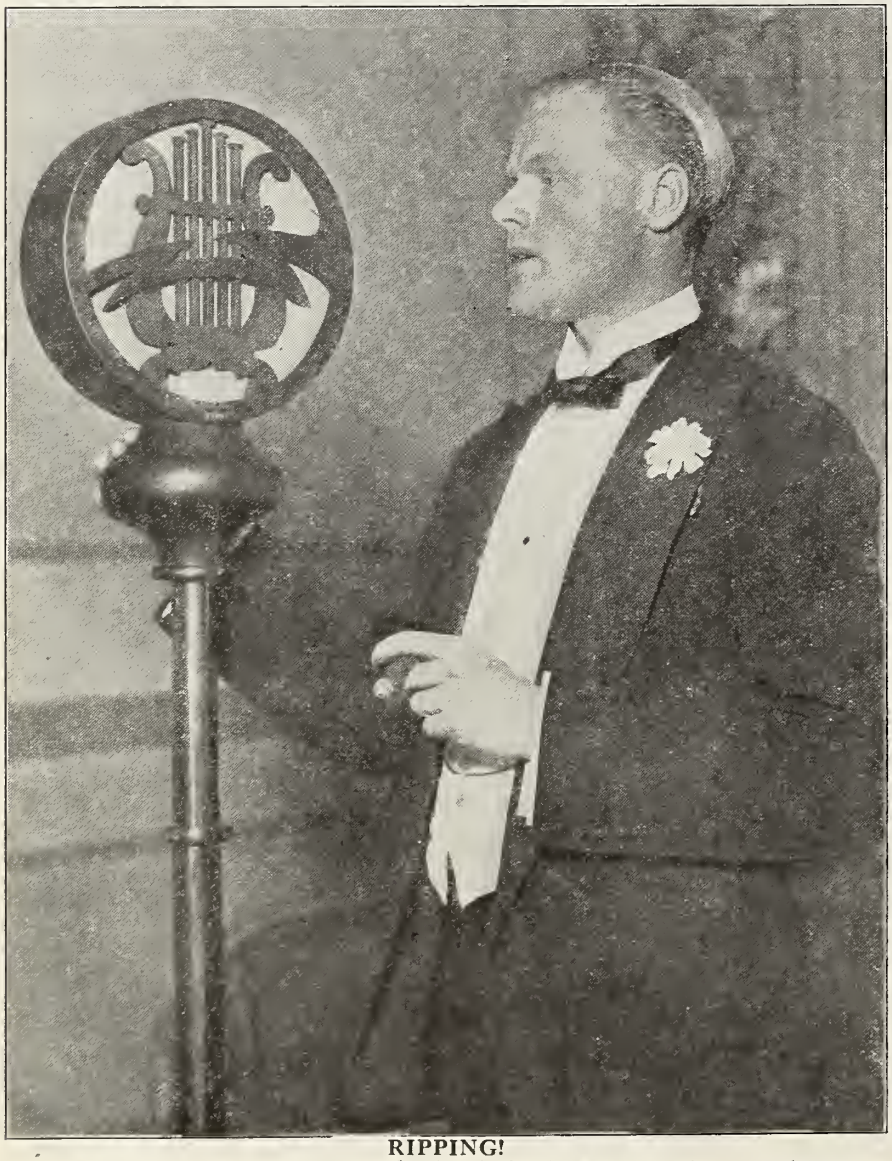
Re-broadcasting does not affect the quality of music or speech. WGY has made frequent use of the radio relay methods and the listeners were at no time aware that a radio transmitting set working on a low wavelength had supplanted the wire link in the system.

There is another and even more important use for the small transmitting set in radio relay and this use suggests a particularly interesting development for radio in the future.

In the relay now in common use at WGY, the small station is used to feed into the larger transmitting set through the introduction of a receiving set between the radio links. It is possible that the future will see many of these small transmitting sets scattered about the country and used to re-radiate on lower wavelengths, concerts received on a sensitive receiver from any one of a half dozen main stations, for the benefit of listeners with crystal sets or short distance receivers.

For example, such a receiving set might pick up the best of the WGY program from Schenectady and then a special feature from WJZ or other station and by the use of the transmitter re-radiate to the country side within a limited distance of the station.

This would give the man with the small receiving set the advantage of listening to a selected program, the best of the main stations. In this manner he would be able to get programs, and to get music that would not otherwise be available to him on his set. Many of the distant stations can be tuned in at will when atmospheric conditions are right but there are nights and days when the average set has difficulty in getting distance. The small re-radiating or relay station practically assures success to all the fans within a hundred miles, at least.

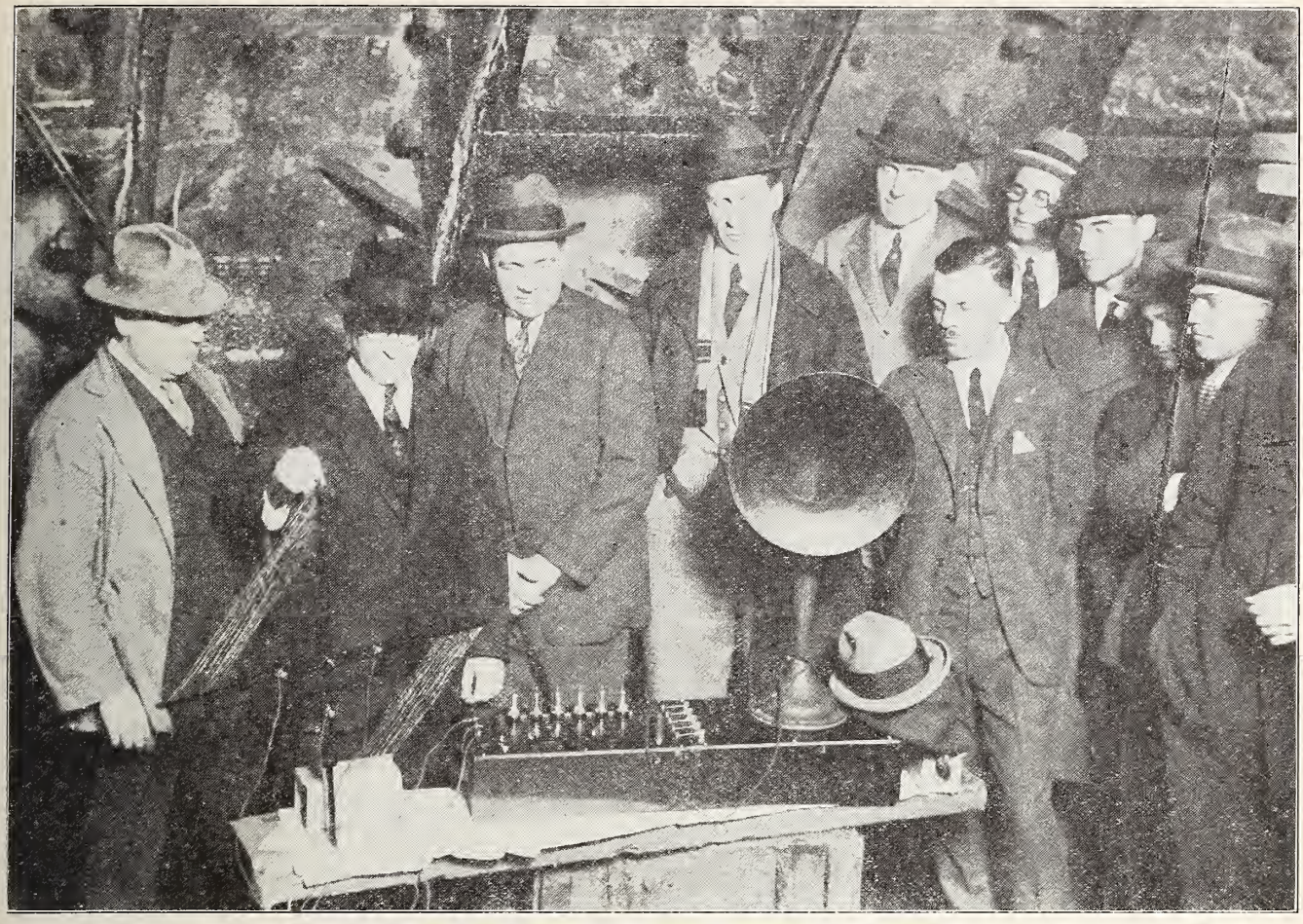


RIPPING!

That's what the Duke of Sutherland thinks about radio. He has been investigating American aviation and the picture shows him talking to American BCL's from Station WJZ, New York. Swagger microphone and topping haircut, we say. (Kadel & Herbert.)

Radio in Jail

"Four walls do not a prison make—nor iron bars a cage." The line from the old poem has been applied to many situa-



RADIO PENETRATES STEEL TUNNEL CASING

G. Y. Allen, radio engineer of the Westinghouse Manufacturing and Electric Company is shown testing reception conditions in the New York-New Jersey vehicle tunnel. Broadcasting was distinctly heard from Philadelphia, Pittsburgh and other cities. The radio waves passed through 500 miles of air, 70 feet of water, 30 feet of mud and through the heavy steel casing of the tunnel. (Photonews.)

tions since it was written. Now comes its application to radio.

WTAM, the broadcasting station of the Willard Storage Battery Company, Cleveland, Ohio, received Christmas greetings from three prisoners in acknowledgment of radio programs received by them. Two of these were prisoners of sickness. The third is actually confined in a state prison.

Mrs. Harold N. Pember, of 14 Goshen Street, Hartford, Conn., sent a disinfected letter, saying she was quarantined with her daughter who has scarlet fever. "You will never realize what a boon the radio has been on these long, lonely evenings," she wrote in appreciation of WTAM programs.

Robert H. Bean, of Manitowoc, Wis., sent the season's greetings, saying there is no station in the United States he enjoys more than WTAM. Bean was a marine engineer on the Great Lakes before an accident left him paralyzed. Cleveland, the home of WTAM, is familiar ground, he says, and the concerts bring back the good times he has had in port there.

The third letter was from Ernest Graham, prisoner in Virginia state penitentiary, Richmond.

Graham is allowed a radio receiving set in his cell through the kindness of the prison superintendent. He says there are twenty-four head phones attached to his receiver and that his companions in nearby cells listen in to concerts after the lights are out.

"The radio helps us to pass the long nights as well as to keep up our courage and to appreciate what freedom means once we get it again," he writes.

"BIG BROTHER CLUB"

Boy and girl radio fans all over the East are becoming greatly interested in the newest Amrad broadcasting feature conducted at WGI, Medford Hillside, under the name of "The Big Brother Club." Over 200 boys and girls are enrolled as active members at the present time.

"The Big Brother Club" is not unlike the Boy Scouts and Camp Fire Girls in purpose and principle. It appeals to boys and girls from 9 to 12 years old, and, according to the by-laws, "any boy or girl owning or listening-in regularly on any receiving set is eligible." The dues are one letter each week to "Big Brother." Meetings held nightly from 6 to 6:15. Each new member is issued a Certificate of Membership Card duly inscribed.

It is expected that Big Brother Clubs will be established at other broadcasting stations in the near future. Address all communications to C. R. Emery, care of Amrad, WGI, Medford Hillside, Mass.

"Mike" Tests Nerves

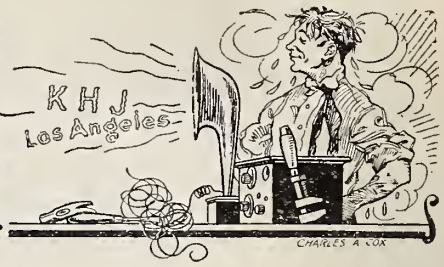
Broadcasting has developed a new test for the nerves, according to several radio broadcast managers.

"Stage fright," "movie nerves" and "buck fever" are all well known to the public, but the little metal microphone, "the door to Radio land," has sent terror to the hearts of many seasoned entertainers who have performed before packed houses without a tremor.

Appearing for the first time before the "Mike" the artists, almost without exception, ask: "How many people will hear this?" What tone of voice shall I use? Do you think I have a good voice for this work?" and many other questions indicating nervousness.

Having performed before "Mike," who is cold and unresponsive, the artist waits impatiently for letters from the invisible fans, whose faces he could not read, to learn whether or not his act "went over." Unless he receives letters of applause his fever is likely to rise until it becomes dangerous.

Pick-ups and Hook-ups by our Readers



DIAL TWISTERS

Names	Addresses	Circuit
Norris Summers	Pee Wee Valley, Ky.	Single Circuit
Richard Jones	Milwaukee, Wis.	Single Circuit
Earle Kidney	Sterling, Ill.	Single Circuit
Harvey J. Duneka	2641 N. Central Ave., Phoenix, Ariz.	Ultra Audion
Curtis Springer	1224 N. Olney St.	Single Circuit
Kenneth Fischer	1219 N. Olney St.	Single Circuit
Both the above TWISTERS live in Indianapolis, Ind.		
John Bennett	Rockville Centre, L. I., N. Y.	Not Stated
Albenue Des Rosius	56 Bridge Av., Windsor, Ont., Can.	Reinartz
Alex Mack	1020 Cherry St., Norristown, Pa.	Hopwood Circuit

ONCE upon a time there was an Editor who wanted to give the fans a chance to compare records in his radio magazine and let the readers know that he wanted lists—

That's us. We like to give the fans what they want, and we try to please them in every way possible

Some time ago, we requested through this department that fans send in their lists of stations heard, and we got just what we deserved. No restrictions were published as to the length of the lists, and by looking over some of those submitted, you'd think you got a hold of the call book for all the stations of the world.

We find that it is an impossible thing for us to determine the record holder for the month, and we cannot find any real restrictions to impose on these fans who laugh at distance as far as radio listening is concerned.

It's this way. Willie Jones writes in telling us that he has heard station XYZ transmitting on sixteen meters, which is located four thousand miles from his house. Mr. Smith tells us that his set using a 23-tube ultra-superheterodyne has heard all in all six hundred stations from the Alps to Omaha.

The point is—whose should be considered a record?

We'll handle it this way. In order to give all the fellows a chance at this, we're going to establish the order of DIAL TWISTERS. We'll publish the lists of those fellows who do real long distance work from a standpoint of location, type of set, and operating conditions. When you write enclose your list neatly compiled, with data on the type of receiver, and any other information that you think would be of value in determining whether you are entitled to the name of DIAL TWISTER.

The Pickups editor will read them over carefully, note the lists, and conditions under which the work was done, and if he thinks it contains something of a feat, will put your name in the list of DIAL TWISTERS, and if space permits publish your letter.

Everybody has an even chance—no matter if you have a ten-tube superheterodyne or a one-tube first tube circuit. We will carefully consider them both, and if the one list and letter shows more meritorious work, we will publish that one.

What say fans! How many of you are going to be classed as dial twisters next month?

THE PICKUPS EDITOR.

Our December 1923 issue contained an interesting account of reception record made by Mr. E. L. Laudell, of Shelbyville, Illinois on a circuit of his own design. Mr. Laudell instructed us to say that fans could have a copy of his circuit by writing. In a later communication, Mr. Laudell says:

"I throw up my hands—I can't possibly answer the mass of inquiries that come in. While I am writing this, I have a splitting headache from writing and reading letters in answer to inquiries received in response to the offer I made. I have now received 500 letters."

We wrote Mr. Laudell for his circuit, and in reply he says:

RADIO AGE,
Gentlemen:

You will find enclosed the circuit on which I compiled the list of stations published in your December, 1923, issue.

Upon inspection you will see that the circuit needs no comment or special parts other than a common variocoupler which must be rewound to suit the circuit given. I am enclosing detailed information regarding the winding of the coils on this coupler, and trust that fans may find as good results awaiting them as I have received.

Very truly yours,
E. L. LAUDELL.

We are printing in Figure 1, a copy of the circuit which Mr. Laudell contends is superior to many others. The primary of the coupler has eighty turns of No. 28 D C C wire, with taps taken off as follows:

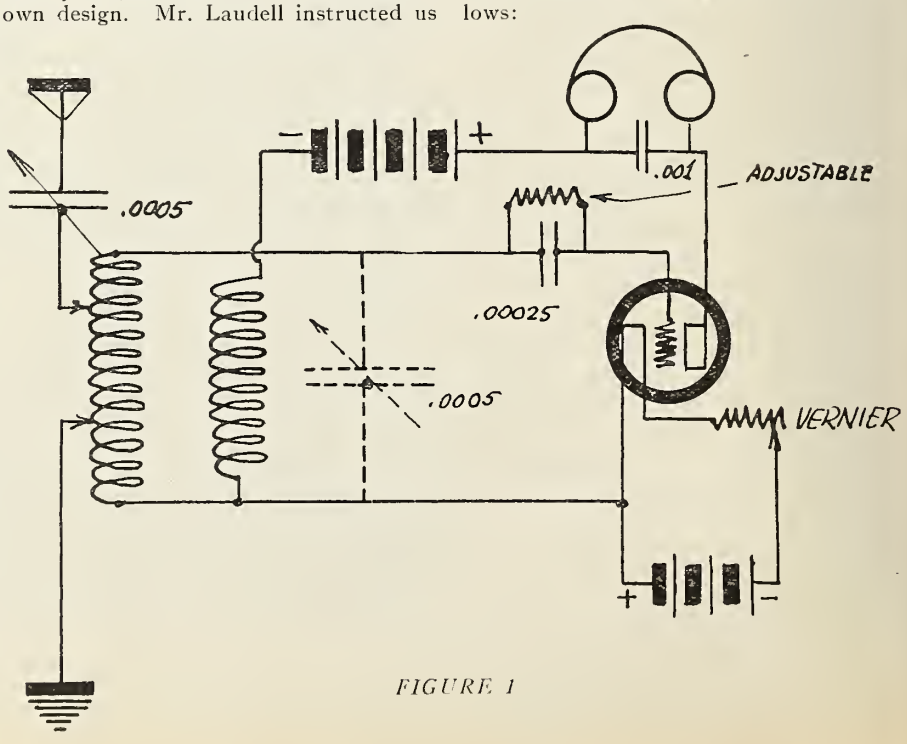


FIGURE 1

Tap the first ten turns every turn, and then wind seventy turns of the wire bringing out loops for taps every tenth turn. This makes the coil have seven taps of ten turns each and ten turns of 1 tap each. The secondary is rewound with the same size wire and had 64 turns. The secondary in the circuit really is not a secondary but is used as a tickler.

The remainder of the circuit is standard with respect to parts, and the diagram shows how the connections are made. Mr. Laudell would be pleased to hear from fans who construct this circuit.

On page 4 of the August issue, we printed a short item regarding reception of signals on short antennas by various fans, and Mr. B. O. Borgeson found that a score of people took the trouble to look up his address, and write him concerning his experiments.

Mr. Norris, Summers, Pinvee Valley, Ky., writes us:

RADIO AGE,
Gentlemen:

After reading Mr. Foltz's letter in the January number last night I decided to take down the stations heard before turning in.

So as a result I am sending my list which contains fifty stations all of which were plain and clear.

I do not claim this to be a record as I can easily do as well any good night. My set is a single tube type, using a U V 199, in the much ridiculed single circuit.

Very truly yours,
NORRIS SUMMERS.

Mr. Summers' list is as follows: CKAC, Montreal, Can.; WJAR, Providence, R. I.; WOAW, Omaha, Neb.; WCAE, Pittsburgh, Pa.; WWJ, Detroit, Mich.; WOR, Newark N. J.; WHAM, Rochester, N. Y.; WHAS, Louisville, Ky.; WDAP, Chicago, Ill.; WGY, Schenectady, N. Y.; WDAF, Kansas City, Mo.; WJAX, Cleveland, Ohio; KFKQ, Conway, Ark.; WCX, Detroit, Mich.; WTAS, Elgin, Ill.; WSAI, Cincinnati, Ohio; WBZ, Springfield, Mass.; WSB, Atlanta, Ga.; WMC, Memphis, Tenn.; KSD, St. Louis, Mo.; KYW, Chicago, Ill.; WIP, Philadelphia, Pa.; KDKA, Pittsburgh, Pa.; WEAF, New York, N. Y.; WFAA, Dallas, Texas; WJAD, Waco, Texas; WNAC, Boston, Mass.; WEAN, Providence, R. I.; WCAP, Washington, D. C.; WMAK, Lockport, N. Y.; WCAS, Minneapolis, Minn.; WOAN, Lawrenceburg, Tenn.; WLAP, Louisville, Ky.; WHN, New York, N. Y.; WOI, Ames, Iowa; WHB, Kansas City, Mo.; WJZ, New York, N. Y.; WBAP, Fort Worth, Texas; KFMQ, Fayetteville, Ark.; KFEX, Minneapolis, Minn.; KGO, Oakland, Calif.; KHJ, Los Angeles, Calif.; WJAZ, Chicago, Ill.; WLW, Cincinnati, Ohio; WBAK, Harrisburg, Pa.; KPO, San Francisco, Calif.; KFI, Los Angeles, Calif.; WJAN, Peoria, Ill.; KFDL, Denver, Colo.; KGW, Portland, Oregon.

Wot say, fans? Looks like the single circuits are coming to the front this issue. We remember way back when a

Pickups By Readers

(Continued)

fellow could look with pride at a record of thirty miles or so with an electrolytic detector—and now

Read this one and weep!

RADIO AGE,

Gentlemen:

I have read with interest letters in the Pickups Dept. Now I'm out with my record, which I believe takes honors from Mr. Foltz in the January number, and also Mr. Wright of Madison, Wis., in the same issue. I have a single tube single circuit receiver which I built myself and wouldn't trade it for any set regardless of make or price. I have heard 151 stations in thirty-two states. The following are stations over 1000 miles distance: KPO, KFDB, KFI, KWH, KHJ, PWX, CHBC, CFCN, WCAR, WCAK, WBAP, WPA, WFAA, KFDF, KFAF, WWL, WAAP, WFY, WEAH, WBL, WKY, KFKB.

A total of twenty-two stations with a 32,650 mileage. If any other reader can show twenty-two stations totaling that much with a single tube set, I would like to see it. I have heard as high as thirty-three stations in a single evening between seven thirty and eleven thirty. In three nights I heard 51 different stations and did not count any station twice either.

Here's another: I have listened to KFI at Los Angeles four consecutive nights for from 30 to 45 minutes each time. Perhaps I could have listened longer only the lure for more distant stations would not permit me.

I owe all my success to a good tube, and careful tuning.

Yours for RADIO AGE, and single circuits,

RICHARD JONES.

When you read over that, you'll probably say Ummm! Pretty good, pretty good, but we'll say—GOOD!!! HUH! THAT'S PERFECT! We think it's so good that we're putting Mr. Jones' name on the Dial Twisters list. Congratulations, Mr. Jones. You're one of the highest Dial Twisters for the month.

And here's another single circuit bug:

RADIO AGE,

Gentlemen:

I have been reading some of the fine distance records made by fans, and want to contribute my list. I am using a single circuit tuner, and for selectivity and ease of control together with its great volume I don't believe it can be beat. I can't just remember the date but a week or two before Christmas I picked up the following stations from seven in the evening to ten: KYW, Chicago (Westinghouse Elec.): WOAW, Omaha; WLAG, Minneapolis; KDKA, East Pittsburgh; WGY, Schenectady; WLW, Cincinnati; WDAP, Chicago (Drake Hotel); WJAX Cleveland; WJY, New York City; WDAF, Kansas City Star; WCAE, Pittsburgh; WMAQ, Chicago (Chi. Daily News); WBAP, Ft. Worth; WJZ, New York City; WHAS, Louisville; WOAI, San Antonio; WBZ, Springfield, Mass.; WOC, Davenport; WSB, Atlanta; WHB, Kansas City; WWJ, Detroit News; WTAS, Elgin; WSAI, Cincinnati; WRM, Urbana, Ill.; WEAF, New York City; WFAA, Dallas; WCAP, Washington, D. C.; WBAH, Minneapolis; KSD, St. Louis; KFKX, Hastings, Nebr.; WNAV, Knoxville, Tenn.; Washington, Pa.; KHJ, Los Angeles, Calif.; CKY, Winnipeg, Canada; WJAZ, Chicago (Edg. Beach Hotel).

KHJ, KFI and CFCA and other Pacific stations all come in with surprising volume and clearness. I can pick them up when they are on the air at will. Last Saturday evening (January 12) I heard about twenty-three stations and not trying for records either. In the course of the evening I had heard among others PWX, KGO, KHJ, KFI, KGW, CKCE, WHN and KPO. Pretty good jaunt, don't you think? Local stations such as Chicago and Kansas City come in so loud that you can hear them 15 to 20 feet from the phones.

Let me hear from some other single circuit fans as to a record of stations heard as consistently as that!

Very truly yours,

EARLE KIDNEY.

Sterling, Ill.

The copy boy watching over our shoulder as we type this remarked with a whistle: "Whew! I'm gonna' go home t'nite an make me one of them tuners. Wotta list, wotta list." We're almost ready to follow the copy boy's example and junk that Rolls-Royce receiver of ours after reading that list. Fine work, Mr. Kidney.

Dec. 31, 1923.

RADIO AGE,

Dear Sirs:

I have been greatly interested by what RADIO AGE has to say on the Ultra Audion Circuit. For the past eight or ten years I have been trying the various hook-ups as fast as they have been foisted upon the unsuspecting experimenter, but even the ones with lots and lots of dials and switches can't beat the Ultra Audion for volume or selectivity.

At present I have only the 23 plate variable condenser, and a rheostat, on the panel, with 75 turns of No. 24 wire on a Quaker Oats box in the rear as a fixed inductance—no taps. I find this far superior to the other methods of winding coils; the variable condenser covers meters from 238 to 526 with a 75 foot aerial, and tuning is very sharp. Using one tube I regularly hear Chicago from Phoenix, Ariz., with KFAD, a mile away, making all the noise he can.

In thanking you in advance, I would like to add that RADIO AGE is exactly right—please, for everybody's sake, don't let it slide into the rut.

Sincerely yours,

HARVEY J. DUNEKA,

2641 North Central Avenue,

Phoenix, Arizona.

That's a little boost for the users of ultra-Audion receivers and here's another one:

RADIO AGE,

Gentlemen:

As a radio amateur of long standing, but who has only lately become acquainted with RADIO AGE, permit me to felicitate you upon the practical wisdom and sound judgment which its editorial contents show.

I read four different radio periodicals. Each is good of its kind. Yours is quite the most useful to the everyday semi-dumbbell like myself, who wouldn't know a heterodyne if it bit him on the ear, but who does admire for to fool away life building new circuits for his ownself.

Incidentially, even for those of a higher order of mentality than mine, I observe a definite authority and precision in your published utterances which are a pleasing contrast to the wide scope many radio editors seem called upon to allow themselves.

I specially congratulate your Mr. Felix Anderson upon the clarity and accuracy of his drawing. Nothing more helpful to me has come my way since first I dealt with radio.

I built the ultra-audion one tube circuit, described in your October number, from one of Anderson's drawings; and it is a marvel of compactness and efficiency. It outclasses a sixty-dollar "boughten" set in distance and selectivity, as well as in volume and freedom from distortion; while, as you can guess, it didn't cost anything like that money! May I suggest the addition of a vernier condenser similar to the Chelten Midget, which I am using in this circuit of yours and which I find a great help in cutting out interference.

The first night I hooked up the set I got QSADX on the following: CHYC; WIP; WDAR; WSAI; WEAF; WOC; WOO; and the rarely-heard (by me, at least) WOQ. These, in the order named, within an hour and a half, tuning through local broadcast from WWAP on 225 meters. Not so dusty, what?

Good luck to you!

Yours sincerely,

D. G. WYLIE.

And seeing that we are featuring single circuit sets this month, we give you a shot at this one compiled by two youngsters in the radio game:

RADIO AGE,

Gentlemen:

We have read several copies of your magazine. We have taken special interest in the "pickups." We are the proud jowners of a single circuit regenerative one-bulb set. We have a record which was made on the 11th of January, 1924, and we think this record cannot be equalled with such a set. We listened between the hours of 6 p. m. and 3 a. m. They are as follows: AA3, KDKA, KFGC, KFI, KFKX, KFMQ, KGW, KHJ, KYW, WBAK, WBAP,

WBAV, WBZ, WCAE, WCBD, WCK, WDAF, WDAP WDAR, WEAA, WEAY, WGY, WHAS, WHB, WHN, WIAO, WIP, WJAR, WJAZ, WMAH, WMAQ, WMC, WOAW, WOO, WOQ, WOS, WSB, WTAQ, WWJ, 3FA, 9BAC, 9BAQ, 9VC, WLW, WOC, WLAG, KFBC.

We also got a Canadian steamer, the Memphis. We are a couple of radio nuts of 14 years. In ten months we have received 276 stations all different. We have received stations in thirty-four states, District of Columbia, six Provinces of Canada, Alaska, Cuba, and Porto Rico. The night we got Alaska we were using three bulbs. We are positive we heard all of these stations for our both ears would not deceive us.

Yours very truly,
CURTIS SPRINGER,
1224 N. Olney St.
KENNETH FISCHER,
1219 N. Olney St.,
Indianapolis, Ind.

And here's another list from a radio bug not yet in his teens which surpasses some of the lists we have received from fellows who are twice his age and who have more than twice his radio experience:

I have seen quite a few records in the RADIO AGE and I think mine will beat them all. I have heard the following: KDKA, KYW, KHJ, KSD, WAAM, WBAA, WBAN, WBAP, WBS, WBZ, WCAU, WCX, WDAP, WDAR, WEAF, WEAN, WFI, WGI, WGR, WGY, WHAS, WHAZ, WHB, WHN, WIP, WJAR, WJAZ, WJZ, WLAG, WLAK, WLAW, WLW, WMAK, WMAQ, WNAC, WOC, WOO, WOR, WPAB, WQAO, WRW, WSB, WWJ, WMAF, WBAY, NAA, WJY, WSAI, WCAP, WCBD, WCAE, WRC, WDT, WNJ,WTAM, WEAM, WBT, WHAM, WCAO, WJAX, WBU, WTAS, WHAR, WOAW, WFAA, WDAF, WCAL, WNAV, KOP, CFCA, CKAC, 6KW.

I have heard a few stations that don't broadcast any more. I have heard eight amateur stations.

I am only twelve years old and I have a list of ninety-three stations in the last five months.

Yours truly,
JOHN BENNETT,
Rockville Centre, Long Island, N. Y.
P. S.—Will you please publish my list?

Laugh those two off, willya! And while you are laughing read this one:
RADIO AGE,
Gentlemen:

I think I have another good record of pickups for a two nights' try. I sent you a list some time ago, but this one has it beat a mile. I am a regular radio bug, and use a Reinartz three tube set with loudspeaker. Let's get this list off our chest right away: KDKA, KHJ, KSD, KYW, KFKB, KFKX, WBAP, WBAV, WBZ, WCAE, WCAL, WCAP, WCBD, WCK, WDAF, WDAP, WDAR, WDAX, WEAF, WFAA, WFI, WGR, WGY, WHAS, WGR, WHAZ, WHB, WHK, WIP, WJAR, WJAX, WJAZ, WJZ, WLAG, WMAQ, WMC, WOAW, WOC, WOO, WOS, WPAH, WRC,

Pickups By Readers

(Continued from page 37.)

WSAI, WSB, WSI, WSY, WTAM, WTAS, PWX, WCX, WWJ, KOP, and amateur stations 8WX, 8MR, 8CAX, 8IM, and 9XN.

Well, folks, how about that list? It's about time I have a little sleep now so guess I'll quit bothering you; but I want to say this—your magazine is a wonder.

I do not miss it any month, as I like it the best of them all. It gets better every month. The only trouble is that you don't get it out often enough. The list I submitted was all brought in on a loud speaker—no ear phones at all.

Very truly yours,
ALBENUE DES ROSIUS,
256 Bridge Av., Windsor, Ontario, Can.

Write that one on your cuff! Next: RADIO AGE,

Gentlemen:

I enjoy very much reading the pickup columns and would like to have a few of my records appear in your interesting publication. I am using a Hopwood circuit with detector and two stages of amplification employing WD 12 tubes. Although situated only 17 miles from Philadelphia with WDAR, WOO, WP and WFI going full blast, I have tuned around them almost at will. My crowning achievements and the ones of which I am most proud are as follows:

The tuning of stations WHB, WHAS, WLAG, SWB, WTAM and numerous stations close by using a three foot loop for an antenna.

The tuning of KFI, KHJ, KGW, and one morning I tuned in KFI, KHJ, and KGW between 12:30 and 1:30.

On the night of Dec. 28 I tuned in 43 stations from 7 p. m. to 12:45 a. m. (when I fell asleep at the switch). You will find the list attached. I also have a record of seventeen stations in three-quarters of an hour to which my better half acted as witness. Although "hearing is believing" I pride myself on the fact that before I log a station I always make sure of the call letters or verify the reception by reference to some program as published in newspaper programs with respect to programs. I submit a sample of my log.

I am a red hot radio fan and could write about it forever if I had the time but I will close hoping that I have not bored you to distraction.

Sincerely yours,
ALEX MACK.
1020 Cherry St., Norristown, Pa.

A Copy of Mr. Mack's Log Stations Tuned in on Dec. 28, 1923:

KOP, Detroit, Mich., police reports and orchestra.

KDKA, E. Pittsburgh, Pa., dinner music.

WCAU, Philadelphia, Hotel Pennsylvania orchestra.

WIP, Philadelphia, orchestra.

WFI, Philadelphia, orchestra.

WOR, Newark, bedtime stories.

WCX, Detroit, orchestra.

WCAE, Pittsburgh, orchestra.

WWJ, Detroit, Detroit News orchestra.

WEAF, New York, artists' concert.

WOO, Philadelphia, orchestra.

WGY, Schnectady, orchestra.

WNAC, Boston, artists' recital from WNAC.

WEAN, Providence, artists' recital from WNAC.

WTAS, Elgin, Ill., orchestra.

WHAM, Rochester, N. Y., reading.

WMAY, St. Louis, address on church work.

WHK, Cleveland, solos and orchestra.

WRAX, Gloucester, N. J., soprana solo, "Annie Laurie."

WCBD, Zion, Ill., xylophone and violin solos.

WJAR, Providence, R. I., orchestra.

WDAR, Philadelphia, Pa., Howard Lannins' orchestra and "Morning Glories."

WHN, New York, orchestra.

WHAS, Louisville, Ky., time signal.

WSB, Atlanta, Ga., address on A. R. R. L.

NAA, Arlington, Va., weather report.

WDAF, Kansas City, concert.

WJZ, New York, artists' concert.

WIS, Jefferson City, Mo., Missouri state prison band.

WRC, Washington, D. C., U. S. army band.

WFAA, Dallas, Tex., concert.

WOAW, Omaha, Neb., orchestra.

KYW, Chicago, Mary Garden in opera, Cleopatra.

KSD, St. Louis, chorus.

WBAP, Ft. Worth, Tex., Masonic orchestra.

WJY, New York, soprano solos.

3AYZ, Philadelphia, testing a new transmitter.

WBZ, Shringfield, Mass., orchestra.

WDAP, Chicago, songs and market reports.

KFKB, Milford, Kans., orchestra.

WMC, Memphis, Tenn., late frolic.

2XB, New York, testing new transmitter.

WJAZ, Chicago, quartet and concert.

Forty-three stations in fifteen states.

Total mileage, 18,501.

Time, 7 p. m. to 12:45 a. m.

The Pickups Editor wishes to acknowledge receipt of letters from the following readers:

H. J. Boyenga, Paul Baker, C. H. Peters, R. S. Merchant, B. P. Kessinger, P. Spencer, C. M. Bullard, H. W. Dillon, J. J. Drechsler, Max M. Barnhizer, Rev. R. A. Brook, and Drew D. Mac Dougal.

Rejectors

(Continued from page 13.)

rub comes in) and considerable patience will have to be exercised in winding a coil of 2,500 turns with so fine a wire as No. 34. It is possible that you may find coils of the dimensions given in some stores which handle transmitting apparatus.

The coil consists of the wire as mentioned above, wound on a tube three inches in diameter. This coil has the property of keeping the interference free oscillations which we have just tuned in, from straying off in the wrong direction, and steers them down the antenna post of the receiver instead. The coil is an absolute necessity in the unit.

The potentiometer, omnipotent in radio frequency circuits, should be of about 400 ohms maximum resistance, and is used to control the bias of the grid of the tube.

The filament posts of the unit may be connected to the common storage battery used for the remainder of the set. It is advisable if possible to use a separate B battery, connecting it to the specified posts, but if no additional batteries are available the voltage used on the remainder of the set may be applied. The voltage should be determined by the type of tube used, but as a general rule, about 80 volts is efficient.

Those contemplating the construction of this type of rejector should carefully observe the rule that good results are the fruits of painstaking care in construction, and discriminating choice of efficient apparatus.

The writer wishes to take this opportunity to thank Mr. Frederick A. Smith, Editor of RADIO AGE, Mr. E. F. McDonald, Jr., of Station WJAZ for their efforts in bringing the writer's article in the January issue of RADIO AGE before the many fans, and wishes to acknowledge receipt of the many letters written him by grateful listeners in response to the results obtained from the instructions printed in that issue.

Simple Heterodyne

(Continued from page 8.)

is supplied to the plate of the tube and is fed back to the grid circuit through the two inductively coupled coils (N) and (M). The primary carrying the plate current is (N) while the secondary in the grid circuit is (M). The primary (N) contains about 60 turns of No. 26 D. C. C. wire while (M) has about twenty turns of the same size wire. In this way the plate current frequency is imposed upon the grid circuit, and the intensity of the energy can be controlled by the plate inductance or by varying the distance or coupling between the two coils, or both. The coil (M) should preferably be the rotor of a coupler while (N) is the stator.

Next to the plate of the tube is the inductance (L) which may be a 50 turn honeycomb coil. Connected across this coil is the 23 plate variable condenser (C2) by which the inductance is varied and by which the frequency in coil (N) is varied. This arrangement can be somewhat simplified by omitting the coil (L) and connecting the condenser (C2) directly across the ends of the coil (N). Coil (N) is now made a 50 turn honeycomb. However, the results obtained by this method are seldom as good as in the complete circuit shown.

Further increase in signal strength is due to "tuned plate" methods, the inductance (L) and Condenser (C2) bringing the plate circuit into or near to a state of resonance in regard to the grid circuit. The total result of all these systems is a circuit having excellent range and terrific signal strength on local broadcasting stations. The combined adjustment of condensers (C1) and (C2) give excellent selectivity and broadcasting stations only a few blocks away are completely eliminated when desired. I

have repeatedly cut out the powerful station WJAZ only two blocks from my home and have brought in out of town stations without a trace of WJAZ even during silent periods.

As the tuning of these units is very critical at all times it is advised that vernier condensers and vernier rheostats be used. Condenser (C2) is particularly critical and requires very close adjustment for maximum results. Both these variable condensers have a maximum capacity of 0.0005 m. f. Trouble with body capacity will be in evidence unless care is taken to connect the stationary plates of condenser (C1) to the grid circuit. If the movable plates are connected at the end of the grid condenser (K1) then the extended shaft of the condenser is at grid potential and every movement of the hand on this dial will detune the circuit. When an amplifying tube such as the UV-201A or C-301A is used the grid condenser (K1) should have a capacity of 0.00025 m. f. The instructions for other tubes will be found within the box.

As a rule, an amplifying tube is better than a soft detector tube for this purpose, and with the UV-201A a "B" battery potential of 67 volts is very satisfactory. This makes the tuning sharper and brings in distance much better than with the ordinary soft detector tube working with 22.5 volts on the plate. However, detector tubes can be used if the plate voltage is kept down below 25 volts. The resistance of the rheostat (R) depends upon the make of the tube.

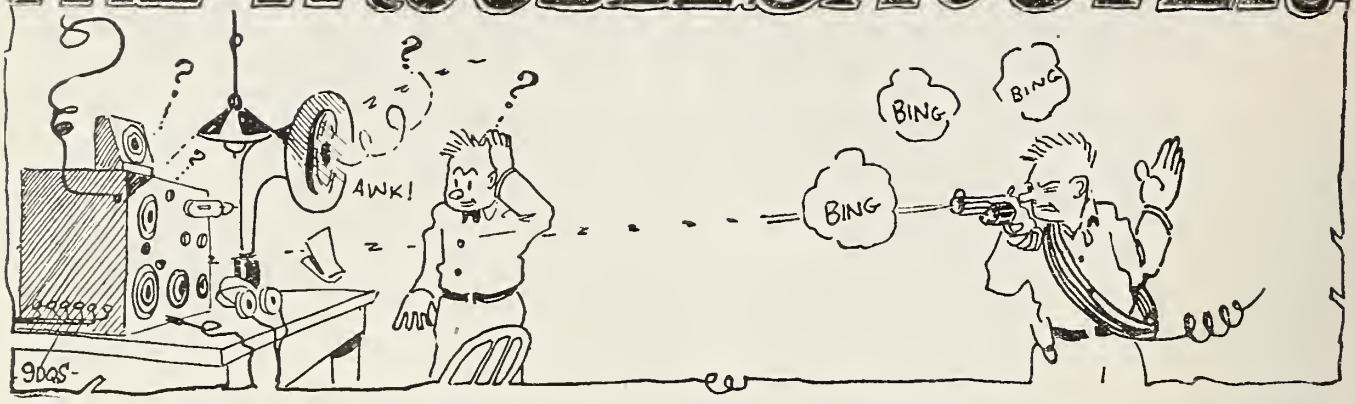
While a variometer can be substituted for the inductance (L), yet it will not perform so satisfactorily unless a fixed condenser of 0.00025 is connected across the terminals of the variometer. The variometer only adds to the expense of construction and in my opinion should not be used. Besides, it is likely to increase the body capacity and cannot easily be adjusted with vernier precision.

Sharp tuning and the other desirable characteristics of this circuit will be lost if a very long aerial is used. In no case should an outdoor aerial of more than 75 feet be used and 50 feet span is preferable, particularly if within a few miles of a broadcasting station. On 30 feet of indoor aerial I have had nearly all the stations on one tube, that is, the large broadcasting stations usually listed in the "pickups" column. With this short aerial, the set tunes sharply and is very selective over a range of from 200 to 600 meters wave length. The two controls are very easily handled after a little practice, and as a fixed type coupler is used, the dial of condenser (C1) can be logged for the different wave lengths and stations. Each station, when accurately on its assigned wave length, comes in sharply each time within one or two divisions on a four inch dial.

A variocoupler can be substituted for the fixed coupler shown but it is not desirable from any point of view. In the first place the number of controls are increased, and secondly it is then impossible to log the stations according to wave length. The variocoupler taps and inductance switches add to the losses in the circuit and of course this is to be avoided. The simplest and most effective coupler is the one shown here. The primary coil (P) consists of about 15 turns of No. 26 or No. 24 D. C. C. magnet wire, and is wound on a three inch cardboard or bakelite tube. The secondary coil (S) consists of from 60 to 70 turns of the same wire and is wound on the same tube spaced about 5-8 inch from the end of the primary coil (P). Do not place the coils closer together than this for the 5-8 inch of loose coupling must be provided to obtain selectivity and to avoid capacity coupling between the two coils.

The isometric view of Fig. 6 shows the typical arrangement of the circuit when placed on a 7" x 14" panel. The various parts in the isometric are lettered to correspond with those on the wiring diagram and the wires are numbered in agreement with the numbering of the wires in Fig. 5. This enables the reader to follow across from wiring diagram to the isometric assembly.

THE TROUBLESHOOTER



The technical department sends out many replies to questions in each day's mail. In order to assure prompt service to our subscribers the direct reply method hereafter must be restricted to those fans who are on our subscription list. Fans who are not subscribers may obtain this service by enclosing 50 cents with their question and the reply will be mailed at once, accompanied by circuit diagram where illustration is needed. All inquiries should be accompanied by self-addressed and stamped envelope.

G. S. B., Kenosha, Wis.

Question: After reading your article in the January issue, I proceeded to build an Eliminator as from your description. I built this especially to be able to eliminate Zion, Ill., Station WCBD. Inasmuch as they are only about six miles from us we like to get them out in some manner. I used a 23 plate condenser and constructed the windings as you specified. The coil I have fitted over and around the condenser. I used it tonight on a try out as WCBD was shooting with full power. The Eliminator stopped them dead, not a squawk from the station. I find however, that I can't tune any near stations by a rather wide margin. The Eliminator was hooked between the ground and antenna as illustrated in figure 9. When I tune out WJAZ, I am unable to tune in KYW. Why?

Answer: First of all I am of the opinion that you are not quite familiar with the action of the filter, judging by your description. The tuning of the filter requires patience, and perseverance to obtain the best results. Have you tried any of the other permutations possible with the filter to find out about the action with different connection? Also would advise that you place a 25 turn honeycomb coil in the antenna lead, which assists the filter in its purpose by raising the fundamental wave of the antenna slightly.

E. S. F., Chicago, Ill.

Question: As a subscriber to RADIO AGE I ask you to kindly print a circuit showing two stages of radio frequency amplification to the standard Armstrong Regenerative circuit. The circuit may use either tuned or untuned radio frequency transformers.

Answer: Figure 1 shows the diagram you desire.

C. T., Chicago, Ill.

Question: As a subscriber to your magazine would like it very much if you would send me diagrams and information on a five tube outfit 2 RF and 2 AF amplification using a loose coupler. I have a standard loose coupler and 43 plate condenser.

Answer: A diagram of the type you mention was printed in the November 1923 issue of RADIO AGE on page 18. The diagram calls for the type of apparatus you mention.

J. M. P., Dayton, O.

Question: Will you kindly advise me if your Push-Pull amplifier as outlined on Page 15 of the January RADIO AGE can be added to my receiver which is of the Westinghouse Aeriola Sr., two stage autio frequency amplifier?

Answer: The amplifier as described may be used as a third stage with a tremendous increase in volume by connecting the output of the amplifier of the set you are now using to the input of the Push-Pull amplifier as described in the January issue. The loud speaker should be connected to the output of the Push-Pull amplifier.

R. E. M., Stratton, Nebr.

Question: I recently constructed a set using the Rosenbloom circuit which you published in the January issue of RADIO AGE. Your diagram calls for a .0005 MF condenser between the antennae and variometer. I tried connecting it up, but it made a buzzing similar to that caused by a loose connection. Can you explain this? By leaving out the condenser I was able to pick up Los Angeles and San Francisco on the West Coast, and WJAZ, WOC, WOS, WHB, KFKA and WLAG with ease. I used fifty feet of ordinary insulated low tension wire strung around the garage for an antenna. Is this a good performance with a single tube? If you can suggest a reason for the performance of the condenser will be very much obliged.

Answer: The action you speak of is

(Continued on page 42.)

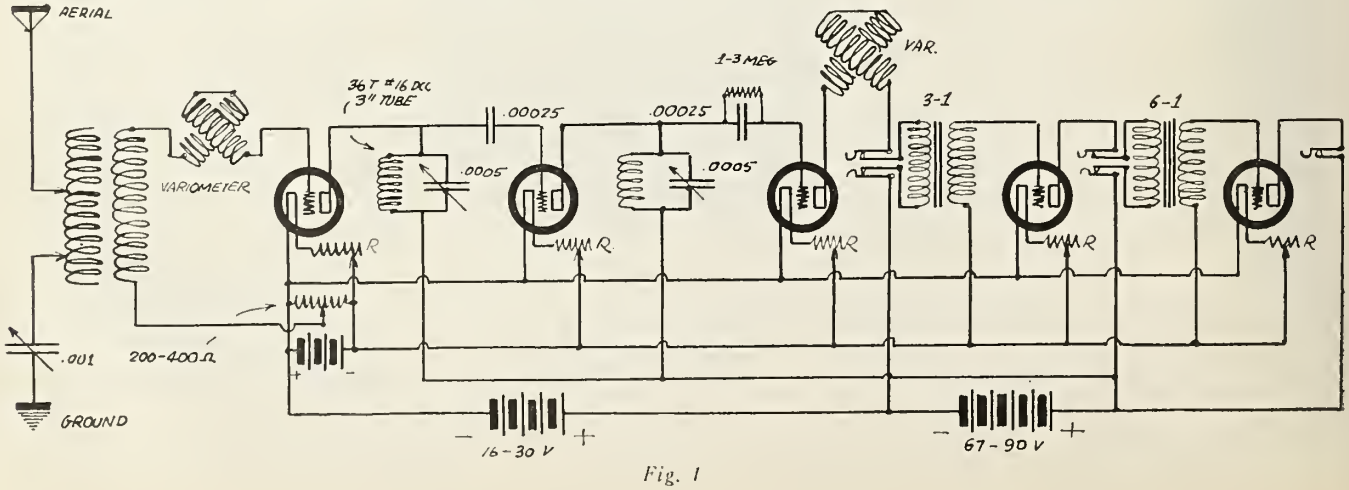


Fig. 1

Avoid "QRM"

(Continued from page 21.)

only half (or even less than half) of the tuning coil in the set, and doing your tuning with a variable condenser as I have just described.

Next let us take up type No. 11, the plain or non-regenerative audion detector used with a single tuned aerial circuit. There are not many of these in use, so far as I know, but they tune best when a series condenser in the aerial is used as I have explained for the simple crystal set.

Crystal Receivers

If your single tuned crystal set has the good features described above and still is not sharply enough tuned, you must go higher up the list. The easiest thing to do is to convert it into a type No. 10 set, which is the double-tuned crystal receiver. The most important thing you have to do for this conversation is to wind a coil of about forty turns of, say, No. 24 double cotton covered wire on a tube 3 1-2 or 4 inches in diameter and connect it in series with a variable condenser between your aerial and ground, which are to be *disconnected* from your single-tuned set. You then connect the aerial and ground binding posts on the set together by a wire if there is a variable condenser in the set. If there is none in the receiver, you connect one between these same binding posts. Then you put the new coil in line with and fairly close to the coil in the receiver and go ahead.

To adjust a double-tuned outfit of the kind that this now is, you must have both of the variable condensers at the right setting at the same time. Of course this correct scale. reading is different for every wave frequency, so the double-tuning feature gives a sort of combination lock effect that is harder to adjust but more selective than the single tuned circuit. You will find that the farther the two coils are apart, within reason, the better the selectiveness. Of course the crystal and telephone side-circuit should be connected across one half or less of the coil in the original set, as explained with regard to the No. 12 type of receiver.

A type of No. 11 single tuned audion set may be converted into a No. 9 double-tuned set in this same way, and will be much more nearly free from interference.

The next most selective set, as we go up the list, is type No. 8. This is the multiple-stage radio-frequency-amplifier outfit that uses fixed or untuned radio frequency transformers. Many of the popular "reflex" sets are made up in this way. Nearly all of them include a stabilizer or variable resistance for adjusting regeneration, but many are not sharply tuned in spite of that. It would take a long time to diagnose and explain the faults in design, in construction and in operation that are common in these outfits; consequently the most helpful thing I can do is to suggest that if you have a set of this type you can probably improve its selectiveness by making up and adding to it a separate antenna-tuning circuit such as I have described for the crystal set. If this does not stop your interference troubles you will either have to improve the general design of your set or else get another that is better or higher up the list.

We now come to type No. 7, which is the popular single-circuit regenerator. A large proportion of interference encountered by radio listeners may be attributed to the inefficiency of receiving sets of this design.

Recognizing Voices

Recently, a new announcer handled his first program through WEAF. On returning home he asked his mother whether she had heard the program during the afternoon. "Yes" she responded, but made no comment. A little surprised he asked how she had liked the announcing. Again a monosyllabic answer. Finally he learned to his astonishment that his mother had not recognized his voice—so carefully had he applied the art of correct tone and enunciation for the microphone in acquiring a "radio" voice.

On the aother hand, not many days previous, another new announcer had been heard for the first time through WEAF for a few brief special announcements. Later in the evening, a friend who had not seen or heard of the announcer for more than three years telephoned a message of congratulation. He had not questioned for a moment but that the announcing voice was that of his friend, so perfect and convincing was its reproduction.

If your newsdealer has sold out his supply of Radio Age you are likely to miss just the hook-up that you have been looking for. To avoid any such chance fill out the coupon in this issue and send in you subscription. Then you will be safe. And don't forget that with each subscription at the special price of $2.50 a year. We send you free the popular Reinartz Radio booklet FREE. Address Radio Age, 500 N. Dearborn Street, Chicago, Ill.

Troubleshooter

(Continued from page 40.)

no doubt caused by some queer freak in your wiring and arrangement of parts to supply the necessary capacity. It might be that your condenser was shorted, causing the buzz you speak of, and when you omitted it from the circuit the remaining wires and apparatus connected to the set furnished enough capacity to offset its removal from the circuit. The list you enclosed is a good list considering the antenna you mention.

N. D. S., Mendon, Mich.

Question: Can you offer any suggestions how I can remedy my set Reinartz of its habit of fading away and then coming back strong as ever again, and sometimes even stronger. I use two stages of audio frequency. I have a reflex transformer. Would like to know if I can add one stage of radio to the present set and use that transformer. Will you send me a hookup using a coupled circuit tuner with a variometer and a condenser. I want one that will tune easy.

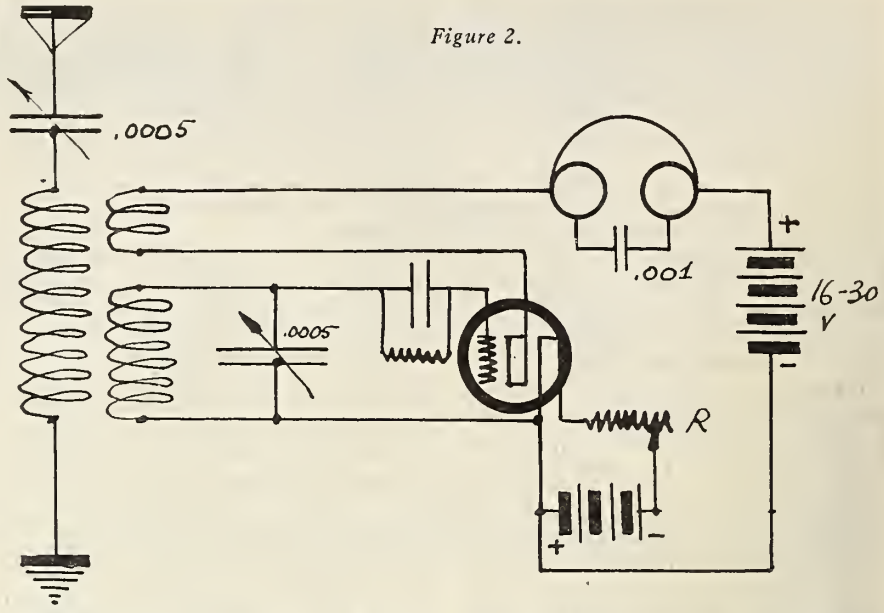
Answer: Fading, I am sorry to say, is a phenomenon that we mere human beings cannot control, and about which we know very little. If you keep your batteries up to the mark, see to it that no loose connections exist etc., it is about all you can do. The transformer you mention will not efficiently function in the circuit. A circuit of the type you desire was printed in the October issue of RADIO AGE on page 5. The diagram showing two stages of amplification was printed in the December issue.

G. R. S., Clinton, Ia.

Question: I have completed the 4 tube neutrodyne, on which I can get stations but not loud. I can put the antenna on the detector and get most of the stations just as loud as without the RF. All my batteries are OK, and I am using good parts. I find that I have to force the radio frequency tubes considerably to get results. Would appreciate your giving me some general hints on the adjustment of the set.

Answer: Would suggest that your limitations are caused by insufficient capacities in the neutrodons to balance the valves properly. A piece of copper about 1 1-2 inch square for each plate of the condenser as illustrated on the enclosed sketch should help. Adjust the neutrodons with the condenser settings at about 55. When adjusting the neutrodons, it is a good plan to pick out a good loud signal, or you may not find the proper place to balance the set.

Figure 2.



S. E. M., Washington, D. C.

Question: I am a subscriber to your wonderful magazine, which I think is a great help to all radio fans, and noticing that you offer assistance, desire a hookup of a single tube set in which I can use the following list of apparatus: 1 23 plate condenser, 1 variometer, 1 variocoupler, WD 11 tube and accessories.

Answer: A circuit adaptable to your apparatus appeared in the July, 1923, issue of RADIO AGE on page 19. The set is a regenerative one, and we have seen it giving very good results.

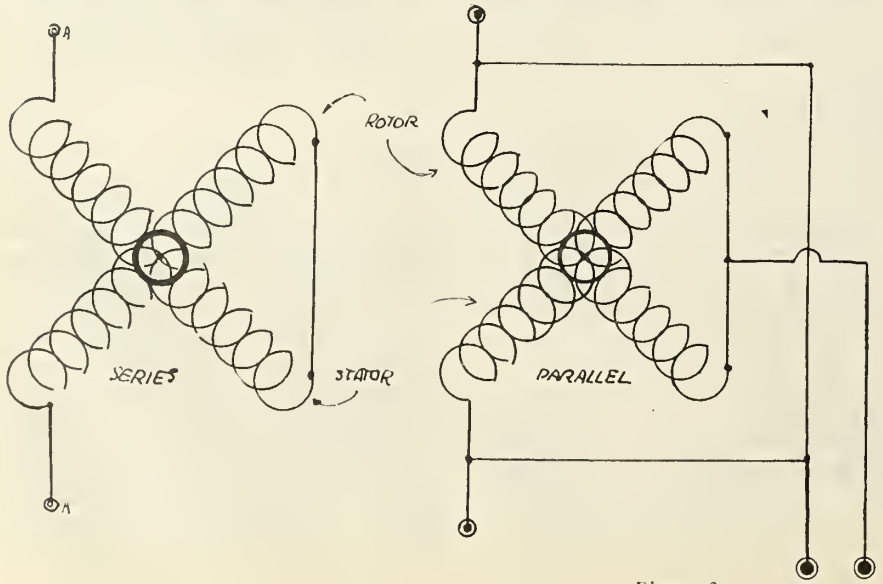
H. G. G., Long Beach, Cal.

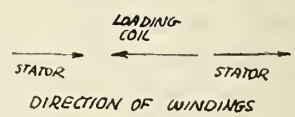
Question: Will you kindly publish the best known hook-up for the 3 coil Honeycomb set using Duo-lateral wound coils for waves from 200 to 500 meters. Object sought—to cut out local broadcasts and bring in long distance. Desire to use 300 tube on detector if OK, and would appreciate a list of parts. Your RADIO AGE is a loud speaker, and I wish you great success.

Answer: I am printing in Figure 2 the proper connections for the parts you mention. If you are having trouble in cutting out local stations why not build one of the rejectors or eliminators as described in the January issue of RADIO AGE? Thank you very much for your comment on RADIO AGE. We hope you will find it more interesting and instructive in the future.

C. F. G., Jr., St. Louis, Mo.

Question: I have been trying the Kopprasch circuit for some time which was described in April, 1923, issue but I don't get the proper results. I saw in your answer to D. P. of Racine, Wis., in the November, 1923, issue several suggestions as to the improvement of reception with this circuit, but after carrying them out find my results little changed. I am afraid that I don't quite understand the connections of the variometers. That is I don't quite get what





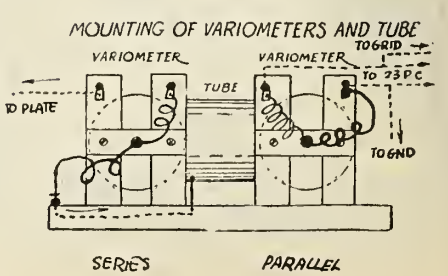


Figure 3.

Complete Corrected List of U. S. and Canadian Broadcasting Stations

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers and broadcasters.

			Wave length
KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh	326
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270
KDPT	Southern Electrical Co.	San Diego, Calif.	244
KDYL	Telegram Publishing Co.	Salt Lake City, Utah	360
KDYM	Savoy Theatre	San Diego, Calif.	252
KDYQ	Oregon Institute of Technology	Portland, Oreg.	360
KDYW	Smith Hughes & Co.	Phoenix, Ariz.	360
KDYX	Star Bulletin	Honolulu, Hawaii	360
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZE	The Rhodes Co.	Seattle, Wash.	455
KDZF	Automobile Club of Southern California	Los Angeles, Calif.	278
KDZI	Electric Supply Co.	Wenatchee, Wash.	360
KDZQ	Nichols Academy of Dancing	Denver, Colo.	360
KDZR	Bellingham Publishing Co.	Bellingham, Wash.	261
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	360
KFAE	State Collge of Washington	Pullman, Wash.	330
KFAF	Western Radio Corp.	Denver, Colo.	360
KFAJ	University of Colorado	Boulder, Colo.	360
KFAN	The Electric Shop	Moscow, Idaho	360
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif.	280
KFAU	Independent School District of Boise City, Boise High School, Boise, Idaho		270
KFAV	Abbot Kinney Co.	Venice, Calif.	224
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280
KFAY	W. J. Virgin	Medford, Oreg	283
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Azbill	San Diego, Calif.	278
KFBE	Reuben H. Horn	San Luis Obispo, Calif.	360
KFBG	First Presbyterian Church	Tacoma, Wash.	360
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and the Chronicle News	Trinidad, Colo.	360
KFBU	The Cathedral (Bishop N. S. Thomas)	Laramie, Wyo.	283
KFCB	Nielsen Radio Supply Co.	Phoenix, Ariz.	238
KFCD	Salem Electric Co. (F. S. Barton)	Salem, Oreg.	360
KFCF	Frank A. Moore	Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)	Billings, Mont.	360
KFCK	Colorado Springs Radio Co.	Colorado Springs, Colo.	258
KFCM	Richmond Radio Shop (Frank T. Doelng)	Richmond, Calif.	360
KFCP	Ralph W. Flygare	Ogden, Utah	360
KFCV	Fred Mahaffey, Jr.	Houston, Tex.	360
KFCY	Western Union College	LeMars, Iowa	252
KFCZ	Omaha Central High School	Omaha, Nebr.	258
KFDA	Adler's Music Store	Baker, Oreg.	360
KFDD	St. Michaels Cathedral	Boise, Idaho	252
KFDH	University of Arizona	Tucson, Ariz.	360
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	360
KFDL	Knight-Campbell Music Co.	Denver, Colo.	360
KFDO	H. Everett Cutting	Bozeman, Mont.	248
KFDR	Bullock's Hardware & Sporting Goods (Robert G. Bullock). York, Nebr		360
KFDU	Nebraska Radio Electric Co.	Lincoln, Nebr.	240
KFDV	Gilbrech & Stinson	Fayetteville, Ark.	360
KFDX	First Baptist Church	Shreveport, La.	360
KFDY	South Dakota State College of Agriculture and Mechanic Arts,	Brookings, S. Dak.	360
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank Co.	Portland, Oreg.	360
KFEJ	Guy Greason	Tacoma, Wash.	360
KFEL	Winner Radio Corp.	Denver, Colo.	360
KFEQ	J. L. Scroggin	Oak, Nebr.	360
KFER	Auto Electric Service Co.	Fort Dodge, Iowa	231
KFEV	Radio Electric Shop	Douglas, Wyo.	263
KFEX	Augsburg Seminary	Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Concentrating Co.	Kellogg, Idaho	360
KFEZ	American Society of Mechanical Engineers (F. H. Schubert,)	St. Louis, Mo.	360
KFFB	Jenkins Furniture Co.	Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.	Pendleton, Oreg.	360
KFFO	Dr. E. H. Smith	Hillsboro, Oreg.	229
KFFQ	Marksheffel Motor Co.	Colorado Springs, Colo.	360
KFFR	Nevada State Journal (Jim Kirk)	Sparks, Nev.	226
KFFV	Graceland College	Lamoni, Iowa	360
KFFX	McGraw Co.	Omaha, Nebr.	278
KFFY	Pincus & Murphy	Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.	Dallas, Tex. (portahle)	226
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	360
KFGJ	Missouri National Guard, 138th Infantry	St. Louis, Mo.	266
KFGL	Arlington Garage	Arlington, Oreg.	234
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFGV	Heldbreder Radio Supply Co.	Utica, Nebr.	224
KFGX	First Presbyterian Church	Orange, Tex.	250
KFGZ	Emmanuel Missionary College	Berrien Springs, Mich.	268
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHB	Rialto Theater (P. L. Beardwell)	Hood River, Oreg.	280
KFHD	Utz Electric Shop Co.	St. Joseph, Mo.	226
KFHF	Central Christian Church	Shreveport, La.	266
KFHH	Ambrose A. McCue	Neah Bay, Wash.	283
KFHJ	Fallon & Co.	Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.	Seattle, Wash.	270
KFHS	Clifford J. Dow	Lihue, Hawaii	275
KFHX	Robert W. Nelson	Hutchinson, Kans.	229
KFI	Earle C. Anthony (Inc.)	Los Angeles, Calif.	469
KFIB	Franklin W. Jenkins	St. Louis, Mo.	244
KFID	Ross Arbuckle's Garage	Iola, Kans.	246
KFIF	Benson Polytechnic Institute	Portland, Oreg.	360
KFIK	Gladbrook Electrical Co.	Gladbrook, Iowa	234
KFIL	Windisch Electric Farm Equipment Co.	Louisburg, Kans.	234
KFID	North Central High School	Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association	Yakima, Wash.	224
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIV	V. H. Broyles	Pittsburg, Kans.	240
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	240
KFIY	Brott Laboratories	Seattle, Wash.	236
KFIZ	Daily Commonwealth and Oscar A. Huelsman	Fond du Lac, Wis.	278
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	Seattle Post Intelligencer	Seattle, Wash.	233
KFJD	Weld County Printing & Publishing Co.	Greeley, Colo.	236
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	252
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg.	252
KFJK	Delano Radio and Electric Co.	Bristow, Okla.	238
KFJL	Hardsaeg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	229
KFJR	Ashley C. Dixon & Son	Stevensville, Mont. (near)	258
KFJV	Thomas H. Warren	Dexter, Iowa	224
KFJW	Le Grand Radio Co.	Towanda, Kans.	226
KFJX	Iowa State Teachers' College	Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	248
KFJZ	Texas National Guard, One hundred and twelfth Cavalry Fort Worth, Tex.		254
KFKA	Colorado State Teachers College	Greeley, Colo.	246
KFKB	Brinkley-Jones Hospital Association	Milford, Kans.	286
KFKH	Denver Park & Amusement Co.	Lakeside, Colo.	226
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark.	224
KFKV	F. F. Gray	Butte, Mont.	283
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	286
KFKZ	Nassour Bros. Radio Co.	Colorado Springs, Colo.	254
KFLA	Abner R. Willson	Butte, Mont	283
KFLB	Signal Electric Manufacturing Co.	Menominee, Mich.	248
KFLD	Paul E. Greenlaw	Franklinton, La.	234
KFLE	National Educational Service	Denver, Colo.	268
KFLH	Erickson Radio Co.	Salt Lake City, Utah	261
KFLP	Everette M. Foster	Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop	Little Rock, Ark.	261
KFLR	University of New Mexico	Albuquerque, N. Mex.	254
KFLU	Rio Grande Radio Supply House	San Benito, Texas	236
KFLV	Rev. A. T. Frykman	Rockford, Ill.	229
KFLW	Missoula Electric Supply Co.	Missoula, Mont.	234
KFLX	George Roy Clough	Galveston, Tex.	240
KFLY	Fargo Radio Supply Co.	Fargo, N. Dak.	231
KFLZ	Atlantic Automobile Co.	Atlantic, Ia.	273
KFMQ	University of Arkansas	Fayetteville, Ark.	263
KFMR	Morningside College	Sioux City, Iowa	261
KFMS	Frcinuth Dept. Store	Duluth, Minn.	275
KFMT	Dr. George W. Young	Minneapolis, Minn.	231
KFMU	Stevens Bros.	San Marcos, Texas	240
KFMW	M. G. Sateren	Houghton, Mich.	266
KFMX	Carleton College	Northfield, Minn.	283
KFMY	Boy Scouts of America	Long Beach, Calif.	229
KFMZ	Roswell Broadcasting Club	Roswell, N. M.	250
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service	Portland, Oreg.	380
KGN	Northwestern Radio Mfg. Co.	Portland, Oreg.	360
KGO	General Electric Co.	Oakland, Calif.	312
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach.	360
KGW	Portland Morning Oregonian	Portland, Oreg.	492
KGY	St. Martins College (Rev. Sebastian Ruth),	Lacy Wash.	258
KHJ	Times-Mirror Co.	Los Angeles, Calif.	395
KHQ	Louis Wasmer,	Seattle, Wash.	360
KJQ	C. O. Gould	Stockton, Calif.	360
KJR	Northwest Radio Service Co.	Seattle, Wash.	270
KJS	Bible Institute of Los Angeles	Los Angeles, Calif.	360
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	360
KLX	Tribune Publishing Co.	Oakland, Calif.	509
KLZ	Reynolds Radio Co.	Denver, Colo.	509
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif.	278
KMD	Love Electric Co.	Tacoma, Wash.	360
KNT	Grays Harbor Radio Co. (Walter Hemrich)	Aberdeen, Wash.	263
KNV	Radio Supply Co.	Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co.	Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture & Mechanic Arts	State College, N. Mex.	360
KOP	Detroit Police Department	Detroit, Mich.	288
KPO	Hale Bros.	San Francisco, Calif.	423
KQP	Apple City Radio Club	Hood River, Oreg.	360
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	360
KQW	Charles D. Herrold	San Jose, Calif.	360
KRE	V C Battery & Electric Co.	Berkeley, Calif.	278
KSD	Post Dispatch (Pulitzer Pub. Co.)	St. Louis, Mo.	546
KSS	Prest & Dean Radio Co. and Radio Research Society of Long Beach, Calif.	Long Beach, Calif.	360
KTW	First Presbyterian Church	Seattle, Wash.	360
KUD	Examiner Printing Co.	San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co.	Los Angeles, Calif.	360
KUY	Coast Radio Co.	El Monte, Calif.	250
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	360
KWH	Los Angeles Examiner	Los Angeles, Calif.	360
KXD	Modesto Herald Publishing Co.	Modesto, Calif.	252
KYQ	Electric Shop	Honolulu, Hawaii	360
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	536
KZM	Preston D. Allen	Oakland, Calif.	360
KZN	The Deseret News	Salt Lake City, Utah	360
KZV	Wenatchee Battery & Motor Co.	Wenatchee, Wash.	360
WAAB	Valdemar Jensen	New Orleans, La.	268
WAAC	Tulane University	New Orleans, La.	368
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	288
WAAK	Gimbel Brothers	Milwaukee, Wis.	280
WAAM	I. R. Nelson Co.	Newark, N. J.	263
WAAN	University of Missouri	Columbia, Mo.	254
WAAW	Omaha Grain Exchange	Omaha, Nebr.	360
WAAZ	Hollister-Miller Motor Co.	Emporia, Kans.	380
WABA	Lake Forest College	Lake Forest, Ill.	266
WABB	Dr. John B. Lawrence	Harrisburg, Pa.	266
WABC	Fulwider-Grimes Battery Co.	Andorson, Ind.	220
WABD	Parker High School	Dayton, Ohio	283
WABE	Young Men's Christian Association	Washington, D. C.	283
WABG	Arnold Edwards Piano Co.	Jacksonville, Fla.	248
WABH	Lake Shore Tire Co.	Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co.	Bangor, Me.	240
WABJ	The Radio Laboratories	South Bend, Ind.	240
WABK	First Baptist Church	Worcester, Mass.	252
WABL	Connecticut Agricultural College	Storrs, Conn.	283
WABM	F. E. Doherty Automotive and Radio Equipment Co.	Saginaw, Mich.	254
WABN	Waldo C. Grover	La Crosse, Wis.	244
WABD	Lake Avenue Baptist Church	Rochester, N. Y.	252
WABP	Robert F. Weinig	Dover, Ohio	266
WABQ	Haverford College Radio Club	Haverford, Pa.	261
WABR	Scott High School, N. W. B. Foley	Toledo, Ohio	270
WABS	Essex Manufacturing Co.	Newark, N. J.	244
WABT	Holiday-Hall, Radio Engineers	Washington, Pa.	252
WABU	Victor Talking Machine Co.	Camden, N. J.	226
WABV	John H. DeWitt, Jr.	Nashville, Tenn.	263
WABW	College of Wooster	Wooster, Ohio	234
WABX	Henry B. Joy	Mt. Clemens, Mich.	270
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	263

Troubleshooter

(Continued from page 42.)

you mean by series and parallel connections. How can I determine the proper way to wind the antenna coil. I am enclosing some sketches which I trust will help clear my trouble. My variometers seem to be wound from right to left while the antennal coil is wound from left to right. I feel sure that my trouble lies in the connecting of the variometers in series and parallel. Can you help me?

Answer: I am printing in Figure 3 some suggestions for wiring up the variometers of the Kopprasch circuit, and feel sure that it will clear up the difficulty without trouble. If you have the antenna coil wound in the opposite direction to the STATOR coils of the variometer you should not have any trouble providing that you have the connections of the rest of the set correctly made.

H. R. H., Jamestown, N. Y.

Question: I am building the eight tube super described in your November issue, and am thinking of using the resistance coupled amplifiers instead of the Audio Transformer coupled type of amplification. I would like to get a diagram of the super with the following diagram added to it instead of the one stage of audio frequency as shown. Would like to know that method is used in tuning an inside loop circuit. Is there any law against my selling this set to a friend? Can I use U V 200 tubes for oscillator and detectors in this circuit? Is it possible to take taps off the B battery used in the amplifier c rcuits for the oscillator circuit?

Answer: You can use the resistance coupled amplifier you submitted a circuit of by merely connecting the input of the resistance coupled amplifier to the output of the second detector at the points indicated for the primary of the audio transformer. The same batteries as are used on the radio amplifier and second detector may be used on this amplifier. When a loop is used with the circuit you mention the connections are made according to the diagram shown in Figure 5. As long as you do not manufacture the set on a large scale, no one will interfere with your selling sets to friends. Separate batteries must be used on the amplifier and oscillator circuits.

Antenna Analogy

(Continued from page 10.)

between the two parts. Every aerial contains a certain amount of inductance and capacity and the primary coil of the set which is in circuit with it furnishes a large amount of inductance. The capacity offered by the aerial is due to the fact that the ground acts as one conductor and the aerial as the other. The higher it is placed, the less the capacity and the greater the length of the vertical part, which will intercept more lines than if it were short. If the aerial has too much capacity, it may be compensated for, by including a variable condenser in its circuit. This will also aid in tuning the set.

As an illustration of just why capacity is necessary in the aerial Figure 8 is submitted. This consists of two closed water tanks connected by a pipe and partly filled with water. A plunger which fits tightly in the pipe is arranged so that it can be moved back and forth from the outside. If the tanks are small, the plunger cannot move very far in either direction, due to the small capacity of the tanks, but if their size is increased, it will be possible to get a greater movement of the plunger. Letting the two tanks represent the aerial and ground and the plunger represent the current produced in the aerial and the lines of force, the power which moves the plunger, one can readily see how too small a capacity would prevent a free movement of current of low frequency and why very little capacity would be necessary for high frequencies of short duration.

From the description given here one always remembering that however it may be constructed to meet his particular needs, the ohmic resistance should be as low as possible, which means that the cross section of both the aerial and the ground wire should be as large as possible.

Contact Across Pacific

Tacoma, Wash.—An unknown American radio operator situated in Tokio, Japan, recently sent a radio message to his mother at Cambridge, Ill., through the amateur radio station, 7HG, in this city, operated by Charles York, marking the first two-way short wave communication across the Pacific ocean. With only a fleeting contact, barely allowing time for the message to come through, York had considerable difficulty in distinguishing the foreign operator's call, JUPU.

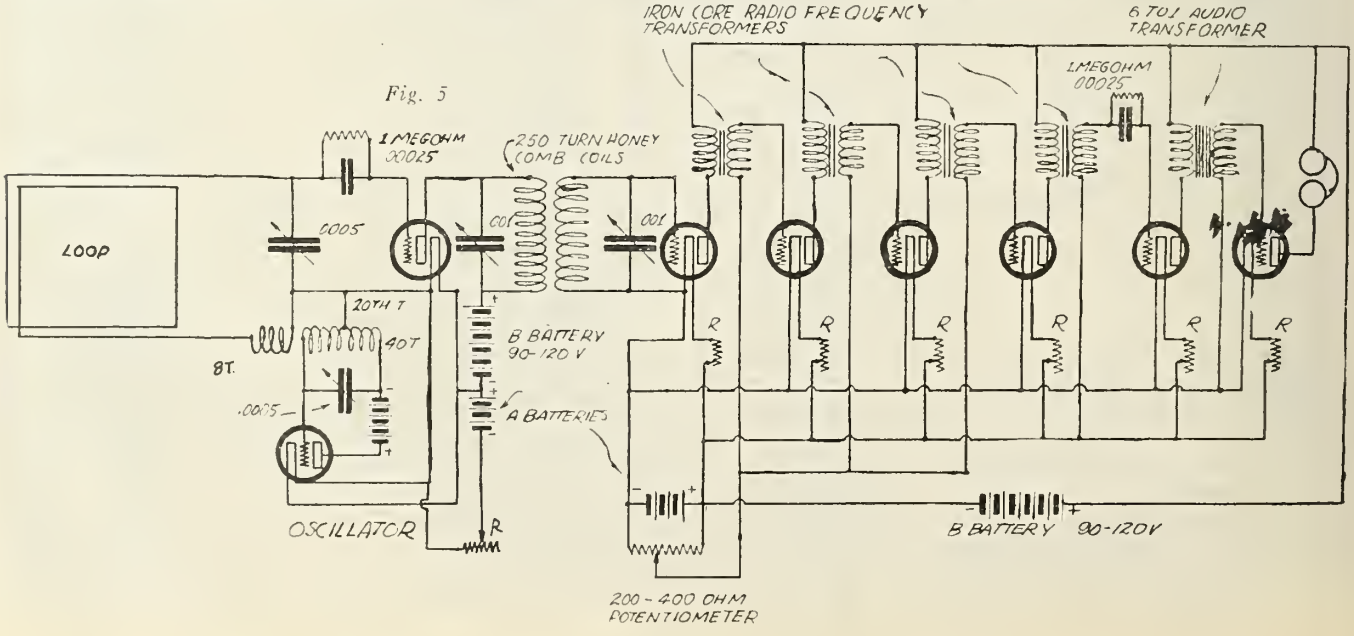
While the signals of amateur transmitters in the United States have been reported by ship operators in remote sections of the Pacific, and as distant as the island of Ceylon in the Indian ocean, this incident is the first in which an amateur has worked both directions across the 4,760 mile stretch of ocean. The message was delivered via the American Radio Relay League traffic system.

The contact hardly had been made and the message copied when communication was interrupted by heavy interference. It was about 1:00 a. m. when York heard a station with pure CW calling on 200 meters and signing with the unfamiliar Japanese call. For a brief interval signals were good at both stations.

The station operated by York is situated on one of the highest hills in that country. He has done a great deal of long distance work, his best previous two-way record being to communicate with Canadian amateur station 1AC situated in Nova Scotia. He had also worked 6CEU in Hawaii and amateurs in every radio district in the United States with the exception of those in the second and fourth.

His antenna is supported by a 65 foot pole at the free end and a 40 foot pole at the lead in end. It is a six-wire flat top 50 feet long with a counterpoise directly underneath. The transmitter uses the Hartley circuit with two Telefunken D. R. P. tubes.

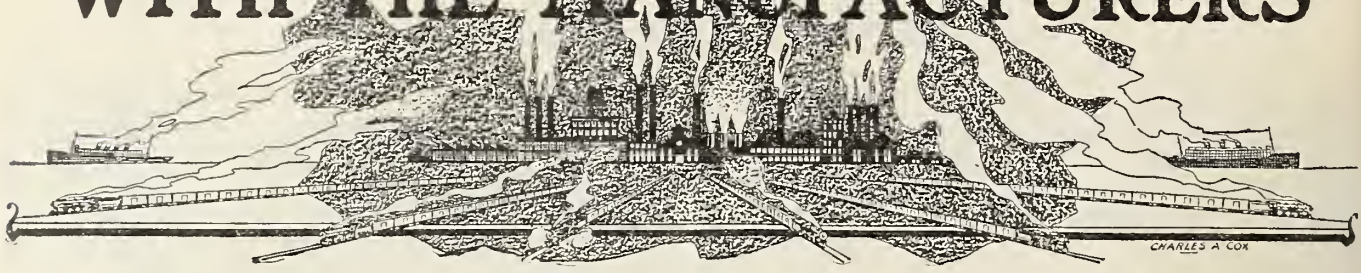
Fig. 5



Complete Corrected List of U. S. and Canadian Broadcasting Stations

WBAA	Purdue University	West Layayette, Ind.	360
WBAD	Sterling Electric Co.	Minneapolis, Minn.	360
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAN	Wireless Phone Corp.	Paterson, N. J.	244
WBAO	James Millikin University	Decatur, Ill.	360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.	Columbus, Ohio	390
WBAW	Marietta College	Marietta, Ohio	246
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.	New York, N. Y.	492
WBBA	Newark Radio Laberateries	Newark, Ohio	240
WBBD	Barbey Battery Service	Reading, Pa.	234
WBBE	Alfred R. Marcy	Syracuse, N. Y.	246
WBBF	Georgia School of Technology	Atlanta, Ga.	270
WBBG	Irving Vermilya	Mattapoisett, Mass.	240
WBL	T & H Radio Co.	Anthony, Kans.	261
WBR	Pennsylvania State Police	Butler, Pa.	286
WBS	D. W. May, Inc.	Newark, N. J.	360
WBT	Southern Radio Corp.	Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co.	Springfield, Mass.	337
WCAD	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa.	462
WCAG	Clyde B. Randall	New Orleans, La.	268
WCAH	Entrekin Electric Co.	Columbus, Ohio	286
WCAJ	Nebraska Wesieyan University	Uuiversity Place, Nebr.	360
WCAK	Alfred P. Daniel	Houston, Tex.	360
WCAL	St. Olzf College	Northfield, Minn.	360
WCAM	Villanova College	Villanova, Pa.	360
WCAO	Sanders & Stayman Co.	Baltimore, Md.	360
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C.	469
WCAR	Alamo Radio Electric Co.	San Antonio, Tex.	360
WCAS	William Hood Dunwoody Industrial Institute	Minneapolis, Minn.	246
WCAT	South Dakota State School of Mines	Rapid City, S. Dak.	240
WCAU	Durham & Co.	Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co.	Little Rock, Ark.	360
WCAX	University of Verment	Burlington, Vt.	360
WCAY	Kesseiman O'Driscoll Co.	Milwaukee, Wis.	261
WCAZ	Carthage College	Carthage, Ili.	246
WCBA	Charles W. Heimbach	Allentown, Pa.	280
WCBD	Wilbur G. Voliva	Zion, Ili.	345
WCK	Stix, Baer & Fuller Dry Goods Co.	St. Louis, Mo.	360
WCM	University of Texas	Austin, Tex.	360
WCX	Detroit Free Press	Detroit, Mich.	517
WDAE	Tampa Daily Times	Tsmpa, Fla.	360
WDAF	Kansas City Star	Kansas City, Mo.	411
WDAG	J. Laurance Martin	Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South)	El Paso, Tex.	268
WDAK	The Courant	Hartford, Conn.	261
WOAO	Automotive Electric Co.	Dallas, Tex.	360
WOAP	Board of Trade	Chicago, Ill.	360
WOAR	Lit Brothers	Phliadelphia, Pa.	395
WOAS	Samuel A. Waite	Worcester, Mass.	360
WOAU	Slocum Kilburn	New Bedford, Mass.	360
WDAX	First National Bank (Appameose County Farm Bureau)	Centerville, Iowa	360
WDAY	Radio Eqnipment Corp.	Fargo, N. Dak.	244
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WOZ	James L. Bush	Tuscola, Ili., Star Store Bldg.	278
WEAA	F. D. Failain	Flint, Mich.	280
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	492
WEAH	Wichita Board of Trade	Wichita, Kans.	244
WEAI	Cornell University	Ithaca, N. Y.	286
WEAJ	University of South Dakota	Vermillon, S. Dak.	283
WEAM	Borough of North Plainfield (W. Gibson Buttfield)	North Plainfield, N. J.	252
WEAN	Shepard Co.	Providence, R. I.	273
WEAO	Ohio State University	Columbus, Ohio	360
WEAP	Mobile Radio Co.	Mobile, Ala.	360
WEAR	Baltimore American & News Publishing Co.	Baltimore, Md.	360
WEAS	Hecht Co.	Washington, D. C.	360
WEAU	Davidson Bros. Co.	Sioux City, Iowa	360
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Tex.	360
WEB	Benwood Co.	St. Louis, Mo.	360
WEV	Hurlburt-Still Electrical Co.	Houston, Tex.	360
WEW	St. Louis University	St. Louis, Mo.	261
WFAA	Dallas News & Dallas Journal	Dallas, Tex.	476
WFAB	Carl F. Weese	Syracuse, N. Y.	234
WFAF	H. C. Spratley Radio Co.	Poughkeepsie, N. Y.	360
WFAH	Electric Supply Co.	Port Arthur, Tex.	236
WFAJ	Hi-Grade Wireless Instrument Co.	Asheville, N. C.	360
WFAM	Times Publishing Co.	St. Cloud, Minn.	360
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn.	380
WFAQ	Missouri Wesieyan College	Cameron, Mo.	360
WFAT	New Columbus College	Sioux Falls, S. Dak.	258
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr.	275
WFI	Strawbridge & Clothier	Philadelphia, Pa.	395
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa.	243
WGAN	Cecil E. Lleyd	Pensacola, Fla.	360
WGAQ	Glenwood Radio Corp. (W. G. Patterson)	Shreveport, La.	360
WGAW	Ernest C. Albright	Altoona, Pa.	261
WGAY	Northwestern Radio Co.	Madison, Wis.	360
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGI	American Radio & Research Corp.	Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett	Philadelphia, Pa.	360
WGR	Federal Telephens & Telegraph Co.	Buffalo, N. Y.	319
WGV	Interstate Electric Co.	New Orleans, La.	242
WGY	General Electric Co.	Schenectady, N. Y.	380
WHA	University of Wisconsin	Madison, Wis.	360
WHAA	State University of Iowa	Iowa City, Iowa	283
WHAB	Clark W. Thompson	Galveston, Tex.	360
WHAO	Marquette University	Milwaukee, Wis.	280
WHAG	University of Cincinnati	Cincinnati, Ohio	222
WHAH	Hafer Supply Co.	Joplin, Mo.	283
WHAK	Roberts Hardware Co.	Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y.	283
WHAP	Otta & Kuhns	Decatur, Ill.	360
WHAR	Paramount Radio & Electric Co. (W. H. A. Pulus)	Atlantic City, N. J.	231
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	380
WHB	Sweeney School Co.	Kansas City, Mo.	411
WHK	Radiovox Co. (Warren R. Cox)	Cleveland, Ohio	360
WHN	George Schubel	New York, N. Y.	360
WIAB	Joslyn Automobile Co.	Rockford, Ill.	252
WIAC	Galveston Tribune	Galveston, Tex.	360
WIAD	Howard R. Miller	Ocean City, N. J.	254
WIAF	Gustav A. DeCortin	New Orleans, La.	234
WIAH	Continental Radio & Mfg. Co.	Newton, Iowa	258
WIAI	Heer Stores Co.	Springfield, Mo.	252
WIAJ	Fox River Valley Radio Supply Co. (Quinn Bros.)	Neenah, Wis.	224
WIAK	Journal-Stockman Co.	Omaha, Nebr.	278
WIAO	School of Engineering of Milwaukee	Milwaukee, Wis.	360
WIAQ	Chronicle Publishing Co.	Marion, Ind.	226
WIAR	Paducah Evening Sun	Paducah, Ky.	360
WIAS	Home Electric Co.	Burlington, Iowa	360
WIAT	Leon T. Noel	Tarkio, Mo.	360
WIAU	American Trust & Savings Bank	Le Mars, Iowa	360
WIK	K. & L. Electric Co. (Herbert F. Kelso and Hunter J. Lohman)	McKeesport, Pa.	234
WIL	Continental Electric Suppiy Co.	Washington, D. C.	360
WIP	Gimbel Brothers	Philadelphia, Pa.	509
WJAB	American Electric Co.	Lincoln, Nebr.	360
WJAD	Jackson's Radio Engineering Laboratories	Waco, Tex.	360
WJAF	Press Publishing Co.	Muncie, Ind.	360
WJAG	Norfolk Daily News	Norfolk, Nebr.	283
WJAK	Clifford L. White	Greentown, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAN	Peoria Star	Peoria, Ill.	280
WJAQ	Capper Publications	Topeka, Kans.	360
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	360
WJAT	Kelly-Vawter Jewelry Co.	Marshall, Mo.	360
WJAX	Union Trust Co.	Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	448
WJD	Richard H. Howe	Granville, Ohio	229
WJH	W. P. Boyer	Washington, D. C.	278
WJX	Deforest Radio Telephone & Telegraph Co.	New York, N. Y.	360
WJY	R. C. A.	New York, N. Y.	405
WJZ	R. C. A.	New York, N. Y.	455
WKAA	H. F. Paar	Cedar Rapids, Iowa	268
WKAO	Chas. Looff (Crescent Park)	East Providence, R. I.	240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Tex.	360
WKAN	United Battery Service Co.	Montgomery, Ala.	226
WKAP	Dutee W. Flint	Cranston, R. I.	360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	360
WKAR	Michigan Agriculture College	East Lansing, Mich.	280
WKAS	L. E. Lines Music Co.	Springfield, Mo.	360
WKAV	Laconia Radio Club	Laconia, N. H.	254
WKAW	Turner Cycle Co.	Beloit, Wis.	242
WKAY	Brenau College	Gainesville, Ga.	280
WKY	WKY Radio Shop	Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn.	417
WLAH	Samuel Woodworth	Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co.	Waco, Tex.	360
WLAK	Vermont Farm Machine Corp.	Bellows Falls, Vt.	360
WLAL	Naylor Electrical Co.	Tusla, Okla.	360
WLAN	Putnam Hardware Co.	Houlton, Me.	288
WLAP	W. V. Jordon	Louisville, Ky.	360
WLAQ	Arthur E. Schilling	Kalamazoo, Mich	283
WLAT	Radio and Speciaity Co.	Burlington, Iowa	360
WLAV	Electric Shop	Pensacola, Fla.	254
WLAW	Police Dept., City of New York	New York, N. Y.	360
WLAX	Putnam Electric Co. (Greencastle Community Broadcasting Station)	Greencastle, Ind.	281
WLB	University of Minnesota	Minneapolis, Minn.	360
WLW	Crosley Manufacturing Co.	Cincinnati, Ohio	309
WMAB	Radio Supply Co.	Oklahoma, Okla.	360
WMAC	J. Edw. Page (Olive B. Meredith)	Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	360
WMAH	General Supply Co.	Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co.	Kansas City, Mo.	278
WMAK	Norton Laboratories	Lockport, N. Y.	360
WMAL	Trenton Hardware Co.	Trenton, N. J.	256
WMAN	First Baptist Church	Columbus, Ohio	286
WMAP	Utility Battery Service	Easton, Pa.	246
WMAQ	Chicago Daily News	Cbicago, Ill.	448
WMAV	Alabama Polytechnic Institute	Auburn, Ala.	250
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	280
WMAZ	Mercer University	Macon, Ga.	268
WMC	"Commercial Appeal" (Commercial Publishing Co.)	Memphis, Tenn.	500
WMH	Precision Equipment Co.	Cincinnati, Ohio	248
WMU	Doubleday-Hill Electric Co.	Washington, D. C.	261
WNAC	Shepard Stores	Boston, Mass.	278
WNAD	University of Oklahoma	Norman, Okla.	360
WNAL	R. J. Rockwell	Omaha, Nebr.	242
WNAM	Ideal Apparatus Co.	Evansville, Ind.	360
WNAN	Syracuse Radio Telephone Co.	Syracuse, N. Y.	286
WNAP	Wittenberg College	Springfield, Ohio	231
WNAQ	Charleston Radio Electric Co.	Charleston, S. C.	360
WNAR	C. C. Rhodes	Butler, Mo.	231
WNAS	Texas Radio Corp. & Austin Statesman	Austin, Tex.	360
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa.	360
WNAV	Peoples Telephone & Telegraph Co.	Knoxville, Tenn.	236
WNAW	Peninsular Radio Club (Henry Kunzmann)	Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNJ	Shotton Radio Manufacturing Co.	Albany, N. Y.	360
WOAA	Dr. Walter Hardy	Ardmore, Okla.	360
WOAC	Maus Radio Co	Lima, Ohio	266
WOAD	Friday Battery & Electric Corp.	Sigourney, Iowa	360
WOAE	Midland Collego	Fremont, Nebr.	360
WOAF	Tyler Commercial College	Tyler, Tex.	360
WOAG	Apollo Theater (Belvidere Amusement Co.)	Belvidere, Ill.	224
WOAH	Palmetto Radio Corp.	Charleston, S. C.	360
WOAI	Southern Equipment Co.	San Antonio, Tex.	383
WOAJ	Ervins Electrical Co.	Parsons, Kans.	258
WOAL	William E. Woods	Webster Groves, Mo.	229
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	380
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	360
WOAP	Kalamazoo College	Kalamazoo, Mich.	240
WOAQ	Portsmouth Kiwanis Club	Portsmouth, Va.	360
WOAR	Henry P. Lundskow	Kenosha, Wis.	229
WOAT	Boyd M. Hamp	Wilmington, Del.	360
WOAV	Pennsylvania National Guard, 2d Battalion, 112th Infantry	Erie, Pa.	242
WOAW	Woodmen of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOI	Iowa State College	Ames, Iowa	360
WOK	Pine Bluff Co.	Pine Bluff, Ark.	360
WOO	John Wanamaker	Philadelphia, Pa.	509
WOQ	Western Radio Co.	Kansas City, Mo.	360
WOR	L. Bamberger & Co.	Newark, N. J.	405
WOS	Missouri State Marketing Bureau	Jefferson City, Mo.	441
WPAB	Pennsylvania State College	State College, Pa.	283
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	300
WPAH	Wisconsin Department of Markets	Waupaca, Wis.	360
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College	Agricultural College, N. Dak.	360
WPAL	Superior Radio & Telep. Equipment Co.	Columbus, Ohio	286
WPAM	Auerbach & Guettel	Topeka, Kans.	360
WPAP	Theodore D. Phillips	Winchester, Ky.	360
WPAQ	General Sales & Engineering Co.	Frostburg, Md.	360
WPAT	St. Patricks Cathedral	El Paso, Tex.	360
WPAU	Concordia College	Moorhead, Minn.	360
WPAZ	John R. Koch (Dr.)	Charleston, W. Va.	273
WPG	Nusawg Poultry Farm	New Lebanon, Ohio	234
WQAA	Horace A. Beale, jr.	Parkersburg, Pa.	360
WQAC	E. B. Gish	Amarillo, Tex.	360
WQAD	Whitali Electric Co.	Waterbury, Conn.	242
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275
WQAF	Sandusky Register	Sandusky, Ohio	240
WQAH	Brock-Anderson Electrical Engineering Co.	Lexington, Ky.	254
WQAL	Coles County Telep. and Teleg. Co.	Mattoon, Ill.	258
WQAM	Electrical Equipment Co.	Miami, Fla.	360

WITH THE MANUFACTURERS



Duostat

The Premier Electric Co., Chicago, recently announced a new and unusual apparatus. This new instrument is called the "Duostat"—so named because it does the work of two Rheostats. The manufacturers claim for it many unusual features. The windings are independent of one another. Each operates one tube. Simplifies wiring. The base is Bakelight moulded, dial silver etched, winding "Nichrome" wire. It is made for all types of tubes. Greatly simplifies installation. Drill one hole, fasten to panel with nut supplied, and Presto—you have a finished job for any 2 stage amplifier.

Liberty Audio Transformer

The Liberty Transformer is very neatly encased in nickled brass with a top of molded condensite. All binding posts are nickle and plainly marked as to terminals. The entire instrument is small in size, the form being upright rather than horizontal. The transformer takes up a space of two and one-half by one and three-fourths inches of panel or base space and is strongly constructed. It has a ratio of five to one, which is sufficient for all needs in the average set not calling for a special high ratio winding.

The transformer proper is well-made of good Swedish steel with the windings well insulated and there is not the least chance of a break or short-circuit due to wires being exposed as the entire transformer is enclosed and no wires can be reached by any means.

The people manufacturing this transformer, by enclosing the transformer in a metallic case, have overcome intercoupling or magnetic coupling between stages, causing howls and shrieks. It is manufactured by the Liberty Transformer Company, Inc., Chicago, Ill.

The Willard Storage Battery Company, Cleveland, O., publishes a monthly quality organ, "The Connector." The publication presents fiction, trade news, trade suggestions, news of the company's already famous broadcasting station, WTAM, and excellent illustrations.

Condenser Construction

A proper soldering connection for a Fixed Condenser has long been the desire of all manufacturers of radio sets as well as amateurs who build their own.

It is, of course, comparatively easy to solder one connection to each terminal of every good Mica Condenser. But the task of making 4, 3, or even 2 clean connections to a Fixed Condenser has always resulted in a very messy job.

With an evident realization of the importance to clear-toned radio reception, of affording the best possible soldered connections and neatly soldered joints, the CHAS. FRESHMAN CO., of New

York City have made a radical improvement in the design of all capacities of their Tested Noiseless Mica Condensers, which should prove a boon to manufacturers and radio enthusiasts who build and tinker with their own outfits.

A lug of special construction is riveted by means of an eyelet to each terminal of the Mica Condenser. The lug is so designed that three or more different wires may be soldered to it, giving exceptionally good contact and allowing right-angle bends. The lug is equipped with three grooves, permitting the wires to be laid properly, and held in place while being soldered.

Another most important advantage is that in wiring a set the connection can be made temporary without soldering. All that is necessary is to lay the wires in the lugs which are so constructed that they can be made to hold the wires without soldering by merely bending over the sides of the grooves to form a contact with the wire. In this way the circuit can be tested and varied so as to give the most efficient results. When this is attained the connections are then soldered.

The accompanying illustrations show several methods in which the wires may be laid through the grooves in the lug, allowing bends of various kinds.

In order to assist users of the Bremer-Tully Vernier Tuning Unit in getting the most out of that instrument the Bremer-Tully Manufacturing Co. has issued a booklet "Better Tuning." The pamphlet contains some interesting photographic illustrations of assembled circuits and several diagrams. The Bremer-Tully Mfg. Co., 532 Canal Street, Chicago, places a price of ten cents on the booklet, which is valuable to the radio fan, whether he uses Bremer-Tully products or not.

The Western Coil & Electrical Co., Racine, Wis., favors us with circulars presenting facts about two outfits produced by that company. The Radiodyne Type W C 10, is one of the receivers described. Superior sensitiveness is claimed for this six-tube outfit. Dry cells or storage batteries may be used. There are only two adjustments. There is a third knob for compensating for long or short balancing wires. The receiver is of the compound circuit type and requires nothing more than a twenty or thirty foot wire for balancing purposes. This wire may be thrown on the floor or strung up behind the picture moulding of any room, or strung up in the attic. No outside antenna is necessary. The outfit is enclosed in solid mahogany rub finish. It weighs 14 pounds and is priced at $150, exclusive of tubes.

The same company produces the W C-5, which receives messages within a radius of 2,000 miles and is priced at $80. It is a four-tube circuit. In order to make it super-sensitive one stage of tuned radio frequency amplification is employed ahead of the detector. It works well with an indoor antenna or without a high or expensive outdoor aerial.

The rapidly increasing number of radio experimenters and receiver constructors has created a growing demand for convenient tools with which to make and assemble sets. Among the manufacturers who specialize in producing such tools is the Simon & Skidmore Mfg. Co., Santa Ana, California. They are makers of the Simore Lightning Change Tools. Their products include, squares, magazine screw drivers, containing three tools, and a magazine tool that contains knife blade and two screw drivers.

Mahoganite

The American Hard Rubber Company asks that the following be published:

"Our attention has been directed to the fact that certain manufacturers of radio materials and parts have recently

Complete Corrected List of U. S. and Canadian Broadcasting Stations

WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	360
WQAQ	Abilene Daily Reporter (West Texas Radio Co.)	Abilene, Tex.	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAV	Huntington & Guerry (Inc.)	Greenville, S. C.	258
WQAW	Catholic University	Washington, D. C.	236
WQAX	Radio Equipment Co.	Peoria, Ill.	360
WRAA	Rice Institute	Houston, Tex.	360
WRAD	Taylor Radio Shop (G. L. Taylor)	Marion, Kans.	248
WRAF	The Radio Club (Inc)	Laporte, Ind.	224
WRAH	Stanley N. Read	Providence, R. I.	231
WRAL	Northern States Power Co.	St. Croix Falls, Wis.	248
WRAM	Lombard College	Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	236
WRAO	Radio Service Co.	St. Louis, Mo.	360
WRAV	Antioch College	Yellow Springs, Ohio	360
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRAY	Radio Sales Corp.	Scranton, Pa.	280
WRAZ	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	233
WRC	Radio Corporation of America	Washington, D. C.	469
WRK	Doron Bros. Electric Co.	Hamilton, Ohio	360
WRL	Union College	Schenectady, N. Y.	360
WRM	University of Illinois	Urbana, Ill.	360
WRR	City of Dallas (police and fire signal department)	Dallas, Tex.	360
WRW	Tarrytown Radio Research Laboratory (Koenig Bros.)	Tarrytown, N. Y.	273
WSAB	Southeast Missouri State Teachers College	Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural College	Clemson College, S. C.	360
WSAD	J. A. Foster Co.	Providence, R. I.	261
WSAG	City of St. Petersburg (Loren V. Davis)	St. Petersburg, Fla.	244
WSAH	A. J. Leonard, jr.	Chicago, Ill.	248
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	309
WSAJ	Grove City College	Grove City, Pa.	360
WSAL	Franklin Electric Co.	Brookville, Ind.	246
WSAN	Allentown Radio Club	Allentown, Pa.	229
WSAR	Doughty & Welch Electrical Co.	Fall River, Mass.	254
WSAT	Donohoo-Ware Hardware Co.	Plainview, Tex.	268
WSAW	John J. Long, jr.	Canandaigua, N. Y.	278
WSAX	Chicago Radio Laboratory	Chicago, Ill.	268
WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	238
WSAZ	Chas Electric Shop.	Pomeroy, Ohio	258
WSB	Atlanta Journal	Atlanta, Ga.	429
WSL	J. & M. Electric Co.	Utica, N. Y.	278
WSY	Alabama Power Co.	Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAF	Louis J. Gaile	New Orleans, La.	242
WTAG	Kern Music Co.	Providence, R. I.	253
WTAH	Carmen Ferro	Belvidere, Ill.	236
WTAJ	The Radio Shop	Portland, Me.	236
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAN	Orndorff Radio Shop	Mattoon, Ill.	240
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gorden & Son	Osseo, Wis.	226
WTAR	Reliance Electric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	275
WTAT	Edison Electric Illuminating Co.	Boston, Mass. (portable)	244
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	360
WTAW	Agricultural & Mechanical College of Texas	College Station, Tex.	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcasting Station	Oak Park, Ill.	226
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTG	Kansas State Agricultural College	Manhattan, Kans.	485
WWAB	Hoenig, Swern & Co. (John Rasmussen)	Trenton, N. J.	226
WWAC	Sanger Bros.	Waco, Tex.	360
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	Alamo Dance Hall, L. J. Crowley	Joliet, Ill.	227
WWAF	Galvin Radio Supply Co.	Camden, N. J.	236
WWAO	Michigan College of Mines	Houghton, Mich.	244
WWI	Ford Motor Co.	Dearborn, Mich.	278
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	517
WWL	Loyola University	New Orleans, La.	280

Canadian Stations

CFAC	Western Radio Co., Ltd.,	Calgary, Alta.	430
CFCA	Toronto Star	Toronto, Ont.	400
CFCF	Marconi Co.	Montreal, P. Q.	440
CFCH	Abitibi Power & Paper Co. Ltd.	Iroquois Falls, Ont.	400
CFCI		Vancouver, B. C.	410
CFCJ		Quebec, P. Q.	410
CFCK		Edmonton, Alta	410
CFCL		Victoria, B. C.	400
CFCN	W. W. Grant Radio, Ltd.	Calgary, Alta	440
CFCO		Bellevue, P. Q.	450
CFCW		London, Ont.	420
CFQC		Saskatoon, Sask.	400
CFUC		Montreal, P. Q.	400
CHCB		Calgary Alta.	410
CHCD		Quebec, P. Q.	410
CHCE		Victoria, B. C.	400
CHCL		Vancouver, B. C.	440
CHYC	Canadian Northern Elec.	Montreal, P. Q.	410
CJCA	Edmonton Journal, Ltd.	Edmonton, Alta.	450
CJCD	T. Eaton Co.	Toronto, Ont.	410
CJCE	Vancouver Sun	Vancouver, B. C.	420
CJCI	McLean, Holt & Co., Ltd.	St. John, N. B.	400
CJCN	Simmons, Agnew & Co.	Toronto, Ont.	410
CJCX		Olds, Alta.	400
CJGC	London Free Press	London, Ont.	430
CJSC	Evening Telegram	Toronto, Ont.	430
CKAC	La Presse	Montreal, P. Q.	430
CKCD	Vancouver Daily Province	Vancouver, B. C.	410
CKCE	Can. Ind. Telephone Co.	Toronto, Ont.	450
CKCK	Leader Publishing Co.	Regina, Sask.	420
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	410
CKY		Winnipeg, Manitoba	450

started to use the name 'Mahoganite' on some of their devices. This name is one of our trademarks for radio material and for panels, dials and other radio parts. Realizing that the unauthorized use of this name by others in the past may have been inadvertent, we are taking this occasion to bring to the notice of the trade the fact that we own the exclusive right to the use of the name 'Mahoganite' for radio materials and parts and that we shall look upon as an infringer anyone who uses this name upon similar products."

An attractive booklet is issued by the Atlantic Radio Electric Co., 308 South Clark Street, Chicago. The pamphlet contains illustrations and descriptions of the well-known "Bestone" radio merchandise. This line is a complete one, including everything from complete tube and crystal sets to switchpoints, variocouplers, variometers, headsets, condensers, and transformers are particularly well presented and attractively priced.

New Grid Leak

The Allen-Bradley Company, manufacturers of the Universal Bradleystat and Bradleyometer, have added another item to their line of graphite disc radio products.

The new device is an adjustable grid leak, known as the Bradleyleak, which was developed to meet the insistent demand for a high-grade, dependable grid leak. It is similar in external appearance to the Universal Bradleystat and is equipped with an adjusting knob which conforms, in general design, with the approved tapered knob now used in most radio equipment and matches perfectly with the adjusting knobs of the Bradleystat and Bradleyometer.

The Bradleyleak can be adjusted between the limits of 250,000 ohms and 10,000,000 ohms or, as usually stated, between one-fourth megohm and ten megohms. The entire range of grid leak resistance between these limits is instantly obtainable without noises, steps or jumps by simply turning the adjusting knob. It is a significant fact that all intermediate values of resistance can be accurately obtained at any time which is a feature not often found in many types of adjustable grid leaks.

The base of the Bradleyleak is recessed to receive a small fixed condenser which is furnished as an extra attachment if desired. The grid condenser is accurately adjusted to a capacity of 0.00025 microfarads.

"Battery Charger"

(*Continued from page 28*)

directly to the alternating current mains and the secondary directly to the rectifier. The voltage of these toy transformers is usually adjustable, so that the rate of charging may be regulated by the controlling switch on the secondary of the transformer. This method will charge the battery faster, and is much more efficient.

New Crosley Factory

In order to meet the demand for Crosley-made radio receiving sets, Powel Crosley, Jr., president of the Crosley Manufacturing Company, has purchased the four-story factory building now occupied by the Thomas J. Corcoran Lamp Company, on Colerain Avenue at Sassafras Street, in Camp Washington, Cincinnati. This real estate transaction involving more than $150,000, surely meets the question of whether the radio industry is an established business or a passing fad, for preparations are being made to manufacture nearly 5,000 radio receiving sets every day in this new plant which will be ready for occupancy by early spring.

The large building will house, in addition to the general offices, manufacturing and assembling departments of the Crosley radio products, the radio broadcasting station, WLW, which will have all of the latest improvements of this particular field in the radio world, making the station one of the finest in the world.

There is a floor space of over 100,000 square feet in this new four-story building, as compared with 30,000 in the present Crosley factory, at Alfred and Colerain, and this large space will be fully utilized with the manufacture of radio receiving apparatus. It is the intention of Mr. Crosley to manufacture radio parts in the present building and to use the new one for the making of the complete outfits. There is a B. & O. and Southwestern Railway company siding which goes to the plant, facilitating the shipping of the raw and finished products.

Reinartz Adaptions

(Continued from page 6.)

Queer as it may seem, the use of radio frequency amplification with the Reinartz circuit is not always according to "Hoyle," but if care is exercised in constructing the set, the results are particularly gratifying.

The reversal of the reactance coil marked "x" in the diagram is often necessary when a second tube is added for radio amplification, but is a matter of experiment. One experimenter winds the entire Reinartz inductance on a 3-inch cardboard tube according to the regular specifications, but instead of placing the plate coil winding "x" alongside of the antenna coil, winds it on a separate smaller tube and inserts it inside of the larger coil. The winding should be in reverse direction to the larger antenna grid coil. The circuit shown makes use of the tuned impedance type of radio amplification, which is highly efficient in covering a large band of waves.

Figure 4 shows the method used by an English amateur who uses the Reinartz hookup for obtaining the best results with radio frequency amplification. With the exception of a few changes in constants it is practically the same as that of Figure 3. He, however, uses only 1 B battery, and gives the following specifications for the winding of the coils.

The entire coil is wound with No. 22 DCC on a 3-inch tube. Ten turns are first wound with taps at every turn. The tenth tap connects to the potentiometer and ground. Twenty additional turns are then wound and a tap is taken off for the grid switch, then fifteen more are wound, and last the coil is completed with fifteen more, making the total number of turns from the tenth tap of the antenna coil to the last grid tap fifty turns.

The plate coil should consist of 40 turns of the same size wire wound on a smaller tube, in the opposite direction to the antenna-grid coil. This smaller tube is inserted at the antenna end of the larger coil, as mentioned before.

The auto transformer coupling arrangement consisting of 36 turns of No. 16 wire on a 3 inch tube should be placed at right angles to the grid inductance, and as far away as possible to offset any inductive effects which might exist.

If an audio frequency amplifier is added, it is necessary to leave the phones connected in the plate circuit of the detector, in order that the phone resistance may act as an impendance.

The writer hopes that these suggestions may develop some successful long distance receptions with two tube Reinartz sets, and would be pleased to hear from fans with regard to any new kinks or wrinkles they may chance to discover in working out these circuits.

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You cannot always get Radio Age on the news stand. Dealers sell out in a hurry. As we were about to go to press for this issue we were still receiving telegrams and letters from dealers asking for new supplies of the January issue. (Did you read that now famous wave-trap article on tuning out interference—four pages of information with ten crystal-clear illustrations?) If you are a subscriber we insure delivery each month.

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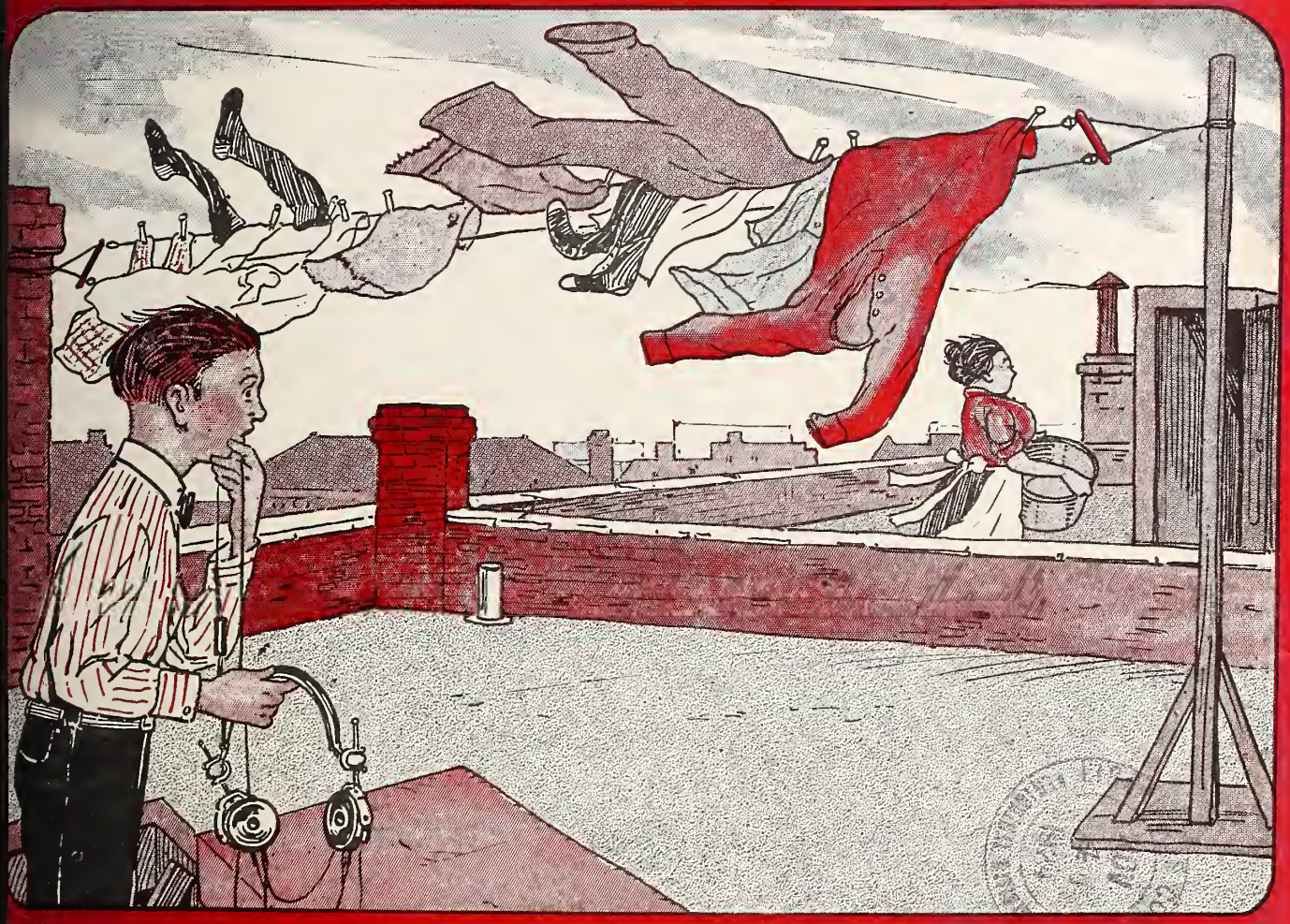
The Magazine of the Hour

MARCH
1924



In This Number

Kopprasch Circuit—Isometric drawing—Fully described. Super Heterodyne—Another fine Pearne article. Winding Heterodyne Transformers—A Rathbun feature. The Simplifigon Receiver—Text and drawings by Anderson. Complete corrected list of Broadcasting stations. More good hookups.

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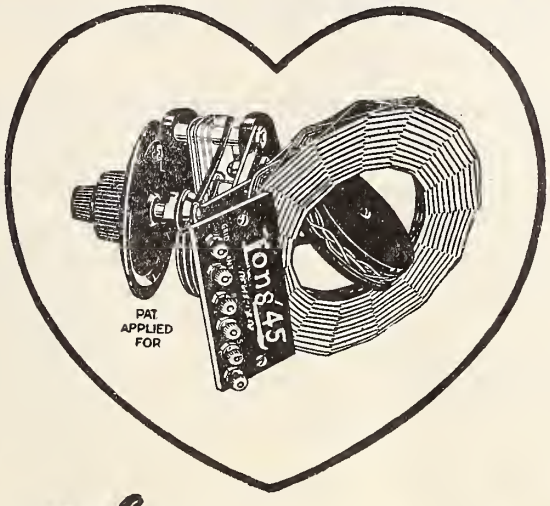

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RADIO AGE

The Magazine of the Hour

Established March, 1922

Volume 3 *MARCH, 1924* *Number 3*

CONTENTS

Radio Age is published monthly by
RADIO AGE, Inc.

Publication office, Mount Morris, Ill.
Editorial and Advertising Offices, Boyce Building,
500 N. Dearborn St., Chicago

FREDERICK SMITH, *Editor*
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17 West 42nd Street, New York City
Telephone, Longacre 1698

Advertising forms close on the 15th of the month preceding date of issue

Issued monthly. Vol. 3, No. 3 Subscription price $2.50 a year.
Entered as second-class matter September 15, 1922, at the post office at Mount Morris, Illinois, under the act of March 3, 1879

What Readers Teach Us.

THOUSANDS of readers of RADIO AGE have written to us in the last sixty days ordering back copies of the magazine. Many of them wanted numbers dated back in the early part of 1922. In fact our supply of many of the issues desired has been exhausted. Most of the letters have specified the particular article in the back number which the reader desired.

Those letters, therefore, have been an education to the editor. He has learned that radio fans are more interested in some circuits than they are in others. He has ascertained what a majority of readers are striving to make, or to understand.

The result of all these letters will be reflected in the coming issues of RADIO AGE. We have already responded to the information thus obtained by presenting particularly good articles on the Reinartz, the Kopprasch, the Four Circuit Tuner, the Single Tube, the Selective Crystal Detector, the Heterodyne and various other hookups. In this number will be found good drawings and helpful information relating to the Heterodyne, the Simplifigon Coil, the Kopprasch and other circuits in which *we know* the radio public is keenly interested.

For those who were too late to obtain desired back numbers we have prepared a book called "Radio Age Annual for 1924," which contains a collection of the best hookups and drawings published in RADIO AGE. This book is being sold by the thousands because, like the magazine, it presents radio problems and solves them in a manner that is clear, accurate, comprehensive AND ORIGINAL.

Frederick Smith

—Editor, RADIO AGE

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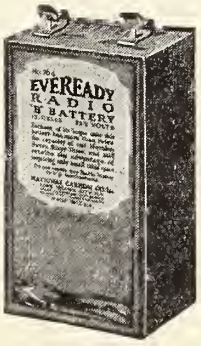

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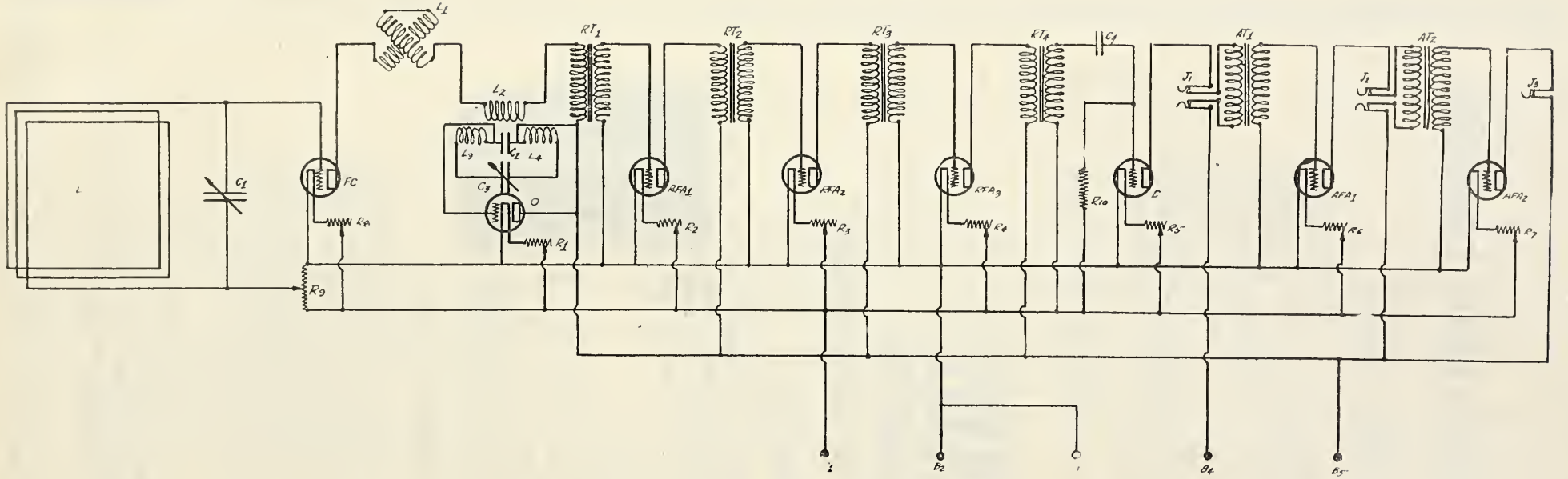


Figure 1. An eight tube Super-Heterodyne of unusual merit, which will give a consistent loudspeaker range to almost any station in the United States. Mr. Pearne describes the construction, principle and operation of this receiver in detail in the accompanying article. The legends have the following values in the circuit:

L—Loop
L1—Variometer
L2—5 turn Oscillator coil
L3—35 turn Oscillator coil
L4—25 turn Oscillator coil
C1—17 plate, .00035 MFD Vernier
C2—Fixed Condenser .001 MFD
C3—23 plate, .0005 MFD Vernier
C4—.00015 MFD Fixed Condenser
R1, 2, 3, 4, 5, 6, 7, 8, 25 Ohm Rheostats
R9—200 to 400 Ohm Potentiometer

R10—Interchangeable Tubular Grid Leak. 1-10 Megohms
RT1, 2, 3, 4, Iron-cored Radio Frequency Transformers
AT1—Audio Transformer 4:1 ratio
AT2—Audio Transformer 6:1 ratio
J1, J2—Two circuit jacks
J3—Single circuit jack
B1—Binding Post, A battery positive
B2—Binding Post, A battery negative
B3—Binding Post, B battery (22½ volt) negative

B4—Binding Post B battery (22½ positive) and 90 volt negative
B5—Binding Post B battery 90 volt positive
FC—Frequency changing tube
O—Oscillator tube
RFA1, 2, 3, Radio Frequency amplifying tubes
D—Detector tube
AFA1, 2—Audio Frequency amplifying tubes

RADIO AGE

"THE MAGAZINE OF THE HOUR"

M. B. Smith
Business Manager

A Monthly Publication Devoted to Practical Radio

Frederick A. Smith
Editor

Constructing the Superheterodyne

The Most Sensitive Receiver in the World

By FRANK D. PEARNE

THERE are many radio enthusiasts who ask to know what is the best kind of a receiver to build, regardless of cost, the idea being to get the greatest possible reception. The answer to this question is the "Superheterodyne." This circuit is without doubt, the most sensitive and best long-distance getter of all. This fact is conceded by most of the radio experts of this, and other countries and for the man who cares not for the cost but wants the best, it is always recommended. It may require more practice to learn just how to tune it and there are more controls necessary than those required in most receivers, but when properly constructed, one may feel sure that he can get any station which is on the air within a range of two or three thousand miles and they have been known to reach as far as seven thousand miles.

How it Operates

The current produced in the loop aerial by the cutting of the lines of force carried to it on the wave from the broadcast station will have the same frequency as that sent out by the transmitter. These frequencies from different broadcast stations will range from 500,000 cycles of the 600 meter wave, to 1,200,000 of the 250 meter waves, which are of course too high to be detected by the human ear. In the usual course of events this wave would appear as shown at "A" in Figure 2. The changes which take place in the amplitude of this wave is really what produces the sound in the phones, or loud speaker. It must be understood that the frequency of the wave remains the same, but that sounds striking the diaphragm of the microphone at the broadcast station, merely change the height, or amplitude of the wave. An example of just how this change, or modulation of the wave takes place is shown in Figure 3. This is the modulation which occurs when the letter

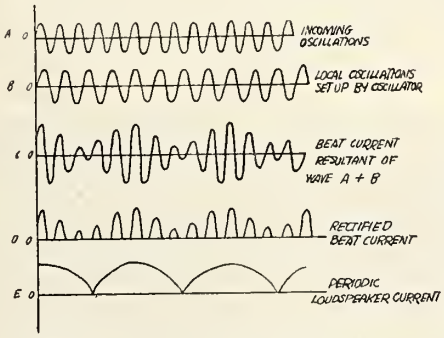


Figure 2. This illustration shows in chart form the action of the Super-Heterodyne receiver described herewith. At A, we have the incoming wave as radiated by some transmitting station. Upon these oscillations, oscillations generated by the oscillator tube of the set are superimposed. The local current is of slightly different frequency, as shown at B, and the combined frequencies A and B result in a so-called "beat" current shown at C. This beat current is sent through the radio frequency amplifiers and is tremendously amplified, effecting a much greater current to be rectified by the detector than would ordinarily be obtained. The detector permits the oscillations (or amplified beat current) to pass only in one direction, and the signal takes the form of the wave shown at D. The signal, in the form of a pulsating direct current shown at E, is then transposed into mechanical energy by the loud speaker.

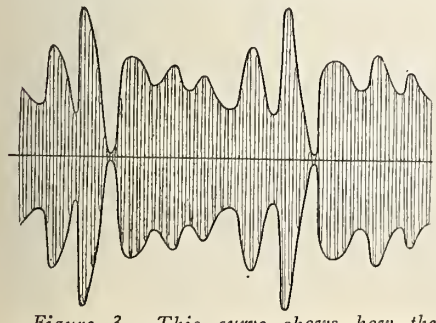


Figure 3. This curve shows how the transmitting station's wave is varied in amplitude when the letter "A" is spoken into the transmitter.

"A" pronounced as in "father" is spoken in front of the microphone.

It will be noticed that the frequency remains unchanged, but the tops of the different oscillations are cut off according to the vibration of the microphone diaphragm. Figure 4 shows the same modulated wave after it has been rectified by the detector.

From this it will be plainly seen that the oscillations occur entirely too fast to affect the diaphragm of the receiver, but after they are rectified, as shown in Figure 4 it becomes a varying direct current, which varies according to the shape of the peak of the rectified current and this current being direct in its nature, will vary the diaphragm of the head phones, or loud speaker and cause it to reproduce the sounds produced in front of the microphone.

Now, in order that signals, music, etc., may be heard from a great distance, it is necessary to amplify them, or build them up to a greater strength than that at which they are impressed upon the loop. This is best done before they are rectified for the reason that no distortion takes place when they are amplified in their original form, or rather at the frequencies which are too high to be heard by the ear. This is called radio frequency amplification and by its use the strength of the incoming signal may be built up to such an extent that signals which are entirely too weak to be heard with an ordinary detector alone are magnified to an enormous strength before they are rectified and brought down to audio frequency, or in other words made audible in the phones. Here, however, is where the first serious difficulty is encountered. There are several methods of radio frequency amplification, the most popular being the transformer method.

Every radio frequency transformer has what is known as a fundamental wave length of its own, which means that there is one particular frequency at which it will work at very high efficiency, this efficiency falling off rapidly as the frequency varies from the fundamental. Various methods of changing this fundamental wavelength have been suggested, for the reason that so many different frequencies are used by broadcast sta-

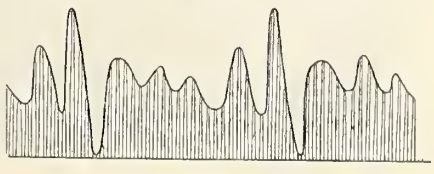


Figure 4. The same curve as illustrated in Figure 3, after being rectified by the detector tube of the set.

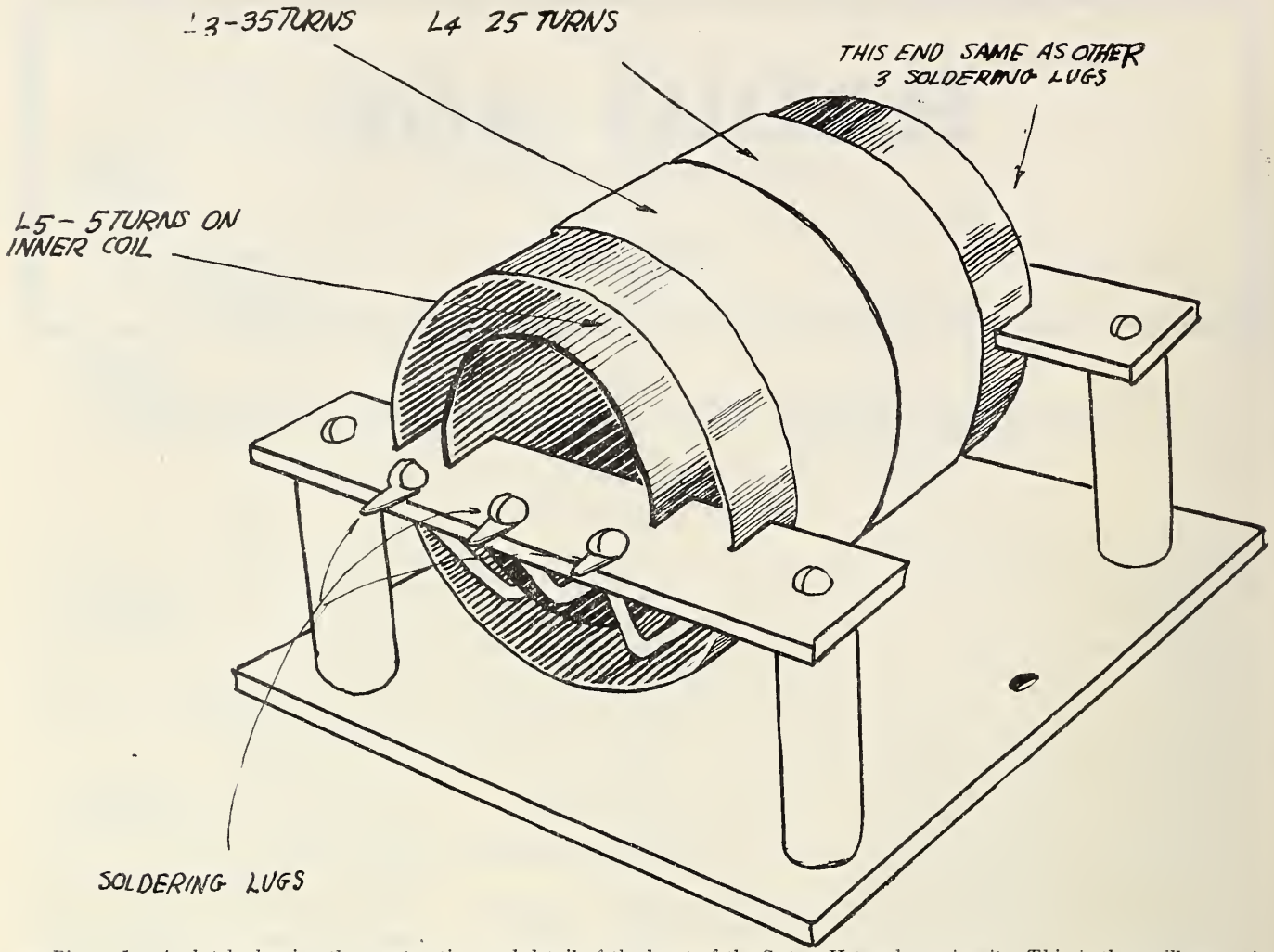


Figure 5. A sketch showing the construction and detail of the heart of the Super-Heterodyne circuit. This is the oscillator unit, which consists of one 25 turn coil, and one 35 turn coil, wound side by side on the same form, and the coupling coil (L5) wound on a tube of smaller diameter placed inside of the larger. The unit is mounted by slotting two pieces of bakelite as shown and inserting the coils. The entire unit is then mounted upon a bakelite or hard rubber base, and is securely bolted together upon four legs. The two end pieces, acting as supports for the tubes, also serve the purpose of a mounting for the connectors.

tions and in order that reception from any and all of them may be obtained at equal efficiency, it would be necessary to change this fundamental wavelength of the transformer to meet the particular frequency of the desired station. Such an arrangement is not very satisfactory as it is always found that one certain wavelength will be received much better than any other.

How Heterodyne Works

This is where the wonderful efficiency of the superheterodyne set solves the problem. Instead of varying the wave length of the radio frequency transformers the frequency at which they work most efficiently is ascertained and the frequency of the incoming wave is changed to that particular frequency, so that no matter what may be the length of the incoming wave, it is always the same frequency when it reaches the radio frequency transformers and consequently they always work at their greatest efficiency, regardless of the frequency of the incoming wave.

At first thought, it would seem that such an arrangement was impossible, but it can be accomplished by means of a local oscillator circuit which produces a frequency which may be varied at will. These local oscillations are super-imposed upon the incoming oscillations and the result of this combination is a "beat" wave which will have a frequency equal to the difference between the two. Because of the fact that the frequency of the local oscillating circuit may be varied, a beat oscillation which has the same frequency as the fundamental frequency of the radio frequency transformers may be obtained, no matter what the frequency of the incoming wave may be.

Thus it will be seen that the radio frequency transformers always operate at the same frequency, no matter what the frequency impressed upon the loop may be, and the result of such an arrangement is a highly efficient transformation system, building up the weak signals to such an extent that when they reach the detector they are rectified at great strength after which they may be again amplified at audio frequency to get any desired volume.

By reference to Figure 2 it will be noted that "A" shows the oscilla-

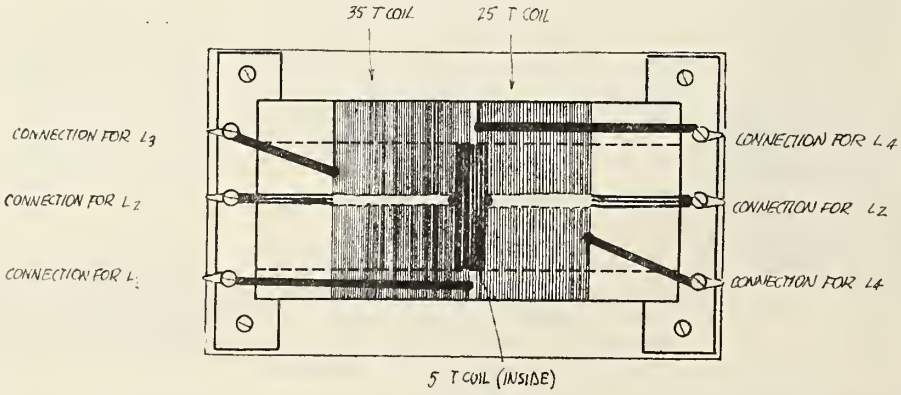


Figure 6. This illustrates the method of making the connections for the inside and outside coils of the oscillator unit. The center lug is used for the inside (L5) coil, and the two outside lugs form the terminals for coils L3 and 4 respectively.

tions of the incoming wave "B", shows the oscillations set up by the local oscillator, "C" is the resultant "beat" oscillations, "D" is the result of the beat oscillations when rectified by the detector and "E" shows the varying direct current which passes to the phones, or loud speaker.

In the circuit shown in Figure 1 the loop is tuned by means of a 17-plate variable condenser and the incoming wave is amplified by passing through an amplifying tube before passing to the oscillator. A variometer is placed between the plate of this tube and the oscillator coil. This variometer is used to control the regeneration. This oscillator coil consists of five turns of No. 22 double silk covered wire, wound in the center of a bakelite tube 1 1-2 inches in diameter and 3 inches long. The other two oscillator coils are wound upon a bakelite tube 2 1-2 inches in diameter and 3 inches long. The 5 turn coil is mounted inside of the tube carrying the two coils, by means of bakelite supports placed across the ends and slotted in the right places to allow the tubes to be held in their respective places when placed in the slots.

Assembling Oscillator

Figure 5 illustrates the method of assembling the oscillator. The 2 1-2 inch tube is wound with two coils, one having 35 turns and the other 25 turns. These two coils are wound in the same direction, the second being spaced about one-eighth of an inch from the first. Bring all terminals out inside of the tubes and connect the leads to clips which are mounted on the bakelite supports. Four brass legs are used as the main support of the oscillator. These are placed between the bakelite tube supports and the base as shown, and should be long enough to keep the coils of the oscillator at least one-half inch from the baseboard. A four-foot loop having 12 turns of wire No. 18 or larger will answer the purpose. This is wound in a solenoid form on four pieces of bakelite mounted on a frame which is made in the form of a cross. Stranded wire is to be preferred and the turns should be about one-half inch apart. A 17-plate variable condenser is shunted across the terminals of the loop as shown. The first tube, that is, the tube which precedes the oscillator is really a radio frequency amplifying tube, although some call it the first detector. This tube as well as all the rest with the exception of the detector tube should be either UV-201-A, or C-301-A.

The detector tube should be either a UV-200, or a C-300. The variometer may be any of the standard types on sale at the radio supply stores. This variometer is connected between the plate of the first tube and the 5 turn coil of the oscillator. The other end of the coil is connected to the post on the first radio frequency transformer marked "P." A .001 M. F. fixed mica condenser is placed between the two outside coils of the oscillator and a 23-plate variable condenser is connected across the two outside terminals of these coils. This is used to tune the miniature transmitting station which is formed by the oscillator.

The two outside terminals of these two coils are also connected to the grid and plate of the oscillator tube. The filament of this tube and the filament of the first tube are each controlled by a 25 ohm rheostat. From this point on, the circuit is the conventional radio frequency amplifier, detector, and two stage audio frequency circuit, all connections being plainly shown in Figure 1 and no difficulty should be experienced in connecting it up. The radio frequency transformers should have a wavelength of about 5000 meters and if any difficulty is found in procuring them, they may be made according to the method described by John B. Rathbun in an article on transformer construction in this issue.

Tuning Hint

In tuning, it will be found that if the first tube is tuned to an incoming wave and the condenser of the oscillator is adjusted so that oscillations of nearly the same frequency are set up, a beat note will be produced. If the oscillator is tuned to the same frequency as the incoming wave, no beat note will be produced. The oscillator is varied until the proper beat note frequency is obtained at which point the signal will be very strong.

MOVIES INVADE RADIO

Moving pictures were taken recently of two Chicago broadcasting stations in action. The above picture shows Norman Alley, of the International Newsreel, as he was "shooting" Jack Nelson, studio director of the Chicago Board of Trade Station, WDAP, in the Drake Hotel, Chicago. Moving pictures of this station and of Zenith-Edgewater Beach, WJAZ, are now being shown on silver sheets all over the country.

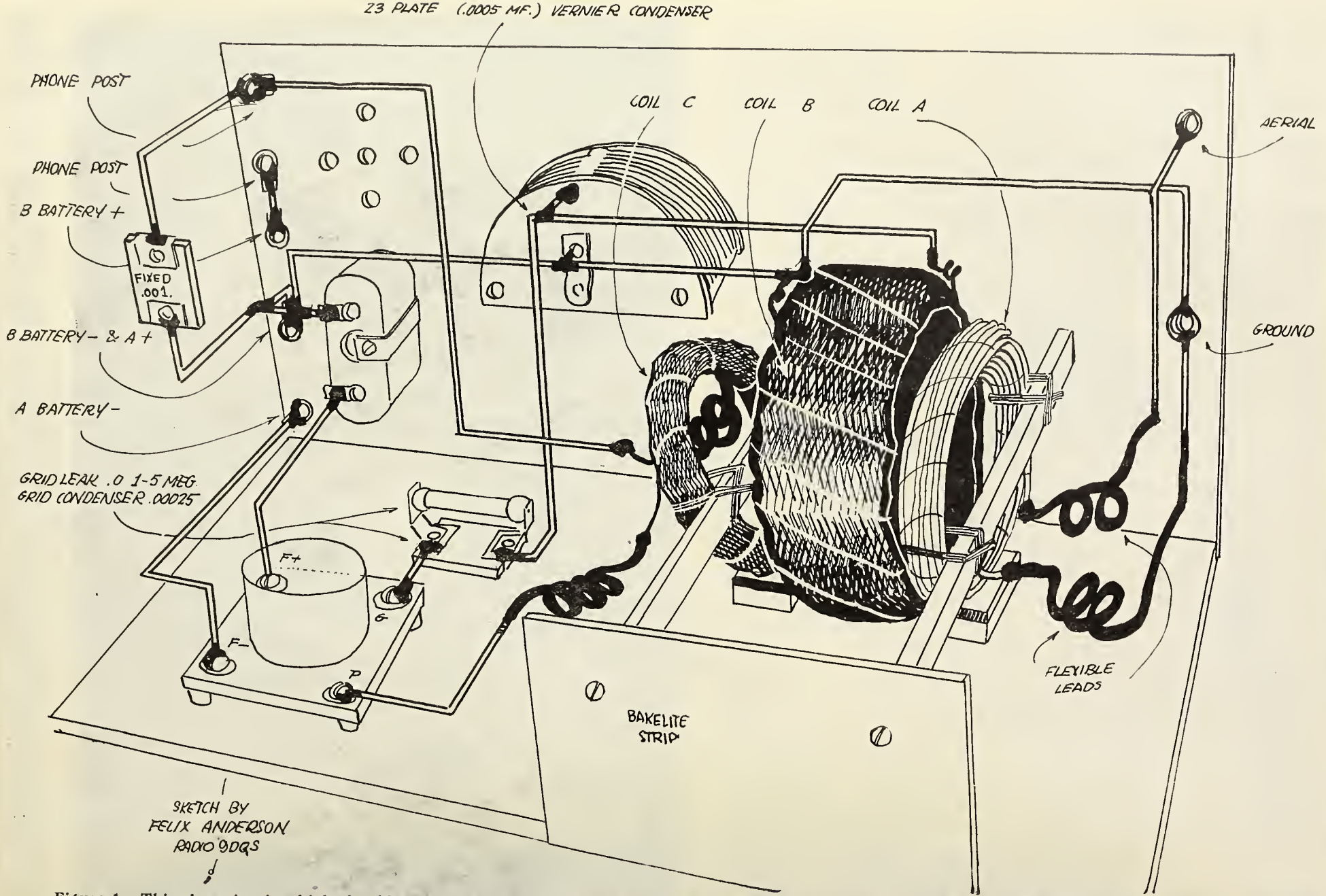


Figure 1. This is a circuit which should be of interest to the fellow who likes to make as many parts of his set as possible. Note the method of obtaining variable coupling between the coils.

How to Make a Simple Low Loss Tuner

By FELIX ANDERSON

Technical Assistant, Radio Age

IN THE course of their radio experiences, Radio Age readers have undoubtedly been afforded the pleasure of visiting the home of some fellow dial-twirler who possesses a receiver of the so called "haywire" type.

He has also probably felt the pangs of jealousy when the list of stations heard on his receiver were compared with the haywire set, and to his chagrin found that the "haywire" set beat his by a mile. In all probability he will recall that he wondered how in the world that mass of radio stuff (usually spread out on a superannuated table) could possibly work at all!

The whole secret lies in the fact that the owner of the haywire receiver in building up the set without all the customary fancy cabinets, nickel plated switches and other hardware that go with an imposing radio receiver, unconsciously eliminating many losses.

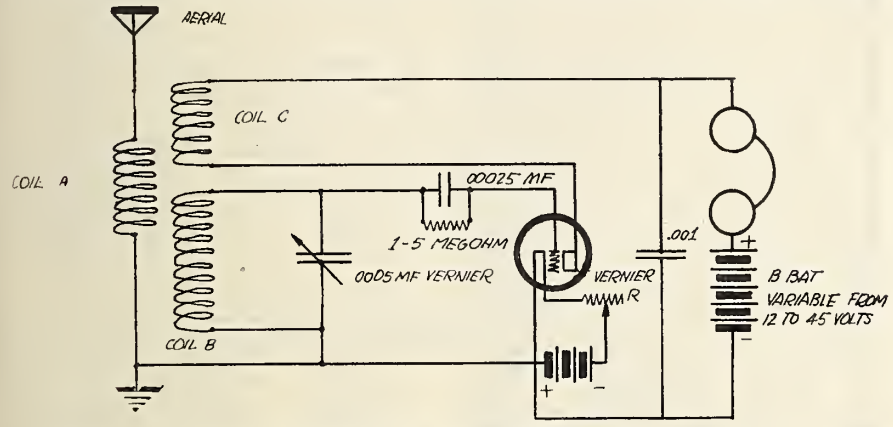


Figure 2. The wiring diagram of the Simplifigon receiver. This type of set is a very desirable one to the bug who is interested in speedy tuning, inasmuch as it has only two major controls and two minor ones. The 23 plate condenser and the tickler are about the only ones that need adjustment after the set has been adjusted in the filament and antenna circuits. Due to the fact that the apparatus is of low loss design and of small quantity the receiver will cover unusual distances.

Of late there has been a decided tendency toward better design, more carefully constructed, *simple* tuners. This movement, originating among amateur transmitting circles, and heralded by their American Radio Relay League organ, QST, has caused considerable interest among broadcast listeners. In recent papers, Mr. K. E. Hassel of the Zenith Corporation and Mr. S. Kruse, Technical Editor of QST, expound several sound rules regarding tuner design and construction, and the writer feels that these principles are so sound and logical that they will no doubt be of interest to Radio Age readers.

General Suggestions

The writer would like to give a few general suggestions on tuner design that can be applied to almost any receiver. In order to do so, it is necessary to define the meaning of a *good* tuner.

First of all, with the terrible interference we are subjected to, we want a tuner that will tune sharply. And we need it badly. Second, we want a tuner that will cover all the waves of the broadcasting stations, namely from 225 to 546 meters. Third, a tuner that will not reradiate and interfere with the reception of our neighbors. Fourth, be simple and with a few major controls. Fifth, be of reasonable cost, and easily constructed. Sixth and last, be reliable so that when a station is once logged it can be heard at will upon properly adjusting the controls to the proper values.

Resistance in Tuning Circuits

To make a tuner that will tune sharply, we must make one that will have little or no resistance in the tuning circuits. Resistance in circuits is something that almost every builder has been "ducking." Tubes, needless controls, dizzy circuits and more amplification stages are added in an effort to evade this problem. *It can't be done!* You can't build a perfect tuner without resistance of some kind or other, but there is at least the consolation that you can build it with as little as possible of resistance. Interference grows worse every day, and the ultimate thing will be to build a tuner with a low resistance, tuned circuit. Just remember that. Whether you are building an eight tube super-heterodyne or a simple first tube circuit, keep the resistance of that circuit as low as you possibly can. Your reward will come later in the form of a sharp tuning, real DX receiver.

How to Keep Resistance Down

Permit us to point out just where the trouble can be found. First of all we can cut down the resistance of our coils by winding them with air insulation. A good example of this type of air insulated coil is the Reinartz coil (the success of the Reinartz set will testify to that) or else the basket-weave variometer. If you must wind the coil on some form, it is highly desirable to wind them on a common *dry* cardboard tube. Laboratory measurements actually show that dry cardboard tubing has lower losses than some of the more expensive materials found in commercial receivers. The tubing can be carefully dried in an oven, and to render it permanently moisture proof, it is a good plan to "dope" it with a good lacquer or aeroplane dope, such as is used on airships. A good mixture is acetone, with a quantity of celluloid dissolved therein. When winding coils, the resistance can further be cut down by winding them with large sized wires (not larger than No. 12 and not smaller than 20 for use in the tuning circuits) and by spacing the wires slightly more than the insulation affords. This spacing will cut down the distributed capacity, which is responsible for the broadened tuning of the set. Solid wire should be used in all cases.

Avoid heavy varnishes and shellacs, and bind them into place instead of glueing them down with some highly resistant varnish. Use rosin for soldering, and keep the coils fully two inches clear of all other units of the receiver. This includes panels, rheostats, condensers and cabinet. A fan will often wonder why his set will work wonderfully outside of the cabinet, but the instant it is replaced will seem to lose its pep. The cause is due to the resistance which is coupled into the coil by the presence of a cabinet that is too small.

Connecting resistances into the circuit is another defect often found in receivers. It is a wise plan to use tube sockets of good insulating material, and to avoid the use of "moulded mud" camswitches or other switching devices. Avoid switches in the tuned circuit entirely. A porcelain socket is excellent if obtainable. Tapped coils in the tuned circuit is always bad business. If it is possible, wind the coils to cover the entire wave-

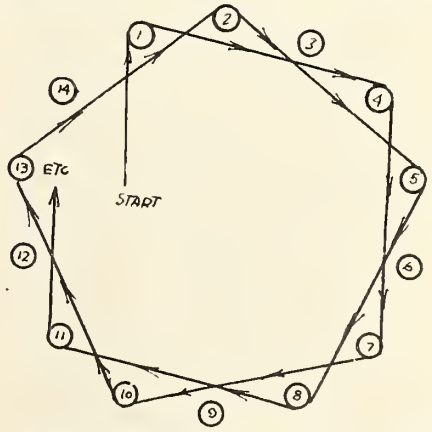


Figure 3. This illustrates the method of winding coils A and B used in the Simplifigon circuit. Fourteen steel pegs are driven into board in a circle (dimensions given in accompanying article) and the wire is wound around as illustrated until the required number of turns have been wound. This type of winding and mounting is applicable to any circuit making use of coils. You can even wind your own honeycombs by this method.

length suited, and if this is not possible, add an exterior loading coil placed at a good distance away from the main tuner. When running leads from the high side of the coil to the stationary plates of the condenser, and from there to the tube, run them high up in the air. Don't run the wiring of any grid circuit too close to the mounting board.

Condensers

The most important and probably most overlooked factor in making a close tuning receiver is the proper condenser. The market is certainly flooded with a lot of rotten condensers, and a great many fans have been duped into buying them because of their fancy vernier adjustments and frills.

You might have an excellent coil from a resistance standpoint, but the entire effect is lost when a rotten condenser is used. In general, a really good type of variable condenser is one of the air insulated type, with the insulating dielectric so placed that it is out of the electrostatic field as much as possible. The leakage paths should be so arranged that the current lost will have to travel over long paths, which means that the stator bolts should be as distant from the rotor bearing as possible. This material should not be too thick and wide. Where insulating bushings are used, they should be large and spool shaped, so that only the rims will touch. The use of thin insulating washers or bushings of small diameter is not good practice.

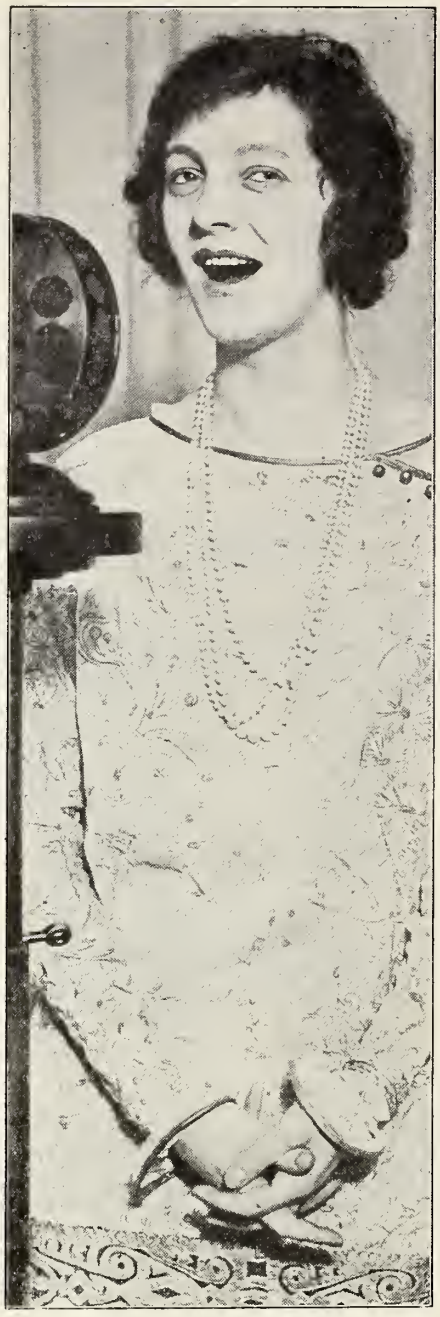
The insulation of the condenser should be of good hard rubber, pyrex glass or other similar insulator of high dielectric properties. Composition insulation is never to be trusted. Sheet bakelite, while not as poor as moulded composition or fibre bases is only average in insulating value as far as a good condenser is concerned.

A metal end plate condenser is very good, but care should be exercised in purchasing a condenser of this type to see that this metal end plate is not connected to the stationary plates of the condenser. The reason for it is this: It is always advisable to connect the "high" or grid leads to the stationary plates of the condenser. If the end plates are connected to these stationary plates you are going to have trouble in tuning due to "body capacity." The rotary plates should always be connected to the filament circuit when used as a secondary control, and when used in either antenna or ground, the rotary plates should go to the aerial or ground respectively.

Most condensers use hard rubber end plates, however, and the mounting screws are fastened thereto. Do not use a condenser with a separate vernier condenser, as the losses will be almost as high as in the main condenser. A friction or geared vernier is the best possible vernier that can be used. Choose one with a smooth, even adjustment.

Shielding of the panels or shafts is not good practice; it is often worse than needless. If a tuner is properly constructed with the stationary plates connected to the high voltage side (grid) of the circuit, no shielding will be necessary.

Fellows often complain that their sets will not work inside of the cabinets, which is only the rule that coils must be kept clear manifesting itself.



SANG TO PRINCE

Miss Gertrude Lawrence, of Charlot's Revue, the London production now playing at the Times Square Theater, New York, pictured singing to the microphone of radio broadcast station WEAF at 65 Broadway. Miss Lawrence cabled the prince that she was to broadcast and received word from him that he would listen in.

Amplifiers

Two stages of audio frequency amplification should certainly be sufficient to bring in the stations of average distance on the speaker; and will if the tuner is constructed to give a good, clear and loud signal to be amplified. The transformers should have a ratio of about 4:1 for the first stage and 6:1 for the second. Ratios higher than this only serve to distort the signals, and really do not offer any gain in volume when the signal is not clear.

A Simple Circuit

Summing up all these requirements and limitations on various radio accessories, we find that if we observe the above rules on any type of tuner the results will be pleasant.

The ear is a very poor judge in the matter; it is too sluggish to compare or notice small differences made in eliminating losses. If we took a tuner and eliminated three per cent of the losses, we would not notice any appreciable change in signal strength, but suppose we made 10 such changes, eliminating nearly thirty per cent of the losses, it would certainly make you sit up and wonder why you didn't do that before.

Now if we make a tuner incorporating the above requirements, we will have a tuner that incorporates close tuning properties, substantial range, and reliability. It is entirely possible to make a tuner that includes the remainder of the definitions.

We don't want to couple the set directly to the antenna, as in the case of the ancient single circuit receiver, because even if we make a wonderfully efficient tuning circuit, we spoil it all by coupling a highly resistant broad tuning part of the receiving system to the set. This explains the broadened tuning of the single circuit receivers. However, we can couple it loosely, and let the antenna act aperiodically as a collector only, and not as a part of the tuning circuit. If we do this, we also reduce the nuisance of reradiating receivers, as a circuit of this type is not so strong an oscillator.

The Simplifigon

With the requirements above mentioned in mind, we will proceed to build a tuner that will incorporate all these desirable qualities. The circuit shown in Figure 2, after a close glance, appears to be a "conglomeration," as Jack Nelson would say, of the single circuit receiver, the Reinartz, Haynes and a few others. We can't call it either or any of them, so for purposes of easier reference we will call it the "Simplifigon." Simplifi for the simpleness of it and the gon for old times' sake.

The circuit is the suggestion of Mr. K. E. Hassel, and the mounting is a compound idea of Mr. Perry O. Briggs, Rado 1BGF, and the writer.

Construction

Before we construct, of course, we will need our parts, which are as follows:

1 7x14 Bakelite or Formica Panel.
1 23 plate, .0005 vernier condenser with gear or friction vernier.
1 Rheostat to suit tube used, vernier type.
1 Tube socket.
1 Grid condenser .00025 MFD.
1 Phone condenser .001 MFD.
1 Grid leak tubular type, interchangeable.
70 feet of No. 16 DCC wire solid copper.
16 feet of No. 18 Annunciator (bell) wire.
Two feet flexible lamp cord.
Waxed string, mounting board, binding posts, bus bar, and two hardwood

(Continued on page 17)

Junior Heterodyne Transformers

By JOHN B. RATHBUN

SHORTLY after the January number of RADIO AGE was issued, the office was in receipt of many letters and telephone calls requesting information on the subject of the long wave radio frequency transformers necessary for the Junior Super-Heterodyne. Such transformers were at that time difficult to locate, and owing to the Radio Corporation taking the UV-1716 off the market, the heterodyne constructors were at a loss as how to proceed. In many cases, we advised the use of the UV-1714 on a wave length of 3,000 meters, necessary changes being made in the two coupling coils to accommodate the lower wave length. This, however, was not entirely satisfactory as there was a pronounced "feedback effect" through the plate-grid capacity on this wave length, and a greater tendency toward self-oscillation in the tubes. The recommendation was simply made so that the enthusiastic builders could get on the job at the earliest possible moment.

It will probably be good news to the majority of readers to know that the transformer situation is clearing up and that in a short time that there will be a number of heterodyne transformers placed on the market. Both iron core and air core types are represented by these makers, and a wave length range from 3,000 to 25,000 meters is offered.

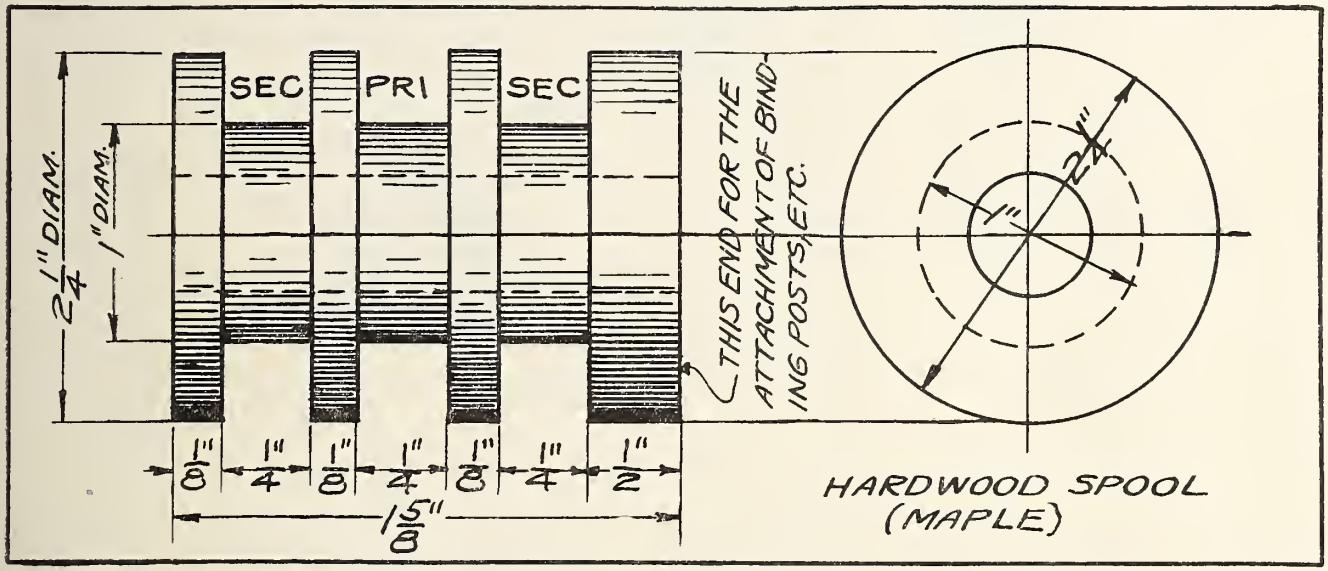
One great trouble with the commercial transformers of the present time is that the old radio frequency practice of a wide wave length band is followed, and this is not the proper characteristic of a heterodyne transformer. For example, a wave length range of from 5,000 to 25,000 meters in a single transformer lowers the possible amplification. According to heterodyne theory, such transformers should be rather sharply tuned so that a fairly narrow peak of amplification is shown. This is, of course, best attained by the use of air core type transformers since the introduction of a metal core tends to broaden the wave length band and introduces other difficulties as well.

So far as the hookup itself is concerned, it makes no difference whether the system operates at 3,000, 5,000 or 10,000 meters except that the size of certain units are changed. The connections are just the same in all cases, the difference lying in the number of turns of wire on the coils and the capacity of the condensers. As to the relative performance on different wave lengths, there is a great diversity of opinion at the present time but I note with satisfaction that there is a decided tendency toward wave lengths as great as 10,000 meters. At such high wave lengths there is little tendency toward capacity coupling between the various radio stages, less interstage coupling within the transformer itself, and less trouble with tubes that are mysteriously inactive. At 3,000 meters, the frequency is still high enough to cause appreciable capacity effects between the grid and plate of the tubes.

It is interesting to note that 10,000 meters corresponds to a frequency of 30,000 cycles per second, and that this frequency is only a little above audio frequency. For this reason, iron core transformers are more effective at 10,000 meters than at longer wave lengths since a deeper magnetic penetration is had in the core iron without extreme subdivision of the iron. Give us a long enough wave length and we can employ audio frequency transformers in place of radio frequency types, and on frequencies approximating 15,000 cycles per second the use of audio transformers is entirely feasible. It has often been the desire of the writer to experiment with the very low frequencies, just above audibility, using standard types of audio frequency transformers for the purpose.

Transformer ratios of the long wave transformers is a variable quantity among commercial types, ranging from a ratio of 1 to 1, to 4 to 1 or even higher. Whether the higher ratios are justified is still a matter of experiment, but it may be said that a ratio of unity (1 to 1) is quite satisfactory, and the ratio permits of smaller units and coarser wire in both the primary and secondary coils. This gain due to the reduction in electrical resistance somewhat offsets the gain due to the high ratios. There has been much discussion on the subject of the proper ratio, and this is not yet settled so far as the average builder is concerned.

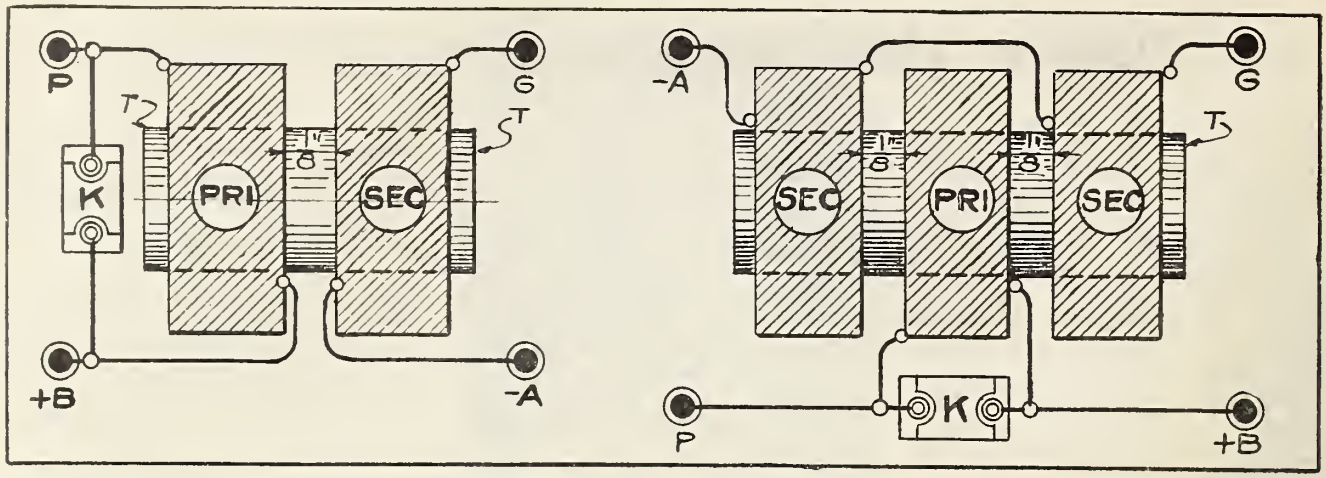
From various experiments performed in Chicago, it would seem that impedance coupling has many desirable qualities, not alone from the standpoint of cost but from the performance as well. In this form of coupling a single inductance coil is used, usually a honeycomb, with a fixed condenser connected across the outer ends of the coil. This is small and compact and it certainly functions well.



The size of the coil and the condenser depends upon the frequency determined upon and is easily and cheaply built by any constructor. The "tuned impedance" is connected to the plate circuit of each stage of radio frequency, one coil per tube, with the remaining end connected to the positive "B" battery connection (*B). A small condenser is connected in the line running between the plate and grid of adjacent tubes to prevent the "B" battery current from paralyzing the grids.

In the following table is given the size of honeycomb coil and the size of the shunted fixed condenser required for the various wave lengths.

Size of Honeycomb in Turns	Size of the Fixed Condenser	Wavelength in Meters
200	0.001	2,870
250	0.0005	2,800
250	0.001	3,910
300	0.0005	3,490
300	0.001	4,900
400	0.0005	4,400



500	0.0005	5,750
500	0.001	8,070
600	0.001	11,600

To insure proper operation, all of the units should be carefully adjusted so that the impedances are as nearly equal in each stage as it is possible to make them. Testing each unit with a wavemeter is the surest method.

Honeycomb Coil Transformers

Very frequently the transformers can be easily built at home and good results can be obtained if the work is carefully conducted. The cost is very much lower, and this is a great factor when three or more stages of radio frequency amplification are used. Of these homemade devices, the honeycomb coil transformer is the most easily built since suitable honeycomb coils can be easily obtained on the market and can be quickly assembled. Very good results can be had.

Figure 1 shows how the two coils constituting the primary and secondary are placed side by side and mounted on a cardboard mailing tube. About one-eighth inch separation is allowed between the coils, but this is not a critical value. A fixed condenser (K is connected across the ends of the primary coil only to increase the natural wave length of the coil and to reduce its size. The number of turns in the primary and the corresponding size of the condenser K) for a given wave length can bedetermined from the table of impedances just given. In this case, where both coils are of the same size, the transformer ratio is of course 1 to 1, but if a higher ratio is desired the number of turns in the secondary can be increased but the size of the primary remains unchanged as this depends upon the wave length.

The terminals of the coil are marked as usual for the grid (G), the plate (P), the negative "A" (-A), and the (+B) battery connections. The grid connection (G) should be taken from the outside turn of the secondary winding. The wire should be No. 28 D. S. C. as is usual with the commercial coils of this size, but No. 30 gage can be used where the coil is to be reduced to its smallest possible dimensions. The paper tube, (T) is the only core, no iron being used. In assembling this transformer care should be taken that the direction of the turns is the same in both coils.

When a two to one ratio is required, we can either have a secondary coil with twice the number of turns, or else employ one primary coil with two equal secondaries mounted on either side of the primary, the two secondary coils being connected in series. This construction is shown by Fig. 2 where the primary coil (PRI) is sandwiched in between the two secondary coils (SEC). The secondaries are connected in series by the bridge wire (M) and particular care must be taken so that the windings of the coils are in the same direction. If this is not done, then the coils will "buck" one another and no transformation will take place. The fixed condenser (K) is connected across the primary coil as usual, and the size of this coil and the condenser are determined by the wave length table as before. This is a very bulky and rather expensive construction.

A more compact winding, particularly adapted to wave lengths above 5,000 meters where many turns are required, is the "spool type" transformer of Figure 3. This spool contains three grooves, the center groove containing the primary winding while the two outer grooves contain the two halves of the secondary winding. The secondaries are connected in series as in Figure 2, and needless to say, all coils are wound in the same direction. No tuning condenser is used for the primary coil as the natural wave length of this coil alone is sufficient to bring the wave length up to 10,000 meters without the aid of the condenser. As each half of the secondary contains twice as many turns as the primary, it is evident that the total transformer ratio is four to one.

The primary winding in the center groove consists of 500 turns of No. 30 D. S. C. wire. Each of the secondary coils in the two outer grooves consists of 1,000 turns of No. 36 D. S. C. wire making a total of 2,000 turns in the primary and giving a total transformer ratio of four to one.

After these coils are wound, and the outer ends are fixed by a dab of sealing wax we can place them within a metal container or else place them within a metal tube for protection and shielding. The four ends of the coil are then brought out to the binding posts after the two secondary coils have been connected in series as shown by Figure 2. To connect the coils of the secondary in series, the inside end of one of the outer coils is connected to the outer end of the other outside coil. Care should be taken to mark the outside end of the secondary by (G), thus indicating that this end goes to the grid of the following tube. This is important as the capacity effect is much less when connected in this way than when the inner end is connected to the grid.

One end of the central primary coil (+B) goes to the positive "B" battery while the other end (P) goes to the plate of the preceding tube. It is likely that the best results are obtained if the outer end of the primary is connected to the plate.

Of course this compact construction or spool wound transformer can be made for other wave lengths, but owing to the comparatively great amount of distributed capacity in a winding of this sort, it is not so effective on the shorter wave lengths as the honeycomb type of coil. It should be remembered that the capacity effect increases rapidly with a decrease in wave length or increase in frequency, and what might prove perfectly correct at 10,000 meters will not be efficient at 3,000 meters. When a number of turns are wound over each other in layers as in the last type of transformer, each turn acts as a plate of a condenser in regard to an adjacent turn, and this capacity between turns becomes an appreciable effect on wave lengths below 10,000 meters. Winding the turns in zigzag fashion as in honeycomb coils greatly reduces the capacity of the winding as succeeding turns are not parallel but cross each other at nearly right angles.

To insure proper insulation, the transformers should be carefully dried out in a moderately warm (not hot) oven until all moisture is expelled from the wire covering. They can now be slipped into their casings and seal up moisture tight. A metal casing such as a brass tube is desirable since it greatly reduces the stray field set up by the transformers and thus prevents inductive disturbances in the circuit. As an additional insurance against this "coupling" by the external field, adjacent transformers should be turned at right angles to each other, and separated by as great a distance as possible with the space allowed. It is well to follow neutrodyne practice in regard to the spacing of the tubes and transformers in the receiving set, keeping the tubes and transformers well apart to prevent coupling between the radio frequency stages.

A Tuned Radio Frequency Amplifier

Will Increase Signal Volume, Selectivity and Receiving Range of Any Standard Receiver

By J. A. CALLANAN

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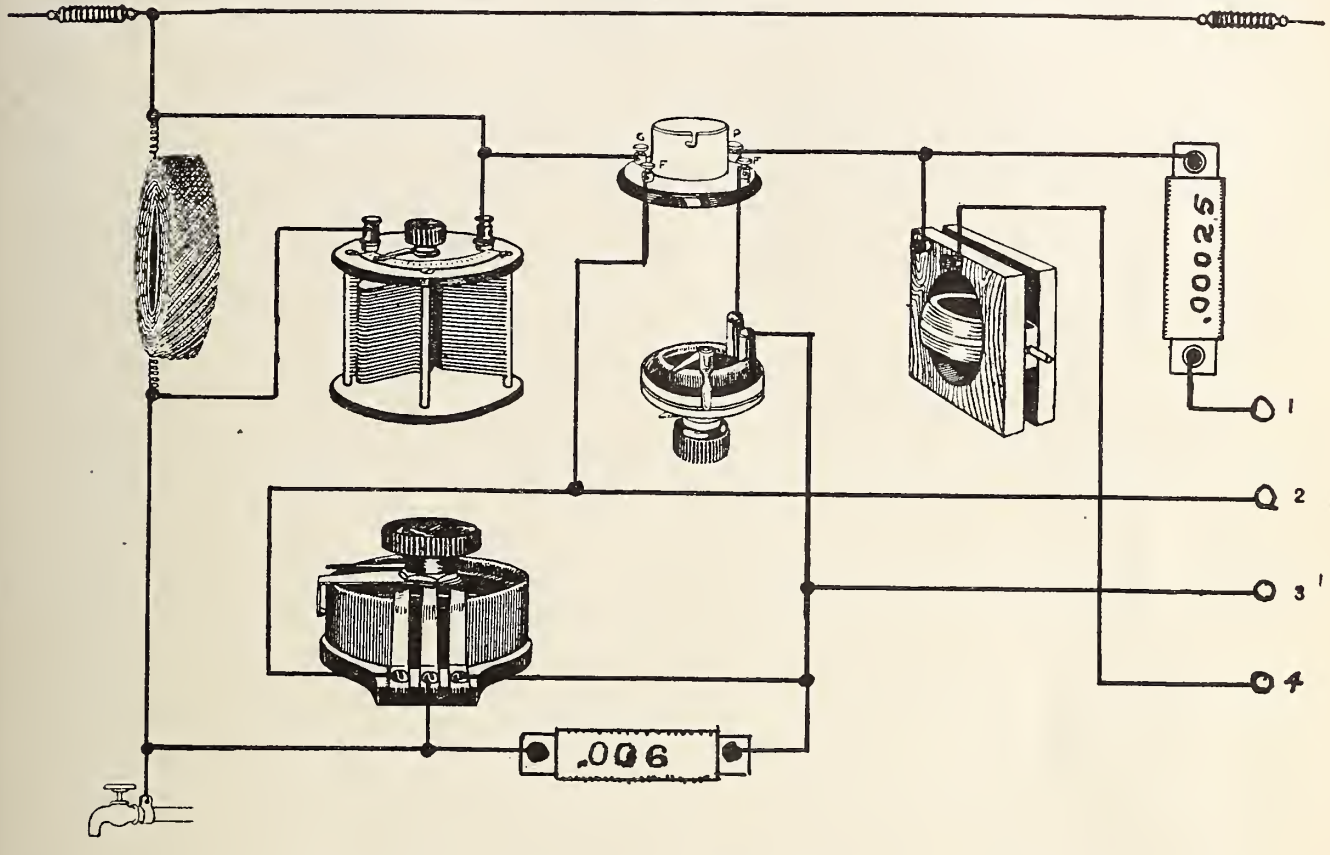

WHILE the most simple type of amplification is that of audio frequency, so named because it is handling currents of frequencies within the audible range, there is another type known as radio frequency amplification and which is at the present time the subject of much discussion and speculation and which is coming more and more into requirement for long range reception as well as in connection with short antenna systems and loop aerials.

In audio frequency, amplification is accomplished after the signal has passed the detector, while in radio frequency amplification the original signal wave is amplified before it is passed to the detector or rectifier. An advantage of this method lies in the fact that it amplifies the wave only and not the many, little irregularities and imperfections which exist in the receiver and audio frequency amplification equipment. Furthermore, most detectors have a critical point at which they begin operating. Signals that come in weaker than this critical point of the detector make no impression upon it and are entirely lost. Thus it is evident that any signal which has failed to actuate the detector will not be heard. With radio frequency amplification, on the other hand, there is virtually no critical point and even the weakest signals can be built up to the desired degree before being passed on to the detector to be rectified to audibility, and from there on for further volume through stages of audio frequency.

Radio frequency is by no means a simple matter and is only now emerging into popularity in this country. The subject cannot be completely covered in an article of this nature even though the author were in a position to essay the task.

Radio Frequency History

It may be interesting to include a bit of history concerned with the subject. This system of amplification dates back a little over ten years, a relatively long time in development of radio communication. At that period two Germans were diligently trying to solve the problem of more sensitive reception, and amplification of the radio signal before detection seemed to be the answer. So we see that it is not a new development, but rather one of the oldest. It made its advent at about the same time as the famous Armstrong regenerative circuit. It did not have the distinction of being born in America, but in Germany.

It came into its own almost immediately in Europe and during the late war there was practically none other in use for sensitive receivers. Its rather belated introduction to the fans of this country is heralded by many as the dawn of a new day.

The writer has experimented with radio frequency in its various forms of untuned and tuned with differing degrees of success.

It is admitted that the ordinary radio frequency transformer responds over a certain limit of wave lengths with a loss of volume on either side of such wave band. No matter what method is used to broaden the wave band with a transformer of fixed ratio there is still one band that is favored while efficiency drops off at either side making transformer coupling a serious problem.

Inductive coupling between the antenna and grid circuits is accomplished with a standard variocoupler and does not noticeably increase the selectivity.

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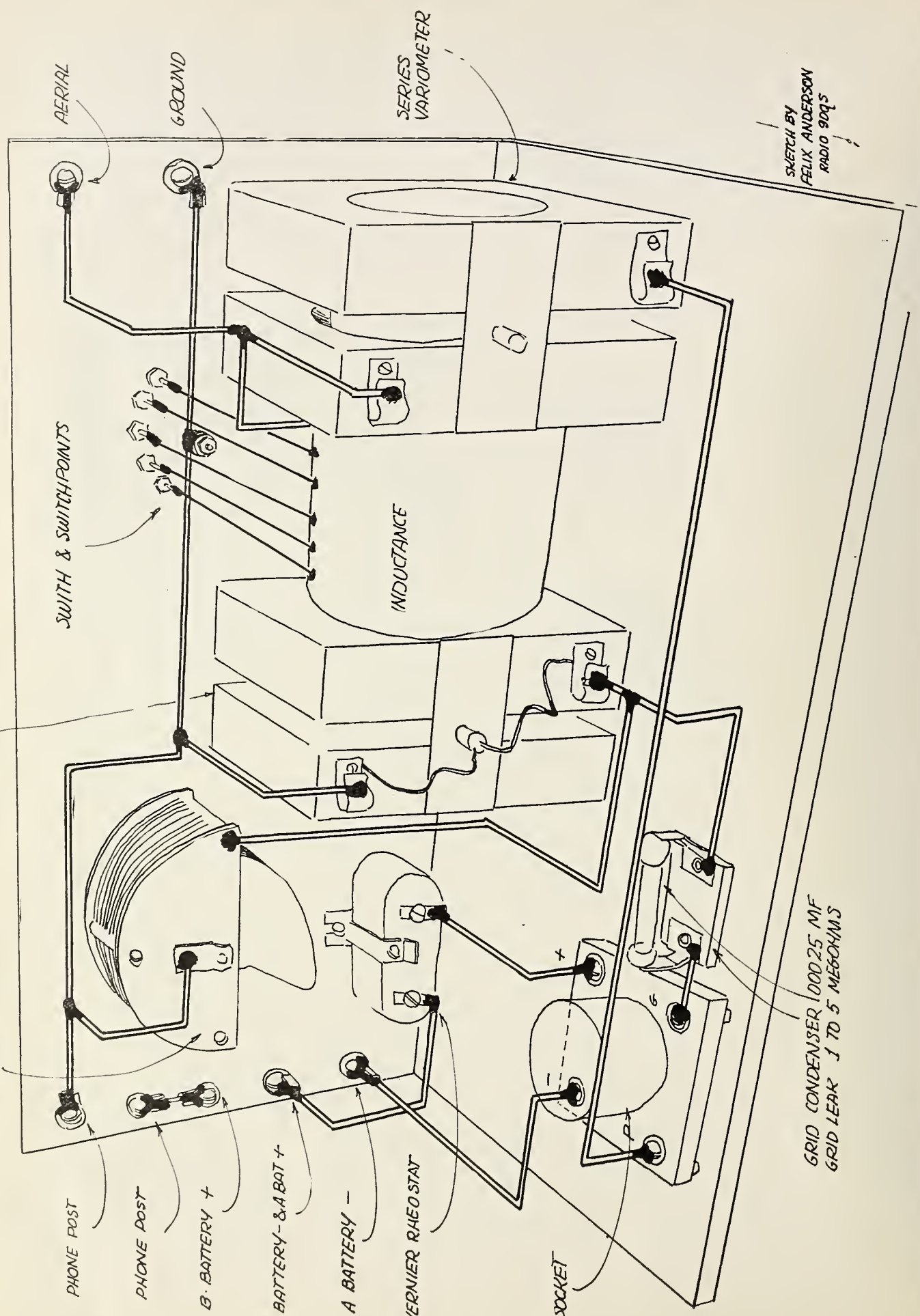


Figure 1. Back panel layout and working drawing of the Kopprasch circuit. The remarkable results obtained with this receiver make it highly popular among broadcast listeners. The secret of this circuit lies in the manner of connecting the variometers, and the clever use of the antenna inductance.

How to Make the Kopprasch Receiver

By FELIX ANDERSON

Technical Assistant, Radio Age

EVER since the original presentation of the Kopprasch circuit in the April, 1923, issue of RADIO AGE, there has been a rapidly increasing interest in that circuit for two major reasons. Primarily, because the Kopprasch circuit offers unlimited possibilities with respect to long distance reception, and secondarily, due to its ability to reach out and get the long distances even in dead spots without fading. Clarity of reception and freedom from tube noises is another one of its important assets, and due to the fact that it has figured prominently in the Pickups and Hookups section of this magazine, we are presenting it to our newer readers who have evinced a tremendous interest in it.

This set was designed by Mr. A. H. Kopprasch of Chicago, who spent many months in perfecting this novel and unusual circuit.

The strength of signals obtained when using this circuit is much greater than any average circuit, and it is even more pronounced when standard storage battery tubes are used. The music, once the set is adjusted, comes in very clearly and distinctively, and stations in California and Oregon have been clearly and distinctively heard in Chicago with but a single tube. These stations were not only heard but were held as long as desired without the customary fading away which is so common with reception at such great distances.

The outstanding feature of the set is the peculiar arrangement of the variometers, one of which is connected in parallel and the other in series. The antenna inductance is wound on a paper tube, which is placed between the two variometers and in inductive relation to them.

Figure 1 shows how this mounting is accomplished, as does the accompanying sketch.

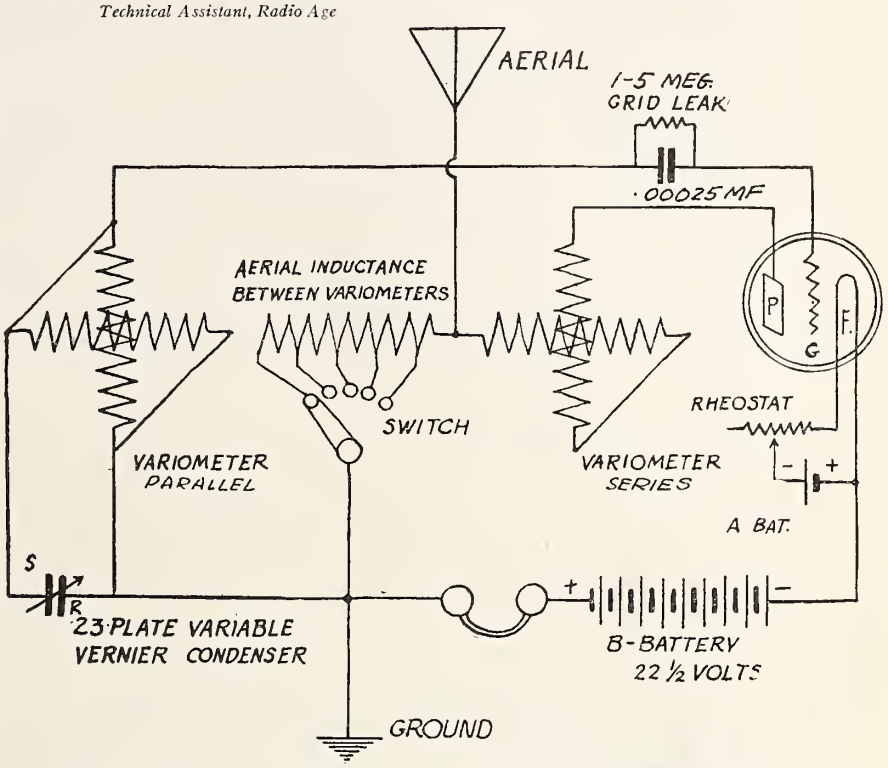


Figure 2—The wiring diagram of the Kopprasch receiver. Note the unusual connections of the variometers.

The tube is made of any heavy cardboard tube, two inches long, and of sufficient diameter to allow the rotors of the variometers to clear it. Fifty-five turns of No. 20 DCC wire is wound on the tube, tapping at every eleventh turn. These taps are connected to the switch points as shown in Figure 2.

This coil should be wound in the opposite direction to the stators of the variometers. The starting end of the winding of the antenna inductance is connected to the series variometer with the antenna post connected to the junction between them.

The variometer on the left is connected in parallel, that is, one end of the rotor winding is connected to one end of the stator winding as shown under "parallel" in Figure 3. The connections are made at the points indicated at C. A 23 plate vernier variable condenser is connected across the terminals C and C as indicated in Figure 2, on the wiring diagram.

The remaining apparatus is standard, the grid leak being of the ordinary tubular interchangeable type, and the grid condenser of the conventional .00025 MFD capacity fixed type. The battery used will be determined by the type of tube used, as will the rheostat. A B battery of the tapped variety is preferred, as often tubes will function more effectively when about 16 or 18 volts is used to energize the plate. Phones should have a resistance of about 3000 ohms.

In mounting the variometers, it is a good plan to mount them firmly on the mounting board in such a way as to be able to force the inductance tube between them firmly. If the tubing slides down, it may be fastened with sealing wax.

Most all of the causes for trouble in this set are found in one of two places: either in the winding on the tube in the incorrect direction with respect to the direction of the stator coils on the variometers or else the value of the grid leak is not correct.

By carefully examining the stators, it is easy to find the direction of the wind-

MOUNTING OF VARIOMETERS AND TUBE

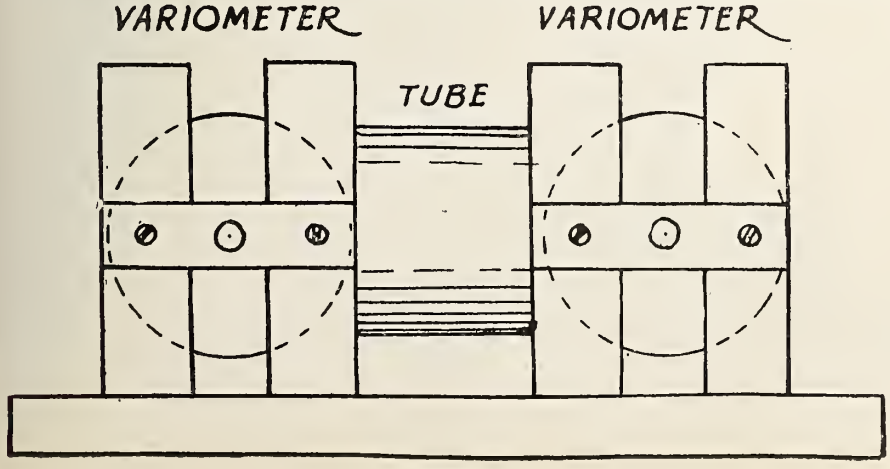


Figure 1

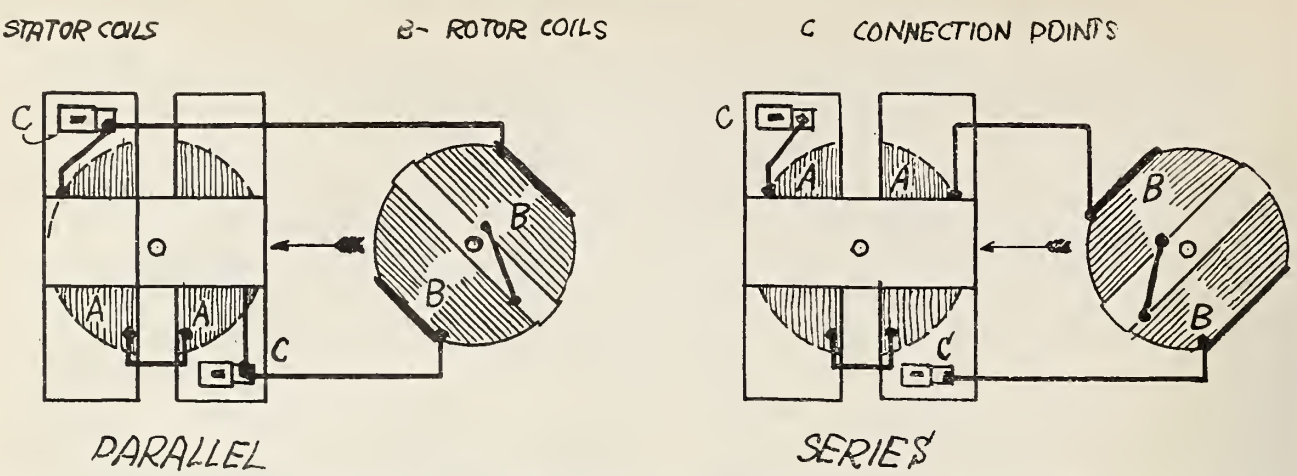


Figure 3. The above drawings illustrate the method of making series and parallel connections of the variometers used in the Kopprasch circuit. The rotors are shown as being outside, to illustrate the connections.

ing; when the two variometers are placed side by side the stators should appear to be a continuation of the winding in the same direction.

The other case of trouble which may be present is a beat noise in the phones. This may sound like a hum or a series of slow knocks, and often presents itself in the form of a screech. This is remedied by inserting a grid leak of lower resistance in the clips. Careful adjustment of this leak is necessary to obtain the best results, and several values should be tried out until the best one is found.

Without doubt there are fans who desire to add two stages of amplification, which is added in the manner exemplified in Figure 4.

Large Antennas

Hartford, Conn.—It is seldom that an amateur radio long distance test is accomplished without there being uncovered some technical truth destined to have a far-reaching effect on amateur transmission and frequently radio communication in general. Recently amateurs in France and Connecticut succeeded in carrying on the first short wave communication between the two continents. After thoroughly going over the construction of French 8AB and American 1MO, the two stations most prominent during the tests, S. Kruse, technical editor of QST has been able to draw some interesting conclusions.

Mr. Kruse believes the transatlantic success was due primarily to the fact that each station participating used antennas that are large for the waves they are working. "Working an antenna that way," he says, "gives high radiation efficiency. The moment that statement is made the tribe of amperehounds will rise in protest. Nevertheless we are putting more power into the ether than ever before, though the antenna current does drop.

"The idea has now been put through some weeks of steady work with amateurs and in every case the successful American stations have been using big antennas with series condensers. Most of us do not have 'X' licenses, so we cannot work on 100 meters, but the lesson is just as good at 150 meters. Be sure to give your antenna a fundamental wave length of at least 220 meters."

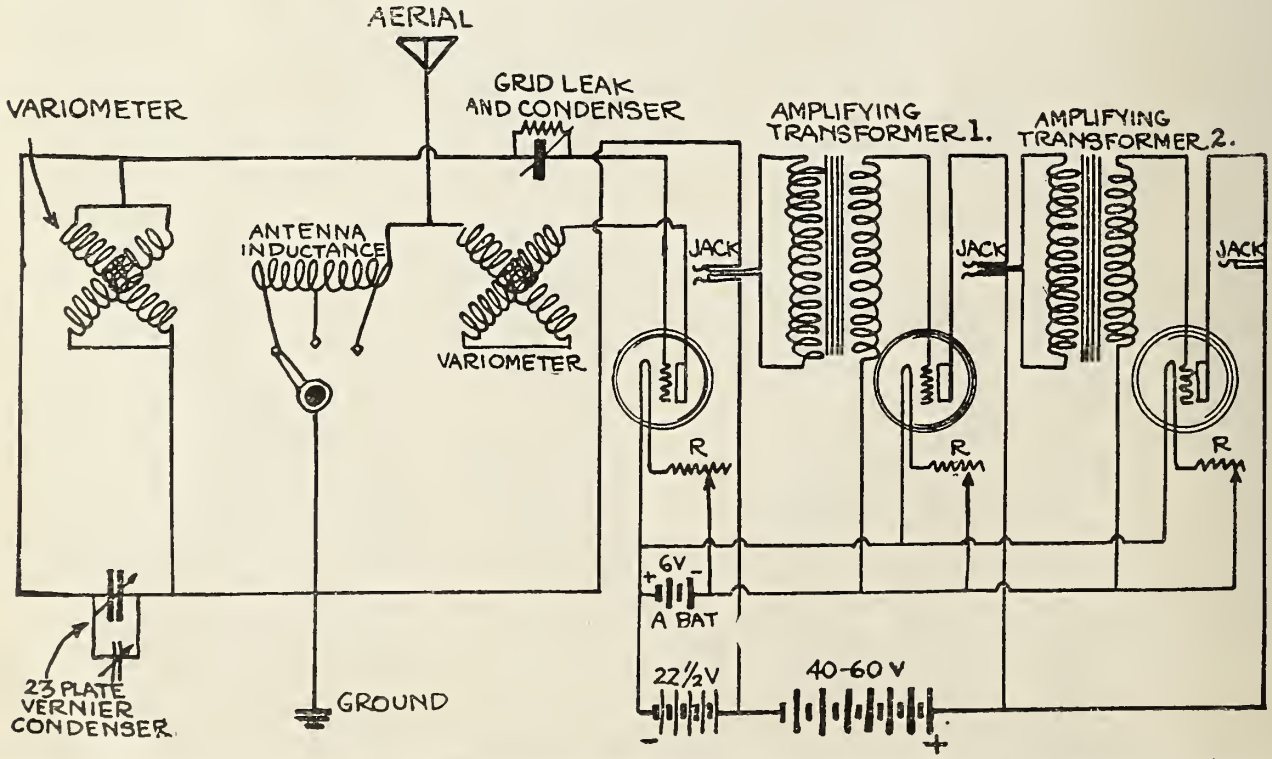


Figure 4. The Kopprasch circuit in connection with two stages of audio frequency amplification. A receiver of this type will bring in distant stations with considerable volume on the loudspeaker. Amplifying transformer No. 1 should have a ratio of about 3 1-2 or 4 to 1 while the second should have a ratio of not greater than 6:1.

The Simplifigon Receiver

(Continued from page 10)

sticks boiled in paraffine. Batteries, cabinet and phones.

1 piece of Bakelite or Formica, 6x4 inches.

After you have assembled this list of apparatus, lay the panel out according to the sketch shown in Figure 1. The tuner shows how simple the general layout of the set is. If you wish, suit your own individual taste in the matter, so long as the foregoing requirements are kept in mind.

Winding the Coils

The only hard part of the entire set is the winding of the coils. This however, requires no skill, but a goodly exhibit of patience.

Starting with coil A, procure a cardboard tubing or other form which has a diameter of 3 inches. Around this form, wind 10 turns of the No. 16 DCC wire and allow a few inches at each end for connections. Slip the coil off the form, and bind the wires together firmly with a piece of waxed string as shown at A in Figure 1. With another piece of waxed string, fasten this coil to the wooden shaft or stick which has been boiled in paraffine, as also shown. This completes coil A.

To wind coils B and C is a little harder. Procure 14 steel pegs (finishing nails without heads will do) and set them in a 4 inch circle as shown in Figure 3. Starting at peg No. 1, with the remaining No. 16 DCC wind around peg No. 4, skipping 2 and 3, from 4 to 7 inside of 5 and 6 and so on as shown. Coil B should have from 45 to 50 turns. This number will vary, due to the fact that hand wound coils cannot be made uniform. In all probability some of the No. 16 wire will be left over, and this can be slipped into spaghetti tubing for wiring. The coil is bound up in the same manner as was coil A, with the wax thread, and is supported by winding the wax thread firmly around a heavy piece of cardboard and mounting the entire coil and cardboard on two small blocks as shown at B, Figure 1.

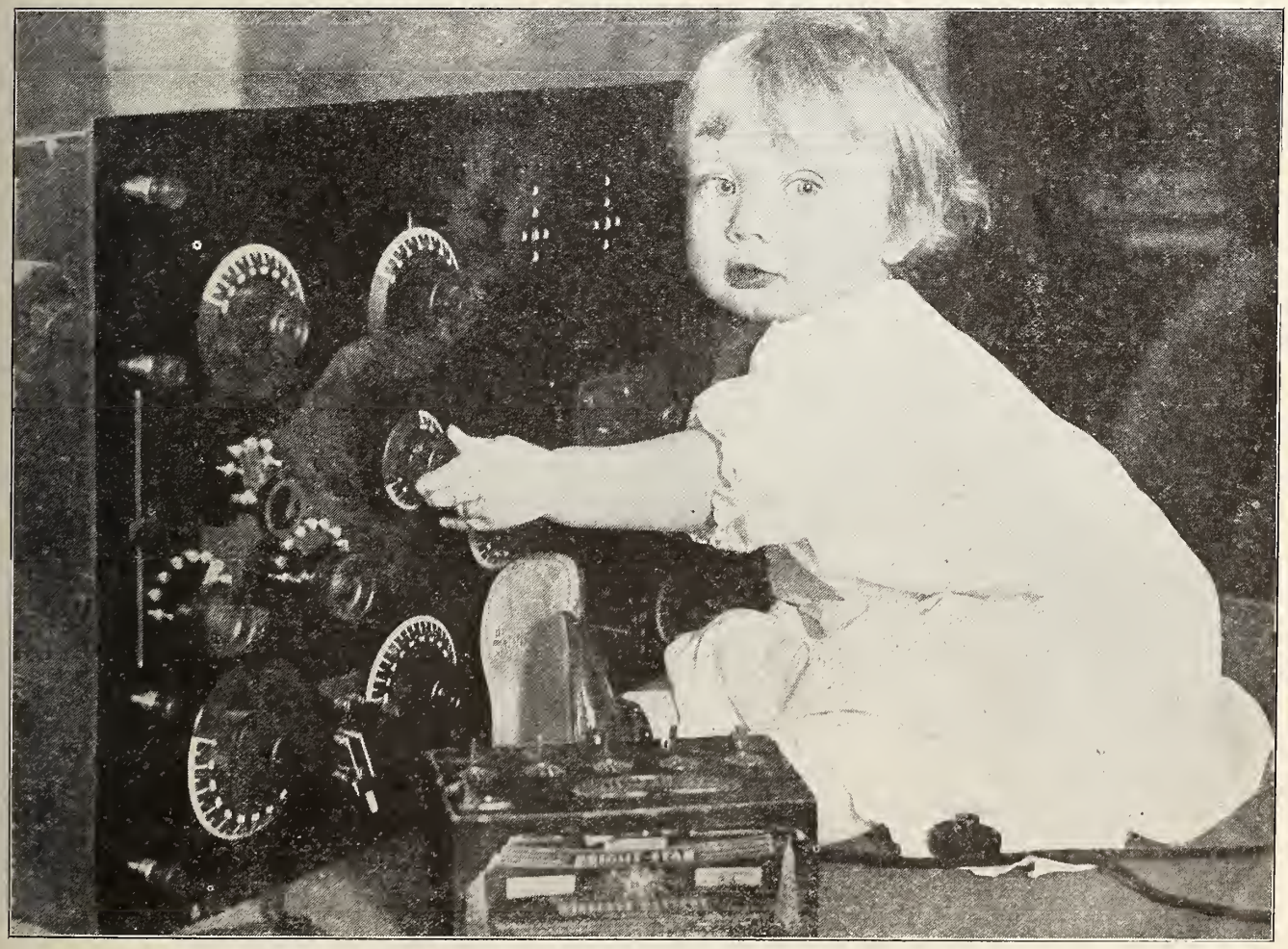
Coil C is wound in the same manner as coil B, with the exception that the circle in which the pegs are set is only 2 7-8 inches in diameter. The winding is done in the same manner, and should be of from 18 to 22 turns. It is best to wind it with about 22 turns and decrease this number until the right value of tickler for the particular tube you are using is found. This coil is also fastened to one of the sticks.

These sticks are screwed to knobs or dials, and are used to vary the coupling of the coils.

Connections to the two movable coils are made with the flexible lamp cord, permitting the coils to be rotated. Wire the set according to the diagram shown in Figure 2, or, if you choose, Figure 1.

Connect the antenna, phones and batteries to the posts indicated and set the filament, rheostat and tickler so that the tube oscillates gently. Rotate the secondary tuning condenser until a signal carrier wave is heard, and clear up the signal with the tickler and rheostat.

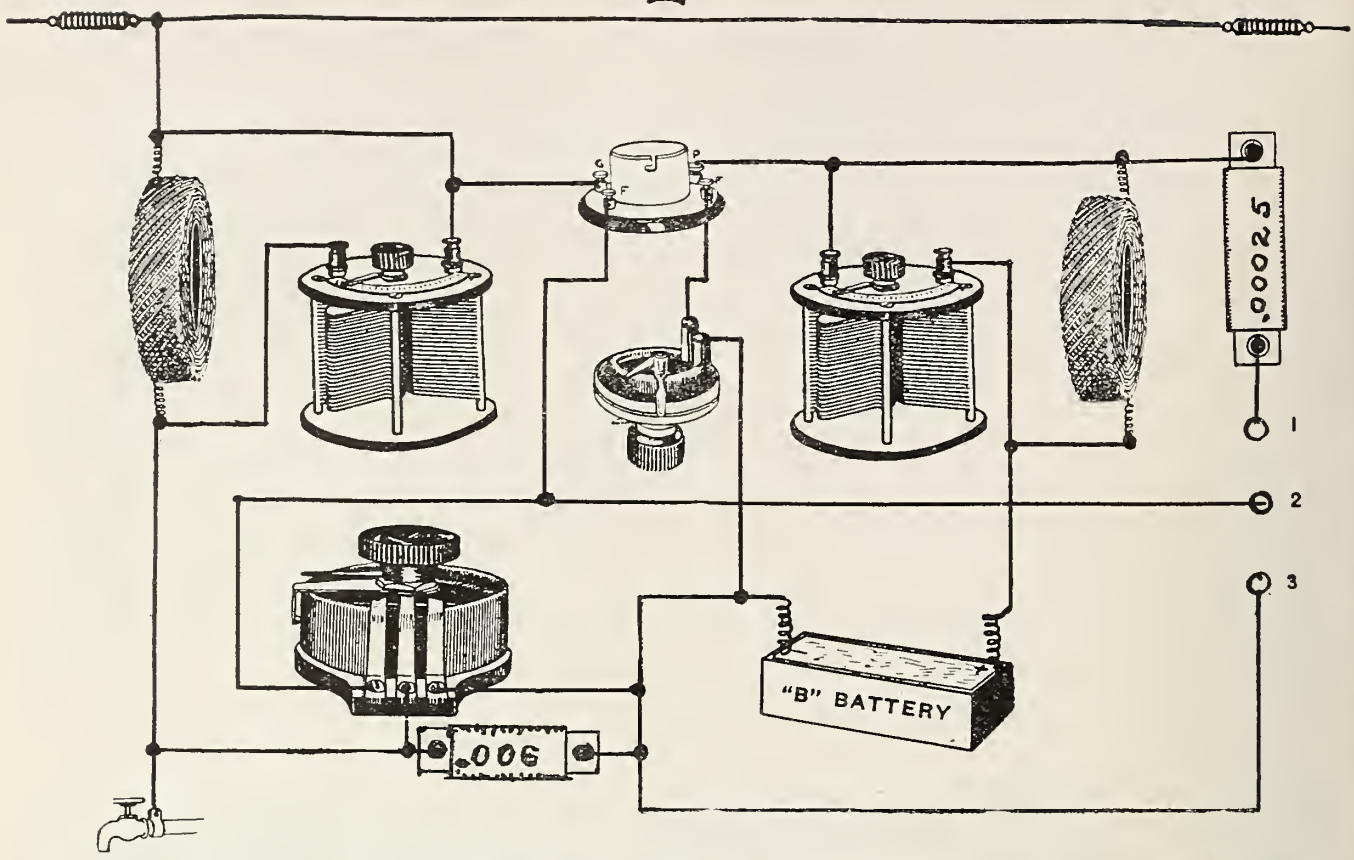
While this is only one of the many efficient circuits that can be constructed upon these principles, it is entirely emblematic of the ideals of low loss principles set forth in the foregoing paragraphs and with two stages of audio frequency amplification built into a separate cabinet as described in the August, 1923, issue or the RADIO AGE ANNUAL, this set should prove equal to any three-tube set devised. The writer does not advise the use of radio frequency with the Simplifigon, feeling that if you desire anything better than a good regenerative circuit with two stages of audio frequency amplification *build a Super-heterodyne.*



IN WONDERLAND

Little Miss Noreen Alley, a Chicago fan, will tell you all about the six-tube receiver made by her daddy, Norman Alley, of the International Newsreel, as soon as she has given it a thorough tryout. She is shown trying to pick up KGO on the loud speaker.

2



A Tuned Radio Frequency Amplifier

(Continued from page 13)

and somewhat decreases sensitivity because of the losses always entailed in inductive coupling.

It is important, then, to the experimenter what method of radio frequency amplification is employed. In the experience of the writer straight tuned radio frequency is considered the most stable and easily adapted to practically any standard circuit.

A single stage of radio frequency amplification in the manner of our schematic diagrams is in the nature of a wave trap designed to amplify the frequency to which it is tuned.

The following circuits were developed as affording the best results on all receivers of experiment conducted.

While we are showing two amplifier circuits it will be seen that they differ only in that one uses a variable capacity (condenser) and the other a variable inductance (variometer) to tune the plate circuit. Results were favorably comparable in either method.

Apparatus

In both circuits the same type of antenna tuning unit is employed. In No. 1 the plate circuit is tuned with a standard variometer. The connections as shown provide for the use of common A and B batteries for receiver and radio frequency amplifier. No negative B connection is indicated as it is made through the A battery wiring in the receiver.

Both coils shown in No. 2 are fifty-turn honeycomb coils. These can be substituted by their equivalent which is accomplished in two coils wound each with forty turns of No. 22 DCC wire on three-inch cardboard tubes. Both condensers are twenty-three plate variables, not necessarily vernier. While No. 2 shows use of a separate B battery it is understood that either method can be used, being optional in either circuit. Results afforded are of equal satisfaction.

A by-pass condenser, .002MF is connected in parallel with the B battery, to prevent radio frequency losses in it.

A U V-201 tube was demonstrably the best radio frequency amplifier tried. A 400 ohm potentiometer is effective for either a six volt or a peanut tube. The value of rheostat is determined by the tube used. The condenser to be connected between the output of the radio frequency amplifier and the antenna binding post of the receiver circuit is a .00025MF (Dubilier preferred). (Be careful to have no grid leak on condenser).

Binding Post Connections, in either circuit, No. 1 to antenna binding post of receiver. No. 2 to positive A. No. 3 to negative A. No. 4 to positive B.

How to Tune

A good operator will never use an oscillating detector to receive radio phone broadcast. . . . The oscillating detector interferes not only with neighboring receivers but will not give stability and good quality of reception.

Oscillations are presented by turning the potentiometer "stabilizer" arm toward the positive side. A radio frequency amplifier tends to oscillate as the grids are placed negative, and amplification is at maximum at a point just below where oscillation starts.

The following pointers may be useful. The writer has observed many times that operators in using a one-step tuned radio frequency set will turn the radio frequency tube to full brilliancy and then go ahead and turn up the impedance variometer or condenser until oscillation starts, imagining that he is then operating at full efficiency and in proper fashion. This is, however, not the case. Most tubes will start oscillating some time before the correct impedance value is reached.

The way to realize as much as possible from a tuned radio frequency amplifier is to keep oscillation down until the correct impedance value is reached. This is found as described herein; it will be observed that as the radio frequency tube is turned down, the band through which oscillation occurs as the impedance is varied narrows down very rapidly. By carefully lowering the filament temperature we eventually find a point where the tube will oscillate through but one or two degrees of scale on the dial. That point represents the value for which we aim. If you simply turn your tube all the way up, and then go ahead and tune your impedance until oscillation starts, you might as well junk your outfit as you are not realizing the possible gain of efficient operation. To get that gain you must resort to a possibly tedious method of keeping the tube low until you find the impedance value for the particular wave you are working up, and this means taking time.

A word about construction is in order. When building this radio frequency amplifier patience and skill are rewarded. Wiring must be neat and all joints secure. The individual units and the circuit should be tested individually before trying the receiver as a whole.

Adding Radio Frequency to the Variometer Set

By BRAINARD FOOTE

THE OLD two variometer and variocoupler regenerator was a good set in its day but the advent of newer circuit arrangements puts it out of date today. The owner of the standard regenerative outfit, however, doesn't want to throw away or junk most of his receiver just to get a better receiving range, because of the expense involved. And yet, nothing has been offered to him in the way of improvement which doesn't mean just that.

However, there's nothing the matter with the variometer, and it may be utilized very effectively in a radio frequency circuit which implies no additional equipment other than another tube, socket and rheostat. The variocoupler is made into a radio frequency transformer, and the left-hand variometer in the set becomes the secondary. The aperiodic antenna system is adopted, and the tuning range of the first variometer is boosted by means of a small shunt condenser.

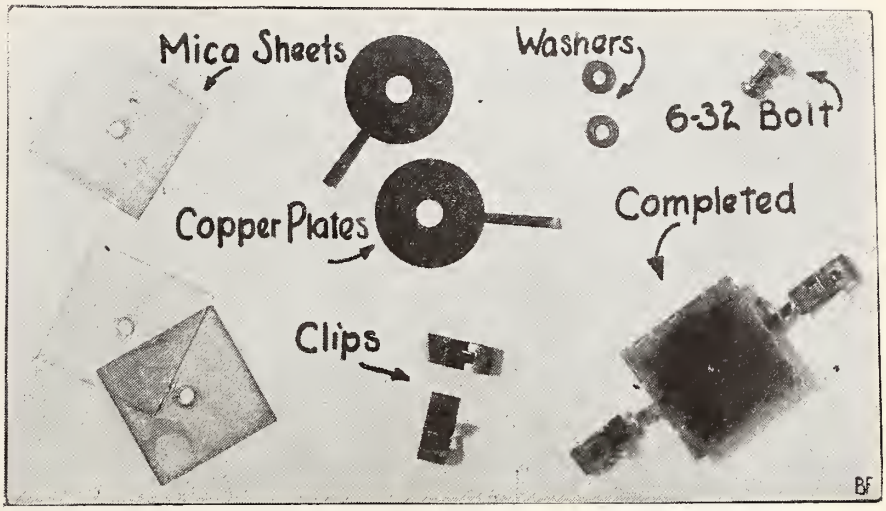


Figure 1—Close-up of the parts used in making the shunt condenser for boosting the tuning range of the variometer. Paraffined paper may be used with as good results as obtained with mica sheets.

What is Gained

The advantages of the change are several, foremost among them being, of course, a considerable increase in DX reception. Selectivity also is improved, and the operating controls are reduced to two only, although there may appear to be more than that in the drawings. Besides the regular equipment of the standard variometer set, the following parts are needed:

UV-201-A tube.
Tube socket.
Rheostat.
Piece of copper or aluminum sheet, 2 by 1 inch.
Piece of mica or heavy paraffined paper, 2 by 4 inches.
Ten or twelve feet of bell wire.

Figure 1 illustrates how the parts for the little shunt condenser are cut and put together. This is condenser "C" on the circuit diagram, and it is needed to raise the wave length range of the variometer, which now is to function as the secondary all by itself. If one hasn't facilities for drilling the copper plates, which are cut to a diameter of one inch, the hole in the center may be roughly punched out with a small chisel. The actual capacity of the condenser is not of particular importance, since the thickness of the paper or mica between the two plates may be altered by the use of more or less sheets until the correct capacity is determined. This may best be done by experiment. The connecting clips for the condenser are cut off from an old "B" battery and soldered to the projecting lugs of the condenser plates. The hole in the plates must be large enough so that the 6-32 holding screw cannot touch them as it passes through.

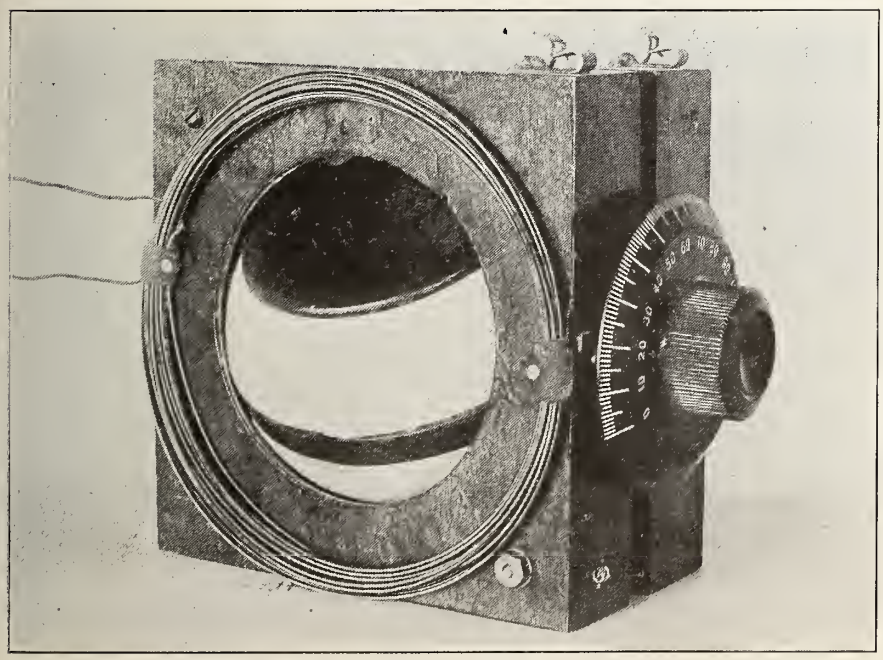


Figure 2—View of the antenna coupling coil in place alongside the variometer. Bell wire, seven turns, form the coil, and it is held in position with the aid of some strips of tape and two little tacks.

The Coupling Coil

Figure 2 illustrates the method of mounting the antenna coil. It is important to determine which side of the variometer is to be connected to the grid, and then to mount the coupling coil at the OTHER end, so that it will be at the "low potential" end of the variometer. This insures high voltage applied to the grid. Moreover, if the variometers are of a type that use the front shaft as a connection, this must be the filament end, or there will be some hand capacity effect. The coupling coil is made of eight turns of the bell wire, wound first on a tubing or other cylinder about four inches in diameter and affixed by a couple of tacks to the side of the variometer. Two strips of tape hold the coil in shape

The remainder of the connections aren't complicated. The primary of the variocoupler now becomes the primary of the radio frequency transformer, and the plate terminal of the R. F. amplifier socket is joined to one of the switch arms. The other switch lever is wired to the plus "B" battery. Thus the number of turns in the primary may be varied at will. The grid circuit of the detector is

left intact, but it is essential that there be a .001 by-pass condenser connected from the detector plate terminal to one side of the filament. The UV-201-A tube is recommended as a superior detector for this type of receiver, although the UV-200 is almost as satisfactory.

The ground is connected to the negative side of the "A" battery, as is the "grid return" lead of the radio frequency tube. The "B" battery should be at least 67 1-2 and preferably 90 volts. Of course, if the UV-200 is used as the detector, the detector plate circuit should be tapped in at the 22 1-2 volt point instead of the 90 volt point, as illustrated in Figure 3.

How to Operate It

First of all, set the switches to include at least half of the variocoupler's primary winding, and set the rotor at the position of maximum coupling, where it may be left, and need not be touched again. Then set the left-hand variometer at about half its scale reading and turn the other one until you hear the customary "rushing" noise of regeneration. Reduce the number of turns in use on the variocoupler until regeneration is heard only over a very few (5 or 6) degrees of the variometer scale. Then swing both variometers up and down their scales, keeping them in tune so that regeneration is taking place, until the carrier wave of a broadcasting station is heard. This is evidenced by the usual "whistle."

Now still further reduce the number of turns on the coupler until oscillation stops. Then retune the variometers until the station is heard clearly without any oscillation. When this position is found, it will usually be possible to tune up and down the scale without starting oscillations at all, but with adjustments set so that the point of oscillation is very close. Thus the set cannot radiate and annoy other listeners, and at the same time, the volume of the DX stations will be very much increased, doubled and tripled in many cases. The selectivity will be found surprisingly sharp, so that it is necessary to tune slowly for fear of passing over a station's wave without noticing it at all.

Should the high wave broadcast stations come in with the left hand variometer set at less than two-thirds scale, the shunt condenser has too large a capacity. This may be remedied by unscrewing it and inserting another sheet of insulation to double the distance between the plates. Another sheet may be added should that also fail to "spread out" the tuning on that variometer sufficiently.

The variocoupler makes a very convenient radio frequency transformer when used in this manner, and the tens and units taps are ideal for close regulation of the coupling. The more turns in use on the primary, the greater will be the feed-back to the grid circuit of the first tube, and sufficient turns should be cut into circuit to bring the set up to the position of maximum sensitivity just before oscillation begins. The actual tuning controls resolve themselves into two, since the coupler controls never need be touched unless perhaps to "put a damper" on some extra loud local station, or to "pep up" the volume from a very faint fellow. The clearness obtained with this arrangement is pleasing indeed, and the volume also is quite a bit greater. The increase in receiving radius is the addition which will be of most value, and the ease of tuning and absence of hand capacity will make the set a joy to use.

Next month: How to reflex the set.

No S O S From NERK

By CARL H. BUTMAN

Although the 300-watt radio transmitter on the "Shenandoah" was disconnected and wet, when she tore loose from her mooring mast at Lakehurst recently Gunner J. T. Robinson, in charge of radio, had his set connected, dried and working within an hour and sent out a reassuring message to the naval air station.

While the "Shenandoah" was undergoing her mooring tests, her 300-foot aerial was also being tested for capacity, inductance and resistance, according to Gunner Robinson, who was abroad on the wild night trip. The radio apparatus was disconnected and replaced by testing instruments to ascertain the efficiency of the present aerial, in anticipation of installing the newly designed 1,000-mile set now building at the naval radio laboratory at Belleview, Md., Mr. Robinson explains.

When the former ZR-1's nosecap gave way, officers and men jumped to controls, engines and ballast releases, but Gunner Robinson, in his radio shack in the control car, sprang to his set. Tearing loose volt-meters, ammeters and other testing instruments, he began hooking up his transmitting and receiving sets, so as to establish communication with the home station. But he found his apparatus was wet from the driving rain and had to dry it all out before he could use his phones or key. In less than an hour he had his set working, but it was not an SOS that he sent, as most sea craft would have been forced to do under the circumstances—he ticked off a message that the "Shenandoah" was under control, which put at rest any fears the navy may have had and allayed alarm among the families of the officers and men.

Out of the silent darkness came a call for NERK, the "Shenandoah's" radio call. It was WOR, at Newark, giving him his first position report, verified later by Lakehurst. The navigators then knew where the gale was driving their ship.

"Communication was then good for the remainder of the trip," says Gunner Robinson. "We kept the base well informed and they gave us weather data," he adds, summing up his brief description of an unprecedented experience fraught with great danger.

It is evident that radio had considerable to do with the remarkable navigation of the aerial cruiser, in advising of her safety, and in bringing in reports from her base. The reports from NERK came through especially well, as the air had been cleared for this mobile station, which proved indeed mobile.

The old set, now almost historic, will soon be replaced with long distance and medium range transmitters, ultra modern receiving sets, and a radio compass for use in the Arctic explorations.

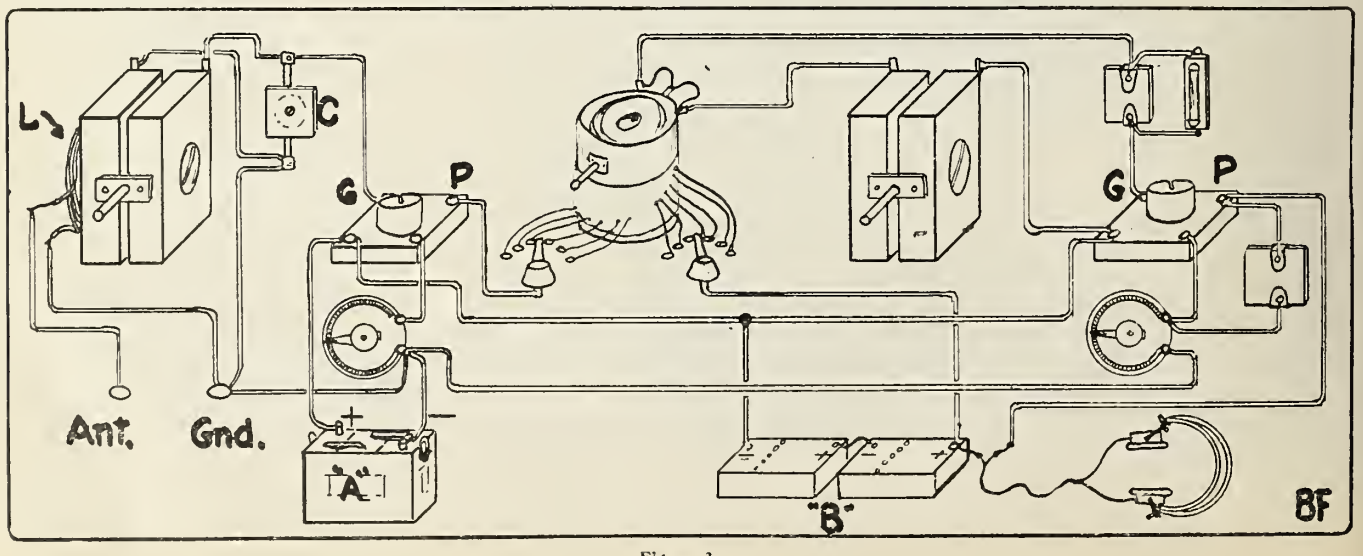


Figure 3

Whistling Interference—Causes and Effect

By JOHN V. L. HOGAN

In the ninth of his series through WEAF John V. L. Hogan, former president of the Institute of Radio Engineers and author of "The Outline of Radio," discussed "Whistling Interference—Its Causes and Cures." In the course of his remarks he said:

THERE are two kinds of whistling interference. Both are caused in the same general way. One kind sounds, in the telephones or loud speaker, like a high note of practically constant pitch and strength. It may quaver a little in pitch and may gradually increase or decrease in intensity or in pitch, but the sound is generally an almost uniform high note. If you listen to distant stations on the 833 kilocycle (360 meter) wave you have often heard such a uniform whistle in the background. Sometimes it is not strong enough to prevent fairly good reception, but whenever you can hear it you may expect the quality of music or speech to be partly or wholly spoiled by it.

This kind of whistle is almost always caused by interference from a distant broadcasting transmitter that has accidentally changed its wave frequency. For example, let us suppose that you are listening to WEAF, whose normal wave frequency is 610 kilocycles. If WOC, in Davenport, Iowa, is sending at its proper wave frequency of 620 kilocycles it will not interfere. But if (as has happened once or twice) WOC's wave frequency should drop to say 613 kilocycles, there would be a whistle in the background of each station's programs. People living about half way between the two stations might hear cross-talk in addition to a very loud whistle, people who were too far from either one of the stations to hear its programs, but who could hear the other, would be troubled by the whistle.

Key of Whistle

If the waves of the two interfering stations are, as we have assumed, 610 and 613 kilocycles, the whistle that is heard whenever both waves are received has a pitch of three kilocycles or 3,000 cycles. This corresponds to the highest G on the piano keyboard. The whistle is always of a pitch equal to the difference in the frequencies of the two interfering waves, as in this case where 613 kc minus 610 kc equals three kilocycles.

As another example we may consider whistling interference between WJZ in New York and WJAZ in Chicago. These stations normally use waves of 660 and 670 kilocycles, respectively, and the difference of ten kilocycles is enough to prevent a troublesome whistle. But on some occasions either or both waves have slipped away from the normal frequency, if they became, for example, 662 and 664 kilocycles, the difference would be only two kilocycles or 2,000 cycles and the whistle would have the pitch of the third C above middle C on the piano.

Interference of this kind, where two inaudibly high frequency waves (such as radio waves of 610 and 613 kilocycles) interact to produce an audible frequency equal to their frequency-difference, is called beat or heterodyne interference. A quite similar effect is had in music, for if two sounds of almost equal pitch or frequency are played together, their waves will interact to produce pulsations or beats at a rate equal to the difference in their frequencies.

RADIO ANNOUNCER

"Billy," a prize white rooster owned by J. O. Maland of the Northwest Farmstead, is a "regular" radio broadcasting station announcer. Mr. Maland is in charge of the Northwest Farmstead's lecture hour program at WLAG, Twin City Radio control operated at St. Paul and Minneapolis by the Cutting & Washington Radio Corporation. A lusty crow from "Billy" into the microphone announces that the lecture hour is about to begin. He also signs off with another crow.

"Billy" receives letters from chickens all over the United States, and presents, consisting of corn, apples, pies, etc.

Listeners Should Act

Constant-pitch whistling interference caused by interfering broadcasting transmitters is becoming more and more scarce, for most of the stations are doing better in holding to their assigned wave frequencies. The only cure for it is to keep the stations adjusted to radiate their correct wave frequencies, and there is nothing that either you or I can do to stop such cases as do occur except to report them to the broadcasting station that is interfered with. If it were not for the fact that this inter-station whistling is so much like the second kind of whistling interference, and so convenient for explaining it, I would not have been justified in giving it so much time.

I hope that the foregoing has made clear to you that whenever your receiver picks up two continuous radio waves whose frequencies are quite nearly alike, you will hear a whistling note whose pitch is equal to the difference in the radio wave frequencies.

This brings us to the second type of whistles, which are usually not uniform in pitch or intensity and which are not caused by interference between broadcast transmitters. These whistles change in pitch, either uniformly or in jumps and sometimes slowly and sometimes so rapidly that they sound like chirps. Sometimes they are faint in the background, sometimes so loud that they completely spoil reception from nearby stations.

If you have a simple regenerative receiver of any type, you have heard just such whistles as you turned the tuning knobs. When you have had your tickler coupling or your plate variometer too far up the scale, you have heard a loud whistle in your telephones or speaker and have probably noticed that you could control its pitch by turning your tuning dial.

I wonder how many of you realize that when you hear such a whistle in your own set, a whistle that drowns out the station you are listening to and whose pitch you can control on your own tuner, you are making the same kind of interference for all your radio neighbors.

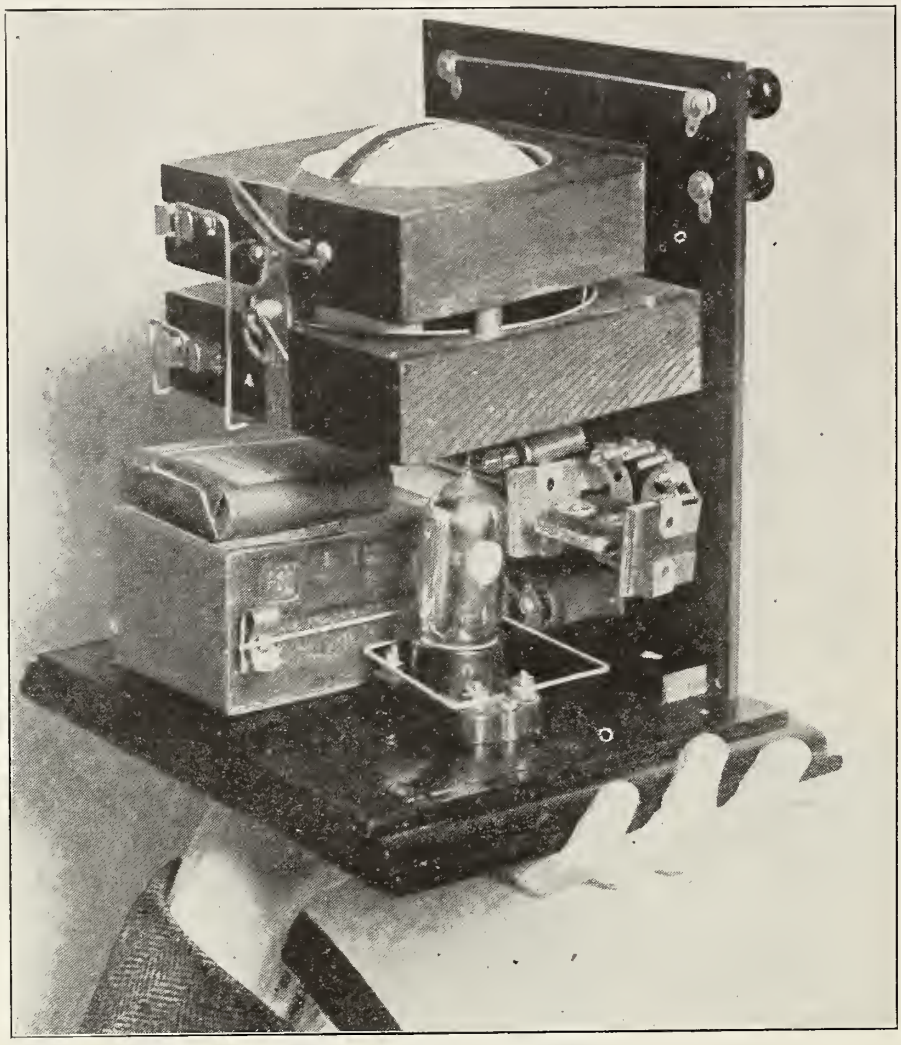
When your receiver whistles in this way, it is acting as a miniature transmitting station.

The whistle is the same kind of beat note that I have already explained, but its pitch usually varies because the waves sent out by the oscillating receiver change in frequency as tuner knobs are turned.

Your Neighbor

To stop a regenerative set from making such interference, you need only reduce the tickler or regenerative variometer dial setting until the receiver stops generating oscillations; you can tell that it has stopped interfering because you will no longer hear the loud whistle.

Whenever you hear a loud, varying whistle of this kind, a whistle whose pitch you can not control with your own tuner, you may be sure that it is caused by some radio neighbor.



MINIATURE RECEIVER

This interesting miniature radio set was built by Raymond Chassevent, a Bronx amateur. Using but one dry cell vacuum tube and a novel hook-up, it will receive when using a ground only, no aerial whatever being necessary. Chassevent uses a variometer and several fixed condensers, the fixed condensers taking the place of a variable condenser. Each condenser covers one broadcasting wavelength, and will bring that wavelength in with maximum efficiency. For instance, one condenser will respond to "WEAF" another to "WJZ" another to "WOR," etc. The various condensers are cut in and out by taps. It is entirely self-contained, dry cells only being used and is so small it can be carried about at will. Note method used for mounting condensers, allowing extra condensers to be added at will.

Standing by

Washington, D. C.—Captain Herbert G. Sparrow, USN, commander of the U. S. Cruiser, "Tacoma," and four radio men were the last to leave this vessel wrecked off Vera Cruz recently—and, at the end, four of them were dead and the other injured. Old naval traditions obtained, not alone through the action of the gallant skipper, but through the four radio men who stood by with him in an effort to keep radio communication open.

While the details of the accident which killed Captain Sparrow, Radio men Lusser, Herrick and Sivin, and injured Chief J. V. Cooper are not available, Admiral Eberle, chief of operations, says he believes all five men were in the radio shack trying to maintain radiophone communication with the U. S. Consulate on shore, which had been established the preceding day on batteries, as the dynamos were out of action. Then the hurricane struck the old cruiser, whose bow was on a reef, and threshed her unmercifully, washing her with terrific seas and pounding her to pieces.

Either a falling mast or an extremely heavy sea is believed by the admiral to have crushed in the radio shack, formerly the captain's emergency cabin, located on the main deck just below and aft of the bridge. The only dispatch bearing on the death of these four men states: "They all were killed on the main deck on January 21, struck by heavy wreckage and seas."

Naval officers picture the captain, who was an authority on electrical matters and a radio enthusiast, and the radio operators, as crowded around the ship's radio apparatus trying to send a last message to the Vera Cruz Consulate, when the crash came.

Investigations, scheduled as soon as the "Prometheus" reaches Charleston with the survivors, may reveal that the navy has developed a new type of hero—the radio man who remains aboard.

SIMPLEX REFLEX SET

By CARL MASSON

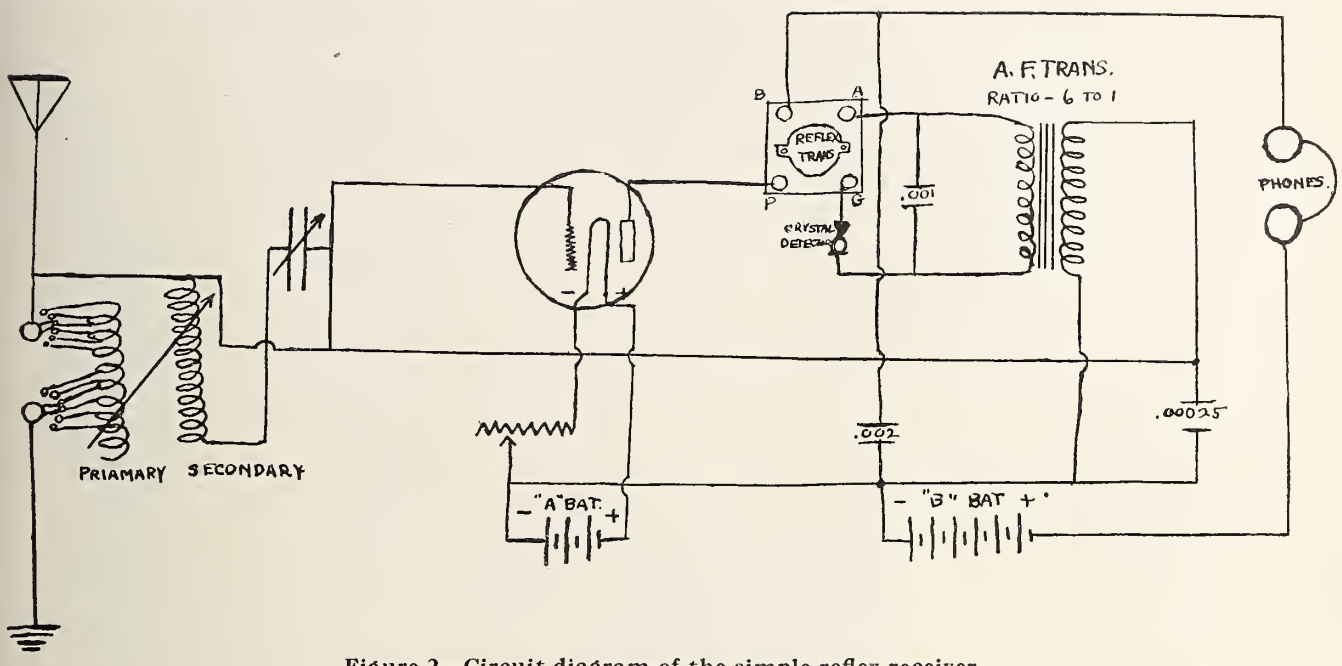


Figure 2—Circuit diagram of the simple reflex receiver.

In spite of the numerous hookups which constantly appear in publication, should we take a census of the various types of sets in use, I feel quite sure that the popularity of the Reflex would be quite evident.

The diagram in Figure 1 shows a one-tube reflex circuit of unusual efficiency in respect to both distance and volume. While this circuit is by no means new but because recently such unusually good results have been secured with it, I believe too little has been said about it.

The panel should measure 7 inches by 12 inches. The general layout is shown in the illustration herewith. Drilling dimensions are omitted, since they would vary according to the type of apparatus used. The variocoupler is mounted to the extreme left. About twelve taps are taken at various intervals and connected to two switches on the panel.

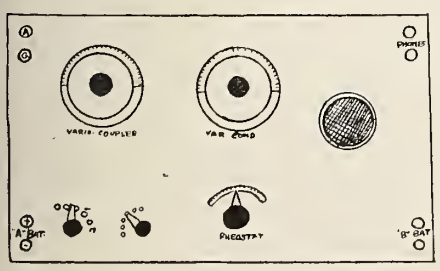


Figure 1—Panel layout of the simple reflex circuit.

The R. F. transformer is of the special type manufactured particularly for use in reflex circuits.

The A. F. transformer may be of any good make, but should have a ratio of six to one. A crystal detector of the fixed type would rid the operator of one more adjustment. The fixed condensers should be of the mica type, with capacities as shown in the circuit. Practically any tube may be used. Very good results have been secured using UV 199. The rheostat of course would depend upon the type of tube. A radio set is no better than its poorest part, therefore when you buy your parts let quality count.

Use bus bar in wiring the set, and if you would have the utmost efficiency, make all connections as short as possible, regardless of appearances from artistic viewpoints. Solder all connections, taking care that all excess flux is removed.

The tuning of this outfit is extremely sharp and selective, but the simple controls make operation quite easy. Judging from the results that users of this outfit report, it is no wonder that it has become so popular. The fact about this circuit, that one tube does triple duty, seems to violate the old adage: "You can't run the mill on the water that has passed."

Wireless Tales

One would scarcely think the sweet song of a canary would in any way affect the prolongation of the incarceration of three of Uncle Sam's sailors in a Japanese prison, but so the tale of an ex-navy operator goes. Three firemen from the good ship, "Orion," got themselves in wrong with the Nagasaki authorities and were detained ashore, although their ship was sailing. Upon the request of his captain, the Orion operator called the flagship to ask that steps be taken to secure the firemen's release and return to the States.

Sparks got his message off, despite the fact that a canary he was bringing home, sang in harmony with the ship's radio wave note. As soon as the operator started to listen in for his O. K. the bird redoubled its efforts in a key which interfered so seriously with the reception of the flagship's answer that it made it impossible to get the message. Spark's couldn't leave his key to put the bird out of the shack, so he threw spare parts and tools in its general direction, without effect. Again he called the flagship; again the dickey bird, now exceedingly unpopular with its temporary owner, began its lusty song. As the ship steamed out to sea, the operator gave up in despair; he couldn't get his answer through the canary's QRM. It developed later that Orion's message was not received correctly, and the unlucky firemen were held in the Japanese "brig," several months, all because of the canary's sweet obligato. The bird finished the voyage in a stateroom, but when delivered to its ultimate owner ashore, although unharmed, it refused to sing again.

United States Accuses Radio Trust

MONOPOLY in the radio apparatus and communication, both domestic and transoceanic, is charged in a complaint issued by the Federal Trade Commission. Efforts to perpetuate the present control beyond the life of existing patents, is likewise charged.

Radio Corporation of America; General Electric Company; American Telephone & Telegraph Company; Western Electric Company, Inc.; Westinghouse Electric & Manufacturing Company; The International Radio Telegraph Company; United Fruit Company; and Wireless Specialty Apparatus Company, are named as respondents and are alleged to have violated the law against unfair competition in trade to the prejudice of the public.

In the language of the complaint "the respondents have combined and conspired for the purpose and with the effect of restraining competition and creating a monopoly in the manufacture, purchase and sale in interstate commerce, of radio devices and apparatus, and other electrical devices and apparatus, and in domestic and transoceanic radio communication and broadcasting."

To attain the present control alleged, the complaint recites that the respondents: (1) acquired collectively, patents covering all devices used in all branches of the art of radio, and pooled these rights to manufacture, use and sell radio devices, and then allotted certain of the rights exclusively to certain respondents; (2) granted to the Radio Corporation of America, the exclusive right to sell the devices controlled and required the Radio Corporation to restrict its purchases to certain respondents; (3) restricted the competition of certain respondents in the fields occupied by other respondents; (4) attempted to restrict the use of apparatus in the radio art manufactured and sold under patents controlled by the respondents; (5) acquired existing essential equipment for transoceanic communication and refused to supply to others necessary equipment for such communication; and also excluding others from the transoceanic field by perferential contracts.

2,000 Patents Involved

From the series of contracts referred to in the complaint it appears that the Radio Corporation of America has the right to use and sell under patents of the various respondents which relate to the radio art. It has also given to various respondents the right to manufacture under these patents. Thus there has been combined in the hands of these corporations patents covering the vital improvements in the vacuum tube used in long distance communications and other important patents or inventions in radio which supplement this central device. Approximately 2,000 patents are involved.

The report of the federal trade commission on the radio industry states that the gross income of the Radio corporation in 1922 was $14,830,856 and that its capital stock on Dec. 31, 1922, was $33,440,033. The holdings of the several respondents in the Radio Corporation of America are given as follows: General Electric company, 620,800 preferred, 1,876,000 common; Westinghouse Electric and Manufacturing Company, 1,000,000 preferred, 1,000,000 common; American Telephone and Telegraph company, 400,000 preferred, no common; United Fruit company, 200,000 preferred, 160,000 common.

It is further stated that up until 1922, the Radio Corporation had an absolute monopoly in the manufacture of vacuum tubes and for the first nine months of 1923 sold 5,509,487 tubes. During the same period the only other concern having the right to make and sell tubes, sold 94,100 tubes.

In the communication field, while the Radio Corporation has some competition in ship-to-shore communication, it has a practical monopoly in transoceanic service. It controls all the high power stations in this country except those owned by the United States government. Agreements of an exclusive character have been entered into with the following countries or with other concerns in control of the situation in those countries, namely, Norway, Germany, France, Poland Sweden, Netherlands, South America, Japan and China. Arrangements have also been made with the land telegraph companies in this country whereby messages will be received at the offices of the Western Union and Postal Telegraph companies.

WILSON FUNERAL

When former President Woodrow Wilson's funeral service was held in Mt. Alban's Cathedral, Washington, D. C., radio transmitted the sermon to the whole country. Photo shows the microphone on the pulpit.

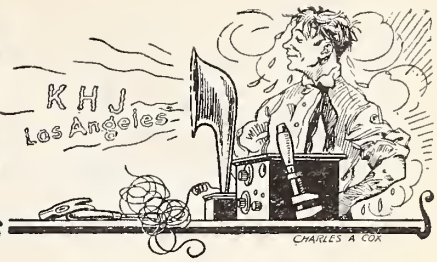
The Contracts

A summary of the contracts between the respondents as recited in the complaint is: First, the organization of the Radio Corporation of America in 1919, under the supervision of the General Electric Company, which company received large holdings in the stock of the Radio Corporation for capital supplied and for its service in connection with the acquisition of the American Marconi Company. An agreement entered into between these companies granted to the Radio Corporation an exclusive license to use and sell apparatus under patents of the General Electric Company until 1945; and the Radio Corporation granted to the General Electric Company the exclusive right to sell through the Radio Corporation of America only, the corporation agreeing to purchase from the General Electric Company all radio devices which the General Electric Company could supply. Subsequently this arrangement was extended to include the Westinghouse Electric & Manufacturing Company, the business of the Radio Corporation being apportioned between the General Electric Company and the Westinghouse Company; sixty per cent to the General Electric and forty per cent to the Westinghouse Company.

Meanwhile in July, 1920, the General Electric Company, and the American Telephone and Telegraph Company, made an arrangement for mutual licensing on radio patents owned by each and providing for traffic relations. The terms of this agreement were extended to the Radio Corporation of America and the Western Electric Company and thereafter to the Westinghouse Company.

The Radio Corporation in March, 1921, made an agreement with the United Fruit Company, which operated a number of long distance radio stations in Central and South America by which licenses under radio patents of the Radio Corporation and of the United Fruit Company and its subsidiary the Wireless Specialty Apparatus Company, were exchanged, and arrangements made for the exchange of traffic facilities, and the definition of their respective fields adopted between the Radio Corporation and the United Fruit Company. Provisions of the agreements between the Radio Corporation of America, the General Electric Company, the American Telephone and Telegraph Company and the Western Electric Company were extended to the United Fruit Company.

Pick-ups and Hook-ups by our Readers



SOME time ago I made it a point to call upon the Editor of RADIO AGE, with the object of finding out how much space he was going to allot for the Pickups by Readers Department, in this issue of RADIO AGE.

Upon entering the Editor's office I was told to take a chair and to wait patiently for a few moments inasmuch as the Editor was rather busy, but would see me shortly.

"He's probably pondering over some deep and important editorial problem or advertising policy," I mused as I took a chair, depositing a stack of Dial Twister letters on a nearby table. "I suppose it takes much thought and deliberation to decide just what department to emphasize to make a first class radio book such as RADIO AGE is."

After a short wait, I was told to step into the Editor's den and I'll bet you can't guess what the Editor was pondering over!

He had a February RADIO AGE opened to the page which had a heading over it, "Pickups by Readers," and was comparing the list of stations heard on his receiver with one of the letters and lists submitted by a Dial Twister!

"You know," he said, "I've got one of the best types of receivers on the market. I've got all the batteries and accessories pepped up to the nth degree. I've sat up until the wee hours of the morning, until I've gotten a taste in my mouth like a blacksmith's apron; but I'll be hanged if I can beat that record submitted by one of these Dumbell Twisters or whatever you call them!"

"Ha!" I laughed, "You're only one of the many, many fellows who are doing the same thing, trying to beat a record or list of some Dial Twister." And feeling sure that he would kick the Pickups by Readers section out of his magazine forever because he couldn't beat one particular Dial Twister record, I added, "Do you think that you can use about a page and one-half of these (dashing down a pile of Dial Twister letters on his desk) in the March issue?"

"For the love of barb-wire antennas and oscillating circuit receivers—are all those letters from Pickup fans?" he asked.

"That's what they are nothin' but," I answered quickly.

The Editor pondered deeply for a few moments, puffing vigorously on a black cigar, and then turning back to his record comparing in the Pickups section of the preceding RADIO AGE he muttered:

"Ummmm! If the fans like 'em as well as I do, they must get a pretty big kick out of them!"

And looking up he decided:

"Let 'em run freely. Understand? If you've got enough of them let 'em run freely. And by the way, when you've finished compiling them and got them in copy form, I want to be the first one to read that copy—I get just as big a kick out of them as a nigger does reading ghost stories ten minutes before bedtime. Don't slam the door as you go out."

And so I'm letting 'em run freely, to the extent of a couple of pages or so.

THE PICKUPS EDITOR.

DIAL TWISTERS

Name	Address	Circuit
John Sabiston, Jr.	Bay Shore, L. I., N. Y.	Atwater-Kent
Curtis Springer	1224 N. Olney St.	Single Circuit
Kenneth Fischer	1219 N. Olney St.	Single Circuit
Both of the above TWISTERS live in Indianapolis, Ind.		
Russel R. Thomas	227 Laurier Av., W., Ottawa, Ontario, Can.	Haynes
Frank P. Oberst	Racine, Wisconsin	Single Circuit
Richard Jones	300 N. Warner Av., Bay City, Mich., Corrected from last month	
George S. Everhart	4214 Ruckie St., Indianapolis, Ind.	Eliminator
Charles E. Rogers	4409 N. Lincoln St., Chicago, Ill.	Eliminator
H. S. Frederickson	406 Howard St., Charles City, Ia.	Ultra-Audion
Joe Hafert	1323 Woodbine Pl., Ft. Wayne, Ind.	Reinartz
Wilson B. Lemberger	2037 Osborn St., Burlington, Ia.	Zenith
H. A. Englebaugh	1328 Winona St., Chicago, Ill.	Eliminator Crystal
G. S. Baird	32 Maltbie Av., Sheffern, N. Y.	Erla-Tripiex
Frank W. Smith	2306 Edward St., St. Joseph, Mo.	Reinartz
Max M. Barnhi er	Mt. Morris, Ill.	First Tube
H. J. Boyenga	Greene, Ia.	Reinartz
J. H. Jones	Crestwood, Ky.	Cockaday
Francis Tye	607 N. 8th Av., Maywood, Ill.	Rosenbloom
A. W. North	61 N. Lincoln Av., Fond du Lac, Wis.	First Tube

John Sabiston, Jr., of Bay Shore, Long Island, wants to start out this month by hanging a bakelite crepe on the lists of Curtis Springer, Kenneth Fischer and his neighbor John Bennett of Rockville Centre, Long Island, N. Y., and submits the following to substantiate his claim:

RADIO AGE,
Gentlemen:

I am a regular subscriber to your magazine, and I take great pleasure in reading the Pickup Page. I notice the excellent pickups of Curtis Springer, Kenneth Fischer and my close neighbor John Bennett of Rockville Centre, and want to say that while I think their records are good, I feel that I have a list that will equal if not surpass them all.

I have an Atwater-Kent three tube set that I wouldn't sell for all the sets on the market. Getting down to business, here is my list of stations heard from January first to February ninth, practically all of them on a loudspeaker. As one would say when playing dice: "Read them and weep!"

KDKA, KFKX, KOB, KOP, KSD, KYW, PWX, WAAF, WAAW, WBAH, WBAP, WBT, WBS, WBAU, WBZ, WCAE, WCAP, WCBD, WCX, WDAR, WDAF, WDAP, WDAY, WDT, WEAF, WEAN, WFAA, WFAY, WFI, WGI, WGR, WGY, WHAM, WHAS, WHAZ, WHB, WHN, WIP, WJAR, WJAX, WJAZ, WJZ, WJY, WKAQ, WLAG, WLW, WMAF, WMAQ, WNAC, WOS, WOAW, WOC, WOO, WOR, WPAB, WPAH, WRC, WSAD, WSB, WTAS, WTAM, WSAI, WWJ, WQAM, WCAD, WMAK, WCAL, WSY, WIAD, WFAB, WCE, WHAA, NPG, NRE, CFCA, KGO, WMC, WBL, 6KW, WHK, KFAF, CKCK, CKAC, CHCB, CHYC, CFCF, CJCN.

Besides this I got a complete test from station 9BM of Canada, on the night of January 8, from 12:15 to 1:36 a. m. On this test they broadcast on the following wave lengths: 400, 300, 350, 450 500,550, 341, and I was waiting for them every time they came on. What do you consider this?

I am a great radio bug, and I would sit up till five a. m. if they broadcast that long.

I trust that you will give my record due consideration, and hope expectantly to see my name on the Dial Twisters list for next month. What say?

Very sincerely yours,
JOHN SABISTON, JR.
Bay Shore, Long Island, N. Y.

All we've got to say is—wait till the Editor reads that one! That's what we would call a record for consistent work, Johnny, and you've certainly made the DT list.

However, judging from the appearances of this correspondence you'll have one extra bakelite crepe to hang on

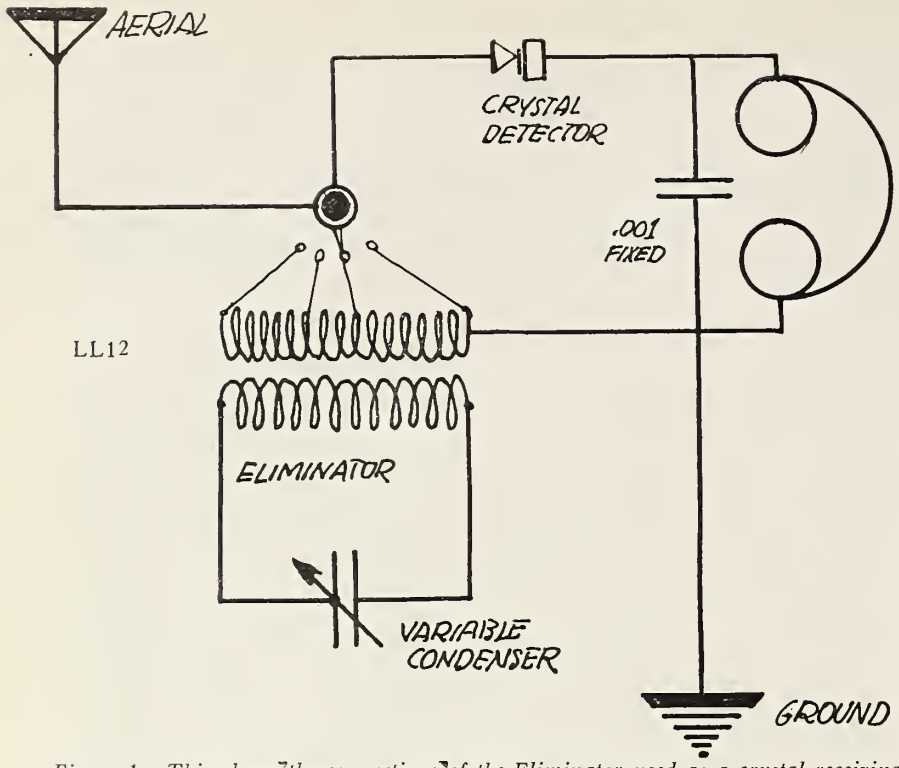


Figure 1. This shows the connections of the Eliminator used as a crystal receiving set tuner, with which Mr. Englebaugh claims such unusual results. L1 is the primary of the Eliminator, and consists of from 8 to 12 turns of No. 24 or 26 DCC wire; L2 is the secondary, consisting of about 42 turns of the same size wire, which is shunted by a condenser of either 23 or 42 plates. The size of wire is not important. The primary is wound directly over the secondary, being separated by a layer of empire cloth or writing paper. Full details of the original Eliminator were published in the January, 1924, issue.

your own record, because, because—well just read this:

RADIO AGE,
Gentlemen:

We are very much interested in your Pickups Page, and have a record which we think will put us nearer the top in the DT list.

On Saturday night (our friends don't state what Saturday) using a three tube single circuit set, we made a little record for a single night. Fifty-eight all told! The list is: WHAS, WSB, KDKA, BI6, BI4, WJAK, 9ESI, WBZ, WCAE, WDAP, WDAF, WWJ, 9WE, 9VC, WJAR, WGY, WPAB, WEAF, WCK, WLAX, WCBD, WOS, WTAQ, WOC, WRC, WHN, KFSB, WDI, WGR, WMC, KSD, KYW, WOAW, WDAR, WBAV, KFKB, WSAH, WJAZ, WBAP, KHJ, 5ST, WTAS, KFKX, 1XU, WLAG WIAI, 9XAT, WHAA, KFAE, 9QI, KFSG, KFI, 5ZG, 9ANY, KGW, WAAW WTAM and also Kalia, Cuba.

The Cuban station said they had no call letters yet. They broadcast on 360 meters.

Since December twenty-seventh 1923 to February eighth, 1924, we have heard all told *two hundred four* different stations, most of the time only using two tubes. Try to beat that!

(Here is where the joke comes in—read the names carefully, and then laugh! —[The Editor.)

Yours very truly,
CURTIS SPRINGER,
1224 N. Olney St., and
KENNETH FISCHER,
1219 N. Olney St.,
Indianapolis, Ind.

Mr. Sabiston—If you'll take our advice, don't try to beat that. These kids get the wooden ohm-saw for the month. Your letter came just in time DT's and what a timely defense you present yourselves with!

Now we are all, without doubt, interested in that Haynes circuit published in the December, 1923, issue of RADIO AGE, and we have a lot of letters of fans who want addresses of other DT's that are getting results so that they can compare records. Here's a letter that puts the Haynes on the Dial Twister's list:

RADIO AGE,
Gentlemen:

I am writing to let you know of the success I have had with your Haynes DX hookup as published in the December, 1923, issue of RADIO AGE. With detector and one stage of audio frequency amplification with a Canadian tube as a detector and a WD 12 as amplifier, I have heard as many as thirty-two stations in a single night on a loud speaker unit consisting of a Baldwin type C phone with a table talker, which by the way is home-made.

Most of these stations are around the 1000 mile mark. Last Thursday night (January 31) I picked up WKAQ, San Juan, P. R. on the loud speaker and held him for three quarters of an hour! Tonight (February 7) I went after him again and got him right off the bat on the same place on the dials. I have a list here that says that WKAQ is silent on Thursday nights, but that can't be so, as several of my friends with larger sets picked him up also.

I log all my stations and never find them to vary over five degrees of the vernier. I intend to add two more stages of audio, and if the police allow me I will be tuned in every night. And as Jack Nelson of Willy Dapp (WDAP) says, "That's that!" Very truly yours,

RUSSELL R. THOMAS.

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227 Laurier Avenue West,
Ottawa, Ontario, Canada.

Mr. Thomas wants to know if two stages of radio frequency can be added to the Haynes, and wants to know if we have a diagram. Frankly we tell you that as yet we have no diagram that has been actually tested out to give results, but feel quite sure that it could be added to the Haynes much in the same way as to the Reinartz, with the exception that the tickler coil would probably have to be changed a little. Are there any experimenters who can help him out? We would suggest that you add the push-pull amplifier as described in January instead of the radio frequency as you will then be blessed with greater volume and still retain the benefits of a straight regenerative circuit. To tell the truth, we are not inclined to recommend radio frequency with highly regenerative circuits due to the fact that it is quite a problem for the average dial twister to engineer his set to get the best results. And if you don't use radio frequency in the right way, you wont get much satisfaction.

And as the barber says, "Next!"

RADIO AGE,
Gentlemen:

After reading some of the letters of the February Pickups Page, I decided to write and let you know what my single tube single circuit set is doing.

On a good night I have no trouble tuning in from thirty to forty stations and hear them with surprising volume and clearness. Among those I have heard are KHJ, KPO, KFDL, WFAA, WDAT, WDAJ, WJAR, CKAC, WEAF, WIP, WSB, KDKA, WSY, WCAP, WOR, WMC, KSD, WCAE, WHAS, WHAM, WHN, KFKX, WOAW, WWJ, KOP, WBZ and others.

On December twenty-eighth I tuned in forty-eight stations and all together I have heard 111 different stations. I am using a WD 12 tube on my set.

To RADIO AGE, "The Magazine of the Minute" (not hour) I wish good luck.

Very truly yours,
FRANK P. OBERST,
Racine, Wisconsin.

We note, Frank, that you are only using one tube, and are pleased to say that you have results almost equal to the record established by Ken Fischer and Curt Springer in this issue, who, while they have a hot record, honestly state that they use two and three tubes. There is one thing sure and that is, Mr. Sabiston can't nail that bakelite crepe on your record. HI!

By the way, fellows, I suppose many of you had orders in for the RADIO AGE ANNUAL that big fat book full of the latest dope and circuits and had to

wait quite a while before your orders were shipped. We wonder if you felt this way about it:

RADIO AGE,
Gentlemen:

I received your card acknowledging my dollar saying that the book would be sent me as soon as it came off the press! For the LUVAMIKE has the press busted? When do you think I wanted to build the set? I'd like to have it before I die of old age.

Let me hear from you soon—don't keep me in this awful suspense.

Respectfully,
L. A. CASS,
6446 Ellis Ave., Chicago, Ill.

Mr. Cass has no doubt built his set by now and is enjoying the comprehensive contents of the Annual, but that doesn't stop us from making the remark that Dial Twisters are probably the most impatient people in the world. As the indulgent mother said to her son, who was crying because the theatre he had just been rescued from caught fire, just as the play in progress was nearing the climax: "Patience, Alfonso, patience! They will resume the play as soon as the theatre is rebuilt!"

And seeing that we are inclined to print a few kicks this month, we also print this one:

RADIO AGE,
Gentlemen:

My list appeared in your February number but due to some error on your part my name on the Dial Twisters list was followed by "Milwaukee, Wisconsin." I wish to thank you for placing me on the list and also ask you if you will please correct this error.

Since writing you I have added many stations to my list and want to add the following over 1000 miles: WNAD, KGW, KLX, WDAH, the first being 1000 miles away, the second 2100, the third 2300 and the last only 1700!

Please do not think me a "limelight bug" but I would like to see a record held by anyone on a single tube set that beats mine. If you can find just a little corner in your excellent department will you please give my correct address and state that I will gladly give all data and hookup of my set to anyone writing me. I would like to see everyone in the U. S. A. get just as good results as I am on my set. And everyone can, too.

I think that your Dial Twisters' idea is a splendid one; it makes you feel pretty good to see your name on a list like that after working into the small hours of the morning to get up a list. I am not able to decide an appropriate compliment for RADIO AGE.

Thanking you for publishing my list, I am, Yours very truly,
RICHARD JONES.

P. S. After writing this I read the lists by the youngsters in their "teens." Well, as far as that goes I'm only seventeen but like everyone else (although they don't like to admit it) I enjoy the bedtime stories too, especially if they come from a station two or three thousand miles from here.

And now Mr. Printer, please put this address in italics. If we know what's what, Mr. Jones is going to be swamped with letters because I have already had a number of requests for his address: *Richard Jones, 300 North Warner Avenue, Bay City, Michigan.*

Also, Dick, RADIO AGE lives at 500 North Dearborn St., Chicago, Ill., and not at Mount Morris, Ill. Mount Morris is only the place where RADIO AGE is printed. (That last remark has all the earmarks of a comeback, eh, wot?)

Due to the fact that "Variety is the spice of life," we won't let this whole department be filled with kicks, so we're going to print a couple of renditions entitled, "Of all my wife's relations, I love myself the best."

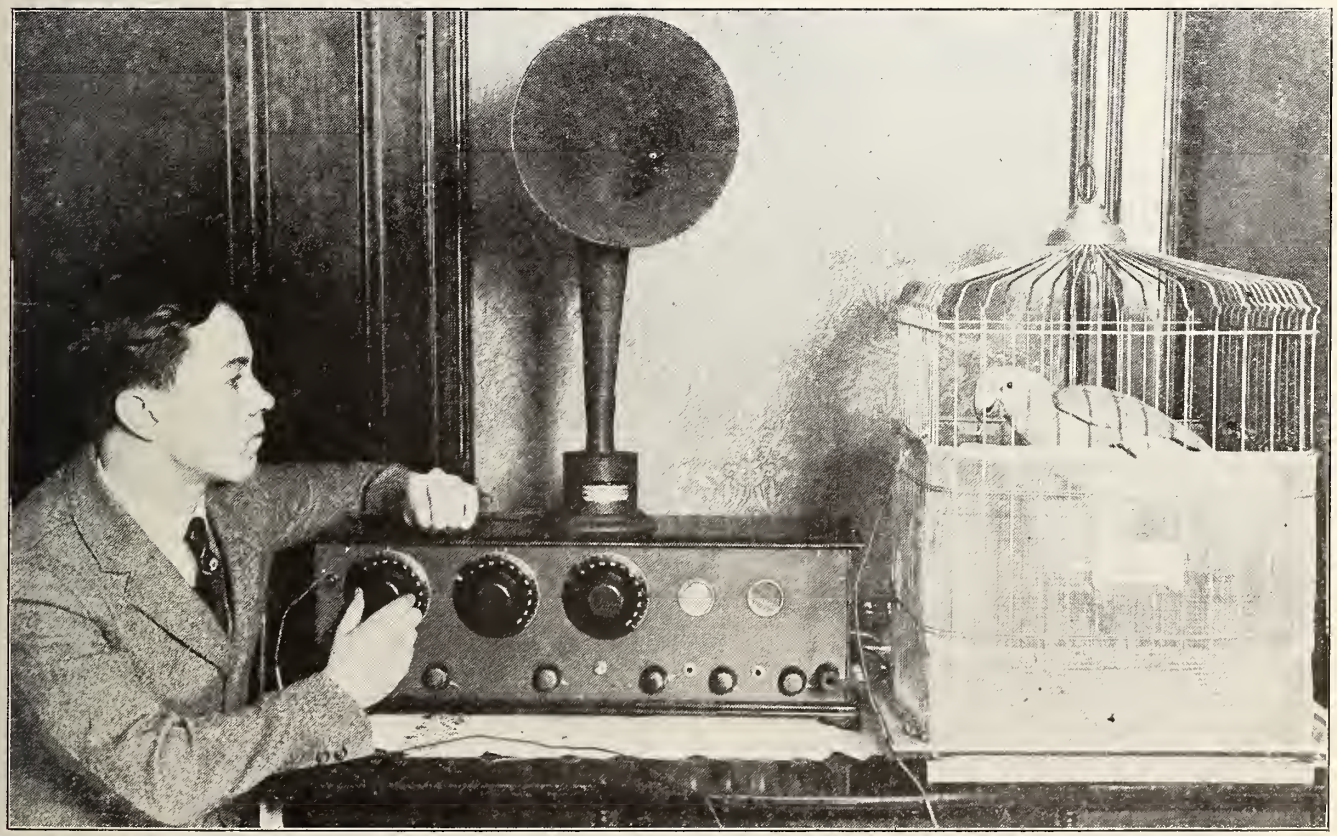
RADIO AGE,
Gentlemen:

Tried out your eliminator as described in January, 1924, of RADIO AGE. It works fine. It certainly is an aid in tuning. Tell the fellows that they might get better results by winding it with number 18 SCC wire.

Last night my variocoupler went on the bum. I disconnected the coupler and used the eliminator as a fixed tuner, the 8 turns as primary and the 40 turns as secondary. It worked better than any coupler I have ever used. IT BROUGHT IN KHJ ON THE LOUD SPEAKER!

Yours truly,
GEORGE S. EVERHART.
4214 Ruckle St., Indianapolis, Ind.

This is RADIO AGE broadcasting;



A CAGE ANTENNA

A new type of radio enthusiast has made his appearance in Robert McAffee's home on West End Ave., N. Y. He is none other than the family's pet parrot, "Jake." He is so interested in radio that he calls out all local and distant stations by heart. He is also so familiar with the voices of the various radio announcers that he is constantly imitating them. He wants to do his part so he permits his cage to be used as an aerial.

stand by one moment. Our next number will be a barber-shop rendition of the parody on "You Can Take Me Away from Dixie," etc., entitled "I can tune out stations in Chicago, For interference I don't give a rap. 'Cause in series with my antenna, I've got a RADIO AGE WAVE TRAP," sung by Chas. E. Rogers, accompanied by the Pickups Editor on a squealing, howling, oscillating and yowling ten tube neutrodyne. Let's go!

RADIO AGE,
Gentlemen:

Broadcasting advertising pays. Had it not been for WJAZ the Edgewater Beach Station announcing one Sunday night that your RADIO AGE contained some very interesting hookups along the wave trap line for eliminating stations not desired, I would not have thought of buying one of your magazines; but upon hearing this in the air, I at once went to three or four stores to purchase one; and you can rest assured that I will not miss a single copy from now on, as your book is without question the best of its kind on the market to-day as far as radio is concerned; and as soon as some of my subscriptions are up on some of the other magazines I intend to be a yearly subscriber for yours.

I constructed the wave trap on page 5 of your January issue and tried it out last night while the opera was on from KYW and WDAP, the Board of Trade Station and the Daily News WMAQ, and must compliment you on your information. Between the hours of 7:30 p. m. and 10 p. m. this wave trap cut out the Chicago stations and I was able to pick up WHAS, Louisville, Ky.; WTAS, Elgin, Ill.; WGY, Schenectady, New York; WHB, Kansas City, Mo.; KDKA, East Pittsburgh, Pa.; WDAF, Kansas City, Mo.; KSD, St. Louis, Mo.; WOR, Newark, New Jersey; WJAX, Cleveland, Ohio, and WEAF, New York City, New York. I think this is a very good record for a one tube set with the assistance of your wavetrap. I intend to construct the last-mentioned trap and see if that will render me any better service than the first-mentioned one, although I am more than pleased with the results, and want to thank you for being able to receive such good and valuable information for such a small cost as twenty-five cents, the price of your magazine.

Yours truly,
CHARLES E. ROGERS,
4409 N. Lincoln St., Chicago, Ill.

Knowing how hard it is to tune out Chicago stations when trying to get a DX program, we are putting Mr. Rogers name on the DT list, as it is a real accomplishment. Maybe not from a standpoint of distance or consistent work but for doing something that was formerly claimed that only a superheterodyne with a special oscillator could do. Good work, Mr. Rogers.

At last we have a fellow who has apparently got a list that compares with Ken Fischer and Curt Springer's records, in respect to the number of stations heard. He only misses their single night record by eight stations, but beats their aggregate number by a considerable figure.

RADIO AGE,
Gentlemen:

I am a constant reader of RADIO AGE and so I'm naturally interested in the Pickups Department.

I have noticed for some time, the records of BCL's from all over the country, but as yet I've seen nothing that beats mine! Therefore I think I'll "tell the world" about my record. Beat it if you can!

I have a home-made detector, and two step using the ultra Audion hookup. My antenna is a plain single wire about 90 feet long, strung between two trees.

My total number of stations to date is 251, with an aggregate Mileage (i. e. from my set to each station) of 169,111 miles. This includes stations from Canada, Mexico, Cuba, and Porto Rico.

Last night, January 25, I played a game of radio golf, or in other words, I tried to see how many different stations I could get in one evening. I put on the Baldwins at just 6:45, and when I quit at 10:45, I had a list of 50 different stations that I had heard during that four hour period.

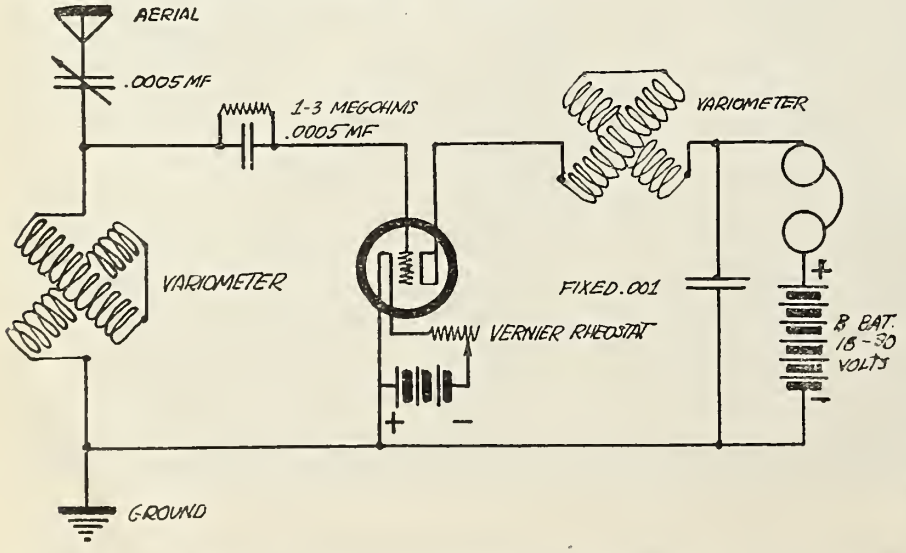


Figure 2. A simple single circuit regenerative set, with which one of the DT's gets such good results. Fellows having trouble with the Rosenbloom might give this one a twirl.

Here is the list. If any one doubts it, I have the exact time of hearing each station, to prove it:

*1 WAAN, Columbia, Mo.
*2 WJAK, Greentown, Ind.
3 WGY, Schenectady, N. Y.
4 KDKA, Pittsburgh, Penn.
5 WDAP, Chicago, Ill.
6 WHAS, Louisville, Ky.
7 WCK, St. Louis, Mo.
8 KFKB, Milford, Kans.
9 WHB, Kansas City, Mo.
10 WOAW, Omaha, Neb.
11 WMAQ, Chicago, Ill.
12 KYW, Chicago, Ill.
13 WCAE, Pittsburgh, Pa.
14 WBAP, Ft. Worth, Tex.
15 WRC, Washington, D. C.
16 WHA, Madison, Wis.
17 WSB, Atlanta, Ga.
18 WOC, Davenport, Iowa.
19 WMC, Memphis, Tenn.
20 WEAF, New York City.
21 WLAG, Minneapolis, Minn.
22 WJAR, Providence, R. I.
23 WBAV, Columbus, Ohio.
24 WJAD, Waco, Texas.
25 WCAL, Northfield, Minn.
26 KLZ, Denver, Col.
27 WTAS, Elgin, Ill.
28 WCBD, Zion, Ill.
*29 CHYC, Montreal, Canada.
30 WDAR, Philadelphia, Pa.
31 WOS, Jefferson City, Mo.
32 KHJ, Los Angeles, Calif.
33 WJY, New York City.
34 WDAF, Kansas City, Mo.
35 CKAC, Calgary, Canada.
36 CKCK, Regina, Canada.
37 WFAA, Dallas, Tex.
38 WOO, Philadelphia, Pa.
39 WJZ, New York City.
40 KFAF, Denver, Colo.
41 KFAE, Pullman, Wash.
42 WNAD, Norman, Okla.
43 KFDY, Brookings, S. D.
*44 KQV, Pittsburgh, Pa.
45 WJAZ, Chicago, Ill.
46 KFI, Los Angeles, Calif.
47 KFEL, Denver, Colo.
48 WJAQ, Topeka, Kan.
49 KGW, Portland, Oregon.
*50 *CYL, Mexico City, Mexico.*

(The star means new station.)

Well—can any one beat it? If they can let's hear 'em broadcast.

Yours very truly,
H. S. FREDERICKSON,
406 Howard Street,
Charles City, Iowa.

The editor will wear warts on his fingers when he tries to beat that one. In the meantime, Mr. Sabiston still has an extra bakelite crepe that he is trying to get rid of at 66 3-4 per cent off. HI!

And here's a fellow who gallantly defends the Reinartz!

RADIO AGE,
Gentlemen:

I have not heard much from Reinartz owners, therefore I am sending in my list of stations for the month of January. I put my set together December 31, set it up on January 1, and the stations I have received since then are as follows: KDKA, WGY, WOC, WFAA, WLW, WHAS, WGR, WCAD, KFKX, WJAX, WMAK, WTAS, WDAP, WHD, WOS,

WLAG, WLAX, WSAI, WDAF, KYW, WBZ, WHAZ, WPAM, WCAL, KLZ, WMC, WSB, WNAD, WJAZ, WCK, WWJ, WRW, CFCA, WOAW, WBAP, WTAM, WOAI, WCAM, WCBD, WOR, WPQB, WBBD, WEAM, WMAQ, WJAD, KFKB, 9AMJ, 9AFY, 9ALW, 9AFA. The last four are amateur radio telephone stations.

I think my little one-tube Reinartz makes a close stab for the record this month. All fifty of the stations came in very clearly. Would like to hear from some of the other Reinartz bugs. Write.

Respectfully,
JOE HAFERT.
1323 Woodbine Place, Fort Wayne, Ind.

By golly, if you could catch fifty stations in the first month you had your set up, you are a pretty apt learner in the matter of learning to tune, and we are putting your name on the DT list. Usually it takes about a month or two before a fellow learns to get his first DX station.

And here's another fellow who makes the grade of Dial Twister because his work for one evening is commendable.

RADIO AGE,
Gentlemen:

I am submitting the following list of stations as logged by me on November 26, 1923, using a Zenith detector and two-stage audio frequency amplifier. Homemade.

I believe that this list entitles me to membership in your much prized "Order of Dial Twisters."

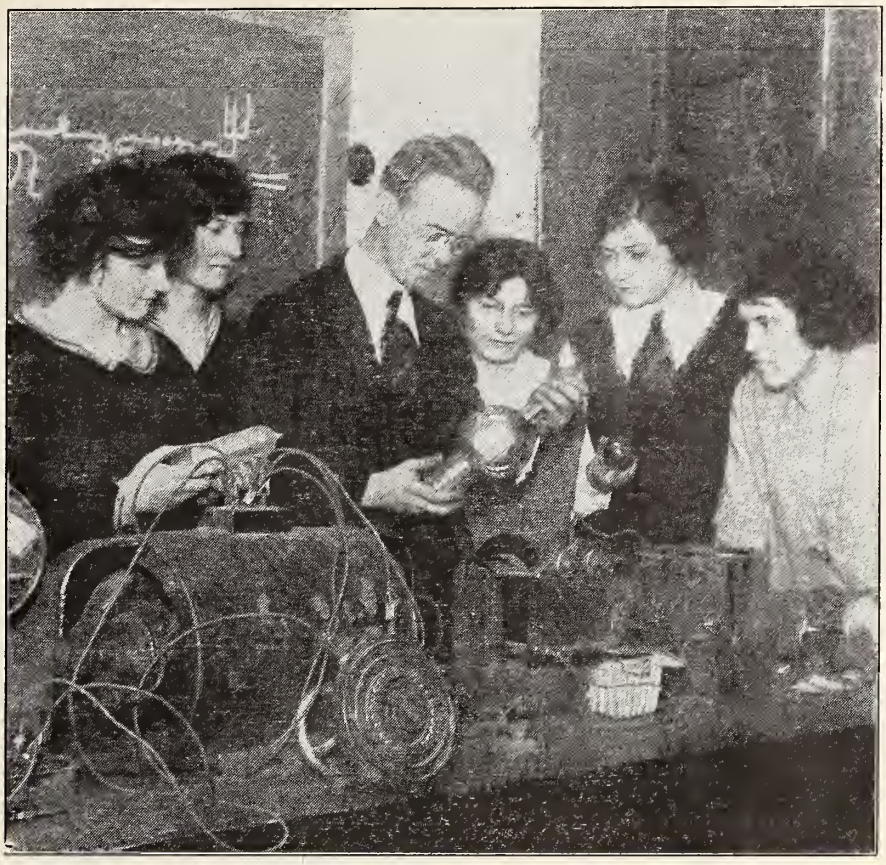
WCX, Detroit, Mich., KDKA, East Pittsburgh, Pa., WBZ, Springfield, Mass., WCAE, Pittsburgh, Pa., WLAG, Minneapolis, Minn., WOO, Philadelphia, Pa., WWS, Detroit, Mich., WEAF, New York City, N. Y., WBAP, Ft. Worth, Texas, WDAF, Kansas City, Mo., WHAZ, Troy, N. Y., WAAW, Omaha, Nebr., WPAH, Waupaca, Wis., KFKB, Milford, Kan., WSB, Atlanta, Ga., WOC, Davenport, Iowa, KSD, St. Louis, Mo., WTAS, Elgin, Ill., WLW, Cincinnati, Ohio, WGR, Buffalo, N. Y., WRK, Hamilton, Ohio, WCBD, Zion, Ill., WBAV, Columbus, Ohio, WMC, Memphis, Tenn., WOS, Jefferson City, Mo., WDAR, Philadelphia, Pa., WOR, Newark, N. J., KFI, Los Angeles, Calif., WSZ, New York City, N. Y., WBAH, Minneapolis, Minn., KFKX, Hastings, Nebr., WOAW, Omaha, Nebr., WRC, Washington, D. C., CFCN, Calgary, Canada, KPO, San Francisco, Calif., 8XJ, Cleveland, Ohio, KFDL, Denver, Colo.

These stations total about 23,150 miles and were logged between the hours of six p. m., and twelve-thirty a. m.

Respectfully,
WILSON B. LEMBERGER,
2037 Osborn Street, Burlington, Ia.

Now you will probably wonder why that deserves the title of DT. The secret that Wilson is only fourteen years old, and any youngster who will have patience to sit at a radio set for six hours to listen for DX ought to get the credit he should have. ATTA' BOY, Wilson!

And while we have been gloating over tube records, we have probably been mentally reproached for not giving some thought to the crystal bugs, but don't convict us that way. Here's a kink for the crystal bugs that will no doubt receive the welcome and grateful thanks of many fans who are not so fortunate as to possess a tube set:



RADIO SCHOOL FOR WOMEN

The first radio school for women has opened at the Bedford Y. M. C. A., Brooklyn, New York. It is the first school of its kind. Photo shows J. S. Peterson, the instructor, explaining the intricacies of the vacuum tube to his pupils.

RADIO AGE,
Gentlemen:

Yours of January 28 received; in reply will say that the purpose of my previous letter was to have you publish this crystal innovation as a follow up on your eliminator. There is really nothing that I have done to improve on your idea, as I only stuck in a crystal detector and phone jack and ran the wires right through to the phones. Since writing my previous letter I have been fortunate enough to get DX on this hookup.

Monday night I heard a speech at KDKA, East Pittsburgh, Pa., and incidentally, might mention that a friend to whom I gave this hookup got WWJ of Detroit, Mich., on it. It is a very sensitive hookup and works very fine with the crystal and you still can use it as a wave trap for your tube set if you happen to have one.

I realize what a trial the people have when WJAZ or one of the other local stations of Chicago starts operating and I think there are a good many fans who are looking for a good efficient crystal hookup, and this is it.

I am not much on drawing, but will do the best I can, so I enclose herewith a sketch of the idea.

Yours very truly,
H. A. ENGLEBAUGH,
1328 Winona Street, Chicago, Ill.

P. S. I have used both No. 24 and 22 DCC for the eight turns but they work about the same.—H. A. E.

Eureka! Perhaps this is what thousands of fans who can only afford a crystal set are looking for. To Mr. Englebaugh the entire credit goes—we never dreamed that the eliminator could be used that way. The eliminator was described in the January 1924 issue of RADIO AGE as an interference preventer, and since then, we have received fifty-seven different varieties of uses for the unit. The whole secret lies in the way you construct the unit; if you make it carelessly and use poorly designed parts, you can't possibly expect results, and any fans who try out this unusual use of the eliminator should bear this in mind. Mr. Englebaugh would be pleased to hear from fans who construct this trick receiver. A diagram of the whole smear is shown in Figure 1.

Reflex fans probably will find the following letter of interest.

RADIO AGE,
Gentlemen:

While looking through the Pickups page, I have been tempted to write the results I have obtained from my homemade Erla 3 tube Reflex. I use an indoor aerial strung between two rooms, and

the following is a partial list of the stations I have succeeded in hearing clearly and loudly. This does not mean I had to nearly bust an eardrum to listen. Those with the mark were heard on the loud speaker, which is a Morrison Phonograph Unit attached to a Clear Tone horn.

KDKA, KYW, PWX, WAAN, WAAT, WBAN, WCAE, WCAL, WACM, WCAP, WCBD, WDAF, WADP, WDAR, WEAF, WFAA, WFAB, WFI, WGR, WGY, WHAS, WHAZ, WHN, WIP, WJAX, WJAZ, WJY, WJZ, WLAG, WOAG, WOAP, WOC, WOR, WOS, WBAM, WSDX, WOAZ, WRC, WRW, WSAI, WSB, WTAM, WTAS, CHYC. Local stations not mentioned but have all been heard.

I have not seen any reflex circuit featured with a list like this one, and would like to hear what the other reflex fans say.

Yours for radio,
G. S. BAIRD,
32 Maltbie Avenue, Suffern, N. Y.

That's a nice little list, isn't it? You've got to give credit to Mr. Baird—we know how hard it is to make a reflex do its darndest. You fellows who are having trouble might give Mr. Baird a ring—perhaps he can give you some valuable suggestions.

RADIO AGE,
Gentlemen:

It seems as if the Reinartz bugs have been falling behind of late with their reports, so thought I'd boost it a bit. About one month ago, I built a set for a friend of mine who had never operated a set and had only listened a few times. The first time I tuned in with the set I heard Havana, Cuba, Los Angeles, Calif., San Francisco, Calif., and Portland, Ore., together with Calgary, Canada, and New York City. It was by far the loudest set I'd ever heard. Announcements and music from Kansas City and Omaha came in so loud that it could be heard across the room. We had no loudspeaker, but we hung the phones on the wall and still heard the signals. Later one stage of audio frequency amplification was added. The set was delivered Christmas eve and to date his record is as follows: WKAQ, KGW, KPO, PWX, KFI, KHJ, CFCN, CFCA, KFAF, KFKX, WAAW, WOAW, KFKB, WNAD, WFAA, WBAP, WOAI, WPAM, WOQ, WDAF, WHB, WOS, KSD, WOC, WEQU, WLAG, WBAH, KYW, WJAZ, WMAQ, WDAP, WTAS, WCBD, WMC, WHAS, WSY, WLW, WSAI, WTAM, WJAX, WCX, WWJ, WCAE, KDKA, WOO, WGR, WGY, WEAF, WOR, WCAP and WSB.

Not a large list, only fifty-one stations, but pretty good for a newcomer. Wonder if any Kopprasch or Cockaday, "fiends" can report as good. The hookup is a slight modification of the standard Reinartz using two taps in the grid circuit and none in the plate or antenna. Other than these slight changes it is standard.

Very truly yours,
FRANK W. SMITH,
2306 Edward Street, St. Joseph, Mo.

Good work, Mr. Smith. The reason your friend gets such good results is due to the fact that when you omitted the taps on the coils you unconsciously cut down many losses, and lowered the entire resistance of the circuit. We'll bet that the tuner is a peach for selectivity, too. It is a far wiser plan to make your coils of sufficient size to suit the wave desired and to use a sufficiently large condenser than it is to use a tapped coil and a smaller condenser. The losses incurred in the taps and dead ends of the coils, while not of appreciable notice in signal strength, will when removed increase the general effectiveness of the set as a whole.

FRENCH GENIUS

Latest portrait of General Gustave Ferrie, the man who has developed radio in France during and since the war. He is head of all the military radio stations in France. He controls the Eiffel Tower post as well as many other stations.

Here's a letter from the town where RADIO AGE is printed:

RADIO AGE,
Gentlemen:

This is to let you know that I have with the little "First Tube Set" and a one-stage amplifier pulled down through my antenna almost every station of importance from New York City to San Francisco, Calif. Here is a partial list of them: KDKA, KFAF, KFFZ, KFI, KHJ, KLZ, KPO, KYW, WEAF, WCAE, WCAP, WCBD, WCX, WWJ, WDAP, WEAH, WEAS, WGY, WHA, WHAN, WHB, WIAB, WIAO, WJAZ, WLAG, WHAS, WLW, WMAI, WMC, WOAG, WPAB, WPAC, WPAD, WSB, WSY, WTAM, WTAS and many others which I failed to put down when I heard them.

It might be of interest to you that I have made five of these little receivers, and they always worked the first time I hook them in.

Yours very truly,
MAX M. BARNHIZER,
Mount Morris, Ill.

The little "first tube set" mentioned above was described in detail in the October, 1923, issue of RADIO AGE, and we have been getting lists that look like the call book on it ever since. RADIO AGE has a staunch bunch of boosters out in Mount Morris, who are employed in the plant where RADIO AGE is printed. Among them are H. V. Biery, Grover Hammet, W. I. Prugh and many others. And believe me, Mt. Morris is certainly radio nuts. They've got a fifty-piece brass band that broadcasts from WOC every once in awhile, and telephone interference and everything. Hot town, that.

Here's a little letter which will make some of the fellows with super-heterodynes look like they have a glass arm:
RADIO AGE,
Gentlemen:

Why all this fuss? There is no use talking, the Reinartz is by far the best receiver! (Ha! How do you like that DT's?—The Ed.)

Come on, you Reinartz fellows—they aren't going to pull the wool over our EARS. This one ought to help testify to that. Here is a list of stations heard in two and one-half hours time: WWJ, WSB, KSD, WCAE, CKCK, WHB, WFI, WLAP, WGY, KDKA, WSAI, WHN, WFAN, KHJ, WMAW, WJZ, WBAP, WCX, WOAW, WBAV, WCAI, WJAN, WLW, WDAP, KFKB, and in addition to these mentioned I hear PWX, Havana, Cuba, Portland, Ore., Calgary, Can., San Diego, Calif., San Francisco and lots of others.

Only a Reinartz will do this. They've got to show me.

Yours very truly,
H. J. BOYENGA,
Greene, Ia.

And that's that! All we're going to do now is to brace ourselves for the flock of letters which will come in in answer to this one telling Mr. Boyenga where to get off. It looks like he started something. That's a good list—only two and a half hour's listening and twenty-five stations; you know some of these fellows think that they've nailed a record when they pull in twenty-five in a week.

The following ought to be of interest to Lloyd E. Foltz, a fan who for the past several issues has been the target of much "razzing." Also to the users of Cockaday sets.

RADIO AGE,
Gentlemen:

If you can spare the room in your Pickups section of the most valuable radio periodical published (Thank You —The Ed.) please print the following

and I'll try and help Lloyd E. Foltz defend the Cockaday DX title.

The following stations were heard on a Type C Baldwin Loud Speaker with two stage of audio, the circuit, of course, being a Cockaday. All were heard loud and clear with enough volume to fill a good-sized bungalow!

WLAQ, 360; WTAM, 390; WWJ, 517; WJAZ, 448; WGI, 360; WGR, 319; WEAF, 492; Wcap, 469; WSD, 546; PWX, 400; WRC, 469; WOC, 484; WCAE, 462; WSB, 429; WFAM, 360; WHN, 360; WCK, 360; WJAR, 360; CFCA, WSY, 360; WIAD, 360; KDKA, 326; WOI, 360 (this station has a radius of only 200 miles); WPAH, 360; WFAA, 476; WOS, 441; WCAL, 360; WOAI, 385; WJAX, 390; WSAI, 309; KYW, 536; WLW, 309; WMAK, 360; WHA, 360; WCAE, 462; WJAD, 360; WOAN, 360; and KFKX, 286.

You will notice that WOI of Ames, Iowa, has a radius of only 200 miles, but in spite of this fact I have heard them both clearly and loudly. I gave the meter wave length of the different stations for the reason that some of the fans don't seem to think that this circuit is capable of going from the lowest to the highest waves. I think that the foregoing will most clearly demonstrate this point. There is only ten meters difference between my local station WHAS and WTAM, Cleveland, Ohio, and I have repeatedly listened to an entire concert from WTAM while Louisville was going full blast.

Only five meters between WHAS and WOR at Newark, N. J., and I have also heard an entire concert from WOR, while Louisville was on with no interference from Louisville whatever.

Any RADIO AGE reader desiring information on this set may get same gratis by writing me at Crestwood, Ky. I want to see the Cockaday bunch at the top.

Here's hoping that I have contributed at least two or three good points for the Cockaday and a good many more for the RADIO AGE.

Very truly yours,
J. H. JONES,
Crestwood, Ky.

The Cockaday fans will probably welcome that letter, Mr. Jones, and will especially feel that it bears weight when we tell them that Mr. Jones is an old friend of RADIO AGE, and has been visiting the Pickups section before. It seems that Mr. Jones has at various times been a Reinartz fan, an Erla bug but this is the second letter we have had from him with reference to the Cockaday.

RADIO AGE,
Gentlemen:

Purchased my first copy of RADIO AGE, January, 1924, and am much interested in the Pickups page. I would like to give you a slant at my list heard on a two-variometer single circuit set with detector only. The following are the stations heard since August, 1923. The amateur are all phone. If the list is too long, cut out the ones closer than 500 miles.

PWX, at Havana, Cuba, was tuned in at about 7:30 one evening through powerful interference created by WDAP.

I have heard KFI and KHJ several times, one time when my antenna lead in was lying on the roof.

I use a UV 199 tube, 22 1-2 volts on the plate and an aerial of one wire about ninety feet long, including lead in. Have tuned in as many as twenty-eight stations in one evening, with KFI the farthest. I am leaving out several amateur stations which I have heard but in spite of that, my list totals 103 stations. I am enclosing a copy of my hookup, which I think will be of interest to fans. (We are showing the hookup in Figure 2.) The list is as follows: KYW, WDAP, WMAQ, WPAD, WAAF, WTAS, WCBD, WOAW, WLW, KDKA, WMC, WLAG, WGY, WDAF, WSB, WHB, WSAI, WGR, WHAS, WWJ, WOC, WCAE, WFAA, WBAP, WBAV, WJAX, WDAR, WOO, WOS, WHAZ, WJY, KSD, WIAS, WCX, KFJK, WOR, WTAM, KOP, WBAH, WEAF, WCAP, KFDY, WIP, WHA, WEAH, WCK, WMAK, KFKB, WMAY, WSY, WAA, WHAM, CFAC, CFCN, CKCE, WRC, WPAH, PWX, 9CE, WRAD, WWAE, KFJL, KFKX, WEAS, WMAH, KLZ, KHJ, WBZ, WNAV, CKCK, KFDL, KFI, WIAO, 5LJ, 2BXL, 9DNI, 9BRX, 9BRN, 9CNN, 9ASH, 9GB, 9JC, 9CJX, WCAL, KFIX, WABT, WEAN.

Yours very truly,
FRANCIS TYE.
607 N. Eighth Avenue, Maywood, Ill.

Next time you send in a list, tear out the broadcast stations pages from some old RADIO AGE, and with a pencil indicate "leave this and this out, I've heard all the others." HI! That's a nice list, and will probably show the fellows who contemplate building the Rosenbloom circuit what it can do.

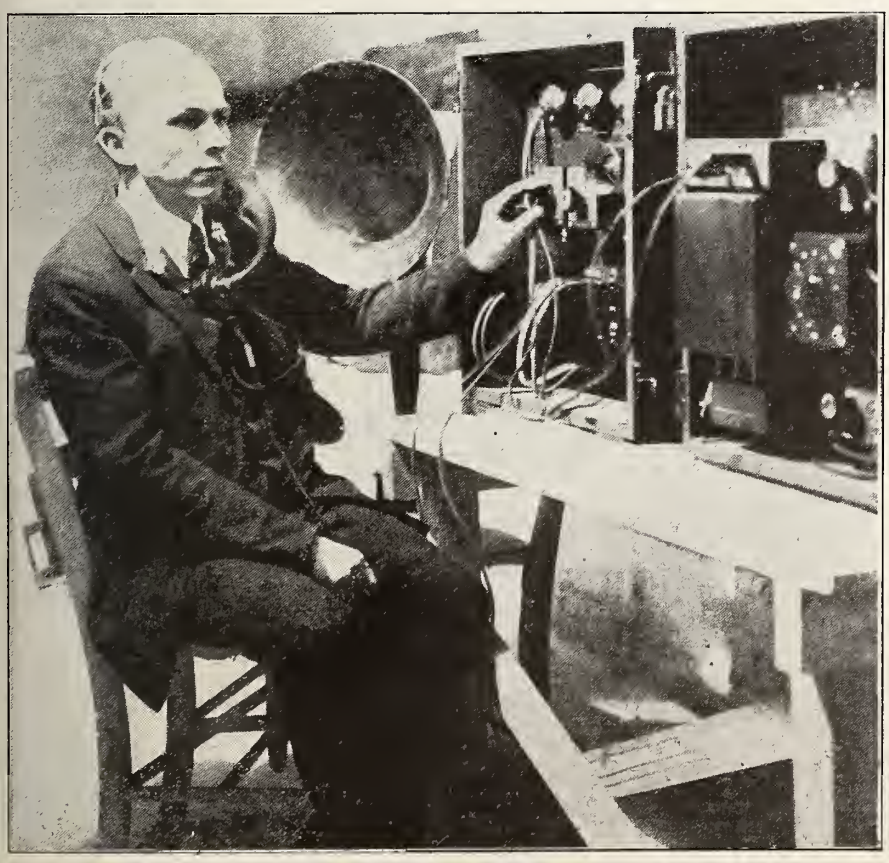
RADIO AGE,
Gentlemen:

Have been trying several hookups but have not had much success and as I had the parts I thought I would try your first tube set as described in the January issue of RADIO AGE. Got it wired up at about 8:45 p. m., and up to 10:30 p. m., I got the following twelve stations which I think is some good work for one and three-quarters hours. I am using a C 299 tube and they all come like a house afire. It sure is some hookup. Stations were received as I am listing them: WCAE, WCBD, KDKA, WOAW, OMAHA, WPAH, WLW, WHB, WHAZ, WDAR, WGR, KFKF, and KFKB.

Would recommend the circuit to anyone having trouble with their sets, as this one sure gives the satisfaction.

Yours truly,
A. W. NORTH,
61 N. Lincoln Avenue, Fond du Lac, Wis.

Now this is the part that gets us; a fellow will monkey around, mortgage his house and sell his car to get money enough for a ten tube super-heterodyne—and then when he can't get it to work goes and tries out a circuit of the type mentioned. By jimminy, it's not the kind of circuit that counts, it's the make of the set. The secret of that little "First Tube" circuit lies in the fact that



HISTORIC BROADCAST

Photo shows John Hammond in crypt below Bethlehem Chapel operating radio equipment by which the nation heard Ex-President Wilson's funeral services.

it has so few parts that you can't help but construct it with few losses. On the other hand, when you improve on a circuit, add taps, more condensers and more fancy coils you usually increase the resistance and losses in the circuit and the result is a bum set. If you take our advice, make a simple little tuner, learn how to keep the losses down and enjoy a variety of stations that you couldn't get with a poorly built ten tube super-heterodyne. Frankly, we say from personal experience in the game that if you find that an amateur takes more than two hours to wire up and make a circuit it really calls for an investigation. The general rule is to slam the thing together and then give it a test, and when it doesn't work—classify it as a failure. That's the thing that won't jibe with a large receiver, and it really takes weeks and often months before you get all the parts working in proper unison, because there are so many of them. With the little "First Tube" circuit the whole thing is based upon a few major pieces of apparatus, and it is almost impossible to fail with it. We don't mean to reflect on Mr. North's former sets or anything like that—we just feel that his letter is typical of many ill advised fans, who think that the only way you can get DX is to add more tubes, power and spend more money on a larger set, when the real solution of their problem lies in reconstructing their original set with the intention of cutting out losses when they do so.

Well, fellows, I guess that's about enough for this issue. True to our word, we've been running them pretty freely, and rather than crowd out some good feature, we'd better quit.

Before we do so the Pickups Editor wants to extend his thanks to the fans who sent in their letters but whose letters are not published, due to lack of space.

By the way, it looks like the Editor has been putting his two cents here and there, and I suppose he has read them pretty thoroughly.

S'long! See you next month.

Ship-Shore Record

All records were broken for commercial 600 meter continuous wave transmission when Operator M. A. Obradovic, of the S. S. "West Nilus," while ninety-five miles north of Wellington, New Zealand, copied a number of messages direct from WIM, the Radio Corporation of America station at Chatham on the Massachusetts coast. The distance is 9,300 miles and perfect reception obtained in broad daylight.

Operator M. A. Obradovic, whose reception has been checked and confirmed, sent a letter to marine superintendent at Chatham on December 23, in which he reported the history-making achievement. The letter reached the United States more than fifty days after it was mailed in New Zealand.

Washington Show

Washington, D. C.—Washington's radio dealers with the co-operation of officials of the federal government will stage in Convention Hall here the week of March 19 to 26, one of the most pretentious radio expositions ever held in the United States.

With the array of exhibits that have featured radio shows in other cities, augmented by special government displays, some of which have never been on public view, Washington's first radio show is destined to attract nation-wide attention.

The Department of Commerce which has supervision and control over all of America's activities in the field of radio; the Bureau of Standards, the government's famous experimental laboratory, and other federal agencies interested directly or indirectly with radio and its development, will take an active and leading part in making the radio exposition in the nation's capital an epoch in radio history.

The fighting arm of the government—the army, navy and marine corps—also will be represented at the show with exhibits of historical value. The navy has planned to exhibit a replica of the 300 watt radio transmitting station on the giant dirigible, "Shenandoah," which kept the navy department in constant communication with the big ship during her sensational gale-driven flight up the Atlantic coast in January. The army, which proudly boasts that its radio engineers are at least two years in advance of the radio wizards employed by the leading manufacturers of radio products in the development of improved apparatus, has promised an exhibit to prove its claim.

Officials of the government departments, including President Coolidge, the chief executive, and members of his cabinet, are expected to take an important part in the elaborate and unique entertainment features of the show, tentative arrangements for which already have been made.

Radio in the Movies

A praiseworthy bit of co-operation with the radio industry has just been released by Kinograms news weekly in the shape of "Behind the Scenes of a Broadcasting Station."

E. F. McDonald, Jr., of the Zenith-Edgewater Beach Hotel Broadcasting Station, WJAZ, and Ray L. Hall, head of the Kinograms news weekly chanced to meet one day on the stage of Selwyn theatre in New York.

"Radio speaking, I am rather well acquainted with WJAZ," said Mr. Hall.

"It has often entertained me in my home in New York state. I have never seen the station, however. Often wondered what it looked like."

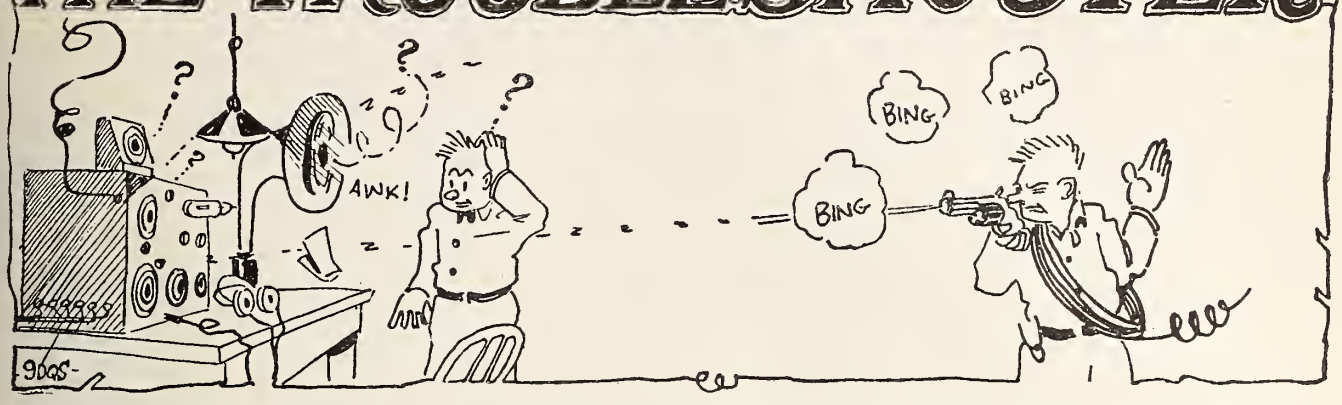
Said Mr. McDonald, "I shall be glad to arrange that not only you see it, but all of your big family of Kinogram fans the country over."

That was the starter of the film.

Next to seeing the station with one's own eyes, the picture is the closest to a full realization of the beauty of the crystal studio; the complexities of the operating and motor rooms; the gaiety of the guests in the marine dining room; the eager faces of the famous Oriole orchestra; and all that happens when the artist stands in front of the microphone and sings to his eight million or more WJAZ listeners.

Movie audiences are introduced to the grand opera stars: Florence Macbeth, Angelo Minghetti, Virgilio Lazzari, Mary Fabian and Myrna Sharlow of the Chicago Civic Opera Company in periodic flashes of the crystal studio. We are shown how the concert is put on the ether at the very moment it is being received in the different parts of the country; in a play spot of a metropolitan section in the east, vast throngs of skaters are entertained with the very same concert by means of the Zenith radio sets conveniently placed in different parts of the lagoon.

THE TROUBLE SHOOTER



E. S. M., Detroit, Mich.

Question: Your February issue came today, and first of all I must compliment you on its contents and general appearance. I am a reader of several radio publications, but this RADIO AGE takes the cake. It's a King Bee—don't let it slip. Now I have a little kick coming. I want to know why the author of that code article didn't give us more code Q signals while he was at it. I got interested in the stuff and have been talking it to the wife ever since, till she's nearly dazy. Let's have some more Q signals as soon as possible.

Answer: I am printing elsewhere in this department a complete list of Q signals as are used by the transmitting operators in the course of the regular wireless conversations. I might add that now, due to the fact that international amateur communication is becoming more and more common, the various nations are adopting a form of calling which will enable listeners to identify foreign amateur stations. Thus an American amateur calling a French "ham" would call F8AB F8AB F8AB U9DQS U9DQS U9DQS, etc. The F would classify him as French and the U preceding the American call identifies the last station as United States. The same applies to Canadian who sign "C," the British "G," and Australian "A." Sometimes the Australian sign "Aussie" and then their call. For full details on this code work, those interested should see the November and December issues of RADIO AGE, and to keep pace with amateur code developments, it is advised that readers refer to the amateur code journal QST at Hartford, Connecticut, a periodical which specializes in advanced amateur transmitting and receiving problems.

J. W. H., Topeka, Kans.

Question: I want to thank you for your January article in the RADIO AGE on the Junior Heterodyne. That is an article a great many have been looking for, particularly us fellows that are in the game with a shoe string and an oat meal can. Beg pardon if I pull a boner, but is not your tickler circuit short circuted on socket VI plate post? Having recently built a 5-tube Neutrodyne, using ice cream containers to build the transformers on, I would like to record the result for your information and advice. The transformers are wired 15 turns on primary with 60 turns on secondary, tapped at 15th turn for neutrodons. Am using Bremler-Tully .0005 MF vernier variable condensers, 19 plates on rotor and 2 on vernier. The result is that all balancing is done on the 0 to 55 divisions of the condenser dials, which are 100 division dials. Cannot separate stations on this space to good advantage. St. Louis balances on 55 55 55 and Cincinnati on 8 8 8 degree settings on the dials. Hastings, Nebr., KFKX comes in on about half of the three verniers, that is a 286 meter station. There are a good many stations down around the wave that Hastings operates on, and I would like to bring them in. My friends have made transformers 13 and 54, 14 and 56, and mine is 15 and 60 windings. They advise me to cut plates off of these condensers in order to spread the range over 100 divisions of my dials. The scrap is heated at times, as I cannot see it that way. It seems to me that I should not destroy the condenser capacity. Now I don't want to bind you down with a lot of red tape and ask you to sign on the dotted line. I know that each technical engineer

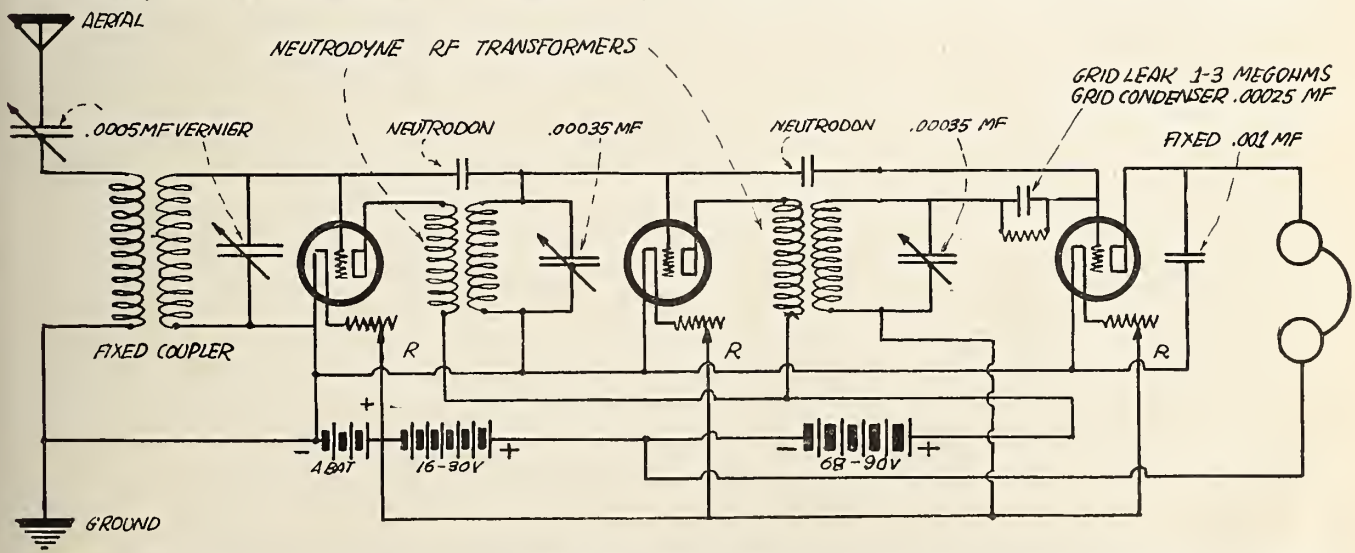


Figure 1. A hookup diagram of a three tube neutrodyne. The transformers are made according to the instructions outlined in the accompanying answer. The fixed coupler is constructed according to the directions given in the October, 1923, RADIO AGE, and consists of eight turns of No. 28 DCC wire on a three and one-quarter inch tube. The secondary consists of fifty turns of the same size wire wound on the same tube, with a separation of about one inch between the windings. No taps are taken off the fixed coupler. The condensers across the secondaries of the Neutrodyne transformers are 17 plates.

INTERNATIONAL RADIOTELEGRAPHIC CONVENTION

List of Abbreviations to Be Used in Radio Communication

Abbreviation	Question	Answer or Notice
PRB	Do you wish to communicate by means of the International Signal Code?	I wish to communicate by means of the International Signal Code.
QRA	What ship or coast station is that?	This is.....
QRB	What is your distance?.....	My distance is.....
QRC	What is your true bearing?.....	My true bearing is.....degrees.
QRD	Where are you bound for?.....	I am bound for.....
QRF	Where are you bound from?.....	I am bound from.....
QRG	What line do you belong to?.....	I belong to the.....Line.
QRH	What is your wave length in meters?	My wave length is.....meters.
QRJ	How many words have you to send?..	I have .....words to send.
QRK	How do you receive me?.....	I am receiving well.
QRL	Are you receiving badly? Shall I send 20?..... . . . — . for adjustment?.....	I am receiving badly. Please send 20. . . . — . for adjustment.
QRM	Are you being interfered with?.....	I am being interfered with.
QRN	Are the atmospherics strong?	Atmospherics are very strong.
QRO	Shall I increase power?.....	Increase power.
QRP	Shall I decrease power?.....	Decrease power.
QRQ	Shall I send faster?.....	Send faster.
QRS	Shall I send slower?.....	Send slower.
QRT	Shall I stop sending?.....	Stop sending.
QRU		I have nothing for you.
QRV	Are you ready?.....	I am ready. All right now.
QRW	Are you busy?.....	I am busy (or: I am busy with.....). Please do not interfere.
QRX	Shall I stand by?.....	Stand by. I will call you when required.
QRY	When will be my turn?.....	Your turn will be No.....
QRZ	Are my signals weak?.....	Your signals are weak.
QSA	Are my signals strong?.....	Your signals are strong.
QSB	{ Is my tone bad?..... { Is my spark bad?.....	The tone is bad. The spark is bad.
QSC	Is my spacing bad?.....	Your spacing is bad.
QSD	What is your time?.....	My time is.....
QSF	Is transmission to be in alternate order or in series?	Transmission will be in alternate order.
QSG	.....	Transmission will be in series of 5 messages.
QSH	.....	Transmission will be in series of 10 messages.
QSJ	What rate shall I collect for?.....	Collect.....
QSK	Is the last radiogram cancelled?.....	The last radiogram is cancelled.
QSL	Did you get my receipt?.....	Please acknowledge.
QSM	What is your true course?.....	My true course is.....degrees.
QSN	Are you in communication with land?.....	I am not in communication with land.
QSO	Are you in communication with any ship or station (or: with.....)?	I am in communication with..... (through.....)
QSP	Shall I inform.....that you are calling him?	Inform.....that I am calling him.
QSQ	Is.....calling me?.....	You are being called by.....
QSR	Will you forward the radiogram?.....	I will forward the radiogram.
QST	Have you received the general call?....	General call to all stations.
QSU	Please call me when you have finished (or: at.....o'clock)?.....	Will call when I have finished.
*QSV	Is public correspondence being handled?.....	Public correspondence is being handled. Please do not interfere.
QSW	Shall I increase my spark frequency?	Increase your spark frequency.
QSX	Shall I decrease my spark frequency?	Decrease your spark frequency
QSY	Shall I send on a wave length of..... .....meters?.....	Let us change to the wave length of..... meters.
QSZ	.....	Send each word twice. I have difficulty in receiving you.
QTA	.....	Repeat the last radiogram.
QTC	Have you anything to transmit?.....	I have something to transmit.
QTE	What is my true bearing?.....	Your true bearing is .....degrees from.....
QTF	What is my position?.....	Your position is.....latitude..... longitude.

*Public correspondence is any radio work, official or private, handled on commercial wave lengths.

When an abbreviation is followed by a mark of interrogation, it refers to the question indicated for that abbreviation.

has his own special ratio for these transformers. I am disposed to make new transformers in hopes that my set will be better, and would appreciate a few words from you with regard to ratios.

Answer: First of all I want to tell you that as far as beginners in the radio game are concerned, I am not in favor of recommending neutrodyne receivers to novices—the balancing of the tubes requires quite a knowledge of radio principles and tube characteristics, and inasmuch as no two tubes are exactly the same with respect to capacity, it is a pretty hard thing for the novice to balance a neutrodyne receiver properly. Of the many neutrodynes I have seen in possession of broadcast listeners, I find that very few of the fellows know enough about them to get the best results. However, with respect to your transformers, the general rule is to wind the ratios of these coils about 4 to 1. This is greatly dependent upon the type of tube used, and for UV 201A, WD 11 and UV 199, I would recommend a ratio of primary on a 3-inch (diameter) tube wound with about 15 turns of No. 26 DCC wire, and the secondary on a 3 1-2-inch (diameter) tube wound with 50 turns of No. 26 DCC. This ratio is a matter of experiment, and the results obtained are a matter of the type of tube used. Also hand wound coils vary a great deal, and no definite number can be given, outside of this general specification. A tap at the 15th turn of the secondary for the connection of the neutrodon is recommended. Often this is not necessary, the neutrodon being connected directly to one side of the parallel circuit as shown in Figure 1. The condenser across the secondary should be a 17 plate. When the tap is added, the connections are made as in Figure 2. For those interested in Neutrodyne circuits we would say that the most advantageous method of adjusting the neutrodon is to proceed in the following manner. It is assumed that two stages of neutrodyne radio frequency amplification are used. First, place a piece of cardboard in the tube socket of the first radio frequency stage so that the tube does not make contact with any of the connectors of the tube socket. Light the second tube and detector (if an amplifier is used do not use it; or closer adjustments may be obtained with the detector alone.) Select some strong local station, and if no station is in your immediate vicinity, set up a temporary wavemeter as a source of oscillations using a small buzzer as the source of your power. Here is where the delicate adjustment lies. Vary the capacity of the neutrodon of the first radio frequency amplifier tube until no signal is heard whatever from either the station or wavemeter, whichever you may be using. Keep the wavemeter at a distance of about six feet from the set. If the signal fails to disappear, try a larger neutrodon. A good one may be constructed according to instructions printed in January, 1924, RADIO AGE. The neutrodon must be absolutely correctly adjusted or the set will give only indifferent results. When the first stage has been properly balanced, proceed in the same manner with the second stage. During this adjustment the first stage of radio frequency should be on. Don't make these adjustments in a haphazard manner—if you do the set won't work properly. It will only get local stations, will howl and give poor results. The adjustment of the neutrodons together with the careful construction of the set is the secret of the Neutrodyne circuit. The trouble with J. W. H.'s receiver is quite apparent. The condensers and coils which he is using are too large for the 300 meter stations. In any case where it is desired to lower the wave length of a circuit, it is advisable to decrease both the capacity and inductance of the circuit respectively. In your case would recommend that you wind your transformers according to the ratios mentioned, and decrease the size of your condenser. This would enable you to tune with the entire condenser, making use of the whole dial scale of degrees. The additional 45 degrees that you mention as now inactive are not in use and are only dead timber, only serving to make the tuning of the receiver more critical.

C. T. S., Warren, Pa.

Question: I have built the Haynes circuit using the 180 degree variocoupler as shown in your hookup published in the December RADIO AGE, but find that in

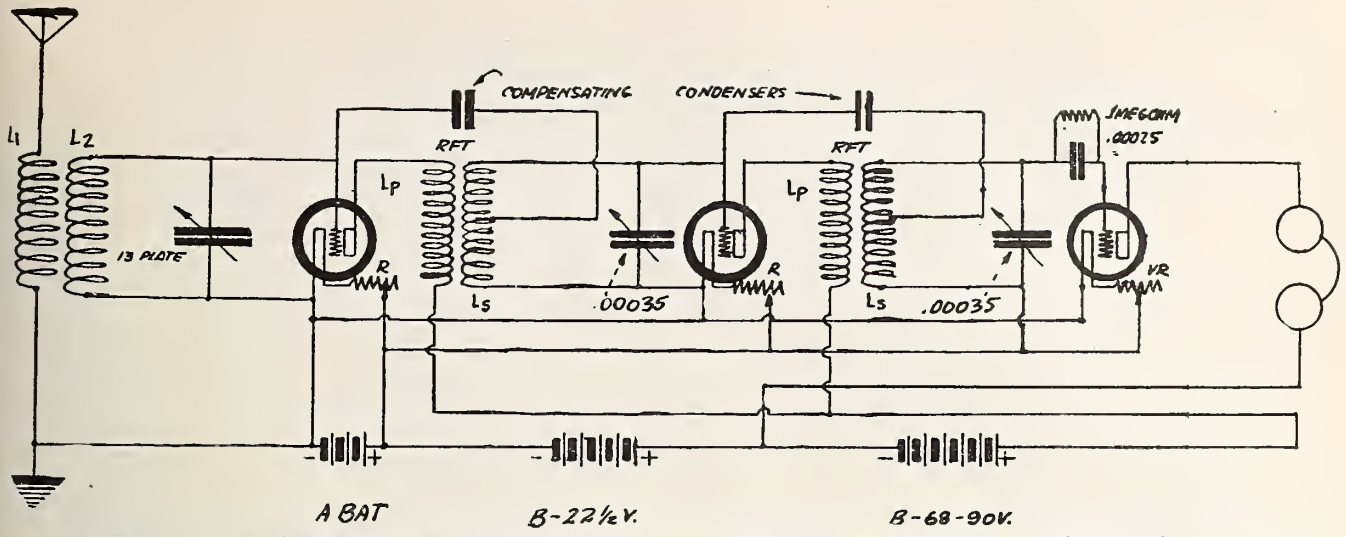


Figure 2. Another diagram of the Neutrodyne, with taps taken off the transformers as described in the accompanying question showing how the connections are made when this method of connecting the compensation condensers is used.

order to tune in, the position of the rotor is very critical, and the tube spills over all too easily. I am using No. 18 wire on the stator and No. 20 on the rotor with a 23 plate condenser and with a UV 199 tube. It seems that the 23 plate condenser works better than the 11 plate in the circuit. Would like to have you answer the following questions on the above circuit. Would you advise using No. 20 wire on the stator or taking off some of the No. 18 wire to make the circuit balance more easily? Is the Haynes considered a single circuit? Is it as selective as the Cockaday circuit? Can the variocoupler be purchased complete? What is the diameter of the rotor and stator? Please furnish hookup for this circuit using push-pull amplification with UV 199 tubes. Will I have as loud a reception with push-pull transformers as I get with the 10:1 and 3:1 transformers?

Answer: Would not advise that you disturb the winding of the stator coil, as this probably is not at fault. You might rewind the rotor with some of the No. 18 wire, and experiment a little with the exact number of turns. The action you describe suggests too large a tickler coil, and it would probably be a wise thing to cut down on the number of turns. It also might be attributed to too high a plate voltage on the detector bulb. With the U. V 199's, a plate voltage of anywhere from 18 to 45 volts is often possible and necessary in the matter of getting the best results out of the circuit. Increase the size of your grid leak, and the circuit will not be so finicky. The Haynes is a modified single circuit, but because it has two permutations for tuning it would probably be better to classify it as a two circuit tuner. If properly operated and constructed it is about equal with the Cockaday for selectivity. This however is dependent upon the operator, and careful handling is the only way it can be brought to comparison with the Cockaday. Ordinarily, the Cockaday is considered super-selective. The variocoupler can be purchased from the Haynes-Griffin Co., of New York. completely made up. The diameter of the rotor and stator are not very important, but in any case if the diameter of the stator exceeds 3 3-4 inches, the number of turns on both coils should be decreased. The amplifier described in the January issue of RADIO AGE, being a push-pull circuit is connected up by placing the input of the first push-pull transformer to the output (phone connections) of the detector. Your reception will be louder and clearer due to the fact that your tubes are only working half the time, and higher plate voltage can be applied.

H. L. C., Joliet, Ill.

Question: I would like to ask a question concerning my receiver on which I am having trouble with an alternating current hum. My antenna is close to a power line and three big transformers. Would another wire alongside of my present antenna grounded at both ends reduce the hum? What would you suggest?

Answer: The grounded wire you speak of would only detract from the effectiveness of your receiver, and lower the effective height of your antenna as a whole. If you can't run your antenna at right angles to the source of the interference, would advise that you erect a pole of as high an altitude as you can, and run the aerial up and down (vertically) in the air. The effectiveness of your set would increase materially, and it would also be at right angles to all the wires which run parallel to the earth.

J. F. M., Chicago, Ill.

Question: Will you kindly give me a sketch showing how we can both get results without interfering with one another on the following tangle: My four wire antenna was up about 2 years and a party moved in down stairs and put one wire over mine and the result is that I cannot get outside stations.

Answer: The same goes for you JFM; run your antenna straight up and down in the air on a single pole as high as you can afford. Your antenna will still be at right angles to your friend's, and you have the advantage of more effective working antenna, the whole thing being a sort of a lead in without a flat top giving a strong sharp signal as described by Mr. Pearne in the February issue in his articel on antenna analogy.

F. M. H., San Diego, Cal.

Question: We are troubled very greatly with interference from a powerful arc station (call being NPL) here around San Diego, and I would appreciate it if you would inform me as to whether it would be advisable to use a wave trap with the little "First Tube" receiver in this locality. This station makes life miserable around here for radio fans, and if this little set described in your article cannot tune out any of this interference it would be practically useless. What would you advise?

Answer: We have read with considerable concern of the powerful arc interference created by NPL, and understand that the San Diego Radio Club has created a movement to put a stop to the "mush" created by the interfering arc of this station. With reference to the circuit you mention, we wish to say that if it is carefully constructed of good apparatus it will tune about as closely as any two circuit set devised. While not over selective, it will give admirable results where interference is not too strong. If the interference you speak of is particularly violent, we would certainly recommend the addition of a wave filter as described in January, 1924, and would recommend that you use a 43 plate condenser instead of a 23 plate to cover the wave of NPL inasmuch as we know that they transmit on a higher wave than the broadcasting stations. We want to be frank with you and say this in defense of the receiver. Arc interference is composed of so called "harmonics" which occur at various waves with varying intensity. If one of these harmonics of any considerable audibility happens to be on the wave you desire to listen on, no set can tune them out. It is entirely a matter of how frequent these harmonics are, and where they occur that will judge whether you will be able to shut them out.

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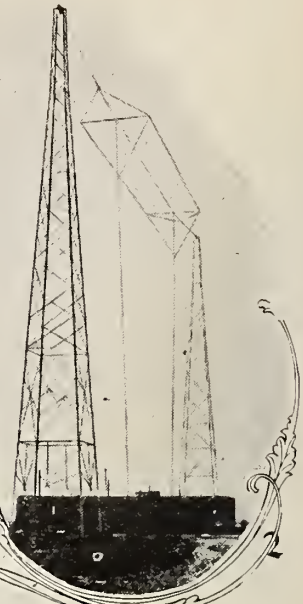

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SUNSET STATION

Above is the studio of the New General Electric broadcasting station, KGO, at Oakland, Calif. At the right is a glimpse of the antennae. Below is the station building and the operating room. The portraits are those of Martin P. Rice, director of broadcasting for the General Electric Company at Oakland, Denver and Schenectady, and J. A. Cranston, Pacific coast manager of the General Electric Co.

What the Broadcasters are Doing

KFKX, The Repeating Broadcasting Station

By D. G. Little and F. Falknor, Radio Engineers, Westinghouse Electric and Manufacturing Company

From the Electrical Journal, January, 1924

ON NOVEMBER 22, 1923, there was put into operation the latest type of radio broadcasting station—a type which presages a great advance in the art of broadcasting radio programs. The repeating of programs which are originally presented in Pittsburgh, makes available to more distant listeners the high quality of program which is obtainable only in the larger cities. While experiments along this line have been carried on for some time, KFKX is the first station to seriously attempt a service of relaying or repeating regularly a previously announced radio program, broadcast from a distant station.

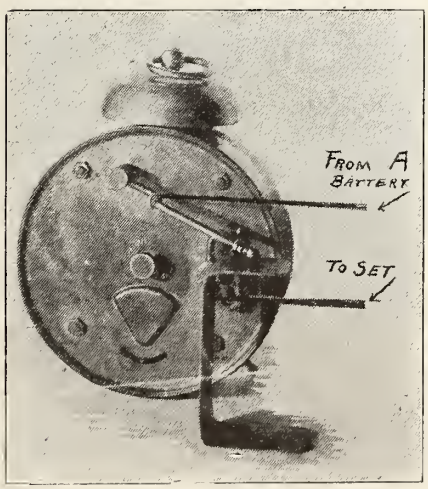
It has long been desirable to interconnect broadcasting stations in various parts of the country, so that national events could be enjoyed by the nation as a whole instead of by only those in a small area. At least two solutions of the problem are to-day in use to some extent. One is the use of long-distance telephone lines and the other the use of a primary broadcasting wave or frequency. This primary frequency must necessarily be selected in a band where atmospherics and existing radio stations interfere the least. It is also highly desirable to have this carrier frequency more independent of intensity fluctuations due to change from daylight to darkness than generally is the case in the series of frequencies now used for broadcasting. From an interference standpoint, frequencies at least as high as 3,000 kilocycles are obviously the best.

The high frequencies have many advantages for such purposes. One of the most important of these is that "fading," which is so annoying at the usual frequencies, is reduced at the higher frequency to the point where its effects are negligible. The elimination of fading is one of the first essentials of successful repeating by radio. The 3,200 kilocycle waves seem to carry almost, if not quite, as well during the daytime as at night, thus meeting another requirement of successful repeating. High-frequency transmission is also exceptionally free from static interference. While special equipment is necessary both for the transmitting and receiving of programs at this high frequency, there is no particular difficulty involved in designing equipment which will give the highest type of service.

Not an Experiment

While the first of this type to establish regular service, Station KFKX is by no means an experimental station. The repeating of programs at high frequency from Station KDKA has been carried on in an experimental manner by the Westinghouse Company for some time.

In June, 1922, it was decided to conduct preliminary tests on a large scale by repeating, at Cleveland, Ohio, signals transmitted from East Pittsburgh, Pa. Station KDKA was equipped to transmit at frequencies near 3,000 kilocycles while the Cleveland station's equipment consisted of a receiver for this frequency, and an 803 kilocycle transmitter. This apparatus was completely installed and ready for actual tests about September 1. Tests conducted between these two points, from September, 1922, until January, 1923, indicated that the use of a very high frequency as a primary carrier in a repeating system was not only highly desirable but entirely possible from a practical standpoint.



Station KYW, Chicago, broadcasts news bulletins at half-hour intervals throughout the day and night. Paul C. Kahn, 3222 Carroll Ave., Chicago, has invented an alarm clock device that automatically "brings in" the station. The clock is timed with the station time and the alarm is set for the half hour. When the alarm sounds the lever attached to the alarm wind comes down and completes the circuit. When the announcer signs off the clock is again set for the next period.

In July, 1923, it was decided to attempt repeating over a greater distance, with the object of transmitting the programs of KDKA to the Pacific coast. A series of tests was made between KDKA at East Pittsburgh and points intermediate between St. Louis, Mo. and Denver, Colo., to determine the maximum distance from KDKA that the secondary transmitter could be located. After the completion of this investigation, it was decided that the point in question was roughly near the center of the boundary line between Nebraska and Kansas.

Near Center of United States

The locating of a city or town having the desired facilities for power and suitable space available was next necessary. The city of Hastings, Nebraska, seemed to meet all necessary requirements, and arrangements were made to locate the equipment at that place. Hastings is located almost ideally for the purpose of repeating programs from Pittsburgh so that they may be heard with ordinary receiving equipment throughout all the middle west and can be heard on the Pacific coast with less elaborate equipment than is necessary to receive directly from KDKA.

The new station is very close to the center of the United States. The country around Hastings is level and the particular location is relatively free from static and other radio interferences. The nearest broadcasting station of 500 watts or more is at Omaha, Nebr., a distance of 142 miles. Hastings is almost 1,000 miles from Pittsburgh and 1,200 miles from Los Angeles. Under

CANADIANS IN CONFERENCE

Recent session of prominent radio men and officials of the Department of Commerce at which 450 meter wave length for ship and shore communication was discussed and suggestions made for an allotment for another wave length. Photo shows Canadian radio men who were present at the conference. Left to right—C. P. Edwards, director of department of Marine and Fisheries; W. A. Rusch, Supt. of Canadian Government Radio service; J. H. Thompson and H. M. Short, general manager of the Marconi Wireless Telegraph Company of Canada.

ordinary conditions its programs should be heard at any point west of Pittsburgh. The opening program was received on loud speakers at Washington, D. C., about 1,100 miles and New York City, over 1,200 miles from Hastings.

Although designed primarily for repeating programs from KDKA, a complete studio is provided at Hastings where local programs will be given at regular intervals. The first program on the night of November 22, was given partly from Hastings and partly from East Pittsburgh. The principal address delivered in the studio at East Pittsburgh was received with loud speakers at a convention in session at Salt Lake City, Utah, 700 miles distant from Hastings and 1,700 miles from Pittsburgh. Reports from this convention and from other western points, as well as from New York and Washington, indicate that this first program was heard clearly over a wide range of territory.

When a program from East Pittsburgh is to be repeated at Hastings, KDKA transmits on its regular frequency of 920 kilocycles (326 meters) and at the same time sends out the same program on a carrier frequency of 3,200 kilocycles (94 meters). The 3,200 kilocycle wave is picked up at Hastings and the output from this receiver is used to control the radio transmitter at Hastings. In this manner programs from East Pittsburgh are rebroadcast with practically no time lag from KFXX at a frequency of 1,050 kilocycles (286 meters). Provision is also made at Hastings for repeating the signals at a second high frequency to a third more distant repeating station, when this becomes desirable.

Local Interference

The initial step, after Hastings had been selected as the location of the new station, was the installation of experimental equipment for both receiving and broadcasting. The problem of rebroadcasting or radio-repeating was then undertaken. As most of the major problems had already been worked out at Cleveland, the difficulties to be overcome at Hastings were mostly of a detail nature.

The most troublesome and perplexing of all details soon proved to be that of local interference caused by leaky power lines and the operation of electrotherapeutic apparatus by physicians and hospitals. Most of this equipment is based on resonant circuit principle and, because of the high decrement and overabundance of harmonics generally found, causes a constant band of interference from about 300 to at least 3,750 kilocycles. By experiment it was found that in the case of some of the above mentioned apparatus the radius of this area of interference was at least a half mile. Since it was impossible to remove this interference, the receiving equipment used to pick up the Pittsburgh signal was moved out of the city and placed about one mile north of the local transmitter.

In the new receiving location, it was found that the received speech level was satisfactory for repeating at all times except between 8 a. m. and 4 p. m. central standard time. Various primary carrier wave frequencies between 3,448 and 3,000 kilocycles were used in order to determine the most suitable one. Above 3,333 kilocycles it was found that the signal was maximum about 7 p. m., central standard time, and would fall to about ten per cent strength before 8 p. m. At 3,000 kilocycles the signal strength increased until about 11 p. m. and then remained approximately constant until about 4 a. m. From this data one would naturally assume that at some frequency between these two hours the strength of signal should remain constant at all hours. In fact, it so happened in all cases observed that slightly above 3,333 kilocycles the signal was relatively weak at all times although it apparently maintained a constant level from at least 4 p. m. to 9 p. m.

All of these effects on signal strength were also observed in Cleveland, Ohio, during January, 1923. No opportunity to corroborate the Cleveland observations was afforded, however, until the establishing of the Hastings station. It is of interest to note that the two sets of observations were taken after ten month's lapse of time, at different periods of the year, and with entirely different receiving and transmitting equipment. Since the most of the repeating was to take place in the evening, a frequency was selected near 3,200 kilocycles.

Antenna

The antenna is of cage construction, there being two cages of eight No. 12 copper wires each, on 1.5 inch diameter spacers. The cage length is 35 feet. These are swung tightly between ten foot cross arms at the tops of two fifty-four foot wooden poles, as shown in Fig. 6. The down lead is a 1.5 inch diameter copper tube rigidly supported on porcelain insulators from one of the poles. The antenna ammeter and additional loading inductances are connected in series with the down lead part way up the pole. An insulated counterpoise is supported on stakes a short distance from the ground and there is also an experimental counterpoise similar in construction to the antenna between the lower cross arms and the poles.

Studio

In addition to the repeating apparatus installed at Hastings, a local studio is also provided in the business section of Hastings. The room used is about fifteen by twenty feet. The floor and walls of this room are suitably padded to reduce sound reflection to a minimum. A complete condenser microphone system has been installed and used exclusively. A novel feature of this studio equipment is that "back to back" amplifiers are used entirely. The studio and station, separated nearly one mile, are connected by several telephone circuits, over which orders are sent to and from the studio and the program speech sent to the station.

Cost is Low

Tests that have been conducted up to the present time show that while constructional difficulties naturally increase at these high frequencies, the results obtained are most encouraging. The costs of construction, maintenance,

and operation of a high-frequency system of radio repeating is far below that of wire lines. The performance is also infinitely better from the standpoint of distortion of the audio signal transmitted. Contrary to the condition on wire lines, the speech frequencies suffer the same attenuation throughout the limits of audibility, thereby greatly improving the quality of transmission. There are two apparent advantages to wire transmission, in that the number of channels open to use has practically no limit, and that attenuation is constant at all times of day. In answer to the first advantage it may be said that assuming 3,000 cycles per second as the necessary wave band for radio use, 1,000 channels are available between 6,000 and 3,000 kilocycles. This is ample for the needs of this continent. Tests also show that it is possible to use carrier frequencies having satisfactory characteristics for daylight use.

Phonograph Stations

WABU, the new Victor talking machine broadcasting station at Camden, N. J., will soon give the public an opportunity to hear phonograph records in the making. That is, radio fans will be permitted to hear original records before they are released. When famous vocalists or musicians are about to perform for the reproduction on master phonograph records in the studio, a microphone will be placed alongside the recording apparatus and as the artist renders his piece for record the radio fans will hear it over the air.

The Columbia Graphophone Company, through co-operation of the A. T. & T. Company and station WEAF, will also start broadcasting new records soon.

This system is likened to "first nights" at operas and theatrical productions, seats at which are always sold at a premium or distributed to the elite and members of the press. By means of radio broadcasting, fans will now be permitted to hear new records before they are put on the market. It is a unique feature, welcomed by all receiver owners who await the advent with pleasant anticipation.

Schools Use Radio

For the first time in the history of education active use of radio broadcasting on an extensive and permanent basis as an educational aid was inaugurated on February 18, when the Board of Education of the city of New York, acting with the co-operation of the Radio Corporation of America, broadcast through station WJZ the first of the daily educational radio programs which have been scheduled.

These programs, arranged by the newly created radio committee of the Board of Education, are broadcast from 2 to 2:30 o'clock on every school day. A special and permanent broadcasting apparatus is to be installed in the office of Dr. William L. Ettinger, superintendent of schools, and the programs on every Tuesday afternoon will be broadcast by WJZ directly from there. On all other school days the programs will be given at the studio of station WJZ at Broadcast Central, Aeolian building.

The programs are designed primarily to acquaint the people with the work of the schools, educate the public as to education.

SON OF GREAT COMPOSER

Siegfried Wagner, son of the great German composer, Richard Wagner, speaking from Station WJZ, when thousands of radio listeners heard his appeal for $200,000 which will enable him to resume the musical festivals at Bayreuth, which were originated by his father.

More Stations

The limits of "Radio Land" are being extended so rapidly on both land and sea, and so many fans are asking for aid in identifying stations outside our borders, we are listing hereafter the neighboring foreign broadcasting stations.

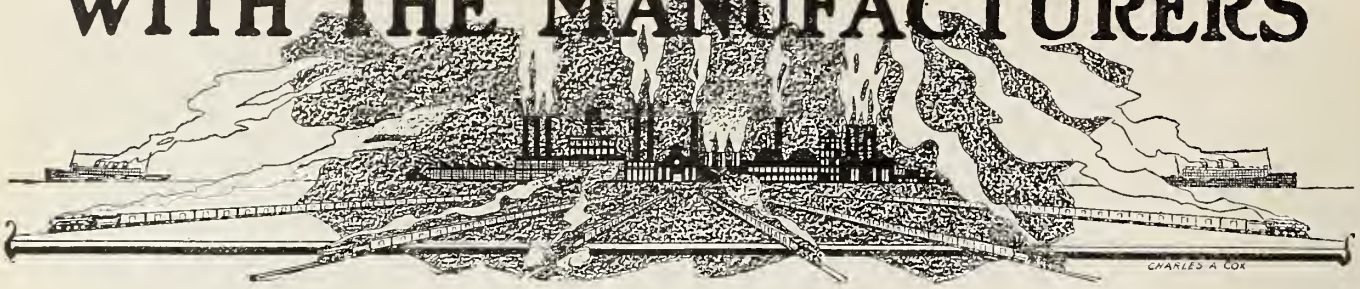
In Canada, for example, there are now thirty-six stations broadcasting, many of which are heard in the states. They all are identified by their initial call letter "C," assigned to the dominion by the International Bureau at Berne.

Cuba has thirty-one stations which broadcast, eighteen of them situated in Havana. Except for well-known PWX, these stations all have initial numbers instead of letters, and are in consequence sometimes confused with American amateur stations, which also start with the district numbers.

With the licensing of KFNG, at Coldwater, Miss., on January 18, every state in the union had one or more broadcasters, it was learned at the Bureau of Navigation, Department of Commerce. This is not the first time, however, that each state has been listed; last year a broadcasting station opened up in Corinth, Miss., which completed the roster, but this station later dropped out, leaving one of the forty-eight states unrepresented.

During January, twenty-seven new broadcasting stations started operation and twenty signed off for the last time, the Department of Commerce states. Broadcasting gained seven stations, and on February 1, stood at 554 stations.

WITH THE MANUFACTURERS



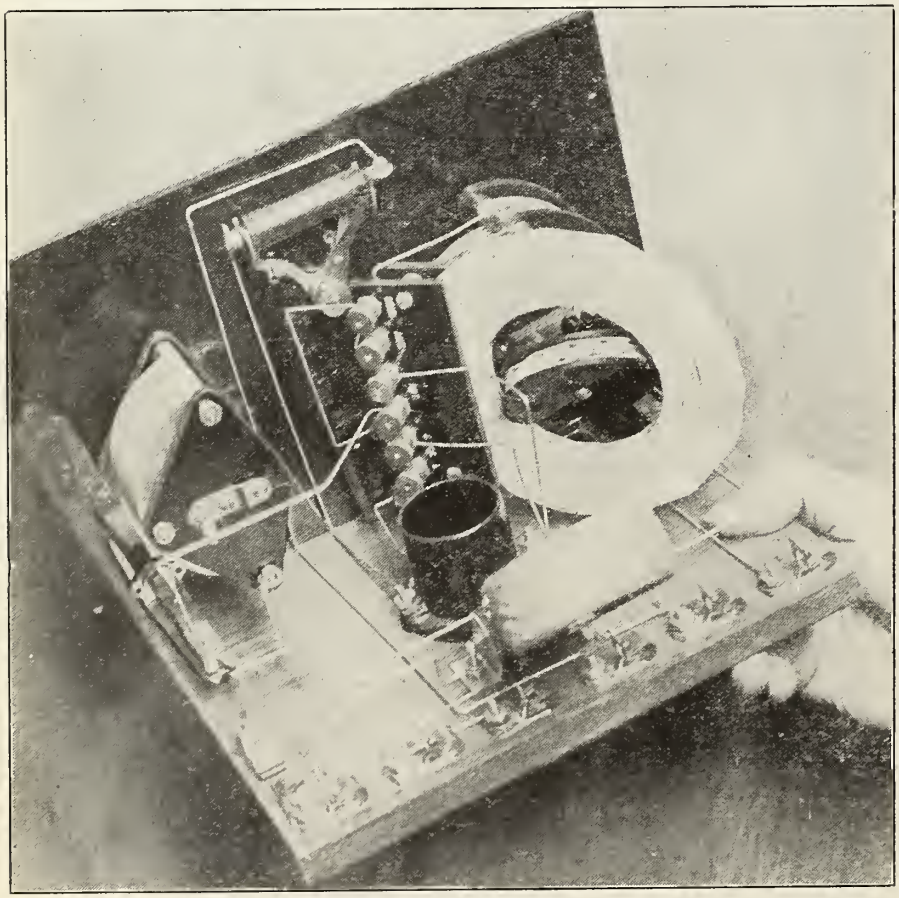
Summer Business

The danger of permitting radio to become a seasonal business is pointed out in a recent speech by David Sarnoff, vice-president and general manager of the Radio Corporation. Since the radio combine has more at stake than any other individual or collective interest, Mr. Sarnoff's advice should carry weight. He said:

"I think one of the dangers to the radio manufacturer at this time, and of course ultimately to the distributor, is the thought which is in the mind of a great many distributors, apparently, that radio is a desirable thing because it offers an opportunity for sales during a period of the year when other lines of merchandise do not move readily, and I think that the distributor and the dealer today, more than any one else, are making radio a seasonable business. There is not the slightest excuse, in my opinion, for having a seasonable business in radio. It has been amply demonstrated that people will use radio in the summer, when you give them sets at the right prices, in the right way and with the proper convenience.

"What are the dangers of a seasonable business? The season only lasts a few months, and it takes two or three months to get up steam. You are losing momentum as you are going downhill, and you have a valley in the curve when you are doing nothing, and you force new patterns, new designs, because you want to start off at the beginning of the season with a new line of merchandise. When you find yourself at the end of the season with an old line of merchandise you want to give it away to get rid of it. You don't want it on the shelves. That is true of the cloak and suit business. If you get into that kind of business, however, neither the manufacturer nor the distributor is going to be happy. The manufacturer has got to keep his factory running all the year round. He has to have quantity production, so as to reduce prices. He has to carry on consistent and insistent national advertising. He has to have an inventory and the like.

"Therefore, unless there is a very good natural reason over which you have no control, for creating a seasonable business—you can't sell overcoats in the summer—I say you are heading for trouble if you do create such business merely because it happens to fit in with your situation at the time. You must avoid that in every way possible."



NEW "LONG-45"

Another new circuit has appeared in the radio field. Using but one tube, it works on a loop aerial. It is really a new type of regenerative circuit construction, using a special type variable inductance and other parts.

Distortionless Amplifier

Continuing their work of improvement of radio station WBZ in Springfield, Westinghouse engineers are putting in the latest devices and apparatus developed for better broadcasting of all types. The most recent addition to the excellent equipment of this New England station is a voice amplifier of entirely new design which reproduces and magnifies the sound impulses without distortion before they are "fed" to the station's transmitter.

Radio Exports Grow

Radio exports for the year 1923, totaled $3,448,112, compared with $2,897,799 last year, according to Department of Commerce statistics. While the shipments of radio apparatus form only about five per cent of the total value of all electrical exports, which in 1923 passed the $72,000,000 mark, radio exports increased about seven per cent out of a total gain of $9,000,000. December radio exports totaled $335,308, compared with $381,827 for November and $270,061 in October.

Cockaday Coil

The Precision Coil Company, Inc., is the exclusive manufacturer of the Authorized Cockaday Coil. It is authorized by him and each coil bears the word "approved" above his signature. It is wound on hard rubber tubes (one eighth inch wall) with No. 18 double silk covered magnet wire. All terminals have copper soldering tabs and are located to give shortest leads possible to the condensers. Nickeled fittings give the coil a finished appearance. There is no shellac, paint

Your Radio Problems Solved for 30 Cents in Stamps

IF YOU are constructing a receiving set, and you need help in the way of clear diagrams and full detailed descriptions you may have it by return mail.

We have laid aside a limited number of back numbers of Radio Age for you. Below we are listing the hook-ups and circuit diagrams to be found in these magazines. Select the ones you want, enclose 30 cents in stamps for each one desired.

We advise immediate attention to this as the stock of back numbers of several issues already has been exhausted.

May, 1922

—How to make a simple Crystal Set for $6.

June, 1922

—How to make a Receiving Transformer.
—Aerials under ground and under water.
—Electric light wires as auxiliary to radio.

October, 1922

—How to make a Tube Unit for $23 to $37.
—How to make an Audio Frequency Amplifying Transformer.

November, 1922

—Photo-electric Detector Tubes.
—Design of a portable short-wave radio wavemeter.

January, 1923

—How to make a sharp-tuning Crystal Detector.
—Fixed condensers in home-made receiving sets.
—Description of loading coil for simple sets.

May, 1923

—How to make the Erla single-tube reflex receiver.
—How to make a portable Reinartz set for summer use.

June, 1923

—How to build the new Kaufman receiver.
—What about your antenna?

July, 1923

—The Grimes inverse duplex system.
—How to read and follow symbols.
—Proper antenna for tuning.

September, 1923

—How to load your set to receive new wave lengths.
—Simple Radio Frequency Receiver.

October, 1923

—Your First Tube Set.

November, 1923

—The Super-Heterodyne.
—A Three-Circuit Tuner.
—How to Learn Code.

December, 1923

—Building the Haynes Receiver.
—Combined Amplifier and Loud Speaker.
—A selective Crystal Receiver.

January, 1924

—Tuning Out Interference—Wave Traps—Eliminators—Filters.
The article which was favored with the grateful interest of the radio public after its announcement by Station WJAZ.
—A Junior Super-Heterodyne.
—Push-Pull Amplifier.
—Rosenbloom Circuit.

February, 1924

—How to make a battery charger.
—Improved Reinartz Circuit.
—Interference rejectors
—Single Tube Heterodyne.
—How antenna functions.
—Adding two audio stages to selective receiver which began as a crystal set.
—Superdyne receiver.

RADIO AGE, Inc.

500-510 North Dearborn Street - - - - - - - - - - CHICAGO, ILL.

or varnish on the coil. The manufacturer claims for it: High dielectric strength, low moisture absorption, maximum sensitivity, minimum capacity effect, low leakage, high selectivity. The price is $5.50.

The Teledyne

A new four-tube radio receiving set, to be known as the Teledyne and employing engineering features which overcome radiation, generally credited as the worst form of radio "interference," is announced by Bowden Washington, chief engineer of the Cutting & Washington Radio Corporation.

The receiver, according to Washington, has the following advantages over the conventional double circuit set:

1. Will not transmit.
2. Increased volume.
3. Greatly increased range.
4. Somewhat increased selectivity over the best conventional double circuit sets.

"It has for some time been evident that the customary 'transmitting' regenerative set was becoming a grave menace to the future of radio and yet this principle which so greatly increases volume and range could not be discarded," said Washington.

"Experiments made in view of overcoming this problem of radiation led to the perfection of the Teledyne, a set which takes advantage of this previously known method in the radio art of securing volume, range and selectivity but does not throw wave impulses into the air and annoy neighboring sets.

"The first stage of the Teledyne circuit operates in the following manner:

"It is well-known that when a resonant circuit, consisting of an inductance and a capacity in parallel is placed in series with the plate circuit of a vacuum tube, the grid circuit of which is also resonated to the same frequency, the resonant plate circuit will produce oscillations and somewhat off this resonant point, 'negative resistance' or regeneration. If this circuit is coupled with the plate circuit with sufficiently close coupling

the same phenomena will occur. If, however, the coupling is at a certain critical value regeneration can be produced without possibility of oscillation. This latter value is that used in the Teledyne.

"The antenna circuit consists of the usual inductance but of two values, tuned by a series condenser, which, by the way, operates a cam switch choosing either of these inductance values over the two available 180 degree scales, with the grid-filament input leads across this inductance.

"The plate circuit of the first stage is coupled, at the critical value mentioned heretofore to the grid inductance of the detector, which latter is tuned by the usual variable condenser. The adjustment of this condenser resonates the detector grid circuit and at the same time regenerates the radio-frequency amplifier, thereby increasing its response by lowering the antenna resistance.

"The antenna inductance which is also the grid inductance of the radio-frequency amplifier is carefully mounted at minimum coupling position with the detector grid inductance. This is necessary in order to prevent parasitic feed back causing oscillation of the first tube and, incidentally, as the detector is the only tube which can be over regenerated and oscillate, this minimum coupling position prevents these oscillations from getting into the antenna circuit.

"The tuning of this set is extremely simple and either of two methods may be employed. First, the regeneration of the detector may be left low and the antenna condenser and detector grid circuit tuning condenser may be handled in a manner resembling the tuning of a one-stage neutrodyne. The second method is similar to the usual manner of handling a two circuit regenerative receiver i. e., oscillate the detector, turn its condenser until a heterodyne note appears, tune the antenna until it is loudest and reduce the regeneration. The difference is that the heterodyne note does not go out on the air and become a pest for several blocks in all directions.

"Owing to the double use of regeneration this receiver with four tubes is more sensitive than the conventional five-tube neutrodyne.

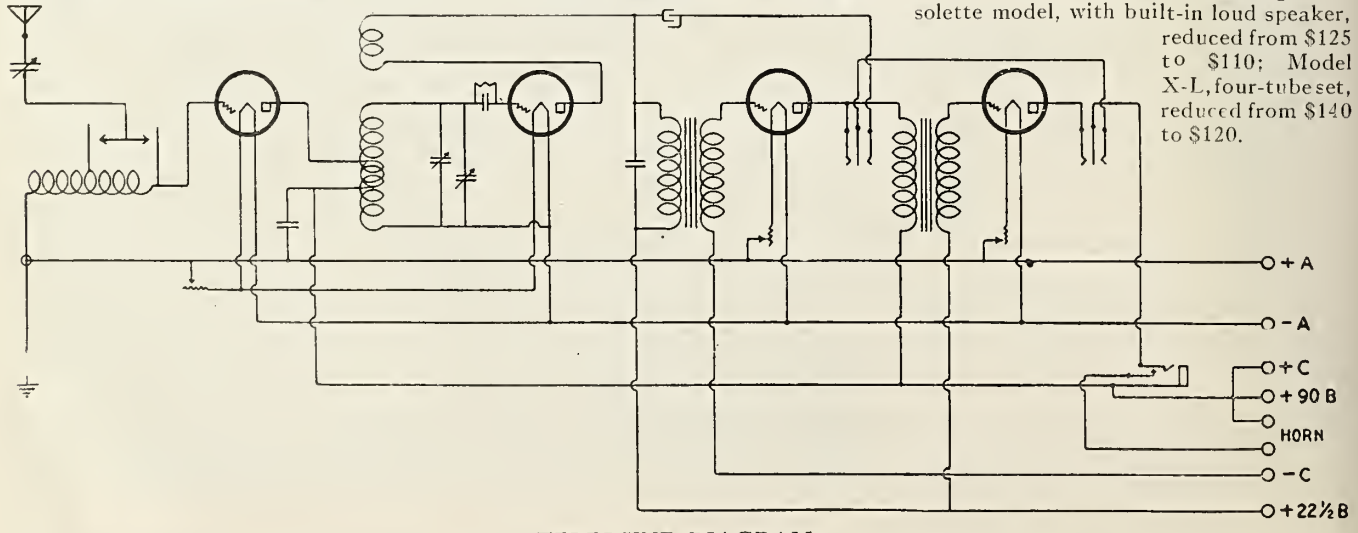
"It is of course extremely simple with the neutrodyne to tune a station once logged, as it is with this set, but it is somewhat more difficult to pick up new stations. Hunting for new stations with the Teledyne is as simple as with the old-fashioned single circuit receiver but without its drawbacks.

Crosley Lowers Prices

The Crosley Radio Corporation announces that greatly increased production makes possible the reduction of prices on the various complete sets manufactured by the big Cincinnati company. The Crosley Company makes more receivers than any other organization in the world and its announcement will be of general interest to the trade and to the radio public.

A new two-tube receiver is offered consisting of Armstrong regenerative detector and one stage of audio frequency amplification, giving loud speaker volume on local stations at all times and on distant stations under fair receiving conditions. The instrument, known as the Crosley Model 51, sells at $18.50.

Reductions on other Crosley sets are as follows: Type V, single tube regenerative, reduced from $20 to $16; two stage audio frequency amplifier to match the Type V, reduced from $20 to $18; Model VI, two tube receiver, reduced from $30 to $24; Type 3-B, three-tube Armstrong regenerative in mahogany cabinet, reduced from $50 to $42; Model X-J, four-tube receiver, reduced from $65 to $55; Type 3-C, three-tube Armstrong consolette model, with built-in loud speaker, reduced from $125 to $110; Model X-L, four-tube set, reduced from $140 to $120.



TELEDYNE DIAGRAM

Wiring diagram of the Teledyne, four-tube receiver which Cutting & Washington offer with the announcement that it will not transmit and that it has good range, volume and selectivity.

Hongkong Listens In

The urge to broadcast and listen in has reached Hongkong, China, where a few foreigners interested in radio got together about eight months ago and formed the Hongkong Radio Society, membership in which now numbers over a hundred, Consul Webber reports to the Department of Commerce. Today there are over 500 listeners in but it is estimated that this number will be doubled within a year's time.

So far there are only two broadcasting stations in Hongkong, the consul states; one, a 100-watt American set, operated by the local telephone company which transmits phonograph music for an hour each evening; the other, a ten-watt Canadian set is operated by the Radio Communication Company, Ltd.

WLAG Record

Minneapolis, Minn.—Another American radio broadcasting record was recorded when a letter was received by the Cutting & Washington station, WLAG, from Mrs. Charlotte Jorgenson, Kragero, Norway, saying that the writer and her husband had been listening regularly to WLAG concerts.

The letter, addressed to Mrs. A. H. Dieseth, Minneapolis, a neighbor of Mrs. Jorgenson when the latter lived in Minneapolis, said Mrs. Jorgenson heard Hazel Dieseth, a daughter of Mrs. Dieseth, sing on a WLAG program and recognized her voice and name.

It is approximately 5,176 miles from Minneapolis to Kragero, Norway.

Radio exports for the year 1923 totaled $3,448,112, compared with $2,897,799 last year, according to Department of Commerce statistics.

CLASSIFIED ADVERTISEMENTS

Six cents per word per insertion, in advance. Name and address must be counted. Each initial counts as one word. Copy must be received by the 15th of month for succeeding month's issue.

HELP WANTED

U. S. Government Positions. $100 to $250 month. Quick increase. Become Railway Mail Clerks—City Mail Carriers—Postoffice Clerks. Income Tax Auditors. Steady work. No strikes—no layoffs. Pleasant, interesting. Short hours. Paid vacation. Influence unnecessary. Schedule examination places—free. Men-women, 18 up. Write immediately. Franklin Institute, Dept. G, 114, Rochester, N. Y.

FREE HOOKUP

Sixty-thousand miles on Home-made Receiver. Twenty-six hundred mile range. Hundred-station log and Hookup free. Spencer Roach, 2905 Columbia Avenue, Philadelphia, Pa.

BOOKS

If you have not bought your Reinartz Book, fully illustrated with hook-ups and clear description of how to make this popular circuit, send $2.50 in money order or currency and we will send you the booklet "Reinartz Radio" and place you on the subscription list of Radio Age for one year. Address Radio Age, 500 N Dearborn Street, Chicago, Ill.

RADIO CALL CARDS printed TO ORDER. Red call, black printing. 100, $1.75; 200, $2.75, prepaid. Color changes 35c extra. Government postals 1c extra each card. LETTERHEADS 8 1-2x5 1-2 AND ENVELOPES, 100 EACH, $2.25; 200 EACH, $3.25. ARRL emblem used on cards or stationery if requested. Send TODAY. Department 62C, Radio Printers, Mendota, Illinois.

RADIO ODDS AND ENDS

No. 14 square tinned bus wire— 2 ft. lengths—64 feet for $1.00. $1.20 set of 8 lettered binding posts—60c. Spaghetti—3 ft. lengths, red, yellow, green or black—7 lengths—21 ft.—$1.00. 50 assorted brass screws, nuts, washers, lugs, etc.—50c. All four items prepaid return mail—$3.00. Redio list for stamp—none free. Kladag Radio Laboretories, Kent, Ohio.

FOR RENT—Factory with wood working mechinery and power installed, suitable for making Redio Cebinets. Also office and show room if desired. William H. Gardner, 7326 Roosevelt Road, Forest Park, Ill.

Acme Charger

The Acme battery charger for radio A and B, also automobile batteries has recently been brought out on the market. The capacities that these battery chargers are built in are two ampere and five ampere sizes with an attachment on both sizes to charge up to and including 36 B type cells

The construction and design is unique, and the operating characteristics are such that Radio A batteries can be charged while set is in operation.

These battery chargers are being manufactured by The Acme Electric and Manufacturing Company, Cleveland, Ohio.

Selectoformer

The need of variocouplers, switches, taps, etc., is largely done away with by the Selectoformer just designed by the Electrical Research Laboratories of Chicago. The manufacturers announce that it permits of greater selectivity in practically any tuning unit now using a variocoupler, except in one-tube reflex sets. It requires no adjustment and has for its main object the coupling of the antenna to the receiver without causing a broadening of signals.

The antenna circuit is never tuned to resonance with any particular incoming signal and coupling of signal to the receiver is only sufficient to excite the receiver at the wave length to which it is tuned, without adding the resistance of the antenna circuit to the secondary circuit, which always causes a broadening and loss of signals.

With the usual variocoupler it is possible to reduce the inductive coupling between the primary and the secondary to a very low value, but capacitive coupling exists which allows as full a coupling as if the total inductive coupling were maximum. The inductive and capacitive coupling between the primary and secondary circuits is always fixed at a very low value by the selectoformer. With other fixed couplers, reducing the coupling reduces the volume of signals.

The Selectoformer, due to its particular design, reduces the resistance of the secondary circuit and therefore increases the signal volume.

The selectoformer increases the selectivity when substituted for a variocoupler, or loose coupler, and is especially good in the two and three tube reflex sets.

It also makes an excellent wave trap when used with a 23-plate variable condenser and when so used it actually adds to the strength of the incoming signals. It also prevents reradiation from regenerative sets, or others which oscillate, when it is used as an absorbing circuit for such oscillations.

If your newsdealer has sold out his supply of Radio Age you are likely to miss just the hook-up that you have been looking for. To avoid any such chance fill out the coupon in this issue and send in you subscription. Then you will be safe. And don't forget that with each subscription at the special price of $2.50 a year. We send you free the popular Reinartz Radio booklet FREE. Address Radio Age, 500 N. Dearborn Street, Chicago, Ill.

Radio Music Fund

Clarence H. Mackay, Felix M. Warburg, Frederick A. Julliard and A. D. Wilt, Jr., announce that they have constituted themselves a committee to be known as the Radio Music Fund Committee, with the object of raising a fund to be known as the Radio Music Fund for the purpose of broadcasting radio music concerts by the world's greatest artists.

The committee has selected station WEAF, the broadcasting station of the American Telephone and Telegraph Company, 195 Broadway, New York City, to broadcast the proposed concerts because

of the well-known quality of transmission from this station. Concert Management Arthur Judson, manager of eminent artists and of the Philharmonic, Philadelphia and the Cincinnati orchestras, will handle the engagement of artists for these concerts.

The members of the committee, who are already well known for their activities in support of things musical, believe that radio offers a wide and hitherto undeveloped field for stimulating the increasing public interest in good music. The committee hopes through the Radio Music Fund to afford to thousands of people, who for one reason or another are unable to be present at concerts and the opera, the opportunity of hearing by radio, the world's best musical talent.

Prominent broadcasting stations have received hundreds of letters from the radio audience not only expressing appreciation of programs but offering to contribute financially toward the immense cost of maintaining programs. The Radio Music Fund Committee offers the organization through which the radio audience can contribute to the financial support of radio music programs.

The committee has designated Central Union Trust Company of New York to act as depository of the fund. All contributions should be made payable to the Radio Music Fund and sent to Central Union Trust Company of New York, 80 Broadway, New York City, and should be accompanied by the name and address of the contributors. The depository will acknowledge receipt of contributions by postcards

The committee invites contributions to the Radio Music Fund of from one dollar upwards. The fund will be held by Central Union Trust Company of New York subject to the order of the committee and will be expended under the direction of the committee. If, in the opinion of the committee, the contributions received are not sufficient to warrant going ahead with the plan, the committee will notify the bank to that effect and all contributions will be returned as far as possible to the contributors.

All funds contributed will be used for obtaining the service of artists and for direct expenses, and a financial statement will be published or sent to the contributors at the close of the season.

If, after the presentation of radio concerts shall have begun, the committee shall deem it advisable to discontinue such concerts, any balance remaining in the Radio Music Fund may be returned to the contributors or disposed of for musical or educational purposes as may be determined by the committee.

The expense of broadcasting will be borne by the American Telephone and Telegraph Company and aside from incidental expenses in connection with the administration of the fund, the entire contributions of the radio audience will be available for the maintenance of broadcasting programs. When contributions sufficient to warrant it are received, the committee will endeavor to engage the services of prominent artists to appear

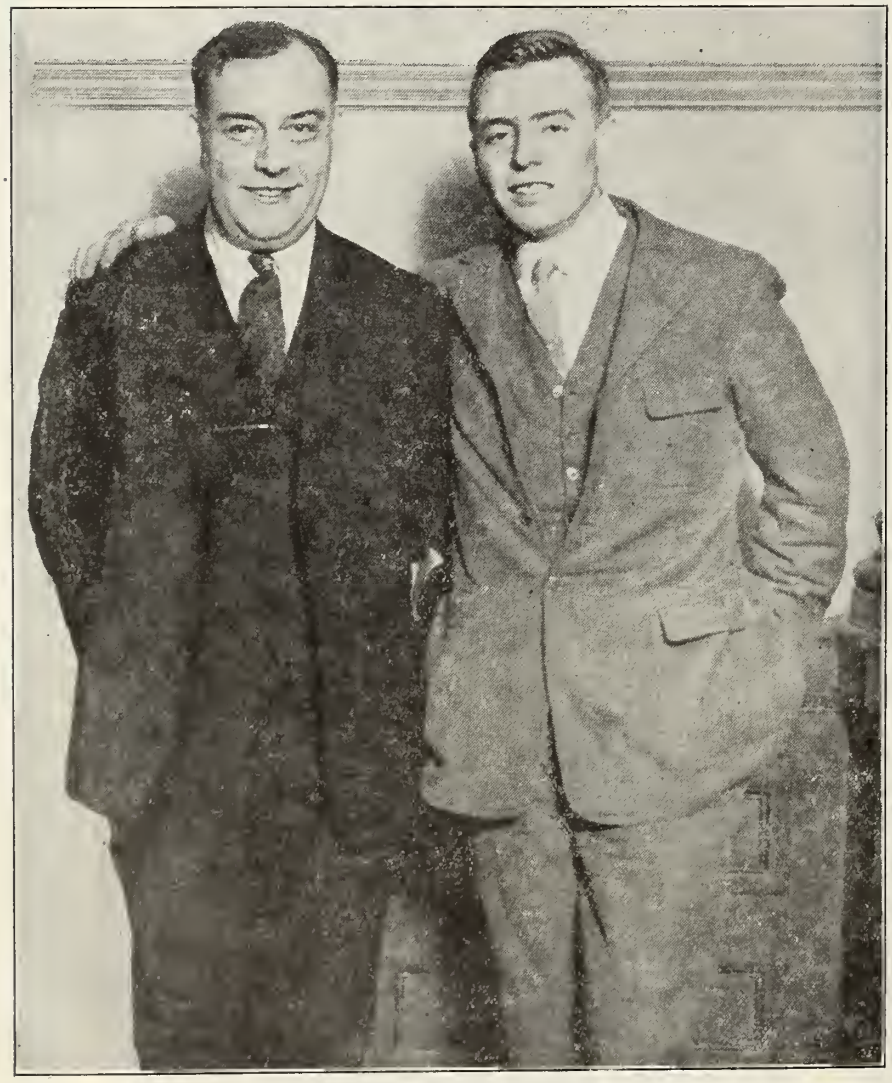
during the remainder of the present season which ends May 1. In the future, if the plan works out successfully, a more definite organization may be effected and the concert season extended over a longer period.

Broadcasters inform RADIO AGE that it is the avowed intention of the American Telephone and Telegraph Company to control broadcasting. It is suggested that one result of the fund plan, as described in the foregoing, would be to introduce the practice of paying performers who now are quite willing to entertain the radio millions without pay: It is pointed out that with such a fund the bigger companies might be able to pay their entertainers and thus make it very difficult for other broadcasters to obtain the services of artists without paying them. Thus the old plan to drive out the independent broadcaster by depriving him of his entertainment and make of broadcasting a virtual monopoly in the hands of the few would be furthered.

Radio Writers Entertained by the Allen-Bradley Company of Milwaukee

THROUGH the courtesy of the Allen-Bradley Company of Milwaukee, a few well known writers of radio articles were invited to inspect the factory where the Bradleystats and Bradleyleaks are manufactured and to attend the meeting of the American Radio Relay League, held in Milwaukee on February 14. The party, which was conducted to the Wisconsin city by Mr. Gohl, Chicago representative of the company, consisted of Mr. David Grimes, of the Sleeper Radio Corporation of New York, Mr. E. T. Flewelling, Mr. Harry J. Marx and Mr. Milo Gurney of the Radio Digest and Mr. Frank D. Pearne of Radio Age. Under the careful guidance of Mr. Gohl the party reached the factory without mishap and spent the entire afternoon inspecting the latest modern methods of manufacturing. This factory is certainly a credit to Milwaukee. Everything used in the construction of their apparatus, with the exception of the porcelain units, are manufactured under one roof, even to the carbon discs used in the resistance units. Up-to-date testing methods and inspections assure one that the finished product is as perfect as human intelligence can make it. Mr. Harry Bradley personally conducted the party through the factory and explained in detail how everything, from the tiny Bradley switches to the gigantic power controllers, are constructed, after which he took the party to the Milwaukee Athletic Club for dinner. At the Club the party was joined by several members of the Allen-Bradley Company, Mr. Bruns of Radio Age and some of the members of the American Radio Relay League. After a splendid supper, the host, Mr. Bradley, finally got the party started for the A. R. R. L. meeting, where they arrived in time to find the hall so crowded that even standing room was at a premium. This large attendance shows the interest which the A. R. R. L. members take in their meetings and speaks well for the future of radio. The meeting was turned over to the visitors, who talked on many subjects pertaining to radio. Mr. Marx gave the first talk, which covered a description of the different types of receiving sets, from the crystal to the king of them all, the super-heterodyne, touching upon the merits of each and explaining their proper application. He was followed by Mr. Flewelling, who gave a splendid discussion on the use of good apparatus and careful construction, clearing up considerable confusion in regard to the reason why some radio enthusiasts get good results, while others fail. Mr. Grimes then took the floor and told of the development of radio, starting with the time when Alexander Graham Bell transmitted the first radio message on a beam of light and stated that at the present day we are still transmitting radio messages on invisible beams of light. Mr. Pearne followed Mr. Grimes with a brief talk on his experience in building the Grimes Inverse Duplex. The next and last speaker was Mr. Milo Gurney, who started in to chastise two offenders who had caused some interference with spark sets and then told what the A. R. R. L. had done to clear up interference of this kind, having finally succeeded in making the air practically clear during the hours of broadcasting. He also explained that most of the code messages heard during these quiet hours were sent out by ships on both the Atlantic and Pacific oceans. The party broke up at the Athletic Club, an hour or so later, all agreeing that it was the end of a perfect day.

The Chairman of the meeting was Edward T. Howell, 9CVI, President of The Milwaukee Radio Amateurs' Club, Inc.



SMILING EXPERTS

Frank D. Pearne, on left, and David W. Grimes as they were snapped at Milwaukee where they attended a radio dinner with other wireless notables as guests of the Milwaukee Radio Club and of the Allen-Bradley Co. Mr. Pearne is Technical Editor of Radio Age and Mr. Grimes is the famous "Inverse Duplex" genius.

Station for Farmers

Sears-Roebuck Agricultural Foundation is building a new broadcasting station which is being erected by the foundation to broadcast agricultural as well as entertainment programs. Samuel R. Guard, is director of the foundation.

The new station will be located on the main building, in Chicago, using the fourteen-story tower for one aerial post. Another post of equal height will be erected on the opposite side of the building. The station, unless other arrangements are made, will have a wave length of 448 meters, and will be the largest made and sold by the Western Electric Company. It will carry a class "B" license, the highest issued by the government. The studio will be located on the eleventh story of the tower, with the operating room on the fourteenth floor. In addition to the main studio, there will be a branch down town in the loop district, with special leased wires through the city to points of advantage for the entertainment features of the program, which will include the best music and theatrical talent. By having the station located in the open district and free from the absorption by all buildings, it is estimated that it will be possible to put more energy in the air than any other station in Chicago.

Theatrical stars will bring the stage to the farmers' parlor, and there will be bedtime stories for the country kiddies. An interpretation of market trends and a current events feature, explaining what is going on in agriculture all over the world will be given, according to Mr. Guard. This new station, which will be the only one in the United States broadcasting exclusive agricultural programs, will be completed early in March. L. P. Dryden will be director of the studio.

Airplane Telephony

By LLOYD JACQUET

While speeding westward at a 120 miles an hour rate, Airmail Pilot Jack Knight, in his radiophone equipped plane, convinced officials of the Post Office Department and engineers of the Westinghouse Electric Company that two-way radio telephone communication between an airship and the field was possible.

Jack Knight left Omaha, bound for North Platte, one of the regular stops on the transcontinental air route, on a test flight early this week. Eugene Sibley, radio traffic supervisor of the United States Airmail Service, was his only passenger. The radio equipment in the plane had been tested previous to his taking off, and found to be in perfect operating condition.

The airmail field at Omaha, which is the headquarters of the superintendent of the western division of the airmail service, had been chosen by General Superintendent Carl F. Egge as the place at which the new one kilowatt Westinghouse radiophone transmitter was to be installed. As Omaha is practically the midpoint on the New York-San Francisco journey, the location of this powerful unit is ideal from a point of centralized communication east and west. It was by means of this specially designed and built set that the officials of the airmail field at Omaha kept in touch with Knight's plane as he was flying to North Platte.

For nearly three hours, that is, the time it took for the pilot to fly between the United States Airmail fields at Omaha and North Platte, signals were exchanged between the speeding airship and the men in the radio room of the Omaha field. A schedule had been worked out, whereby the pilot would "report" to the division superintendent the progress of the plane as it speeded across Nebraska. The voice of the pilot was received clearly, and was received on a loud speaker in the radio room of the field, so that Superintendent D. B. Colyer, special assistant of Postmaster General J. V. Maggee, Mayor J. C. Dahlman, of Omaha, R. L. Davis, radio engineer of the Westinghouse Electric, members of the press, and many others followed the progress of the plane with a map.

When the Post Office Department undertook to transport mail by means of airplanes, the necessity for some means of communication between fields, and between planes and fields was plainly

(*Continued on page 49.*)

RCA Tells Why Tubes Dropped

HEREWITH is published a part of an open letter issued by David Sarnoff, of the Radio Corporation of America. Because of certain facts and conditions well known to the radio industry the drop in the price of vacuum tubes was not surprising but it caused so much interest among tradesmen and buyers of receiver equipment that some space is given to it. The letter follows:

ON January 11, 1924, the Radio Corporation of America reduced the list price of its standard line of receiving radiotrons from $6.50 to $5.00 each. Notice of this reduction was given at the same time by telegraph to all our distributors, and no one was given any advance information or special advantages in connection with this change. The public was informed through suitable advertisements in the leading newspapers of the country on the same day that the lower price became effective.

We have heard from a number of our distributors, who have frankly expressed themselves with regard to this matter, and while some have complimented us on the action taken, there are others who criticised our policy in this particular instance.

The purpose of this communication is to inform our distributors and dealers, with equal frankness, of the circumstances obtaining in this case, which have led to the position taken by the Radio Corporation.

Why was the list price of radiotrons reduced from $6.50 to $5 each?

1. Because the RCA desired to give to the public, as quickly as possible, the benefits of a reduction in price on an article of merchandise which had become standardized in manufacture and on which manufacturing economies on tubes now being produced were made possible through continued and increased public demand for this article.

2. Because the RCA desired to enable its distributing channels to be in a position to offer to the public the best known tube in the world today at a price which would discourage "bootlegging," infringement and unfair trade practices on the part of those whose present activities in the radio market tend to destroy rather than build up public confidence.

3. Because the RCA believes that this decrease in price will bring increased sales and thereby enable more balanced production at the factory, less fluctuations on the market and greater popularity for radio itself; all of which advantages are distributed over the manufacturer, distributor, dealer, consumer and, therefore, over the industry as a whole.

Why did the RCA put this reduction into effect overnight without previous notice?

1. Because it desired to avoid any possibility of individual advantage on the part of one distributor or dealer at the expense of another, which might have resulted from advance notice of the contemplated reduction.

2. Because previous experience on the part of other manufacturers, as well as ourselves, has amply demonstrated the impracticability of avoiding the undesirable effects referred to in the preceding paragraph, except by an instantaneous overnight notice in the case of merchandise having national distribution, as in this case.

3. Because it has been suggested to us from time to time in general discussion and without reference to any particular case, that where a change in price is to be made, the trade generally prefers to have it become effective overnight through simultaneous notification.

What is the financial effect on the jobber and dealer as a result of this price change?

1. While we fully understand that as a bookkeeping proposition the distributor measures his loss on stock in terms of what he would have earned if the price change had not been put into effect, nevertheless it must be recognized that this is not the true measure of actual financial loss. The actual loss is the difference between the price paid for the article and the price at which it is sold, minus the cost of doing business. In this particular case, as a result of the change which went into effect, the jobber will receive in cash fifteen cents less than he paid for the tube he had in stock on January 10, 1924. On the same basis, the dealer will receive thirteen cents more than the actual cost to him for the tube he had in stock on the same date.

Why did not the RCA make an adjustment on jobbers' and dealers stocks of tubes in inventory at date of reduction in price?

1. Because in this particular case the dealer would probably have felt justified in claiming an adjustment on his stock of tubes if an adjustment were made to distributors on their stocks. For the RCA to have adjusted on dealer's and distributor's stock of tubes, would have meant a financial loss to this corporation greater than it feels its distributors and dealers have a right to expect it to assume in view of all the circumstances recited above and in the paragraphs to follow.

2. Because the Radio Corporation of America, in the interest of its distributors and dealers, has always found it necessary itself to carry a large inventory—amounting to several hundred thousand radiotrons—in order that distribution should be prompt, uniform, and satisfactory to the trade and the public. The RCA uncomplainingly carries this heavy investment even in slack periods and now takes a very large loss itself, resulting from the reduction.

Complete Sets

Efforts are being made to standardize radio apparatus and the nomenclature which describes sets and parts. Is it not time all manufacturers and dealers standardized descriptions of sets? When is a set complete? How much more must one expend for tubes, batteries, aerial and for phones?

Just after Christmas, a woman called the Chesapeake & Potomac Telephone Company and asked for aid, explaining that although she knew WCAP was broadcasting, she could not get it on her new set.

The operator inquired if the tubes lit up, whereupon she asked what they were, and being told, said there didn't seem to be any in the set. Further inquiry showed that she had neither tubes, batteries, aerials nor phones, but that the donor of the gift supposed he had presented her a radio receiver ready for operation.

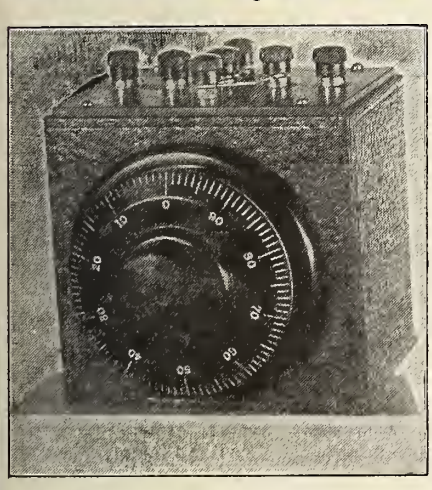
Other examples, such as this, convince of the need of better salesmanship and also of better advertising, for some advertisements are found to be misleading, although probably not intended to be deceptive. The dealer who sold the above set lost the sale of accessories and the purchaser was embarrassed and disappointed when he learned that vital parts were missing from the "set." The word "set" implies that it is a complete entity. An automobile salesman would not sell or advertise a car without a battery, headlights and tires; why should a radio salesman do so? If the set is not complete and ready to operate, why not say: "Without tubes, batteries or phones," as a few agencies do? Complete sets could also be advertised and then the purchaser would know just how much money he would have to spend.

Ship Interference

Amateur radio operators and the broadcasters, it appears, have "laid off" each other as far as interference is concerned, but both are now complaining of the ship interference, supervisors of the Department of Commerce point out. Needless to say, the ships must be permitted to communicate with the shore stations and each other, and while some of them may not have gotten over the idea that the "air" belongs to them, as it did virtually for years, they now claim with some justice that there are not enough channels for their necessary communication.

Ship operators report and supervisors agree that the wavelengths assigned to vessels are not all they should be. The 300 meter wave is not sufficient; the 600 meter wave, used for calling and for distress signals, is always in use, and the 706 meter wave can't possibly serve all the vessels operating. So far as it is known, it is understood that many foreign ships are not yet equipped to use 706 meters, which throws them on the 450 or 600 meter waves. Consequently the ships have to resort to the 450 meter wave assigned them, which is right in the middle of the broadcasting wave band. They are practically forced to use this wavelength for their position reports transmitted between 7 and 11 p. m. daily.

Make Your Receiving Set Selective



The Benson Melody Filter eliminates annoying interferences. It is the inductively coupled type with a high grade .001 mfd. variable condenser. All mounted in a beautiful leather covered cabinet with an engraved bakelite panel.

Don't Fail to renew your subscription!

(*Continued from page 47*)

apparant. In fact, the need of a radio communication circut for such purposes was well appreciated by Second Assistant Postmaster General Paul Henderson as far back as 1919, when the earliest airmail service experiments were performed, using a radio direction finder.

Sence then, many developments have been made by the department, and more recently, tests have been inaugurated between flying planes and fields. In November, 1922, were begun the experiments which culminated in the demonstration held at the Omaha field nearly a year later with gratifying results.

Due to the farsightedness of Second Assistant Postmaster General Henderson, and to the vision of E. B. Mallory, radio manager of the Westinghouse Electric Company, the air service was able to conduct the first satisfactory experiments in communicating between the field and the flying plane.

The problem of communicating between plane and ground is a very peculiar one. Due to the technical limitations of the radio apparatus because of its reduced size and weight, and its operation with reduced antenna facilities and available power, the range of the aerial set is necessarily limited.

To reach the speeding plane from the ground has been equally as difficult. Due to the noise of the engine, local interference picked up by the receiver from the ignition and other electrical circuits of the motor, the use of a comparatively poor antenna system, and the limitations of the equipment in the plane the accomplishment is no small one.

The thousand-watt transmitter which was especially designed and built for the airmail service of the Post Office Department by the Westinghouse Electric Company is the first to be installed at any of the airmail fields. The range of the transmitter is estimated at about 300 to 500 miles daylight, and up to 1,000 miles at night. By means of this transmitter it is possible for the superintendents at the fields to talk to any of their pilots while the plane is in flight between fields, as these are less than 500 miles apart.

Can Radio Be Hooverized?

By CARL H. BUTMAN

COMPLAINTS relating to radio interference are received daily by Secretary of Commerce Hoover, who has become a sort of foster father of the art, now regulated under the 1912 law by his Bureau of Navigation. A recent and unique communication from a fan located on the Florida peninsula, where ship traffic is heard almost constantly, has caused amusement in high official circles. The letter which follows, voices a pathetic appeal from an apostle of Hooverism, and demonstrates the need for definite regulatory laws:

"My dear Sir:

"Help! ! ! ! !

"When you called upon me to conserve, I conserved. When you asked me to sweeten my food with the milk of human kindness, I got indigestion using Florida cane syrup in my coffee. When you asked me to come across, I stepped on the gas. When you asked for help for Near East, I went the limit. When you asked for help for Russia, I sent over a few safety razors and barber shears.

"I have been for you in your every endeavor. I have Hooverized until I didn't know hover who.

"Now *I* want RELIEF.

"I have seven hundred dollars invested in a radio set. It functions perfectly but every program is deadened or the fine passages lost by the damnable interference.

"And this not for one night but every night for a year back, and from any time in the day until I quit in disgust.

"Night after night I try until my patience is exhausted to get a decent reception—and maybe for a minute, sometimes two minutes—a song or music comes in as clear as a bell, and then some deep throated spark begins to shatter the atmosphere and the amplifier takes it up and another station is lost. Some damphool is playing with the keys of his transmitter—or telling some buddy or some other rumrunner that he has a date when on shore with some calico.

"There must be some relief. Were there periods of ten minutes even when one could listen in to lectures, songs or music without interference I would have no complaint. But it is incessant.

"Even when our President spoke his eulogy of Mr. Harding, the code kept jamming the atmosphere and I lost part of the beautiful message. Surely there can be some measure to protect three million radio fans from this insistent interference on every wave length—fellows using old-time sets with a spark as wide as Cumberland Gap that no wave trap can still nor any point on variocouplers, three condensers and four rheostats tune out.

"Dante's Inferno can be no worse than the noises that come to us here in the peninsula of Florida.

"In relief work, in drives, in everything you have accomplished the seemingly impossible—for God's sake let us have relief!

"(From a Florida Fan)."

Mr. Hoover's answer has not been made known, but it is understood that he realizes keenly the need for more authority to regulate radio, both ashore and afloat, even though the voluntary agreement laid down by past radio conferences has modified the radio interference. Legislation defining his duties and setting forth rules and regulations as to amateur, commercial, private and other forms of radio communication is urgently desired by the secretary, as well as additional appropriations and personnel for better and more frequent inspection of stations causing interference.

Chief Radio Supervisor W. D. Terrill, in connection with the recent radio conference on shipping interference, says that coastal stations near New York and most of the shippers have agreed not to use the 450 meter wave but to make greater use of the 600 and 706 meter channels, thus eliminating much spark interference. Other conferences in San Francisco and Seattle, are also reported to have come to practically the same agreement; using the longer wave lengths when off our coasts.

Types of Receivers

By A. K. PHILLIPPI, Radio Engineer, Westinghouse Electric and Manufacturing Company

THE radio columns of the daily papers are filled with questions asking for possible results from certain receiving sets; whether they are good for one hundred miles or a thousand, whether they will get this station or that, and a host of other details. It is evident that a short description of the different types of receivers and what may be expected of each will be appropriate, and will enable many to make a better selection which will more adequately meet the individual's needs.

A radio receiving set is an instrument which, when connected to an antenna, either of the elevated wire or loop type, is capable of converting the high frequency ether or wireless waves into air or sound waves, thus enabling the listener to hear speeches, broadcast programs or telegraphy.

There are many types of radio receivers, varying in sensitivity, selectivity, price and ease of operation.

The crystal receiver is the type most commonly used and the least expensive. This consists of a tuning coil and a crystal detector. Some of these have sharp tuning, or are more selective, while others have broad tuning. Sharp tuning is to be preferred, of course, as it helps to eliminate stations to which one does not wish to listen. The range of the crystal set is small, and on the average it is capable only of receiving signals within a maximum of fifty miles from the broadcasting station; this range depends entirely on the power of the transmitting station, the size of antenna and the sensitivity of crystal. With this type of instrument the music and other programs are almost an exact reproduction of that delivered into the transmitter, as very little distortion occurs. It is used near a broadcasting station and requires a large antenna for best results. Head phones must be used with this set. Receivers of this class are gradually losing their popularity for, as the owner becomes most interested in radio, he feels hampered with only a crystal set and wishes to reach farther out into ether for more distant stations.

Vacuum tube receivers.—The vacuum tube receiver consists of practically the same apparatus as the crystal receiver, except that a vacuum tube is used instead of a crystal for a detector. This set has a distinct advantage over the crystal set in as much as the detector remains adjusted once it is set, while the crystal requires careful adjustment and is easily jarred from a sensitive position. Another advantage of the vacuum set is that it is more sensitive than the crystal. Its sensitivity is, however, still limited, and head phones must be used.

Detector amplifier receivers.—This instrument is one in which the signals are detected by either a crystal or a vacuum tube. The signals are then strengthened by means of one or more stages of vacuum tube amplification, and may be built up to such an extent as to permit the use of a loud speaker.

Regenerative receivers.—By means of the Armstrong or regenerative circuit, amplification and detection with a single tube may be obtained in a receiver, which will give great sensitivity for distant signals. This set differs from others in that a regenerator or tickler coil is used and its function is to build up or amplify the detected signal. By the use of the instrument very weak signals may be heard. This set requires a little more careful adjustment than the other receivers mentioned.

Care should be taken in operating it to use its good qualities and not abuse them. With a little experience the operator will find that when the tickler or regenerator knob is turned to a certain place, the signals received are clear and strong. This is the point of maxi-

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers and broadcasters.

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh	326
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270
KDPT	Southern Electrical Co.	San Diego, Calif.	244
KDYL	Telegram Publishing Co.	Salt Lake City, Utah	360
KDYM	Savoy Theatre	San Diego, Calif.	244
KDYQ	Oregon Institute of Technology	Portland, Oreg.	360
KDYW	Smith Hughes & Co.	Phoenix, Ariz.	360
KDYX	Star Bulletin	Honolulu, Hawaii	360
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZE	Rhodes Department Store	Seattle, Wash.	270
KDZF	Automobile Club of Southern California	Los Angeles, Calif.	278
KDZI	Electric Supply Co.	Wenatchee, Wash.	360
KDZQ	Nichols Academy of Dancing	Denver, Colo.	360
KDZR	Bellingham Publishing Co.	Bellingham, Wash.	261
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	360
KFAE	State College of Washington	Pullman, Wash.	330
KFAF	Western Radio Corp.	Denver, Colo.	360
KFAJ	University of Colorado	Boulder, Colo.	360
KFAN	The Electric Shop	Moscow, Idaho	360
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif.	280
KFAU	Independent School Dist. of Boise City, Boise High School, Boise, Idaho		270
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280
KFAY	W. J. Virgin	Medford, Oreg.	283
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Azbill	San Diego, Calif.	278
KFBE	Reuben H. Horn	San Luis Obispo, Calif.	360
KFBG	First Presbyterian Church	Tacoma, Wash.	360
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and the Chronicle News	Trinidad, Colo.	360
KFBU	The Cathedral (Bishop N. S. Thomas)	Laramie, Wyo.	283
KFCB	Nielsen Radio Supply Co.	Phoenix, Ariz.	238
KFCF	Frank A. Moore	Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)	Billings, Mont.	360
KFCM	Richmond Radio Shop (Frank T. Doeing)	Richmond, Calif.	360
KFCP	Ralph W. Flygare	Ogden, Utah	360
KFCV	Fred Mahaffey, Jr.	Houston, Tex.	360
KFCY	Western Union College	LeMars, Iowa	252
KFCZ	Omaha Central High School	Omaha, Nebr.	258
KFDA	Adler's Musio Store	Baker, Oreg.	360
KFDD	St. Michaels Cathedral	Boise, Idaho	252
KFDH	University of Arizona	Tuscon, Ariz.	360
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	360
KFDL	Knight-Campbell Music Co.	Denver, Colo.	360
KFDO	H. Everett Cutting	Bozeman, Mont.	248
KFDR	Bullocks' Hardware & Sporting Goods (Robert G. Bullock)	York, Nebr.	360
KFDV	Gilbrech & Stinson	Fayetteville, Ark.	360
KFDX	First Baptist Church	Shreveport, La.	360
KFDY	South Dakota State College of Agriculture and Mechanics Arts	Brookings, S. Dak.	360
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank Co.	Portland, Oreg.	360
KFEJ	Guy Greason	Tacoma, Wash.	360
KFEL	Winner Radio Corp.	Denver, Colo.	360
KFEQ	J. L. Scroggin	Oak, Nebr.	360
KFER	Auto Electric Service Co.	Fort Dodge, Iowa	231
KFEV	Radio Electric Shop	Douglas, Wyo.	263
KFEX	Augsburg Seminary	Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining & Concentrating Co.	Kellogg, Idaho	360
KFEZ	American Society of Mechanical Engineers (F. H. Schubert)	St. Louis, Mo.	360
KFFB	Jenkins Furniture Co.	Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.	Pendleton, Oreg.	360
KFFO	Dr. E. H. Smith	Hillsboro, Oreg.	229
KFFQ	Marksheffel Motor Co.	Colorado Springs, Colo.	360
KFFR	Nevada State Journal (Jim Kirk)	Sparks, Nev.	226
KFFV	Graceland College	Lamoni, Iowa	360
KFFX	McGraw Co.	Omaha, Nebr.	278
KFFY	Pincus & Murphy	Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.	Dallas, Tex. (portable)	226
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Standford University	Stanford University, Calif.	360
KFGJ	Missouri National Guard, 138th Infantry	St. Louis, Mo.	266
KFGL	Arlington Garage	Arlington, Oreg.	234
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFGV	Heidbreder Radio Supply Co.	Utica, Nebr.	224
KFGX	First Presbyterian Church	Orange, Tex.	250
KFGZ	Emmanuel Missionary College	Berrien Springs, Mich.	268
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHB	Rialto Theater (P. L. Beardwell)	Hood River, Oreg.	280
KFHD	Utz Electric Shop Co.	St. Joseph, Mo.	226
KFHF	Central Christian Church	Shreveport, La.	266
KFHH	Ambrose A. McCue	Neah Bay, Wash.	283
KFHJ	Fallon & Co.	Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.	Scattle, Wash.	270
KFHS	Clifford J. Dow	Lihuc, Hawaii	275
KFHX	Robert W. Nelson	Hutchinson, Kans.	229
KFI	Earle C. Anthony (Inc.)	Los Angeles, Calif.	469
KFID	Ross Arhuckle's Garage	Iola, Kans.	246
KFIF	Benson Polytechnic Institute	Portland, Oreg.	360
KFIL	Windisch Electric Farm Equipment Co.	Louisburg, Kans.	234
KFIO	North Central High School	Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association	Yakima, Wash.	224
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIV	V. H. Broyles	Pittsburg, Kans.	240
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huelsman	Fon du Lac, Wis.	273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	Seattle Post Intelligencer	Seattle, Wash.	233
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	252
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg.	252
KFJK	Delano Radio and Electric Co.	Bristow, Okla.	233
KFJL	Hardsaeg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	229
KFJQ	Valley Radio, Div. of Elect. Constr. Co.	Grand Forks, N. D.	280
KFJR	Ashley C. Dixon & Son	Stevensville, Mont. (near)	258
KFJV	Thomas H. Warren	Dexter, Iowa	224
KFJW	Le Grand Radio Co.	Towanda, Kans.	226
KFJX	Iowa State Teachers' College	Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	248
KFJZ	Texas National Guard, One hundred and twelfth Cavalry	Fort Worth, Texas	254
KFKA	Colorado State Teachers College	Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association	Milford, Kans.	286
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark.	224
KFKV	F. F. Gray	Butte, Mont.	283
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	341
KFKZ	Nassour Bros. Radio Co.	Colorado Springs, Colo.	234
KFLA	Abner R. Willson	Butte, Mont.	283
KFLB	Signal Electric Manufacturing Co.	Menominee, Mich.	248
KFLD	Paul E. Greenlaw	Franklinton, La.	234
KFLE	National Educational Service	Denver, Colo.	268
KFLH	Erickson Radio Co.	Salt Lake City, Utah	261
KFLP	Everette M. Foster	Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop	Little Rock, Ark.	261
KFLR	University of New Mexico	Albuquerque, N. Mex.	254
KFLU	Rio Grande Radio Supply House	San Benito, Texas	236
KFLV	Rev. A. T. Frykman	Rockford, Ill.	229
KFLW	Missoula Electric Supply Co.	Missoula, Mont.	234
KFLX	George Roy Clough	Galveston, Tex.	240
KFLY	Fargo Radio Supply Co.	Fargo, N. Dak.	231
KFLZ	Atlantic Automobile Co.	Atlantic, Ia.	273
KFMQ	University of Arkansas	Fayetteville, Ark.	263
KFMR	Morningside College	Sioux City, Iowa	261
KFMS	Freimuth Dept. Store	Duluth, Minn.	275
KFMT	Dr. George W. Young	Minneapolis, Minn.	231
KFMU	Stevens Bros.	San Marcos, Texas	249
KFMW	M. G. Sateren	Houghton, Mich.	266
KFMX	Carleton College	Northfield, Minn.	283
KFMY	Boy Scouts of America	Long Beach, Calif.	229
KFMZ	Roswell Broadcasting Club	Roswell, N. M.	252
KFNC	Echo Park Evangelistic Ass'n., Inc.	Los Angeles, Calif.	278
KFNG	Wooten's Radio Shop	Coldwater, Miss.	254
KFNH	State Teachers College	Springfield, Mo.	236
KFNJ	Warrensburg Electric Shop	Warrensburg, Mo.	234
KFNL	Radio Broadcast Ass'n.	Paso Robles, Calif.	240
KFNV	L. A. Drake Battery and Radio Supply Shop	Santa Rosa, Cal.	234
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service	Portland, Oreg.	360
KGN	Northwestern Radio Mfg. Co.	Portland, Oreg.	360
KGO	General Electric Co.	Oakland, Calif.	312
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach	360
KGW	Portland Morning Oregonian	Portland, Oreg.	492
KGY	St. Martins College (Rev. Sebastian Ruth)	Lacy, Wash.	258
KHJ	Times-Mirror Co.	Los Angeles, Calif.	395
KHQ	Louis Wasmer	Seattle, Wash.	360
KJQ	C. O. Gould	Stockton, Calif.	360
KJR	Northwest Radio Service Co.	Seattle, Wash.	270
KJS	Bible Institute of Los Angeles	Los Angeles, Calif.	360
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	360
KLX	Tribune Publishing Co.	Oakland, Calif.	509
KLZ	Reynolds Radio Co.	Denver, Colo.	509
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif.	273
KMO	Love Electric Co.	Tacoma, Wash.	360
KNT	Grays Harbor Radio Co. (Walter Hemrich)	Aberdeen, Wash.	263
KNV	Radio Supply Co.	Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co.	Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture & Mechanic Arts	State College, N. Mex.	360
KOP	Detroit Police Department	Detroit, Mich.	286
KPO	Hale Bros.	San Francisco, Calif.	423
KQP	Apple City Radio Club	Hood River, Oreg.	360
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	360
KQW	Charles D. Herrold	San Jose, Calif.	360
KRE	V C Battery & Electric Co.	Berkeley, Calif.	278
KSD	Post Dispatch (Pulitzer Pub. Co.)	St. Louis, Mo.	546
KSS	Prest & Dean Radio Co. and Radio Research Society of Long Beach, Calif.	Long Beach, Calif.	360
KTW	First Presbyterian Church	Seattle, Wash.	360
KUO	Examiner Printing Co.	San Francisco, Calif.	360
KUS	City Dye Works & Laundry Co.	Los Angeles, Calif.	360
KUY	Coast Radio Co.	El Monte, Calif.	256
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	360
KWH	Los Angeles Examiner	Los Angeles, Calif.	360
KXD	Modesto Herald Publishing Co.	Modesto, Calif.	252
KYQ	Electric Shop	Honolulu, Hawaii	366
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	536
KZM	Preston D. Allen	Oakland, Calif.	360
KZN	The Deseret News	Salt Lake City, Utah	360
KZV	Wenatchee Battery & Motor Co.	Wenatchee, Wash.	360
WAAB	Valdemar Jensen	New Orleans, La.	268
WAAC	Tulane University	New Orleans, La.	380
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	286
WAAK	Gimbel Brothers	Milwaukee, Wis.	280
WAAM	I. R. Nelson Co.	Newark, N. J.	263
WAAN	University o Mfissouri	Columbia, Mo.	254
WAAW	Omaha Grain Exchange	Omaha, Nebr.	360
WABA	Lake Forest College	Lake Forest, Ill.	266
WABB	Dr. John B. Lawrence	Harrisburg, Pa.	266
WABD	Parker High School	Dayton, Ohio	283
WABE	Young Men's Christian Association	Washington, D. C.	283
WABG	Arnold Edwards Piano Co.	Jacksonville, Fla.	248
WABH	Lake Shore Tire Co.	Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co.	Bangor, Me.	240
WABK	First Baptist Church	Worcester, Mass.	252
WABL	Connecticut Agricultural College	Storrs, Conn.	283
WABM	F. E. Doherty Automotive and Radio Equipment Co.	Saginaw, Mich.	254
WABN	Waldo C. Grover	La Crosse, Wis.	244
WABO	Lake Avenue Baptist Church	Rochester, N. Y.	252
WABP	Robert F. Weinig	Dover, Ohio	266
WABQ	Haverford College Radio Club	Haverford, Pa.	261
WABR	Scott High School, N. W. B. Foley	Toledo, Ohio	270
WABS	Essex Manufacturing Co.	Newark, N. J.	244
WABT	Holiday-Hall, Radio Engineers	Washington, Pa.	252
WABU	Victor Talking Machine Co.	Camden, N. J.	226
WABV	John H. DeWitt, Jr.	Nashville, Tenn.	263
WABW	College of Wooster	Wooster, Ohio	234
WABX	Henry B. Joy	Mt. Clemens, Mich.	270
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	263
WBAA	Purdue University	West Lafayette, Ind.	360
WBAD	Sterling Electric Co.	Minncapolis, Minn.	360
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAN	Wireless Phone Corp.	Paterson, N. J.	244
WBAO	James Millikin University	Decatur, Ill.	360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.	Columbus, Ohio	390

mum regeneration and by going past this point the sound becomes mushy. This mushiness indicates that the maximum regeneration point has been passed and that the receiver is oscillating. This not only destroys the quality of the signal but by radiating from the antenna a certain amount of energy, interferes with the neighbor's proper reception of the signal. This misuse has caused considerable unjust criticism of this type of receiver.

The regenerative loud speaking reciver combines the good qualities of the detector amplifier and the regenerative receiver, making possible the amplification of weaker distant signals to such an extent that the volume furnished is ample to operate a loud speaking device. One of the advantages offered by this instrument is that a small antenna may be used with no appreciable decrease in signal strength and the selectivity is increased, thus making it possible to tune out more easily the interfering stations.

Radio frequency receivers.—As this type of instrument, which is quite new to the majority of radio fans, can be used on a loop or short antenna it has helped fill the need for a set that can be used in a congested district such as in apartment houses or in places where the homes are so close together as to make it almost impossible to erect an antenna.

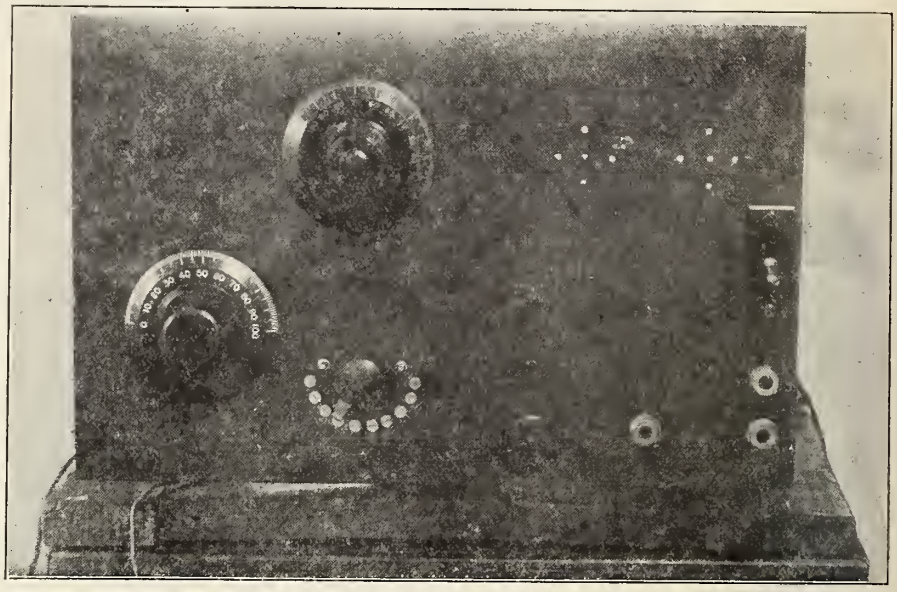
By using radio frequency amplification ahead of the detector tube, the radio waves are amplified before they are detected. Two or more stages of radio frequency are equal to regeneration, which means that to get the same results, one must have more tubes and batteries to operate this type. Instruments of this nature have been designed in cabinets which can be moved about the room with the same ease as a phonograph cabinet.

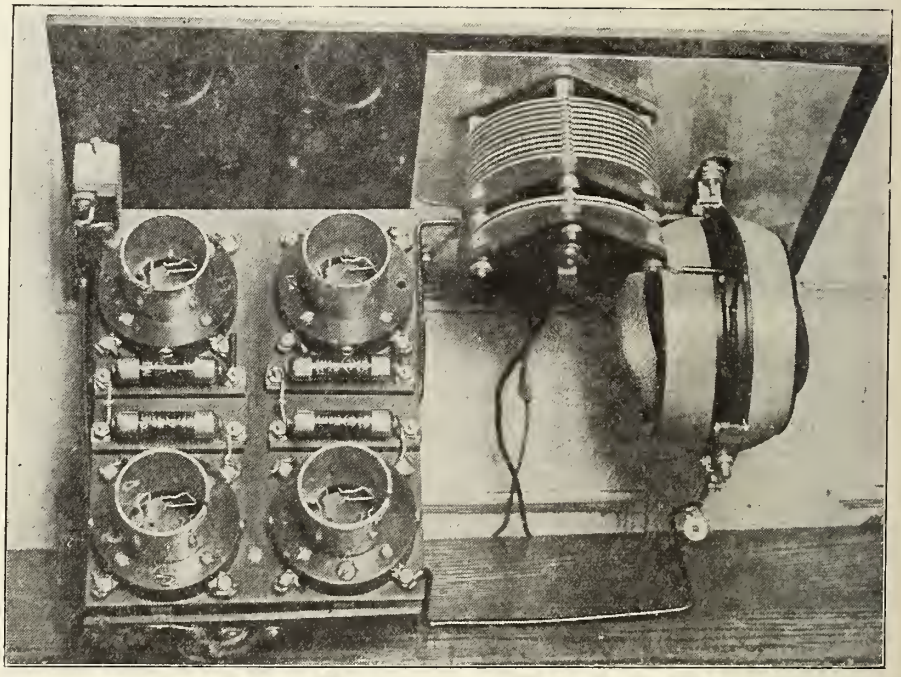
Armstrong's Radio Muffler

THE other day Major Edwin H. Armstrong visited the office of the Chief Supervisor of Radio in Washington. The Major has cut loose from radio for a while and with his wife is en route south in his machine, where he plans a month's vacation and honeymoon in Florida.

Future activities of the major, it is understood, will be devoted to a large extent in remedying interference troubles said to be caused by his famous regenerative circuit. A large amount of the difficulty encountered, it is believed, is due to poor manipulation, but he suggests the use of an additional tube of radio frequency, as a "muffler." Just as in automobiles where excess noises are eliminated by the use of an engine muffler, in the operation of the regenerative sets, a radio muffler can be incorporated. One exception is noted; in the automobile the muffler is placed after the engine, behind it, so to speak, while in a radio set the "muffler" should be put in front or before the regeneration.

No Rheostats





The above photographs picture a method used by a radio fan to eliminate controls for the filaments of the tubes. The cartridge types of resistance are of the proper value to be used instead of rheostats, thereby making the use of four extra controls unnecessary. The circuit is the conventional single circuit using a variocoupler as tuner. The panel view shows how simple the control of this set is. (Kadel & Herbert Photo.)

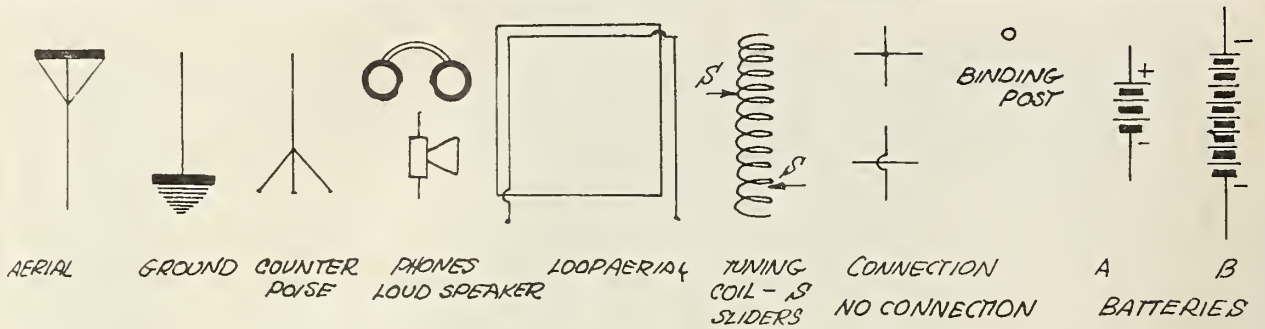
Hints on Transformer Shielding

When the magnetic or electrostatic field of one transformer is so located that it passes into the windings of the adjacent transformer, the first induces currents in the second which cause noises and which forms a by-pass around the amplifying tubes so that all of the energy is not amplified in the tubes. Where possible, the tubes and transformers should be spaced about 5 1-2 inch to 6 inch centers, but where so much room is not available we may have to resort to shielding the tubes and transformers by grounded metal partitions. The shielding, however, is not desirable since it causes losses and usually interferes with the proper arrangement of the wiring.

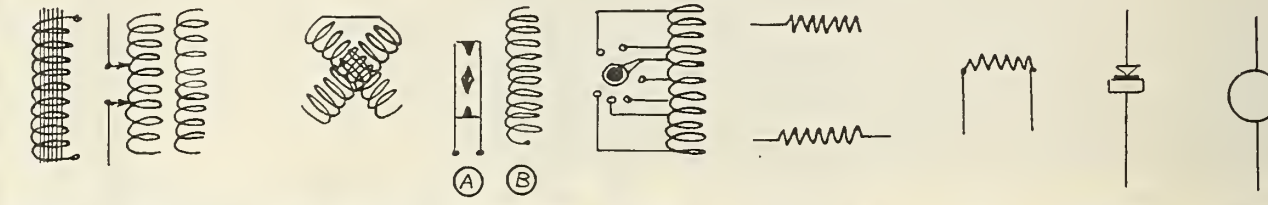
Corrected List of U. S., Cuban and Canadian Broadcasting Stations

WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.	New York, N. Y.	492
WBBA	Newark Radio Laboratories	Newark, Ohio	240
WBBD	Barbey Battery Service	Reading, Pa.	234
WBBE	Alfred R. Marcy	Syracuse, N. Y.	246
WBBF	Petoskey High School	Petoskey, Mich.	246
WBBF	Georgia School of Technology	Atlanta, Ga.	270
WBBG	Irving Vermilya	Mattapoisett, Mass.	240
WBBH	J. Irving Bell	Port Huron, Mich.	246
WBBI	The Indianapolis Radio Club	Indianapolis, Ind.	234
WBBJ	Neel Electric Co., P. E. Neal	West Palm Beach, Fla.	258
WBBK	Kaufmann & Baer Co.	Pittsburgh, Pa.	254
WBBM	Frank Atlass Produce Co.	Lincoln, Ill.	226
WBBN	Blake, A. B.	Wilmington, N. C.	275
WBBO	Mich. Limestone & Chemical Co.	Rogers, Mich.	250
WBBQ	Frank Crook	Pawtucket, R. I.	252
WBBR	Peoples Pulpit Asso.	Rossville, N. Y.	244
WBBT	Lloyd Brothers	Philadelphia, Pa.	234
WBBU	Jenks Motor Sales Co.	Mommouth, Ill.	224
WBL	T & H Radio Co.	Anthony, Kans.	261
WBR	Pennsylvania State Police	Butler, Pa.	286
WBS	D. W. May, Inc.	Newark, N. J.	360
WBT	Southern Radio Corp.	Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co.	Springfield, Mass.	337
WCAO	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa.	462
WCAG	Cylde R. Randall	New Orleans, La.	268
WCAH	Entrekin Electric Co.	Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	360
WCAK	Alfred P. Daniel	Houston, Tex.	263
WCAL	St. Olaf College	Northfield, Minn.	360
WCAM	Villanova College	Villanova, Pa.	360
WCAO	Sanders & Stayman Co.	Baltimore, Md.	360
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C.	469
WCAR	Alamo Radio Electric Co.	San Antonio, Tex.	360
WCAS	William Hood Dunwoody Industrial Institute	Minneapolis, Minn.	246
WCAT	South Dakota State School of Mines	Rapid City, S. Dak.	240
WCAU	Durham & Co.	Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co.	Little Rock, Ark.	360
WCAX	University of Vermont	Burlington, Vt.	360
WCAY	Kesselman O'Driscoll Co.	Milwaukee, Wis.	261
WCAZ	Carthage College	Carthage, Ill.	246
WCBA	Charles W. Heimbach	Allentown, Pa.	280
WCBC	University of Michigan	Ann Arbor, Mich.	280
WCBD	Wilbur G. Voliva	Zion, Ill.	345
WCK	Stix, Baer & Fuller Dry Goods Co.	St. Louis, Mo.	360
WCM	University of Texas	Austin, Texas	360
WCX	Detroit Free Press	Detroit, Mich.	517
WDAE	Tampa Daily Times	Tampa, Fla.	360
WOAF	Kansas City Star	Kansas City, Mo.	411
WDAG	J. Laurance Martin	Amarillo, Tex.	263
WOAH	Trinity Methodist Church (South)	El Paso, Tex.	268
WDAK	The Courant	Hartford, Conn.	261
WDAO	Automotive Electric Co.	Dallas, Tex.	360
WOAP	Board of Trade	Chicago, Ill.	360
WDAR	Lit Brothers	Philadelphia, Pa.	395
WOAS	Samuel A. Waite	Worcester, Mass.	360
WDAU	Slocum Kilburn	New Bedford, Mass.	360
WOAY	Radio Equipment Corp.	Fargo, N. Dak.	244
WOBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WDM	Church of the Covenant	Washington, D. C.	234
WDZ	James L. Bush	Tuscola, Ill., Star Store Bldg.	278
WEAA	F. D. Fallain	Flint, Mich.	280
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	492
WEAH	Wichita Board of Trade	Wichita, Kans.	244
WEAI	Cornell University	Ithaca, N. Y.	286
WEAJ	University of South Dakota	Vermillon, S. Dak.	283
WEAM	Borough of North Plainfield (W. Gibson Buttfield)	North Plainfield, N. J.	252
WEAN	Shepard Co.	Providence, R. I.	273
WEAO	Ohio State University	Columbus, Ohio	360
WEAP	Mobile Radio Co.	Mobile, Ala.	360
WEAR	Baltimore American & News Publishing Co.	Baltimore, Md.	360
WEAS	Hecht Co.	Washington, D. C.	360
WEAU	Davidson Bros. Co.	Sioux City, Iowa	360
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Tex.	360
WEB	Benwood Co.	St. Louis, Mo.	360
WEV	Hurlburt-Still Electrical Co.	Houston, Tex.	360
WEW	St. Louis University	St. Louis, Mo.	261
WFAA	Dallas News & Dallas Journal	Dallas, Texas	476
WFAB	Carl F. Woese	Syracuse, N. Y.	234
WFAF	H. C. Spratley Radio Co.	Poughkeepsie, N. Y.	360
WFAH	Electric Supply Co.	Port Arthur, Texas	236
WFAJ	Hi-Grade Wireless Instrument Co.	Asheville, N. C.	360
WFAM	Times Publishing Co.	St. Cloud, Minn.	360
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn.	360
WFAQ	Missouri Wesleyan College	Cameron, Mo.	360
WFAT	New Columbus College	Sioux Falls, S. Dak.	258
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr.	275
WFI	Strawbridge & Clothier	Philadelphia, Pa.	395
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa.	248
WGAN	Cecil E. Lloyd	Pensacola, Fla.	360
WGAQ	Glenwood Radio Corp. (W. G. Patterson)	Shreveport, La.	360
WGAW	Ernest C. Alhright	Altoona, Pa.	261
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGI	American Radio & Research Corp.	Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett	Philadelphia, Pa.	360
WGR	Federal Telephone & Telegraph Co.	Buffalo, N. Y.	319
WGV	Interstate Electric Co.	New Orleans, La.	242
WGY	General Electric Co.	Schenectady, N. Y.	380
WHA	University of Wisconsin	Madison, Wis.	360
WHAA	State University of Iowa	Iowa City, Iowa	283
WHAB	Clark W. Thompson	Galveston, Texas	360
WHAD	Marquette University	Milwaukee, Wis.	280
WHAG	University of Cincinnati	Cincinnati, Ohio	222
WHAH	Hafer Supply Co.	Joplin, Mo.	283
WHAK	Roberts Hardware Co.	Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y.	283
WHAP	Otta & Kuhns	Decatur, Ill.	360
WHAR	Paramount Radio & Electric Co. (W. H. A. Pulus)	Atlantic City, N. J.	231
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	380
WHB	Sweeney School Co.	Kansas City, Mo.	411
WHK	Radiovox Co. (Warren R. Cox)	Cleveland, Ohio	360
WHN	George Schubel	New York, N. Y.	360
WIAB	Joslyn Automobile Co.	Rockford, Ill.	252
WIAC	Galveston Tribune	Galveston, Texaa	360
WIAD	Howard R. Miller	Ocean City, N. J.	254
WIAF	Gustav A. DeCortin	New Orleans, La.	234
WIAH	Continental Radio & Mfg. Co.	Newton, Iowa	258
WIAI	Heey Stores Co.	Springfield, Mo.	252
WIAJ	Fox River Valley Radio Supply Co. (Quinn Bros.)	Neenah, Wis.	224
WIAK	Journal-Stockman Co.	Omaha, Nebr.	278
WIAO	School of Engineering of Milwaukee	Milwaukee, Wis.	360
WIAQ	Chronicle Publishing Co.	Marion, Ind.	226
WIAR	Paducah Evening Sun	Paducah, Ky.	360
WIAS	Home Electric Co.	Burlington, Iowa	360
WIAT	Leon T. Noel	Tarkio, Mo.	360
WIAU	American Trust & Savings Bank	Le Mars, Iowa	360
WIK	K. & L. Electric Co. (Herbert F. Kelso and Hunter J. Lohman)	McKeesport, Pa.	234
WIL	Continental Electric Supply Co.	Washington, D. C.	360
WIP	Gimbel Brothers	Philadelphia, Pa.	509
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	360
WJAF	Press Publishing Co.	Muncie, Ind.	360
WJAG	Norfolk Daily News	Norfolk, Nebr.	283
WJAK	Clifford L. White	Greentown, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAN	Peoria Star	Peoria, Ill.	280
WJAQ	Capper Publications	Topeka, Kans.	360
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	250
WJAT	Kelly-Vawter Jewelry Co.	Marshall, Mo.	360
WJAX	Union Trust Co.	Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	448
WJD	Richard H. Howe	Granville, Ohio	229
WJH	W. P. Boyer	Washington, D. C.	273
WJX	Deforest Radio Telephone & Telegraph Co.	New York, N. Y.	360
WJY	R. C. A.	New York, N. Y.	405
WJZ	R. C. A.	New York, N. Y.	455
WKAA	H. F. Paar	Cedar Rapids, Iowa	268
WKAD	Chas. Looff (Crescent Park)	East Providence, R. I.	240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Texas	360
WKAN	United Battery Service Co.	Montgomery, Ala.	226
WKAP	Dutee W. Flint	Cranston, R. I.	360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	360
WKAR	Michigan Agriculture College	East Lansing, Mich.	280
WKAS	L. E. Lines Music Co.	Springfield, Mo.	360
WKAV	Laconia Radio Club	Laconia, N. H.	254
WKAY	Brenau College	Gainesville, Ga.	280
WKY	WKY Radio Shop	Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn.	417
WLAH	Samuel Woodworth	Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co.	Waco, Texas	360
WLAK	Vermont Farm Machine Corp.	Bellows Falls, Vt.	360
WLAL	Naylor Electrical Co.	Tulsa, Okla.	360
WLAP	W. V. Jordon	Louisville, Ky.	360
WLAQ	Artbur E. Shilling	Kalamazoo, Mich.	283
WLAV	Electric Shop	Pensacola, Fla.	254
WLAW	Police Dept., City of New York	New York, N. Y.	360
WLAX	Putnam Electric Co. (Greencastle Community Broadcasting Station)	Greencastle, Ind.	231
WLB	University of Minnesota	Minneapolis, Minn.	360
WLW	Crosley Manufacturing Co.	Cincinnati, Ohio	309
WMAB	Radio Supply Co.	Oklahoma, Okla.	360
WMAC	J. Edw. Page (Olive B. Meredith)	Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	360
WMAH	General Supply Co.	Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co.	Kansas City, Mo.	275
WMAK	Norton Laboratories	Lockport, N. Y.	360
WMAL	Trenton Hardware Co.	Trenton, N. J.	256
WMAN	First Baptist Church	Columbus, Ohio	286
WMAP	Utility Battery Service	Edston, Pa.	246
WMAQ	Chicago Daily News	Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute	Auburn, Ala.	250
WMAW	Wahpeton Electric Co.	Wahpeton, N. D.	254
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	280
WMAZ	Mercer University	Macon, Ga.	268
WMC	"Commercial Appeal" (Commercial Publishing Co.)	Memphis, Tenn.	500
WMH	Precision Equipment Co.	Cincinnati, Ohio	248
WMU	Doubleday-Hill Electric Co.	Washington, D. C.	261
WNAC	Shepard Stores	Boston, Mass.	278
WNAD	University of Oklahoma	Norman, Okla.	360
WNAL	R. J. Rockwell	Omaha, Nebr.	242
WNAM	Ideal Apparatus Co.	Evansville, Ind.	360
WNAN	Syracuse Radio Telephone Co.	Syracuse, N. Y.	286
WNAP	Wittenberg College	Springfield, Ohio	231
WNAQ	Charleston Radio Electric Co.	Charleston, S. C.	360
WNAR	C. C. Rhodes	Butler, Mo.	231
WNAS	Texas Radio Corp. & Austin Statesman	Austin, Texas	360
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa.	360
WNAV	Peopies Telephone & Telegraph Co.	Knoxville, Tenn.	236
WNAW	Peninsular Radio Club (Henry Kunzmann)	Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNJ	Shotton Radio Manufacturing Co.	Albany, N. Y.	360
WOAA	Dr. Walter Hardy	Ardmore, Okla.	360
WOAC	Maus Radio Co.	Lima, Ohio	266
WOAD	Friday Battery & Electric Corp.	Sigourney, Iowa	360
WOAE	Midland College	Fremont, Nebr.	360
WOAF	Tyler Commercial College	Tyler, Texas	360
WOAG	Apollo Theater (Belvidere Amusement Co.)	Belvidere, Ill.	224
WOAH	Palmetto Radio Corp.	Charleston, S. C.	360
WOAI	Southern Equipment Co.	San Antonio, Texas	385
WOAL	William E. Woods	Webster Groves, Mo.	229
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	360
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	360
WOAP	Kalamazoo College	Kalamazoo, Mich.	240
WOAQ	Portsmouth Kiwanis Club	Portsmouth, Va.	360
WOAR	Henry P. Lundskow	Kenosha, Wis.	229
WOAT	Boyd M. Hamp	Wilmington, Del.	360
WOAV	Pennsylvania National Guard, 2d Battalion, 112th Infantry	Erie, Pa.	242
WOAW	Woodmen of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOI	Iowa State College	Ames, Iowa	360
WOK	Pine Bluff Co.	Pine Bluff, Ark.	360
WOO	John Wanamaker	Philadelphia, Pa.	509
WOQ	Western Radio Co.	Kansas City, Mo.	360
WOR	L. Bamberger & Co.	Newark, N. J.	405
WOS	Missouri State Marketing Bureau	Jefferson City, Mo.	441
WPAB	Pennsylvania State College	State College, Pa.	283
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	360
WPAH	Wisconsin Department of Markets	Waupaca, Wis.	360
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College	Agricultural College, N. Dak.	360
WPAL	Superior Radio & Telephone Equipment Co.	Columbus, Ohio	286
WPAM	Auerbach & Guettel	Topeka, Kans.	360
WPAP	Theodore D. Phillips	Winchester, Ky.	360
WPAQ	General Sales & Engineering Co.	Frostburg, Md.	360
WPAT	St. Patricks Cathedral	El Paso, Texas	360
WPAU	Concordia College	Moorbead, Minn.	360
WPAZ	John R. Koch (Dr.)	Charleston, W. Va.	273
WPG	Nusawg Poultry Farm	New Lebanon, Ohio	234
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	360
WQAC	E. B. Gish	Amarillo, Tex.	360
WQAD	Whitall Electric Co.	Waterbury, Conn.	242
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275
WQAF	Sandusky Register	Sandusky, Ohio	240
WQAH	Brock-Anderson Electrical Engineering Co.	Lexington, Ky.	254
WQAL	Coles County Telephone & Telegraph Co.	Mattoon, Ill.	258
WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	360

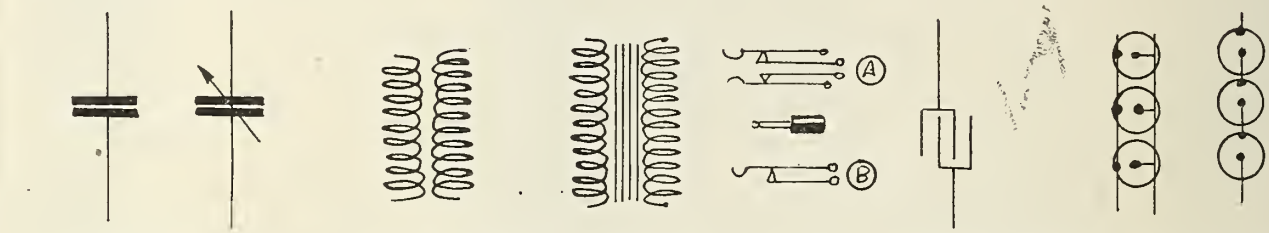
Radio Construction Diagrams



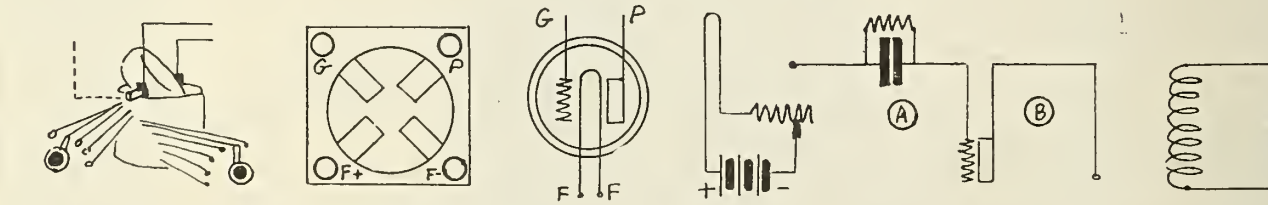
AERIAL GROUND COUNTER POISE PHONES LOUD SPEAKER LOOP AERIAL TUNING COIL - S SLIDERS CONNECTION NO CONNECTION A BATTERIES B



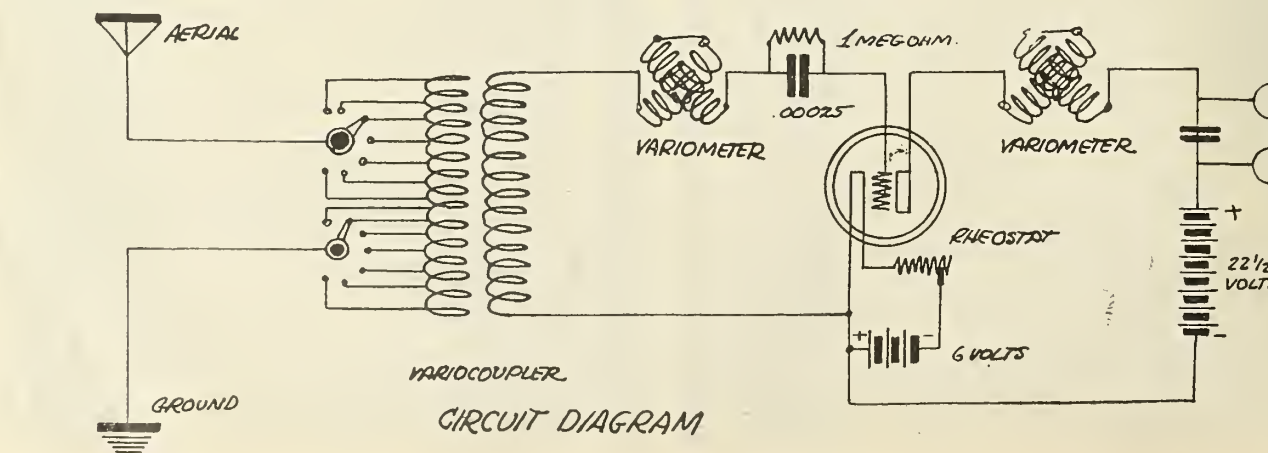
CHOKE COIL VARIO OR LOOSE COUPLER VARIOMETER HONEYCOMB COIL TAPPED COIL RHEOSTAT POTENTIOMETER GRID LEAK CRYSTAL DETECTOR METER



CONDENSER FIXED VARIABLE RADIO FREQUENCY TRANSFORMER AUDIO TRANSFORMER JACKS PLUG CONDENSER AUDIO FREQUENCY CONNECTIONS PARALLEL SERIES



VARIO COUPLER CONNECTIONS TUBE SOCKET CONNECTIONS VACUMN TUBE FILAMENT CIRCUIT A - GRID CIRCUIT B - PLATE CIRCUIT OSCILLATORY CIRCUIT



CIRCUIT DIAGRAM

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

WQAQ	Abilene Daily Reporter (West Texas Radio Co.)	Abilene, Texas	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAV	Huntington & Guerry (Inc.)	Greenville, S. C.	258
WQAX	Radio Equipment Co.	Peoria, Ill.	360
WRAA	Rice Institute	Houston, Texas	360
WRAD	Taylor Radio Shop (G. L. Taylor)	Marion, Kans.	248
WRAF	The Radio Club (Inc.)	Laporte, Ind.	224
WRAH	Stanley N. Read	Providence, R. I.	231
WRAL	Northern States Power Co.	St. Croix Falls, Wis.	248
WRAM	Lombard College	Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	236
WRAO	Radio Service Co.	St. Louis, Mo.	360
WRAV	Antolch College	Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRAY	Radio Sales Corp.	Scranton, Pa.	280
WRAZ	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	233
WRC	Radio Corporation of America	Washington, D. C.	469
WRK	Doron Bros. Electric Co.	Hamilton, Ohio	360
WRL	Union College	Schenectady, N. Y.	360
WRM	University of Illinois	Urbana, Ill.	360
WRR	City of Dallas (police and fire signal department)	Dallas, Texas	360
WRW	Tarrytown Radio Research Laboratory (Koenig Bros.)	Tarrytown, N. Y.	273
WSAB	Southeast Missouri State Teachers College	Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural College	Clemson College, S. C.	360
WSAD	J. A. Foster Co.	Providence, R. I.	261
WSAG	City of St. Petersburg (Loren V. Davis)	St. Petersburg, Fla.	244
WSAH	A. J. Leonard, Jr.	Chicago, Ill.	248
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	309
WSAJ	Grove City College	Grove City, Pa.	360
WSAL	Franklin Electric Co.	Brookville, Ind.	246
WSAN	Allentown Radio Club	Allentown, Pa.	229
WSAR	Doughty & Welch Electrical Co.	Fall River, Mass.	254
WSAT	Donohoo-Ware Hardware Co.	Plainview, Texas	268
WSAW	John J. Long, Jr.	Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory	Chicago, Ill.	268
WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	233
WSAZ	Chas. Electric Shop	Pomeroy, Ohio	258
WSB	Atlanta Journal	Atlanta, Ga.	429
WSL	J. & M. Electric Co.	Utica, N. Y.	273
WSY	Alabama Power Co.	Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAF	Louis J. Gallo	New Orleans, La.	242
WTAG	Kern Music Co.	Providence, R. I.	258
WTAH	Carmen Ferro	Belvidere, Ill.	236
WTAJ	The Radio Shop	Portland, Me.	230
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAN	Orndorff Radio Shop	Mattoon, Ill.	240
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gorden & Son	Osseo, Wis.	220
WTAR	Reliance Electric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	275
WTAT	Edison Electric Illuminating Co.	Boston, Mass. (portable)	244
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	360
WTAW	Agricultural & Mechanical College of Texas	College Station, Tex.	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcasting Station	Oak Park, Ill.	220
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTG	Kansas State Agricultural College	Manhattan, Kans.	485
WWAB	Hoenig, Swern & Co. (John Rasmussen)	Trenton, N. J.	220
WWAC	Sanger Bros.	Waco, Texas	360
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	Alamo Dance Hall, L. J. Crowley	Joliet, Ill.	227
WWAF	Galvin Radio Supply Co.	Camden, N. J.	230
WWAO	Michigan College of Mines	Houghton, Mich.	244
WWI	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	517
WWL	Loyola University	New Orleans, La.	260
WYAM	Electrical Equipment Co.	Miami, Fla.	283
WYAW	Catholic University	Washington, D. C.	236

Canadian Stations

CFAC	Calgary Herald	Calgary, Alberta.	430
CFCA	Star Pub. & Prtg. Co.	Toronto, Ontario.	400
CFCF	Marconi Wireless Teleg. Co. of Canada	Montreal, Quebec.	440
CFCH	Abitibi Power & Paper Co.	Iroquois Falls, Ont.	400
CFCJ	La Cie de L'Evenement	Quebec, Quebec.	410
CFCK	Radio Supply Co.	Edmonton, Alberta.	410
CFCL	Centennial Methodist Church	Victoria, British Col.	400
CFCN	W. W. Grant Radio (Ltd.)	Calgary, Alberta	440
CFCO	Semmemhaack-Dickson (Ltd.)	Bellevue, Quebec.	450
CFCQ	Radio Specialties (Ltd.)	Vancouver, B. C.	450
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCW	The Radio Shop	London, Ont.	420
CFDC	Sparks Co.	Nanaimo, B. C.	430
CFQC	The Electric Shop (Ltd.)	Sasakatoon, Sashatchewan.	400
CFRC	Queens University	Kingston, Ontario	450
CFUC	University of Montreal	Montreal, Quebec.	400
CHAC	Radio Engineers	Halifax, Nova Scotia.	400
CHBC	Albertan Publishing Co.	Calgary, Alberta.	410
CHCD	Canadian Wireless & Elec. Co.	Quebec, Quebec.	410
CHCE	Western Canada Radio Sup. (Ltd.)	Victoria, B. C.	400
CHCL	Vancouver Merchants Exchange	Vancouver, B. C.	440
CHYC	Northern Electric Co.	Montreal, Quebec.	410
CJCA	Edmonton Journal	Edmonton, Alberta.	450
CJGC	London Free Press Prtg. Co.	London, Ont.	430
CJCD	T. Eaton Co.	Toronto, Ont.	410
CJCE	Sprott-Shaw Radio Co.	Vancouver, B. C.	420
CJCI	Maritime Radio Corp.	St. John, New Brunswick.	400
CJCN	Simons Agnew & Co.	Toronto, Ont.	410
CJCX	Percival Wesley Shackleton	Olds, Alberta.	400
CJSC	Evening Telegram	Toronto, Ont.	430
CKAC	La Presse Pub. Co.	Montreal, Quebec.	430
CKCD	Vancouver Dailey Province	Vancouver, B. C.	410
CKCE	Canadian Independ. Telephone Co.	Toronto, Ont.	450
CKCK	Leader Pub. Co.	Regina, Saskatchewan.	420
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	410
CKY	Manitoba Telephone System	Winnipeg, Manitoba.	450

Cuban Stations

PWX	Cuban Telephone Co.	Habana	400
2DW	Pedro Zayas	Habana	300
2AB	Alberto S. de Bustamante	Habana	240
2OK	Maria Garcia Velez	Habana	360
2BY	Frederick W. Borton	Habana	260
2CX	Frederick W. Borton	Habana	320
2EV	Westinghouse Elec. Co.	Habana	220
2TW	Roberto E. Ramires	Habana	230
2HC	Heraldo de Cuba	Habana	275
2LC	Luis Casas	Habana	250
2KD	E. Sanchez de Fuentes	Habana	350
2MN	Fausto Simon	Habana	270
2MG	Manuel G. Salas	Habana	280
2JD	Raul Perez Falcon	Habana	150
2KP	Alvara Daza	Habana	200
2HS	Julio Power	Habana	180
2OL	Oscar Collado	Habana	290
2WW	Amadeo Saenz	Habana	210
5EV	Leopoldo V. Figueroa	Colon	360
6KW	Frank H. Jones	Tuinucu	340
6KJ	Frank H. Jones	Tulnucu	275
6CX	Antonio T. Figueroa	Clenflegos	170
6DW	Eduardo Terry	Clenflegos	225
6BY	Jose Ganduxe	Clenfuegos	300
6AZ	Valentin Ullivarrl	Clenfuegos	200
6EV	Josefa Alverax	Caibarien	225
8AZ	Alfreda Brocks	Stgo. de Cuba	240
8BY	Alberto Ravelo	Stgo. de Cuba	250
8FU	Andres Vinnet	Stgo. de Cuba	225
8DW	Pedro C. Anduz	Stego. de Cuba	275
8EV	Eduardo Mateos	Stego. de Cuba	180

Recognizing Voices

Recently, a new announcer handled his first program through WEAF. On returning home he asked his mother whether she had heard the program during the afternoon. "Yes, " she responded, but made no comment. A little surprised he asked how she had liked the announcing. Again a monosyllabic answer. Finally he learned to his astonishment that his mother had not recognized his voice—so carefully had he applied the art of correct tone and enunciation for the microphone in acquiring a "radio" voice.

On the other hand, not many days previous, another new announcer had been heard for the first time through WEAF for a few brief special announcements. Later in the evening, a friend telephoned a message of congratulation. He had not questioned for a moment but that the announcing voice was that of his friend, so perfect was its reproduction.

Warship's Stunt

The Battleship "Colorado" has just accomplished what radio engineers have said was impossible a few years ago. Her radio personnel has succeeded in receiving messages on five different wave lengths while her transmitter was sending dispatches across the continent on another wave length.

This was accomplished by means of a special high-power tube transmitter.

Farm Report

Radio's first big bow to the agricultural interests of the nation was made recently when, in co-operation with the Stockman-Farmer Publishing Company, the Westinghouse Electric & Manufacturing Company opened its third broadcasting studio in Pittsburgh.

It was discovered that there was a general demand for market information and weather reports via radio, farmers realizing that such information would be of vital importance in the conducting of farm operations and particularly in the marketing of farm products. The first of July, 1923, witnessed the opening of a regular market reporting service which was conducted from the offices of the National Stockman and Farmer and broadcast by Station KDKA, the pioneer in the farm field as elsewhere.

The market reporting service developed so rapidly that it was soon found necessary to broadcast three market reports daily. As now constituted these market reports cover the primary activities of seven livestock markets, the principal grain and feed markets of the country, the New York Cotton market, the Boston wool market, the fur market, produce markets and numerous government reports on market and crop conditions. Two weather reports daily were added to the reporting activities of KDKA until the needs of practically every class of farmers in the nation were being filled by the broadcast market service.

The need for a separate broadcasting studio soon arose and following the first few months of experiment the Stockman Farmer Publishing Company erected a well equipped studio in its building and have now perfected arrangements with the Westinghouse Company to give the required market report service.

The interest of the United States Department of Agriculture was aroused by the success of KDKA's market reports and co-operation resulted, the government with its leased wire service helping the broadcasting station, so that market reports from the various centers of the country could be assembled and put on the air. In addition, the United States Weather Bureau with the co-operation of the Western Union Telegraph Company, gave special service on the night weather report so that this report is now broadcast from KDKA just a half-hour after being issued at Washington, D. C.

Since the inception of the market reporting service in 1923, the National Stockman and Farmer has heard from all but nine far western states while the reports have been heard in Canada, Cuba, Jamaica, the Virgin Islands, South America and England.

Don't Fail to renew your subscription?

—long distance clear signals!

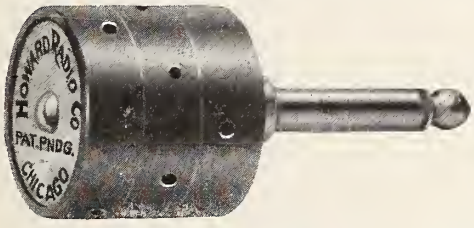
Howard Radio Co. Inc. — Blue Seal Guaranteed Products — Chicago, U.S.A.

You too can get distant stations clearly if you use Howard Rheostats.

The point of oscillation of a tube is narrow, you cannot get the best results unless you are able to control this point. Howard micrometer Rheostat does this, easily, simply—surely.

Smooth, positive contact is just one of the reasons.

Ask your dealer—he knows and will be glad to show you.



No. 1004

Multi Terminal Receiver Plug, instantaneous connection for as many as six pairs of standard receiver tips $2.00

Patd. Aug. 28, 1923

Jobbers Write for Discounts

HOWARD

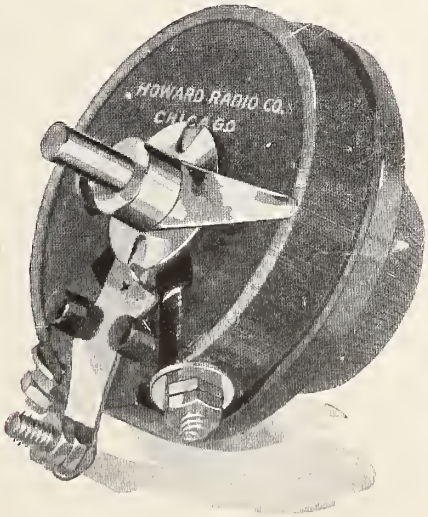
Howard Radio Co., Inc.,

4248 North Western Ave., Dept. A, Chicago

No. 1001

6½	Ohm Rheostat	$1.10
25	Ohm Rheostat	1.10
40	Ohm Rheostat	1.10
60	Ohm Rheostat	1.10

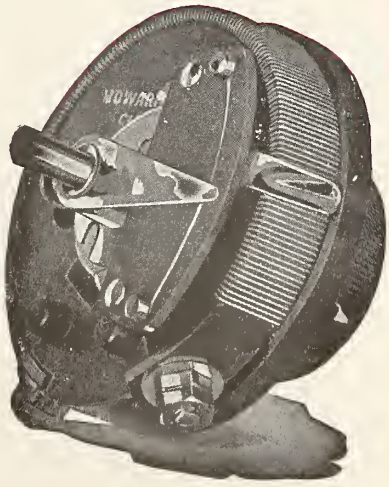
Patd. 870,042



No. 1003

200 Ohm Potentiometer	$1.50
400 Ohm Potentiometer	2.00

Patd. 870,042



No. 1002

6¾ Ohm Micrometer Rheostat	$1.50
25 Ohm Micrometer Rheostat	1.50
40 Ohm Micrometer Rheostat	1.50
60 Ohm Micrometer Rheostat	1.50

Patd. July 10, 1923

Earn $5.00 to $20.00 a Day in RADIO

You can! Hundreds of ambitious men are already earning thousands of dollars in this wonderful new industry—many working only in their spare time. Mail coupon below for Free Book which describes fully the amazing money making opportunities in Radio and tells how YOU can earn from $500 to over $10,000 a year!

THE astounding growth of Radio has created thousands of big money opportunities. Millions of dollars were spent during the past year on Radio—and thousands of young men are needed right now to meet the ever increasing demand of work. Never before has there existed so many and such remarkable opportunities for making money in this wonderful, new field.

Men are needed to build, sell and install radio sets—to design, test, repair—as radio engineers and executives—as operators at land stations and on ships traveling the world over—as operators at the hundreds of broadcasting stations. And these are just a few of the wonderful opportunities!

Easy to Learn Radio at Home In Spare Time

No matter if you know *nothing* about Radio now, you can quickly become a radio expert, by our marvelous new method of practical instruction—instruction which includes all the material for building the latest up-to-date radio apparatus.

Scores of young men who have taken our course are already earning from $75 to over $200 a week. Merle Wetzel of Chicago Heights, Ill., advanced from lineman to Radio Engineer, increasing his salary 100% *even while taking our course!* Emmett Welch right after finishing his training started earning $300 a month and expenses. Another graduate is now an operator of a broadcasting station PWX of Havana, Cuba, and earns $250 a month. Still another graduate, only 16 years old is averaging $70 a week in a radio store.

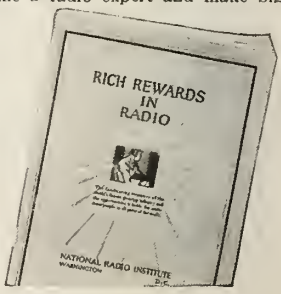
Wonderful Opportunities

Hardly a week goes by without our receiving urgent calls for our graduates. "We need the services of a competent Radio Engineer"—"We want men with executive ability in addition to radio knowledge to become our local managers"—"We require the services of several resident demonstrators"—these are just a few small indications of the great variety of opportunities open to our graduates.

Take advantage of our practical training and the unusual conditions in Radio to step into a big paying position in this wonderful new field. Radio offers you more money than you probably ever dreamed possible—fascinating, easy work—a chance to travel and see the world if you care to or to take any one of the many radio positions all around you at home. And Radio offers you a glorious future!

Send for FREE BOOK

Learn more about this tremendous new field and its remarkable opportunities. Learn how you can quickly become a radio expert and make big money in Radio. Find out what remarkable successes our graduates have had—even a few weeks after their training finished.



We have just prepared a new 32-page booklet which gives a thorough outline of the field of Radio—and describes our amazing practical training in detail. This Free Book, "Rich Rewards in Radio" will be sent to you without the slightest obligation. Mail coupon for it *now!*

NATIONAL RADIO INSTITUTE
Dept. 53CA **Washington, D. C.**

1000 Mile Radio Set FREE

In order to complete your practical instruction at home, learning by actual experience, this splendid regenerative receiving set is now included without the slightest additional cost.

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Please send me without the slightest obligation your Free Book, "Rich Rewards in Radio" and full details of your special Free Employment Service.

Name..... Age.....

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City..... State.....

RADIO FIRMS Secure practical Radio Experts among our graduates. Write us today.

RADIO AGE

The Magazine of the Hour

APRIL
1924

Her Bedtime Story

In This Number

An efficient Super-Heterodyne.

Methods of radio frequency amplification.

What receiving set do I want?

New Reinartz circuit with picture diagram.

Another Rathbun hook-up.

Complete corrected list of stations.

Pick-ups and hook-ups by our readers.

Many illustrations.

Let Our Hook-ups Be Your Guide

Price 25 Cents

The "Long 45" REGISTERED

KIT

All the Parts Needed to Build a Circuit That Brings Them in From Coast-to-Coast on ONE TUBE—High Grade Equipment of Proven Quality—Every Part Tested in Our Laboratory

The Long 45 Circuit has startled the radio world with its efficient simplicity. Performances that were impossible with the larger and much more expensive sets were "all in the day's work" with this remarkable combination. Easy to assemble. Easy to operate. Easy to add to. The Long 45 starts you right in radio and will surprise you every night with programs from distant stations you've never heard before. Instructions and blue print so plain that anyone can build the set.

Your dealer has or can get one for you.

The "Long 45" Kit Contains:

1 Long 45 Tuner
1 Long 45 Cartridge Rheostat
1 Long 45 23-Plate Variable Condenser
1 Bakelite Socket
1 C. R. L. Adjustable Grid Leak and Condenser
1 Long 45 Blue Print
1 35-Turn Branston Honeycomb Coil and Mounting
1 Carter No. 3 Switch
1 Carter Jack
1 7x12 Celoron Drilled Panel
1 Base Board
5 Binding Posts
Bus Bar

Price, $22.50

MARCO MEYER & CO.

RADIO DIVISION RA

1319 Michigan Avenue **Chicago**

Licensed under Armstrong U.S. Patent No. 1,113,149

Eleven Degrees from the North Pole

Ice—endless miles of ice, as far as the eye can see. And frozen fast in the ice, amid the deadly stillness and the unearthly lights of the Arctic, a staunch little eighty-nine foot schooner! But Donald B. MacMillan and his band of brave explorers are not alone tonight.

ZENITH TRADE MARK
Long-Distance Radio

Under their ice-bound hatches they listen eagerly to the news of the outside world, broadcast to them from the Zenith-Edgewater Beach Hotel Broadcasting Station, Chicago—to violins in Newark, Schenectady, Los Angeles—to singers in Atlanta—to a lively orchestra in Honolulu.

Stations in all these cities—and in several hundred others—they have readily tuned in; yet the Bowdoin tonight is only eleven degrees from the North Pole!

Out of all the radio sets on the market, Dr. MacMillan selected the Zenith exclusively—because of its flawless construction, its unusual selectivity, its dependability and its tremendous REACH.

And you can do all that Dr. MacMillan does, and more, with either of the two new models described at the right. Their moderate price brings them easily within your reach. Write today for full particulars.

Zenith Radio Corporation

McCORMICK BUILDING, CHICAGO

Model 3R The new Zenith 3R "Long-Distance" Receiver-Amplifier combines a specially designed distortionless three-stage amplifier with the new and different Zenith three-circuit regenerative tuner.

Fine vernier adjustments—in connection with the unique Zenith aperiodic or non-resonant "selector" primary circuit—make possible extreme selectivity.

2,000 to 3,000 Miles With Any Loud-Speaker

The new Zenith 3R has broken all records, even those set by its famous predecessors of the Zenith line. Satisfactory reception over distances of 2,000 to 3,000 miles, and over, is readily accomplished in full volume, using ***any ordinary loud-speaker.*** No special skill is required.

The Zenith is the only set built which is capable of being used with all present-day tubes as well as with any tubes that may be brought out in the future. The Model 3R is compact, graceful in line, and built in a highly finished mahogany cabinet $160

Model 4R The new Zenith 4R "Long-Distance" Receiver-Amplifier comprises a complete three-circuit regenerative receiver of the feed-back type. It employs the new Zenith regenerative circuit in combination with an ***audion detector*** and ***three-stage*** audio-frequency amplifier, all in one cabinet.

Because of the unique Zenith "selector," unusual selectivity is accomplished without complication of adjustment.

The Zenith 4R may be connected directly to any loud-speaker ***without*** the use of other amplification for full phonograph volume, and reception may be satisfactorily accomplished over distances of more than 2,000 miles..... $85

ZENITH RADIO CORPORATION,
Dept.S , 328 South Michigan Avenue, Chicago, Illinois

Gentlemen:
Please send me illustrated literature on Zenith Radio.

Name.....

Address.....

RADIO AGE

The Magazine of the Hour

Established March, 1922

Volume 3 *APRIL, 1924* *Number 4*

CONTENTS

Radio Age is published monthly by
RADIO AGE, Inc.

Editorial and Publication Offices, Boyce Building,
500 N. Dearborn St., Chicago

FREDERICK SMITH, *Editor*
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First National Bank Building, Chicago
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E. V. HEVEY & COMPANY
17 West 42nd Street, New York City
Telephone, Longacre 1698

Advertising forms close on the 15th of the month
preceding date of issue
Applicants for membership in A. B. C.

Issued monthly. Vol. 3, No. 4 Subscription price $2.50 a year.
Entered as second-class matter April 8, 1922, at the post office at Chicago, Illinois, under the act of March 3, 1879.

A Chat With the Editor

THERE are two departments in this issue of RADIO AGE which demonstrate what we have said repeatedly. That is: This is essentially a readers' magazine. In the section devoted to letters from readers on sets they have built and results they have obtained there is a generous store of useful information for other readers. We want all readers to understand that we are interested in these letters, especially the ones suggesting new hook-ups and new kinks.

Also in the columns in which appear the letters from readers who tell us why they read RADIO AGE there will be found some information that will interest the craft generally. Those readers who write to express approval of certain methods of presenting radio subjects may not find it hard to believe that so many other fans are pleased with RADIO AGE drawings and articles and are buying so many of our magazines that we have been forced to put the print order up to 70,000. That was the March figure. The press run for this issue cannot be definitely estimated as orders from wholesale distributors are still coming in as we are preparing to put the plates on the press.

While we are discussing circulation we may as well call attention to the fact that we are applicants for membership in the Audit Bureau of Circulations, which furnishes verified figures on total number of magazines printed, distributed and sold.

We notice that Canadian readers are increasing in number with gratifying rapidity. Many of them are writing us just the sort of constructive letters we like to get.

For all of you we want to suggest that you do not permit the Spring days to lure you away from attention to several good features that we know are in store for you in early issues.

Fredrick Smith

—Editor, RADIO AGE

"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"

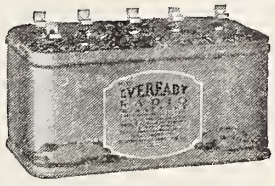
Why Big Cells Count in Radio "B" Batteries

THIS handsome metal case Eveready "B" Battery No. 766 costs only two-thirds more than the smallest Eveready "B" Battery, but it *contains seven times the electricity!* This makes the No. 766 over four times as economical as its baby brother. That is why most people buy it.

Its fifteen large cells give 22½ volts of strong, steady energy day after day. Cells that pour out power the moment you turn on your tubes. Cells that rest well when idle, renewing their vigor for your next demands.

No cells have a bluer-blooded ancestry than these. They are the product of thirty years of dry battery research and development of the world's foremost electro-chemical laboratories. We think that No. 766 is the handsomest battery ever made. But that is a matter of opinion. It is a matter of engineering record, however, that this great standard "B" Battery has proved itself as perfect in performance as we are convinced it is superfine in appearance.

The 45-volt Eveready No. 767 contains the same large powerful cells as the No. 766. For maximum "B" Battery economy, therefore, buy the 22½-volt Eveready No. 766 or the 45-volt Eveready No. 767, as you prefer. Here is the "B" Battery at its best.



Eveready "B" Battery No. 766
22½ volts. Six Fahnestock Spring Clip Terminals, giving variable voltage from 16½ to 22½ volts, in 1½-volt steps. Length, 6¾ in.; width, 4⅛ in.; height, 3 3/16 in. Weight, 5 lbs.

NATIONAL CARBON COMPANY, INC.
Headquarters for Radio Battery Information
New York San Francisco
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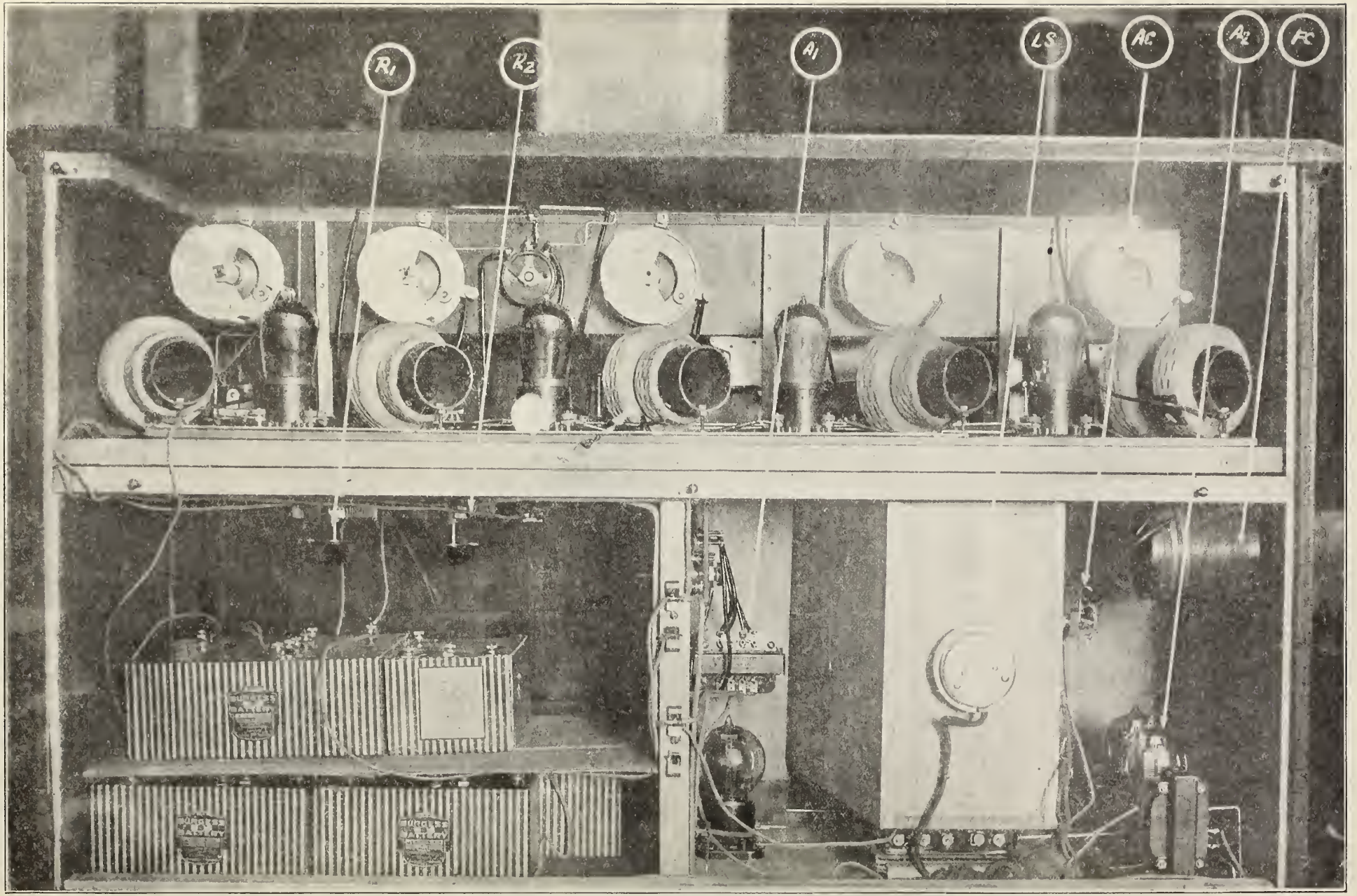


THE McCULLAH SUPER-HETERODYNE

R1 is the detector rheostat, R2 the filament control for all the other tubes, A1 the single stage of audio frequency amplification, LS the loud speaker, AC the antenna connections for either loop or outdoor aerial, A2 the push-pull amplifier used as a second stage, giving the utmost clarity of signals, and FC the fixed coupler, used when an outdoor antenna is connected to the set. The C battery is shown directly under the loud speaker which is built into the cabinet.

RADIO AGE
The Magazine of the Hour

M. B. Smith
Business Manager

A Monthly Publication Devoted to Practical Radio

Frederick A. Smith
Editor

An Efficient Super-Heterodyne

By ARTHUR B. McCULLAH

DELVERS in physical and scientific research have established enviable reputation for their zeal in pushing ahead beyond the confines of their fields. Obstacles have been surmounted by patient toil; perfection has been sought and surpassed and sought again, and the finished task has been only a task begun. In the field of radio research we have been zealous enough and the world is witness to the wonders accomplished; yet it is a fact that our search for an instrument that would prove a practical receiver for the layman, we have attempted to single out the simplest type of set without regard to the fundamentals and sensitivity and quality, and have shied away from the greatest and most efficient of all systems—the super-heterodyne, because of its supposed difficulties in construction and control.

Contrary to general belief, the super-heterodyne is a simple and easily controlled receiver, if built right. Tuning is much more easily done than on a one-tube receiver. This is because of the fact that the signal of a transmitting station is made to fit the set rather than the set made to fit the signal, the procedure followed out in small sets.

It is possible to construct a super-heterodyne in which the control centers around two dials, the tuner and the heterodyne, or oscillator. In constructing a set of this type, one must adhere closely to the constructional details that follow. If this is done, no difficulty will be experienced in building a really super-set, and one that will meet all of the expectations as to selectivity, distance, and quality of reproduction.

Theory of Amplification

Before going into the explanation of the actual construction of the receiver, it might be well to review the theory of operation. Let us first, as a matter of primary importance, consider the common short wave receiver with both radio and audio frequency amplification.

It will be found that one stage of audio frequency amplification will give by far more amplification than two stages of radio frequency amplification. This is due to three factors, viz.: (1) the alternating current losses are much greater at high frequencies due to the increase of eddy currents and dielectric absorption (losses); (2) leakage through stray capacity is greater at high frequencies than at low frequencies; (3) it is more difficult to control tube oscillations at high frequencies than at low frequencies. These three factors show concisely that the low frequencies can be amplified best, and the logical thing to do therefore would be to amplify them at the low frequencies (long waves) instead of the high frequencies where all these losses have to be contended with.

Unfortunately, however, broadcasting is done on extremely high frequencies (short waves) and in order to obtain the desired results, it is necessary to lower the frequency so that it may be amplified more efficiently. Although this was accomplished during the war by Major Armstrong with his super-heterodyne receiver, radio designers have shunned this system as being impracticable for the layman. The very term "super-heterodyne" conjured all sorts of difficulties, and designers left the construction and use of the system to only a genius like Mr. Armstrong himself.

Three Units

Instead of building the super on one large panel of large dimensions, we shall build it in a more serviceable size. In doing this, we must think of the set as being in three component parts. These units will be referred to as follows: Unit one, wave-changer; Unit two, the long wave amplifier and detector; Unit three, the audio frequency amplifier. Reference to Figure 00 will show the subdivision of these units, illustrating the heterodyne or wave-changer mounted on the main control panel, the intermediate amplifiers and

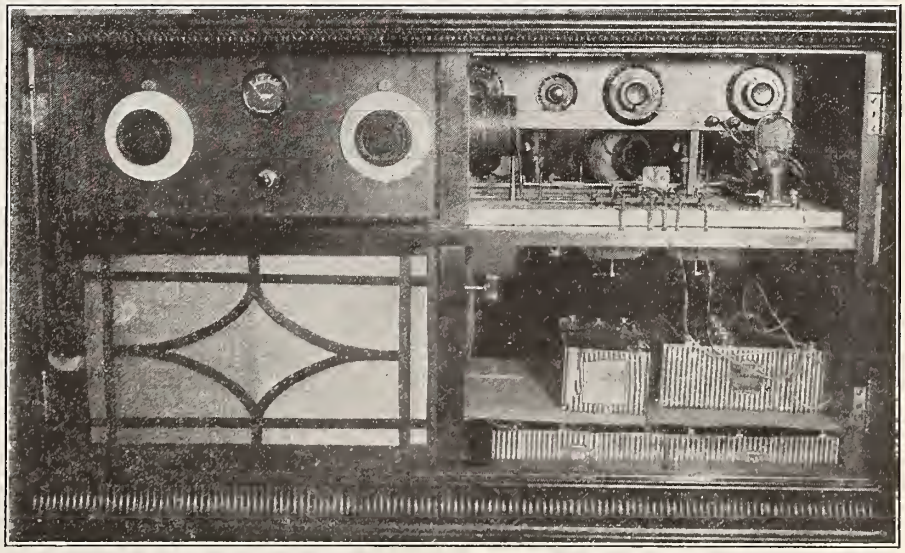


Figure 2

CONSOLE ARRANGEMENT

A front elevation of the beautiful console type of super-heterodyne receiver, its design making it a desirable furnishing for the most elaborate drawing room. The music and programs from broadcast stations issue from the loud speaker with more volume than can be obtained from a phonograph, and with clarity that has not been excelled. The switch-knob directly to the right of the loud speaker enables the operator to control the volume of the signals, from the smoothest and softest intensity, to a deafening roar. The set when not in use presents the appearance of a phonograph.

their controls on a sub-panel, and the audio frequency unit in another section of the receiver.

Why Units Are Separated

By doing this, two things may be accomplished. The units may be arranged attractively and artistically in such a manner that it will not be necessary to have a specially constructed piece of furniture in which to house it. The wiring will be short and direct in the units themselves, and it enables the constructor to exercise his own taste as to the location of the units, so long as the connecting leads are kept within the bounds of reason.

Construction

The coupler and oscillator coils are both wound on the same size tube. The coupler is wound on a bakelite tube 2¾ inches in diameter, which should be 3 inches in length. Two coils are wound, the secondary being wound first, which consists of 60 turns of D. C. G. S. wire. A layer of empire cloth is then wound over the one end of this coil, and directly over the empire cloth, another coil, forming the primary of the coupler is wound. This consists of 4 turns of the same size wire. The construction of this coupler is illustrated in Figure 00, and is the medium used to couple the receiver to the antenna, which can be of the ordinary outdoor type, not over 80 feet overall length, including leadin.

The Oscillator

On another piece of tubing, the same size as before mentioned the oscillator coils are wound. Starting at the left end, wind 27 turns of the No. 20 D. C. G. S. wire, and fasten the end. One-eighth of an inch to the right, start another coil and wind 36 turns of the same size wire. The first coil mentioned is L3 and the latter bears the term L4, and together, they form the oscillator unit of the receiver.

The tubing holding these coils may be mounted on pillars or other suitable mountings; they are a matter of appearance only. The oscillator coil must be mounted near the oscillator bulb and condenser, while the secondary coil may be mounted a good distance away from the secondary condenser if desired. (Note: The oscillator may be mounted in the same manner as described in the superheterodyne article of the March, 1924, issue of RADIO AGE to advantage, by omitting the smaller tubing and using the larger outside one only. This form of mounting is exceedingly effective. While it is possible to use long leads on the secondary circuit, be reasonable, and make them as short as you conveniently can. It is a tuned circuit, and you can add materially to the effectiveness of the receiver by keeping the resistance of this circuit as low as possible.—Tech. Ed.)

The design of the front panel is left to the builder's taste. The only thing that is necessary to have on the main operating panel is the secondary and oscillator condensers, and a filament control switch, which enables the operator to turn the filament current off at will without having to remove one of the battery leads from the battery.

Follow out the detail and wiring diagram of the oscillator very closely, and

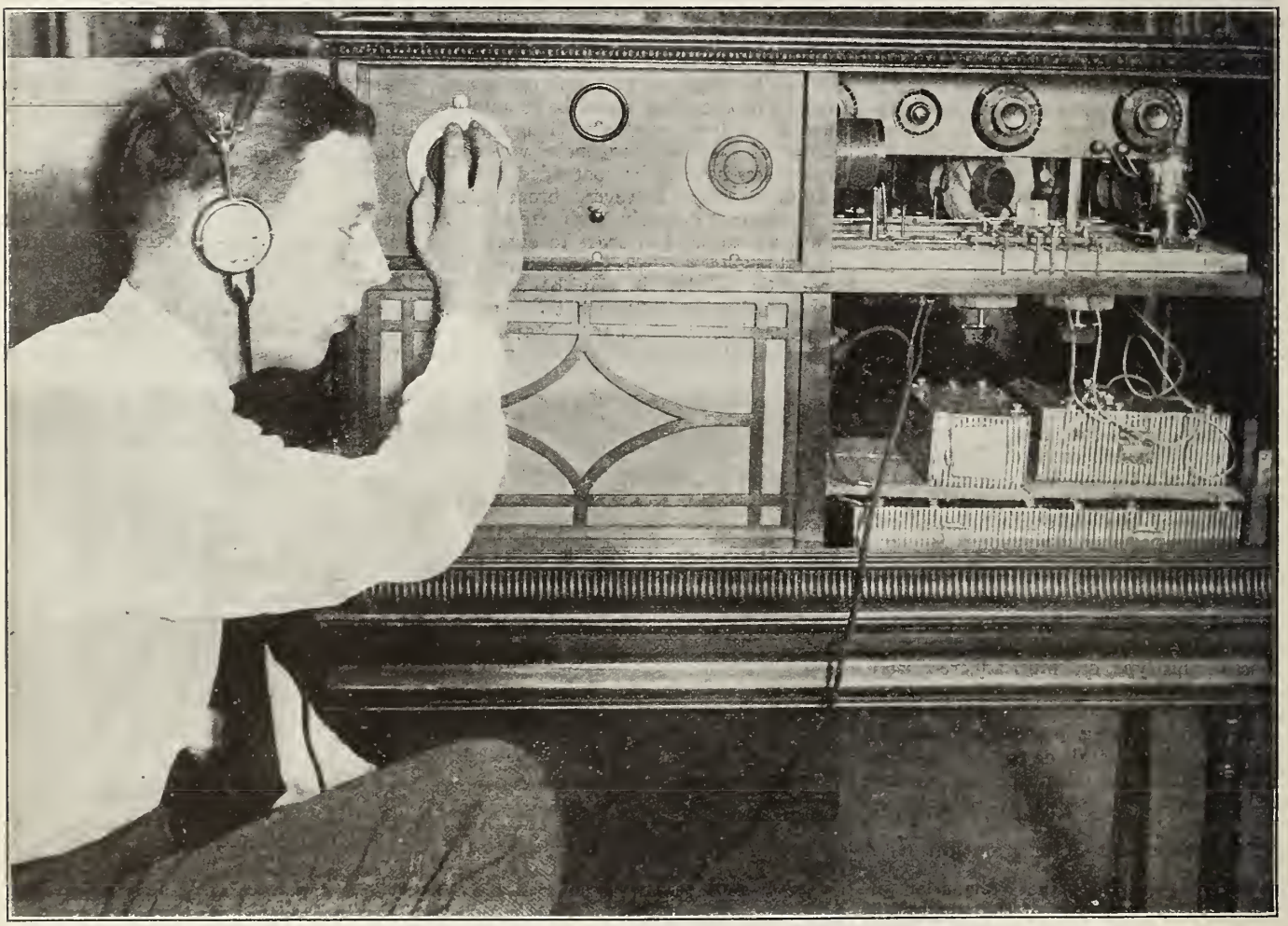
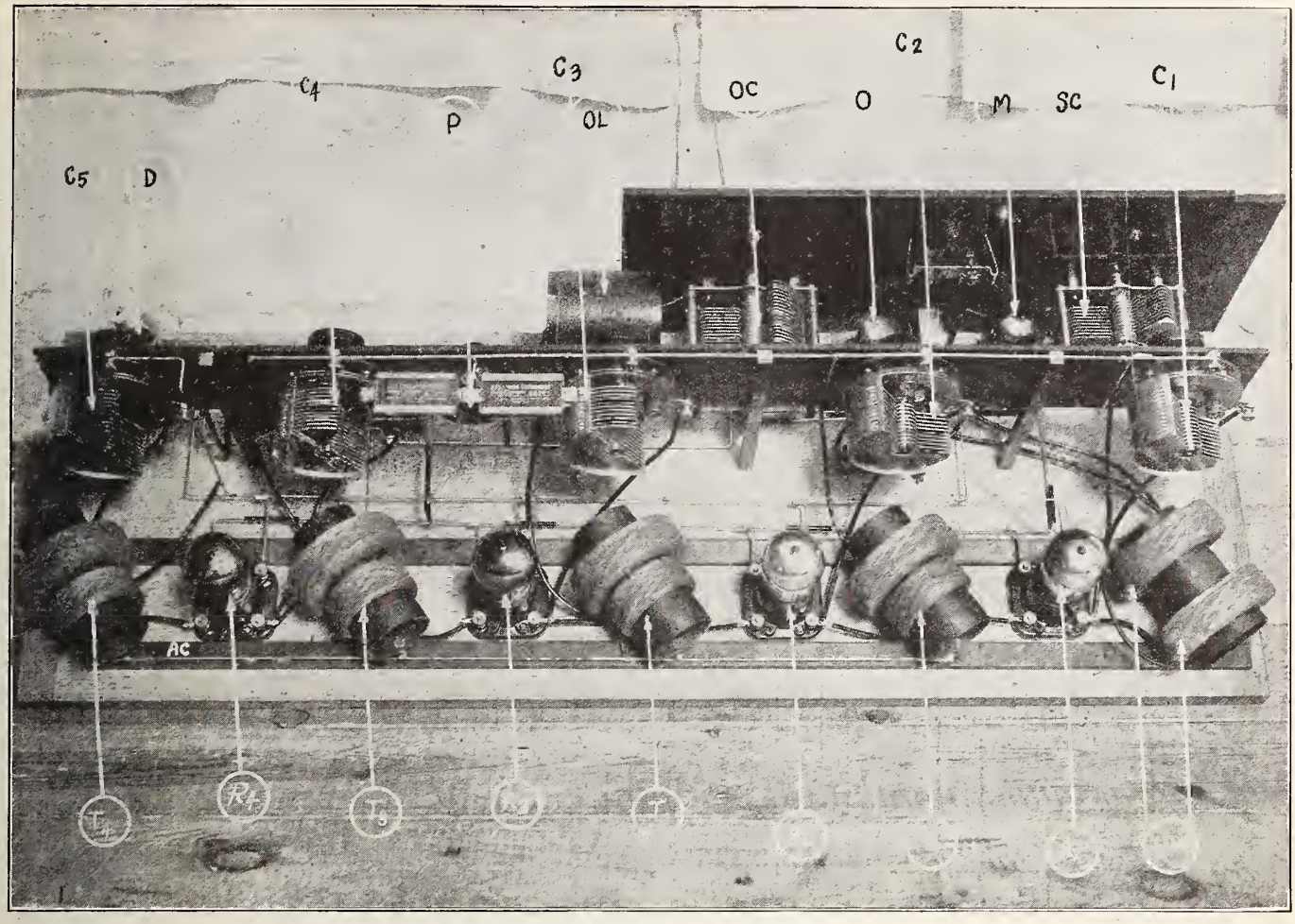


Figure 1
HETERODYNE CRAFTSMANSHIP

Arthur B. McCullah, a student of Lane Technical High School of Chicago, operating the ten-tube super-heterodyne receiver designed and built by himself. The set is a rare example of careful engineering and painstaking workmanship. Stations from every part of the country are received on the loud speaker with unbelievable consistency and volume. The photo shows Mr. McCullah making some preliminary adjustments with the receiver, before plugging in on the loud speaker, which is operated by two stages of audio amplification, consisting of one cascade amplifier and one push-pull type. Operation of this receiver is comparatively simple, the only two controls used being the two shown with the white dials, once the set is adjusted to proper operating conditions. The stations come in on two places on the oscillator condenser dial, and the tuning is so sharp that care must be taken not to pass over the spot where the signal is received.



SNAPPY RADIO ENGINEERING

The back panel view of the oscillator-radio frequency-detector panel of the super-heterodyne receiver. The legends refer to the following units of the receiver: C5 condenser, used to tune the radio frequency transformer T4; C4, used to tune T3; C3 tunes T2, and C2 tunes T1. The primary of the long wave coils LWC is tuned by fixed condensers hidden behind the mounting panel, and the secondary is tuned with condenser C1. OC is the oscillator condenser, OL the oscillator coils, and O the generating tube. M is the frequency changer or modulator tube, and D is the detector. R1, 2, 3 and 4 are the tubes furnishing the radio frequency amplification, while P is the potentiometer used to bias them. SC, the secondary condenser, used for tuning in the signals from the loop or other antenna, and the oscillator condenser OC are the only controls used for tuning, once the set is adjusted. The output from the detector tube D is transferred to an audio frequency amplifier shown in Figure 5. The bakelite strip AC is the angle changer, which changes the angles of all the coils simultaneously. All the controls which require preliminary adjustment are mounted on a separate panel immediately back of the operating panel, which contains only the secondary and oscillator condensers, a meter and a filament control switch.

no trouble in making the heterodyne unit oscillate will be experienced.

Intermediate Amplifier

The long wave (low frequency) amplifier is of the tuned type which gives greater amplification per stage than any other known type. The construction of such an amplifier is very simple.

Ten Giblin-Remler inductance coils are mounted on five pieces of bakelite tubing, two coils on a tubing, which is in turn mounted on two strips of bakelite which, when pulled back and forth, change the angle of the coils simultaneously to a common base. This feature alone adds to the general efficiency of the set due to the fact that the inductive coupling between the air core transformers is minimized.

Two strips of bakelite ¾x34x¼ inch are used to mount the coils. In drilling the hole through the strips it is necessary to place one strip on top of the other that the holes will be the same distance apart. One-inch 6-32 brass bolts are put through the holes in the strip, and three nuts are put on the bolt. The lower one is tightened down while the others are left near the top of the bolt and are clamped through a hole in the tubing as shown in Figure 00.

From the list of materials needed it can be seen that six (6) 400 turn Giblin-Remler inductance coils are needed; four (4) 100 turn coils of the same make so that the coils will all have the same inside diameter.

These ten coils are arranged into five air core transformers. Transformer No. 1 has two of the 400 turn inductance coils mounted on a piece of bakelite tubing just large enough to slide into the small hole in the inductance coil, and 5 inches long. These two 400 turn coils are placed on the extreme end of the 5-inch tube. Transformers 2, 3, 4 and 5 are placed with one 400 turn coil and a 100 turn coil on each tube placed in the center, ⅛ inch apart. The accompanying photograph illustrates the method of mounting them clearly. The opposite ends of the tubing are anchored to the mounting board. When the one strip is moved it changes the angles of all of the coils, and the coupling can be varied, until the lowest possible interaction is obtained.

The secondary of the five air core transformers are tuned with .0005 MF variable condensers and are mounted on a sub-panel. This is done so that after the condensers are once adjusted they will be out of reach and not tempt one to turn them. This sub-panel is 3½x32x3/16, has also a potentiometer mounted between condenser 3 and 4. After the condensers and potentiometer is mounted on the sub-panel this whole sub-panel is mounted on three brass uprights ⅜ inch square and 7 inches long. Their uses are illustrated in the accompanying photos.

Tubes

The four radio frequency tube sockets are placed between their respective transformers. This will make the grid and plate leads shorter and prevent the leads from running parallel. The tubes should

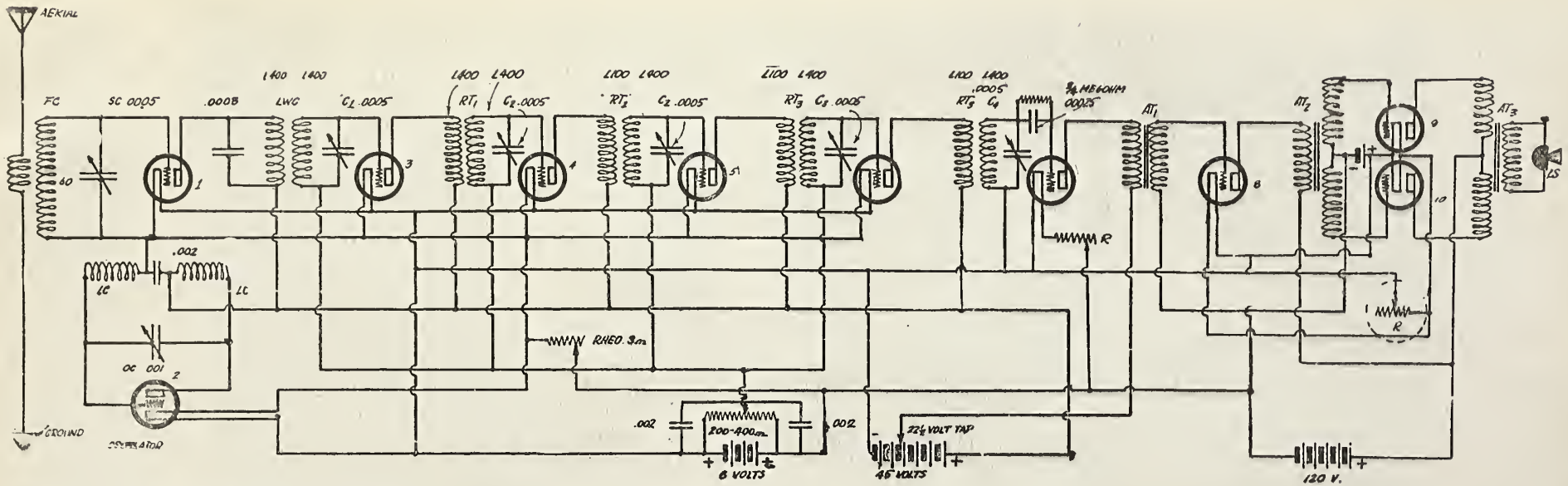


Figure 4—A diagram of the super-heterodyne receiver described and illustrated in detail in the accompanying article. Mr. McCullah describes the construction of this receiver in a clear and concise manner, which should enable the builder to construct it without difficulty.

The transformers are home made, using honeycomb coils, and are tuned with condensers placed across the secondaries. The units bear the following legend:

FC—Fixed coupler.
SC—Secondary condenser, .0005 MF, 23 plates.
LWC—Long wave coils, 400-turn honeycombs.
C1, 2, 3, 4 and 5—23 plate condensers, .0005 MF capacity.
RT1, 2, 3 and 4—Radio transformers primary, 100 turns, secondary 400.
OC—Oscillator condenser, .001 MF, 43 plates.
AT1—Audio frequency amplifying transformer, 4:1 ratio.
AT2—3 Push pull audio transformers.
1—Modulator tube.
2—Oscillator tube.
3, 4, 5, 6—Radio frequency amplifiers.
7—Detector.
8, 9, 10—Audio frequency amplifying tubes.
R—Shown in dotted lines not necessary when 216 A tubes are used.
LS—Loud speaker.

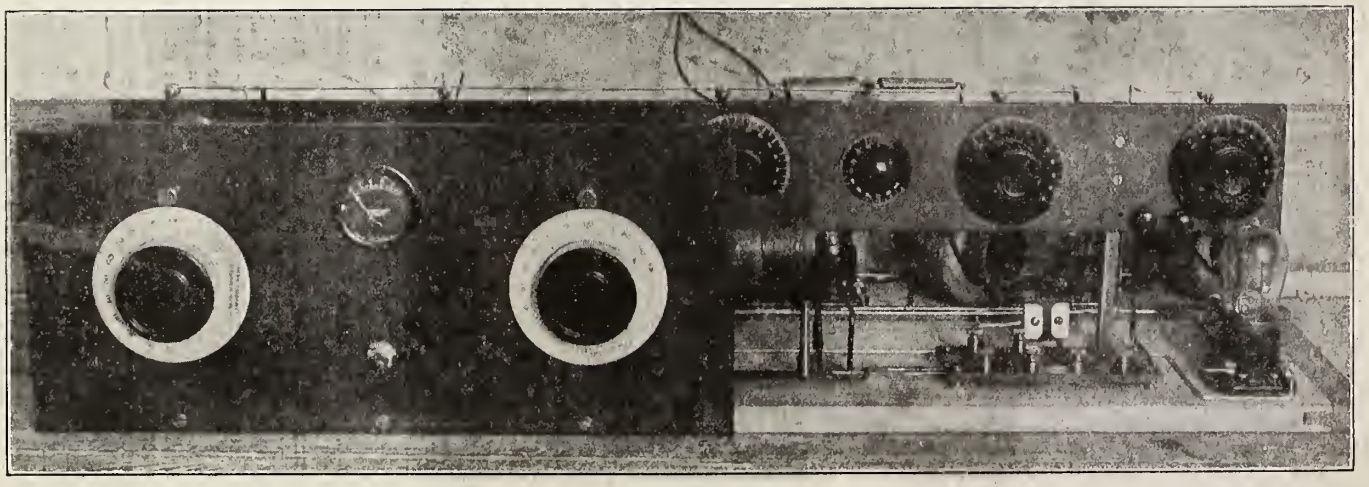
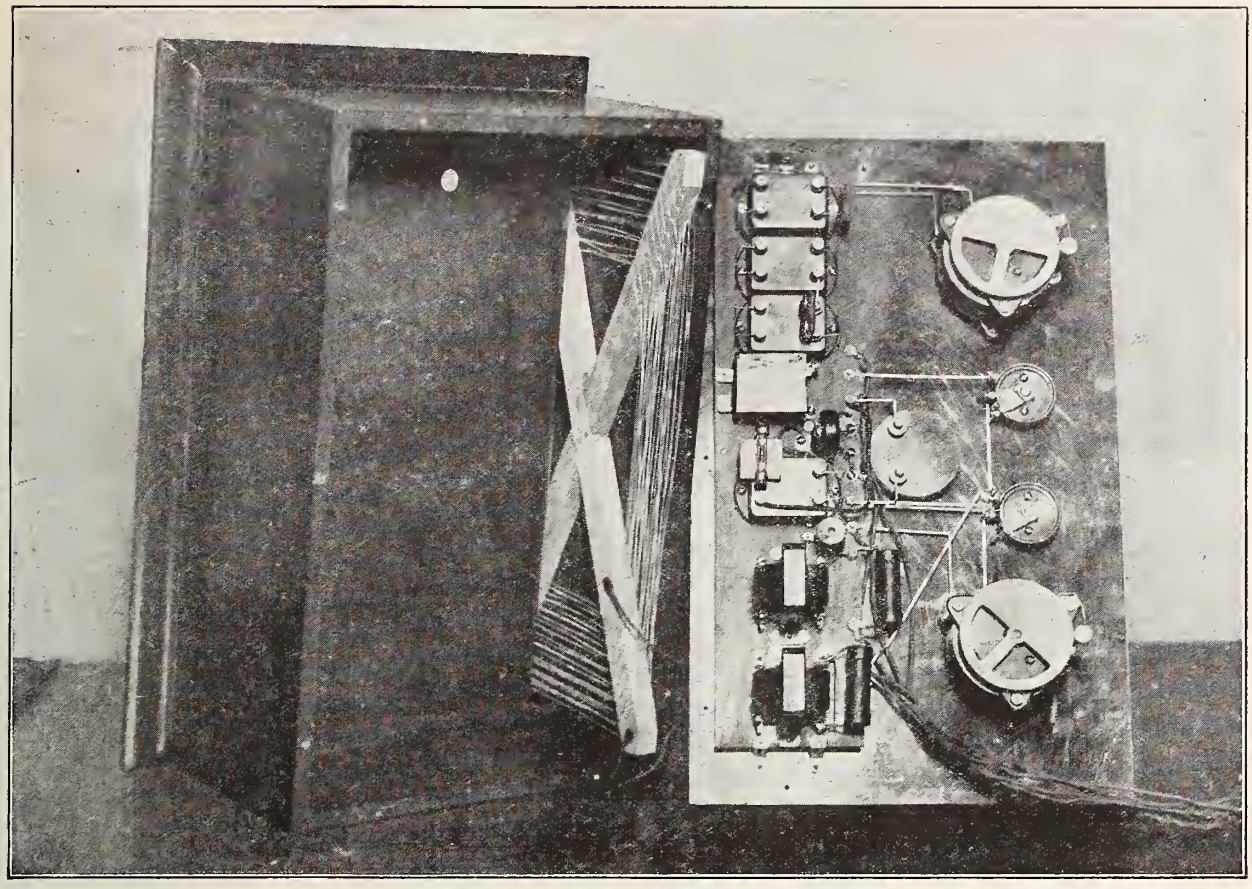


Figure 3

CONTROLS ON SEPARATE PANELS

A front panel view of the McCullah super-heterodyne showing the simple appearance of the receiver. The set is so designed that all the controls which need to be adjusted only once are contained on a separate panel placed immediately behind the operating panel, which mounts only three controls, the secondary tuning condenser, the oscillator condenser, and the filament control switch. The meter is a voltmeter, enabling the operator to keep careful check on the voltage of the filament circuit. The oscillator coils can be seen immediately to the right of the oscillator condenser. Notice the method of mounting this set of inductances.



ARMSTRONG'S SUPER-HETERODYNE

The back-panel and interior of the cabinet of Maj. E. H. Armstrong's super-heterodyne six-tube set, with which he picks up London. It will be observed that the tubes are on the front of the panel. See other photograph.

be UV 201 A amplifying type with the exception of the oscillator, detector and audio frequency amplifiers, which should be WE 216 A, UV 200 and WE 216 A respectively.

On the first radio frequency long wave coils designated LWC, the coil towards the front is called the input coil. This input coil is shunted with a .0003 fixed condenser of the mica type. The coil towards the back of the set is connected to the first variable condenser on the sub-panel. If the baseboard is not long enough the detector tube and socket may be mounted in front of the fifth condenser. It might be well to state here that the grid leak must be of a very low value (about a 1 or ¾ megohm leak will do), to prevent the detector tube from disturbing.

Audio Frequency Unit

The audio frequency amplifying unit is mounted on the same base with the other two units or it may be mounted on another small base near the loud speaker. The audio frequency amplifier is a two-stage the first stage being a common cascade type while the second stage is of the multiple or push-pull type. These are nothing out of the ordinary about this amplifier, and it is not necessary to dwell on the subject of its construction. (Full details were published in the January, 1924, issue on the Push-Pull amplifier. Tech. Ed.)

Tuning Intermediate Unit

The tuning of the long wave radio frequency amplifier is very easy. A small buzzer that gives an 800-cycle note is best for this job. It is connected in series with an ordinary dry cell, and connected across the input coil. The note of the buzzer is then adjusted so as to give a clear note, and to make the least sparking possible. Connect a crystal detector and headset across the secondary or the condenser of the other 400 turn LWC. The first condenser is varied until the buzz is heard at its loudest point. Turn on the current of the first tube (first radio frequency amplifier) and connect the headset and crystal detector across the terminals of the second condenser. Proceed in the same manner by tuning the condenser until the loudest signal from the buzzer is heard; though this time it will be louder, due to the fact that it is amplified by the first RF tube. This process is continued until the entire intermediate amplifier is tuned.

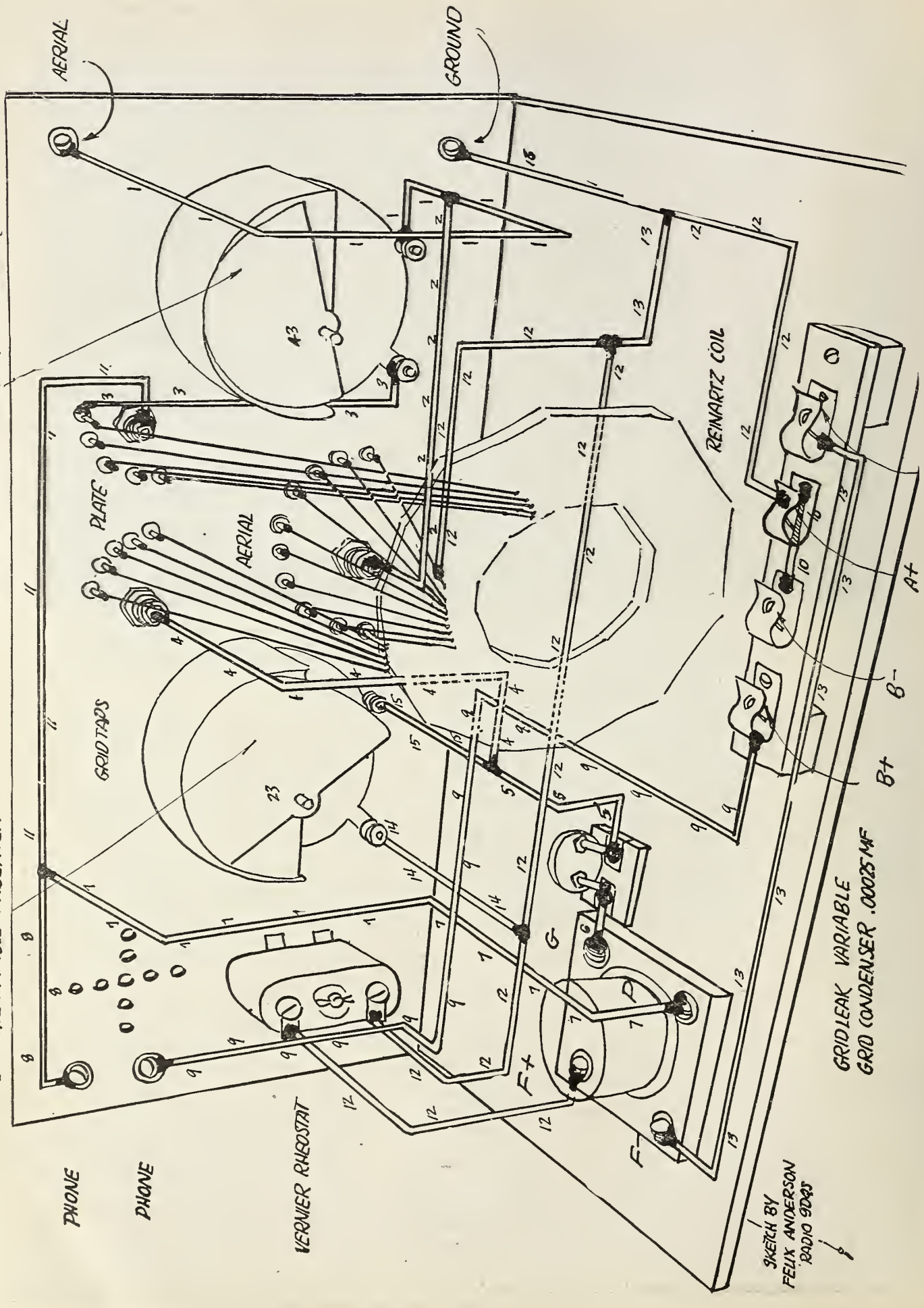
Tuning the Set

Your receiver is now ready for use. Upon tuning in, one will find that there will be two points on the heterodyne dial where the stations come in if everything is adjusted properly. If, however, there are more than two points. the amplifier should be retuned.

List of Materials

2 Dials.
1 Voltmeter, 0-10, Jewell.
5 .0005 variable condensers.
1 .0005 variable condenser.
1 .001 variable condenser.
6 400-turn inductance coils.
4 100-turn inductance coils.
1 Potentiometer.
3 .002 fixed condensers, mica type.
5 pieces of bakelite, 2 inches in diameter, 5 inches long.
2 pieces of bakelite, 3 inches in diameter, 4 inches long.
1 ½-pound spool D. C. G. S.
10 Sockets.
2 ¾x34x¼-inch bakelite strip.
1 3½x32x¼-inch bakelite strip.
1 8x18x¼-inch front panel, bakelite.
1 .00025 grid condenser.
1 1-megohm grid leak.
3 Brass rods, ⅜x7 inches.
1 Carter on-off switch.
1 Audio frequency transformer (4 to 1).
1 Audio frequency transformer, push-pull.
1 Loud speaker unit.
2 Rheostats, power type, 3 ohms.
6 201A or 301A tubes.
4 216A tubes.

EDITOR'S NOTE: Only the very highest quality equipment should be selected in making the set described in the foregoing.


AERIAL
GROUND
43 PLATE VARIABLE VERNIER CONDENSER
23 PLATE VARIABLE CONDENSER
PLATE
AERIAL
GRID TAPS
REINARTZ COIL
PHONE
PHONE
VERNIER RHEOSTAT
GRIDLEAK VARIABLE
GRID CONDENSER .0003 MF
B+
B-
A+
SKETCH BY
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RADIO 9DAS

Selecting the Right Receiver

By FRANK D. PEARNE

THE question of selecting the proper radio receiver to suit his particular case, is more serious to the beginner than one would at first suppose. So many things enter into this problem that it is no wonder that the poor fellow makes an appeal for guidance in this matter, to those who have gone before and have learned by hard and expensive experience, what the uninitiated are up against when they blindly grope about in the purchase of their first radio set.

The number of radio enthusiasts is growing rapidly, so rapidly, in fact, that the manufacturers of radio sets and parts cannot keep the pace, some of them being several thousand behind in their orders for sets, and this, in the face of day and night operation of their factories, proves beyond a doubt that the interest in radio is increasing so fast that it is destined to become one of the greatest industries in the history of our country.

But what of the poor beginner? On every side he hears about this and that wonderful set. He hears about radio frequency, audio frequency, detectors, condensers, all new to him, and he starts out to see what he can get for a reasonable expenditure of good cold cash that will put him in this ever increasing multitude of broadcast listeners.

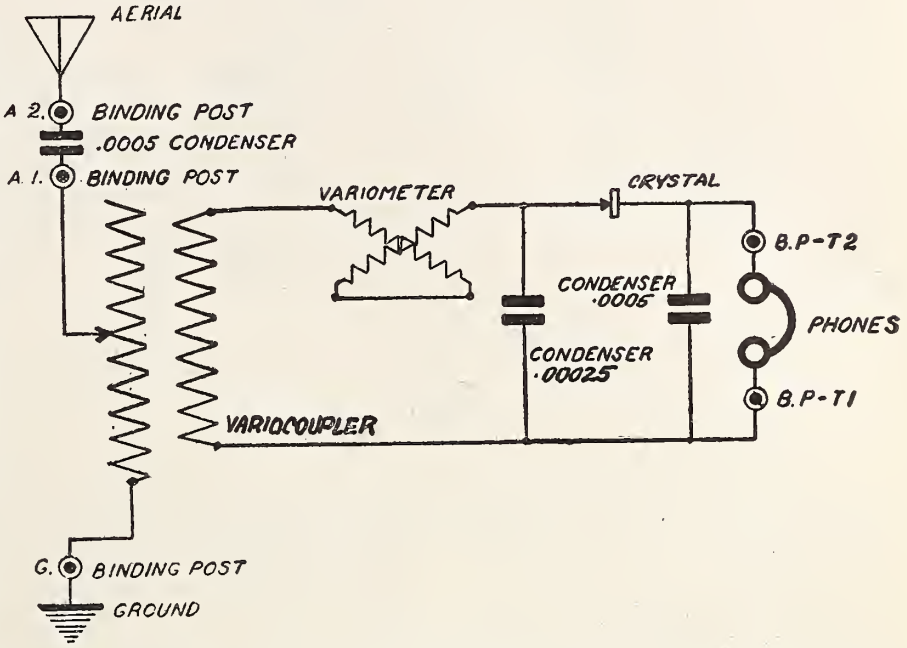


FIGURE 1

A diagram of the Long Distance Crystal receiver, which is a desirable receiver for the new beginner in the radio pastime. The set is easily constructed, requires little or no knowledge of radio, and gives surprising results. The binding posts, A-1 and A-2, are used as part of the tuning system, the A-2 post being used for the lower waves and the A-1 for the higher. This applies especially where the antenna used is a long one.

Buyer Is Bewildered

Here is where his real trouble begins. Every store he enters will show him something different, all being the best that money can buy. His eyes will suddenly be opened to the fact that there are more different types of radio receivers than he ever dreamed of and the farther he goes, the more discouraging it looks to him. If he does find something which looks interesting, some fellow is sure to suggest that he is all wrong and point out to him the numerous defects in this particular set and will probably rave about his own wonderful set, finally convincing the would-be purchaser that he has not yet discovered what he wants.

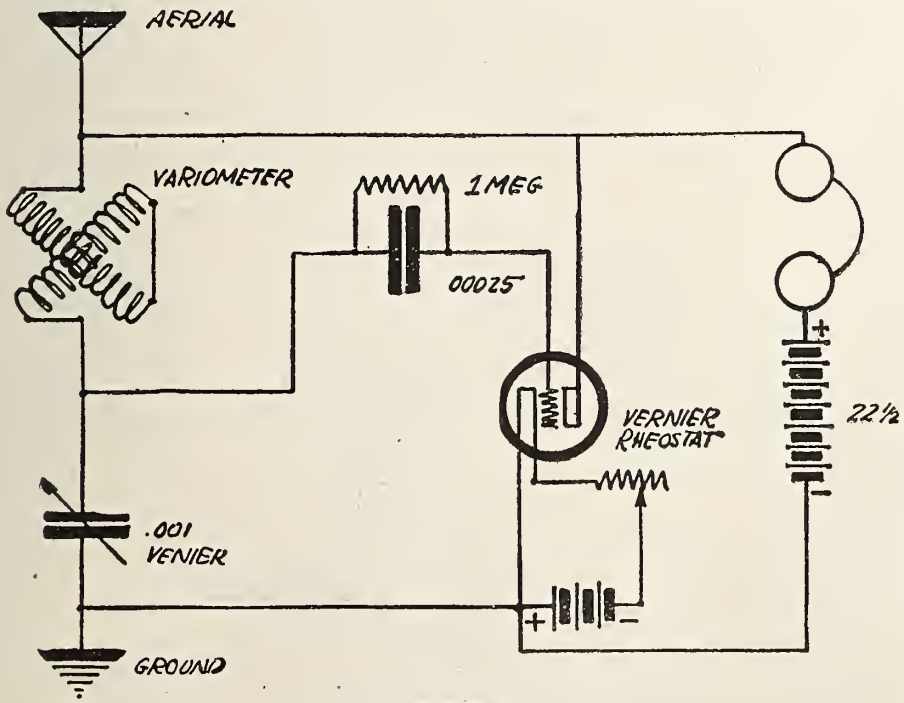


FIGURE 2

A diagram of the type of set which would make a desirable receiver for one who is making his first steps in the art of building a tube receiver. This set was described in detail in the October, 1923, issue of RADIO AGE, together with instructions for the conversion of crystal receivers into tube units. It has a consistent long distance range, and has often accomplished 2,000-mile receptions.

First of all one should understand that hardly any two fans have the same experience with the same set. An outfit which will work very well in one location with a certain aerial, will act entirely different when used in a different location with a different aerial. This fact probably is responsible for so many differences of opinion expressed by those who have had experience.

Then, too, much discontent is caused by the fan who exaggerates the number of long distance stations which he has heard and the beginner, after installing a fairly good set, is much disappointed when he doesn't get these results. As a matter of fact it is very hard to say just what anyone can do with a certain set, until it has been proven by actual practice. As stated before, the selection of the proper set is a question which is really hard for even an expert to answer, for the reason that location has much to do with the results obtained.

Aside from location, there are many other points to consider. It is a well known fact that about 50 per cent of the prospective radio purchasers are governed to some extent by the amount of money

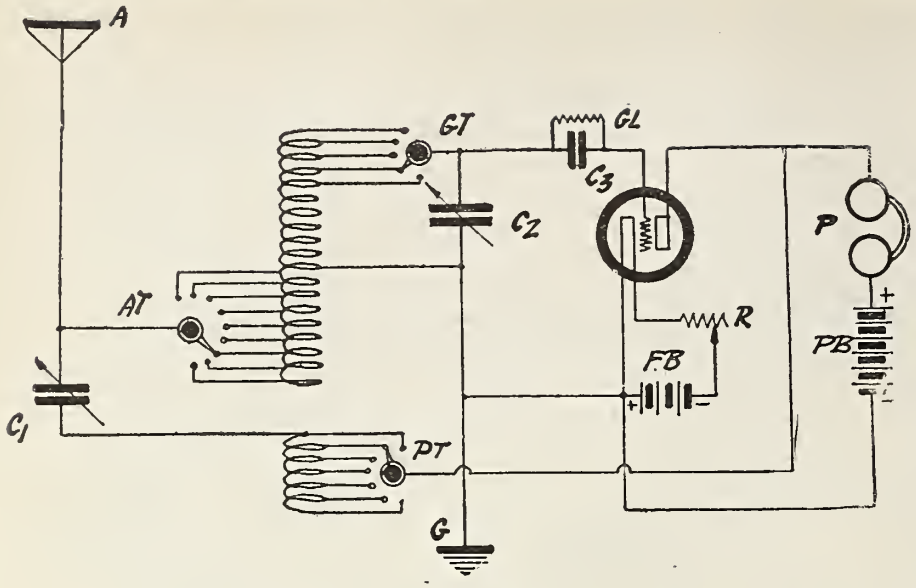


FIGURE 3

A more complicated and very efficient receiver is the Reinartz, illustrated in the above cut. A is the antenna, C1 a 43-plate condenser, C2 a 23-plate (both should be vernier), and C3 is a fixed .00025 MF grid condenser. AT are the antenna taps, GT the grid taps and PT the plate taps on the spiderweb inductance. R is a vernier rheostat, P the phones, and the batteries, PB for plate batteries, 22½ volts, and FB the A battery for the filament of the tube of sufficient pressure for the tube used. G is the ground connection.

involved, while the other 50 per cent care nothing about the cost, but are only interested in getting the best apparatus that money can buy.

Aerial Is Important

There are many beginners who live in apartment in which the set is to be used to put an aerial on the roof and must, of course, have recourse to some kind of inside aerial, such as a loop or a wire stretched around the room, or in an attic. This also requires consideration.

Contrary to the general idea that any kind of an aerial will suffice for an ordinary crystal set, these sets should have the best possible antenna system, so that the already low efficiency of such a receiver will not be hampered with a poor antenna system. It is much easier for a high powered tube set to function with a poor aerial than is the case with the weaker crystal set. The location of the apartment in which the set is to be used will also have to be considered.

If one lives in an apartment on the first floor and must resort to an inside aerial, he cannot expect to get the results which he could get if he lived in a third floor apartment, as the height of the aerial makes an enormous difference in the reception obtained. First, let us consider the beginner who is limited to a cheap set and wants to learn something about local broadcast reception. If it is a case where children are expected to handle it, it would be foolish to invest in a tube set until such a time that they learn something about the general operation of such instruments.

The crystal set, while not so powerful as a tube set, will give one an idea of tuning and the delicate adjustments which must be obtained and at the same time will bring in broadcast entertainment very nicely.

Outside Aerial Best

But right here the beginner should understand that simply because he has a set which is inexpensive and can be roughly treated that any kind of an aerial and ground connection will do. He must bear in mind the fact that in order to get the most out of it, that he should have the best aerial which he can make, in order that the efficiency, which is naturally low anyway in sets of this kind, will not be further reduced.

If one has access to an outside aerial he should take advantage of it by all means. If this is not possible, he must, of course, resort to some kind of an inside aerial. Of course, the higher this is placed the better will be the reception, and one of the best aerials for this work is made by running an insulated wire around the room behind a picture molding. It should encircle the entire room once only, one end being left open and the other brought down to the set and connected to the aerial post and a wire connected to the ground binding post of the instrument should be run along the baseboard to some convenient water or steam pipe, where, after being careful to clean both the wire and the pipe until it is bright, it should be twisted around several times and fastened securely. This connection can also be made with a ground clamp which may be obtained at any radio store.

Crystal Efficiency

Now as to the type of crystal set to be used; one should select something that is good and substantial and has the best kind of tuning apparatus. If he builds the set himself, the arrangement shown in circuit No. 1 will be ideal for the purpose. With this arrangement, on account of its excellent tuning qualities, he may, if he is fortunate enough to have a fairly good aerial, be able to get not only the local broadcasting stations, but some of the distant ones as well. It is generally understood that a crystal set will only receive from distances of from twenty-five to forty miles, and this is true in regard to most of them, because of the poor tuning arrangements which they usually have, but the circuit shown has been designed to give the closest possible tuning and has proven worthy of the name of long distance crystal set.

After one has become somewhat famil-

(Continued on page 36.)

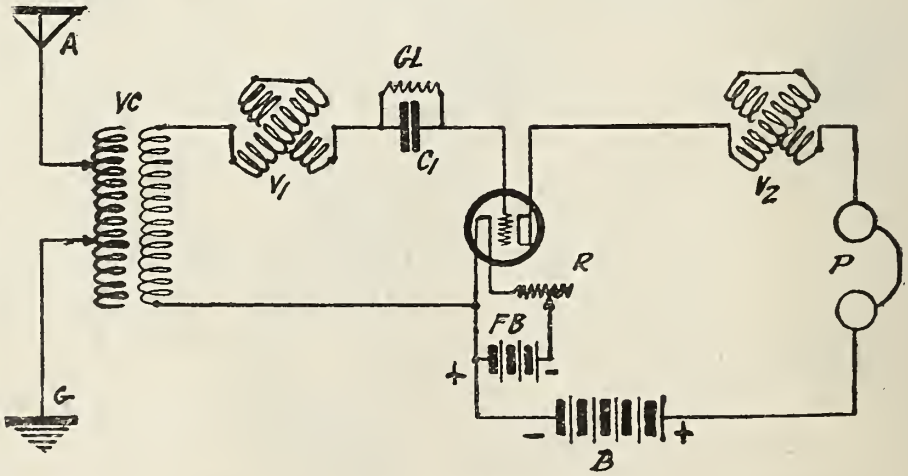


FIGURE 4

An exceptionally close tuning receiver, a type highly desirable in sections where a powerful local station operates nearby. The tuning of this set is an art, and requires much patience, due to the fact that it is so sharp. The circuit is known as the Armstrong, also the Three-circuit regenerative, and sometimes is called the Two Variometer, Variocoupler circuit. The letters bear the following values: A antenna, G ground, V1 grid variometer, GL grid leak, 1-5 meg., C1 grid condenser, .00025 MF, fixed, V2 plate variometer, FB filament battery, B plate battery and P the phones.

The Wizard Ten Dollar Receiver

By JOHN B. RATHBUN

ABOUT two months ago, the writer was called upon to design a simple low priced set. A set which would have all the range of the Ultra-Audion and yet one which would have greater selectivity and which would be less noisy in operation. The controls were to be limited to two, the tuning control and the filament control of the tube, and the retail price of the unassembled parts was to be ten dollars or less. The result was a modified "jammer" or "Man-Day" circuit with new trimmings, and this was given the trade name "Wizard."

The original Man-Day circuit employed a standard variocoupler which introduced an extra control dial for moving the rotor and two tap switches for varying the inductance of the primary in addition to the tuning condenser. By employing a special fixed coupler with two stationary windings, somewhat similar to the neutrodyne type transformer, the tuning control was reduced to one unit—the variable condenser. This at once simplified the control and greatly reduced the expense of building the receiver, all without loss of selectivity or volume. The primary coil of the coupler is of the aperiodic type, while the secondary coil is alone tuned by the variable condenser. A potentiometer was added later as a means of more accurately controlling regeneration on faint signals and has proved its worth repeatedly.

What Drawings Show

In *Figure 1* we have the circuit diagram of the modified Wizard circuit together with a Bill of Materials which gives the names and sizes of the various units. Each of the binding posts is located in approximately the position that they occupy on the panel, and all of the wires are numbered to correspond with the numbered wires on the isometric drawing, *Figure 3*, of the assembled set. The binding posts are indicated by the small circles enclosing a solid black dot, and their arrangement is such that one or more stages of audio amplification can be added easily.

Starting at the left of the diagram we see the fixed coupler having the primary coil (L1) and the secondary coil (L2). The primary coil consists of 28 turns of No. 26 D. S. C. wire and the secondary contains 66 turns of the same wire. Both coils are wound on the same tube and are separated from each other by 5/8 inch as shown in *Figure 2*. The ends of the primary coil go to the aerial and ground posts, while the ends of the secondary connect respectively with the grid condenser and moving arm of the potentiometer (PO). Full details of the coil are shown by *Figure 2*.

Across the secondary coil (L2) is connected the vernier variable condenser (C) by which the circuit is tuned to the required wave length. The tuning is very sharp and critical and a vernier condenser is therefore necessary for the best results. The whole arrangement is exceedingly selective for so simple a set, and like the neutrodyne, the condenser dial can be "Logged" or marked accurately for each wave length. To avoid trouble from body capacity it will be necessary to connect the stator or stationary plates of the condenser (C) to the grid line (4), while the rotor connection goes to the potentiometer arm wire (5). For the sake of compactness, the coil (L1-L2) is attached to the condenser terminals by means of small sheet brass brackets in a manner familiar to those who have seen certain types of the neutrodyne.

Best Condenser

While a 17 plate condenser can be used at (C), *Figure 1*, in many cases, yet it is safest to use a 23 plate (0.0005) condenser for this purpose in order that the full band of broadcasting wave lengths can be covered. With a larger condenser than this, the tuning is altogether too critical for comfort, even when equipped with a vernier.

Experiments have shown that a value of 0.00025 mf is best for the grid condenser (GC), and that the grid leak (GL) should be a variable leak, preferably of the lead pencil mark type. The lead pencil mark grid leak is adjusted by varying the thickness of a lead pencil mark drawn between two screws on the leak, and is the most effective and cheapest of all leaks for this purpose. The tube is quite sensitive to grid leak values and a fixed leak does not give the best results. Tubes vary among the same makes, and a different leak value must be determined by experiment for each individual tube.

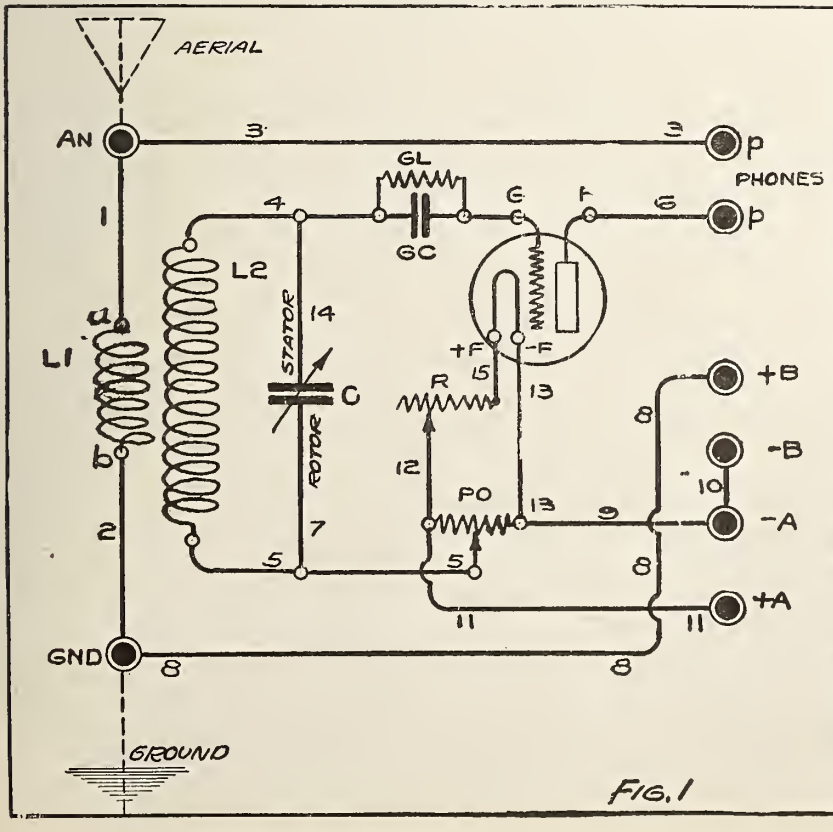


FIG. 1

BILL OF MATERIALS

PART	NAME	SIZE
A	"A" BATTERY	TO SUIT TUBE
B	"B" BATTERY	22.5-67 V.
C	VERNIER VAR. CONDENS.	23 PLT. (.0005)
GC	GRID CONDENSER	0.00025
GL	GRID LEAK	VARIABLE
L1-L2	COMPLETE FIXED COUP.	SPECIAL
p-p	HEADSET (PHONES)	STANDARD
PO	POTENTIOMETER	200 OHM
R	RHEOSTAT (VERNIER)	TO SUIT TUBE
S	SOCKET	TO SUIT TUBE
T	TUBE, UV-201A, UV-199	UV-200.
◎	BINDING POSTS	STANDARD
—	HOOK-UP BUS WIRE	NO 14
AN	COMPLETE AERIAL	50-60 FT
U	PANEL	7"x9"x3/16"
V	CABINET	7"x9"
W	BASE-BOARD	FOR CABINET

WIZARD CIRCUIT (FB-12B)

THE FIXED COUPLER L1-L2 CONSISTS OF TWO COILS OF NO 26 D.S.S. WOUND ON A 2.5" TUBE. THE PRIMARY L1 HAS 35 TURNS, AND THE SECONDARY L2 HAS 60 TURNS. COILS SPACED 5/8".

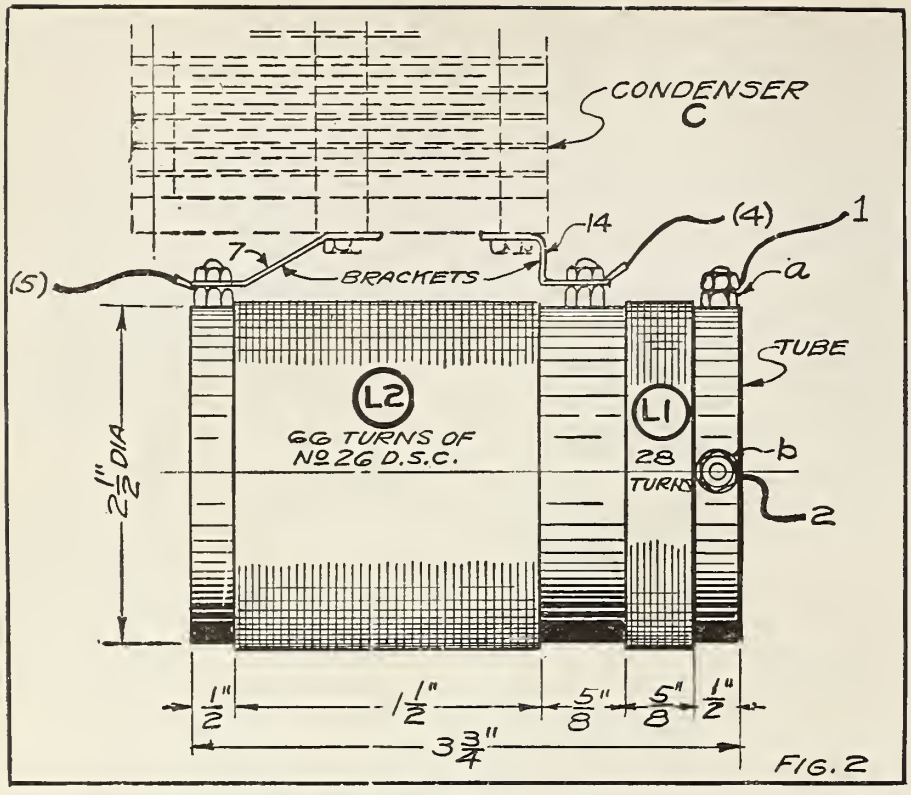


FIG. 2

A potentiometer (PO) acts like a vernier on the control of the regeneration and is necessary to clear up weak signals and to get the maximum signal strength. As originally designed, the potentiometer was omitted on the score of expense, but it is certain that it justifies the additional cost, particularly for those seeking distance on their sets. An ordinary 200 ohm potentiometer is sufficient for this purpose, although a 400 ohm instrument gives still finer tuning.

Rheostat

At (R) is a vernier filament rheostat, the resistance of which depends upon the tube For a UV-200 or C-300 detector tube, a 6 to 7 ohm rheostat is best. The the UV-201A or C-301A tube a 25 ohm rheostat is best, although a 15 ohm rheostat can be made to answer. The UV-199 or C-299 tube calls for a 30 to 40 ohm rheostat. In circuits of this sort, the control of regeneration is controlled principally by the rheostat and potentiometer, hence a vernier type gives the closest tuning and the greater distance. With a plain rheostat the change in resistance between two turns of wire is too great for proper control.

Of course a six volt power tube is the best, the writer having the best results with the C-301A or UV-201A Next comes the UV-199 or C-299 tube, which operates on three dry cells. Good results can be had with the WD-11 or WD-12, but as these tubes tend to broaden the tuning the set is not so selective when they are used. The same rheostat is used with the WD-11 as with the C-300 or UV-200 detector tubes. Soft detector tubes such as the UV-200 or C-300 work quite well at plate voltages ranging between 16 and 22.5, but are not suited for the higher "B" battery voltages, which are instrumental in long distance work and loud local signals.

With a hard tube such as the C-301A or UV-199, we can carry a "B" battery voltage of from 45 to 90 volts with great success. With the average tube, maximum signal strength is attained at about 67 volts or with three 22.5 volt "B" battery blocks connected in series. This gives tremendous volume on local stations, but cannot be used on the soft detector tubes. High plate voltages increase the sharpness of the tuning, but at the same time increase the noise and the tendency for the tube to "tip" over when the rheostat is adjusted. In radio there is never any gain without some corresponding loss.

Follow Instructions

On carefully following the circuit diagram, *Figure 1*, it will be seen that the coupler coil (L1) acts not only as a primary coil in the aerial circuit, but that it acts as a tickler coil as well since it is in series with the "B" battery and plate (P) of the tube. This means that the spacing between the primary and secondary coils (L1) and (L2) is of importance in order that we gain the maximum regeneration without excessive sensitiveness on the part of the rheostat adjustment. Again, the spacing of the coils controls the degree of "loose coupling" between the primary and secondary and therefore the degree of selectivity. If fewer turns are used in (L1) than shown, we will have increased our selectivity, but will have to burn the tube brighter to make up for the loss in feed-back. The proportions are a compromise arrived at by experiment, and should not be changed.

The tube ordinarily supplied for this circuit has an internal diameter of 2.5 inches or an external diameter of $2\frac{11}{16}$ inches. This may be either a bakelite tube or plain cardboard, but a bakelite tube is best as it does not shrink and loosen the windings. When a 3-inch tube is used, take off two turns on both the coils (L1) and (L2) because of the increased length of wire and the greater inductance and wave length. If you cannot reach the lower wave lengths at any adjustment of the condenser (C), then remove a few turns from the coil (L2) at the outer end. This will reduce the wave length. Much depends upon the length of your aerial as to the wave length range, a long aerial requiring fewer turns than a short aerial. A very long aerial, exceeding 100 feet in length, has a decided tendency toward reducing the selectivity and therefore should be avoided. The ideal length for locations where there is much trouble from interference is about 60 feet.

Direction of Windings

About the only trouble that has been experienced by amateurs in building this set is that of "Bucking" or reversed coils. Both coils (L1) and (L2) must be wound in the same direction around the tube, and must then be connected up so that the primary current, feed-back current and secondary currents all flow in the same direction. If the set does not prove sharply selective when hooked up, or if the signals are weak, then try the effect of reversing the primary coil connections (a) and (b). This should immediately improve the performance if the coils were opposed or bucking each other. Best connect up (a) and (b) temporarily at first until we determine the proper connection to make by experiment. The direction of winding, whether right hand or left hand, makes no difference as long as both coils are wound in the same direction.

A panel 7 inches by 9 inches by $\frac{3}{16}$ inch will be amply large for this set, and it has been mounted on a panel as small as 6 inches by 7 inches. Both of these panels are standard sizes and are easily obtained at a radio store. Cabinet and baseboards are easily found for these sizes of panels.

To reduce the cost of building to a minimum, we can omit the potentiometer (PO) and then connect the end of the wire (5) to the point where the ends of wires (9) and (13) are connected. Thus, without the potentiometer, the wires (5), (9) and (13) are all connected together at a common point, leaving wires (12) and (11) as before.

Radio's Expansion

Educational institutions and newspapers have recognized the value of broadcasting, it is indicated by the February Radio Service *Bulletin*, issued by the Bureau of Navigation of the Department of Commerce. And there is an increasing number of churches which have found the radio an effective aid in their work.

The latest list of stations broadcasting weather reports, music concerts and lectures shows ninety-five broadcasting stations connected with universities, colleges and other schools. The same directory lists forty-six newspapers or publishing houses, which have their broadcasting stations; while twenty churches are shown in the lists. This does not, however, include a number of churches whose services are broadcasted through some other station, it was pointed out.

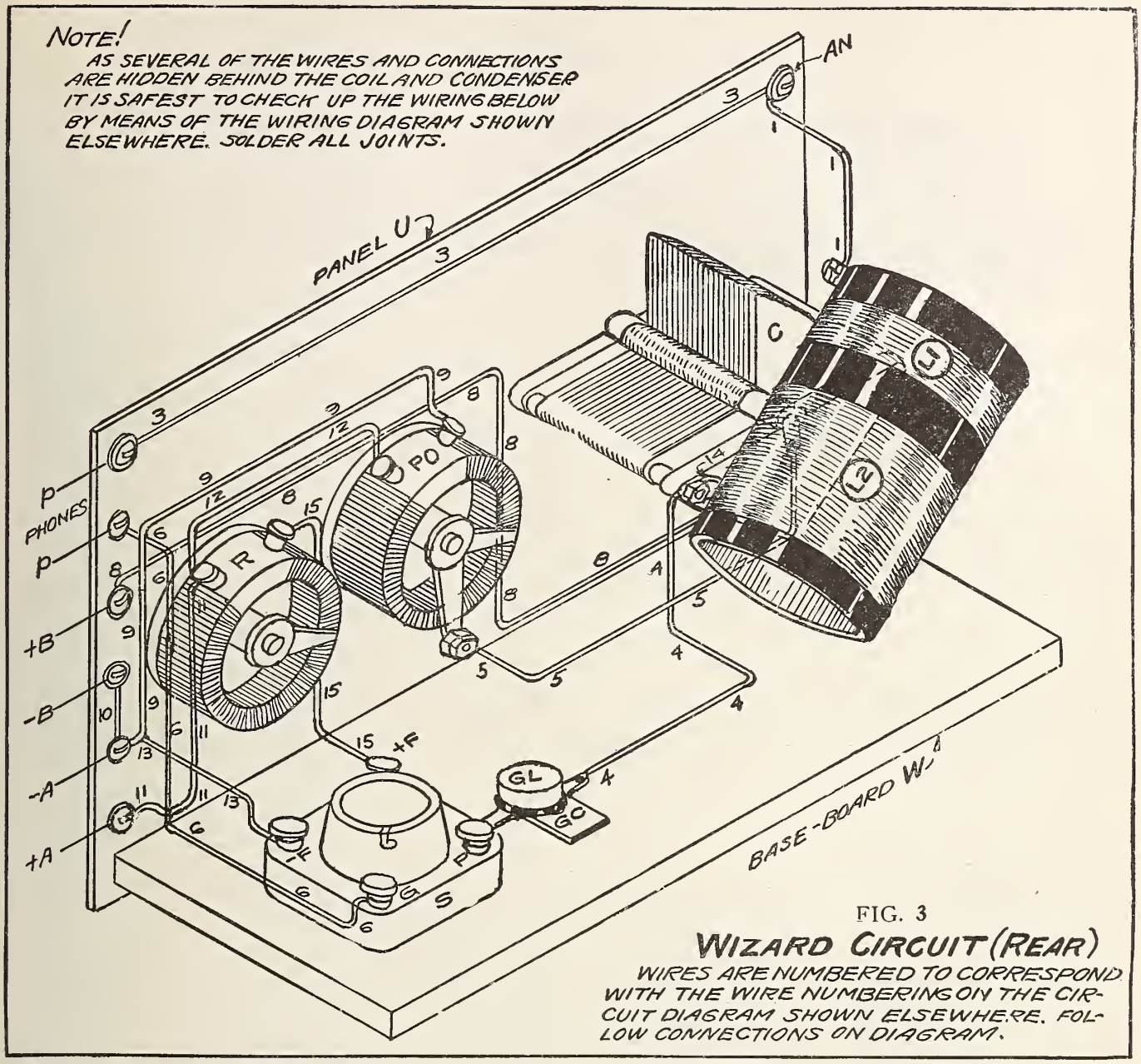


FIG. 3

WIZARD CIRCUIT (REAR)

WIRES ARE NUMBERED TO CORRESPOND WITH THE WIRE NUMBERING ON THE CIRCUIT DIAGRAM SHOWN ELSEWHERE. FOLLOW CONNECTIONS ON DIAGRAM.

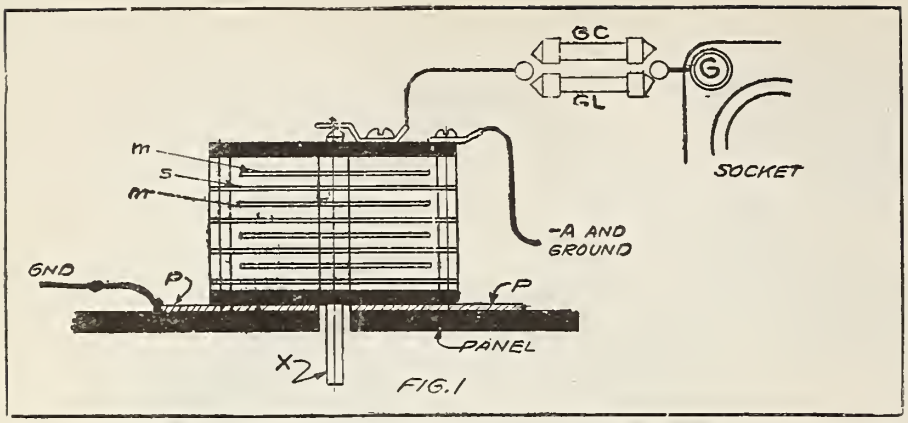
Guarding Against Body Capacity Effect

By ROSCOE BUNDY

WHEN the grid line or other parts connected with the grid post of the vacuum tube socket are raised to a relatively high potential by regeneration or radio frequency amplification, when a very noticeable electrostatic field is set up about these parts which seriously interferes with the operation of the receiving set. Moving the hand or any other conductor in the electrostatic zone causes momentary variations in the capacity of the circuit which may completely detune the receiver or cause it to shriek badly. This effect is not confined to the immediate vicinity of the grid circuit, but may even extend for several feet around the set under extreme conditions so that a person walking past may cause the set to become completely detuned. This effect is called "body capacity" and is one of the most troublesome diseases to which a set may fall heir.

In the milder forms, body capacity is confined to the tuning controls, the tuning being affected only when the hand is removed from the variable condenser or variometer knobs. A station can be tuned in very accurately while the hand is on the dial, but as soon as the hand is removed, the signals disappear or the set will begin to howl. As a rule, this is most noticeable on faint signals from distant stations, and is not always in evidence on strong local signals where regeneration or amplification is not being pushed to the limit. In the more severe cases, the body capacity effect may extend to other parts of the circuit, causing still more trouble and trouble that is far more difficult to cure. Certain single circuit receivers, such as the Ultra-audio or Flewelling, frequently develop "phone cord capacity" in which a strong electrostatic field exists in the head set and phone cords. Every time that we move our head or touch the earpieces or cord, the set is either detuned or else it starts to howl. Any circuit in which the plate is conductively connected with the grid is likely to have this trouble to a greater or less extent.

To reduce body capacity in the control system, we must first keep all parts



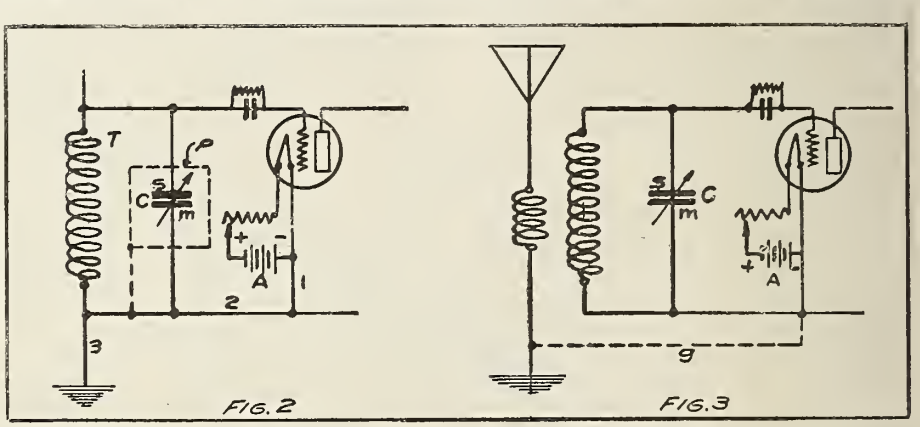
connected with the grid as far back of the panel as possible. This is rule No. 1. This refers not only to the wiring of the grid lines but to the grid condenser, leak and variable tuning condenser parts as well. Where a grid variometer is used it is of particular importance to keep this instrument as far in the background as possible, and to arrange matters so that the charged shaft does not bring the charge up as far as the panel. That part of the shaft which carries the dial and which projects in front of the panel will bring the electrostatic field forward just as surely as the windings or body of the instrument itself. Further, the charged shaft comes right into the dial where it is directly subjected to the condenser effect of the fingers and where it is in exactly the right position to cause trouble. It should be remembered that any amount of dial insulation surrounding the shaft will have no effect on the electrostatic field. We cannot insulate against an electrostatic charge in the same way that we insulate a current carrying part, but we can prevent the charge from coming forward by using a shaft of insulating material such as a rod of bakelite or hard rubber.

It is a far simpler matter to reduce the body capacity effect with the variable tuning condenser in the secondary circuit than with a variometer for the reason that the two halves of the condenser are well insulated from one another. With a condenser, the stator should be connected to the grid line, while the rotor and shaft are connected to the grounded part of the circuit. This follows from the fact that the stator or stationary plates are located well back of the panel, while the rotor is mounted on the shaft and hence would bring the grid charge forward were the rotor connected to the grid line.

Figure 1 shows a variable condenser having the rotor or movable plates (m) mounted directly on the shaft with the shaft stub (X) projecting beyond the front of the panel. If the rotor and shaft are connected to the grid post (G) through the grid condenser (GC) and the grid leak (GL), then it is certain that the front end of the shaft (X) will be at grid potential and that there will be trouble with body capacity if a sufficient potential is established on the grid by regeneration. If the grid line is connected to the stationary plates or stator (S), then all parts at grid potential will be located well back of the panel and the tendency toward body capacity on the controls will be reduced by this amount. Again, connecting the stator to the grid allows us to connect the rotor to the ground or to (—A), which still further protects against trouble.

It should be noted at this point that it is common practice to ground the (—A) line of a receiver so that the charge on the controls is reduced. In single circuit sets the (—A) is nearly always grounded, but in two and three circuit receivers it may be necessary or desirable to run a separate ground wire to the (—A) line at some point. Grounding the (—A) does not completely eliminate body capacity in every case, but is at least of assistance. In making such ground connections, one should be certain that the ground does not cause a short circuit.

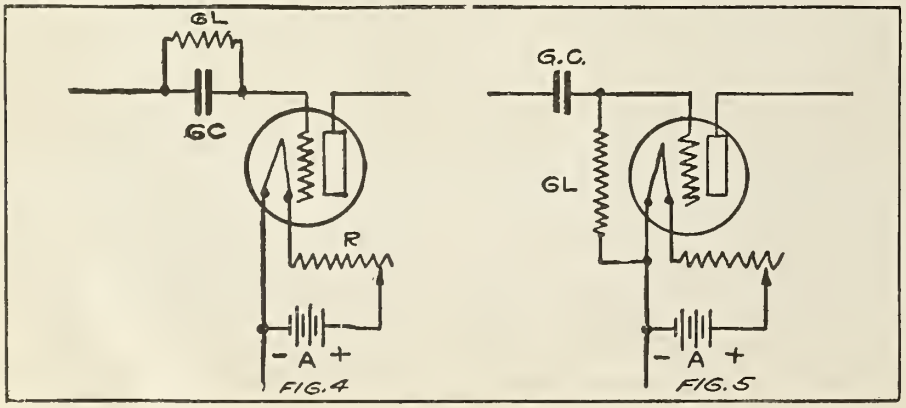
Shielding the various parts of the circuit is a last resort as it usually reduces the signal strength to a certain extent, but when properly applied it is the most effective means. In *Figure 1* a thin sheet of metal (P) called a "shield" is placed between the condenser and the back of the panel, and this shield is then grounded to the ground post of the set. This grounds the greater part of the electrostatic field that would reach the hand and hence reduces capacity effect. Sheet brass, tin foil or sheet aluminum are used for this purpose, but it should be noted that the shield is not in the least effective unless connected to ground. The metal ungrounded simply affords an excellent means of carrying the field still further to the front, just as with any other conductor. Placing a disc of metal on the inside of the dial and then grounding the disc through a brush is still another method of shielding employed by makers of certain condensers.



As a rule, the shield should be installed as far away from the charged surfaces of the condenser plates or variometer windings as possible, so as to reduce losses which take place to the grounded plate. Where possible the condenser should be moved back from the panel as far as the length of the shaft will permit, and then the shield will be at least ½ inch from the plates. Care must also be taken to cut out the plate for some distance around the shaft hole and condenser screws so that the condenser will not be short circuited or grounded.

Figure 2 is a diagram of a single circuit tuner where the (—A) is grounded naturally by the arrangement of the circuit. The stator plates (S) of the condenser (C) are connected to the grid while the rotor plates (m) go to the (—A) and ground as should be the case. Dotted lines represent the shielding and shield

(Continued on page 51.)



Radio Frequency Amplification

With Interstage Transformers

By P. E. Edelman

RADIO freqency amplification ahead of detection is used to boost the radio frequency current to sufficient value so that good operation results on distant signals. The general methods are:

1. Combined with regeneration.
2. Transformer interstage coupling, tuned or untuned.
3. Impendance or resistance coupling.
4. Frequency conversion plus method (2) or (3), as in superheterodyne, etc.
5. Modifications of method (2) with means to stabilize.

Radio amplification before detection avoids distortion such as is liable to occur when two or three stages of audio amplification are used, and permits very weak incoming energy to be built up so that the detector will operate as well as on strong radio signals. Unless the rectifying ability of the detector is also increased there is little advantage in increasing the number of stages of radio frequency amplification beyond the point which gives sufficient radio frequency output to fully operate the detector. That is why with usual radio amplifiers, local stations are only heard as loud as the detector output with full radio input permits. Sometimes radio amplification is said to increase range but not volume, but if means are provided to use all the radio output of the amplifier it is possible to get loud volume without further audio amplification or with only one additional stage of it.

To get full benefit of radio amplification on strong incoming radio energy it is necessary to increase the ability of the detector to handle the increased energy and rectify all of it. The usual detector tube will not do this, as its output is limited. It is customary to employ enough radio amplification to operate the detector on distant signals and reduce the radio input or turn down the amplifier tube filaments when listening to local stations.

Transformer Interstage Coupling

The most popular and generally used interstage coupling for radio amplifiers is afforded by transformers and will now be discussed. Special forms of coils are often used but are not essential. Ordinary coils in the form of variocouplers, inductance coils, spiderwebs, honeycombs, etc., may be used. The essential features are to minimize capacity effects, and secure good inductive transfer of energy from one out-put to the next input circuit.

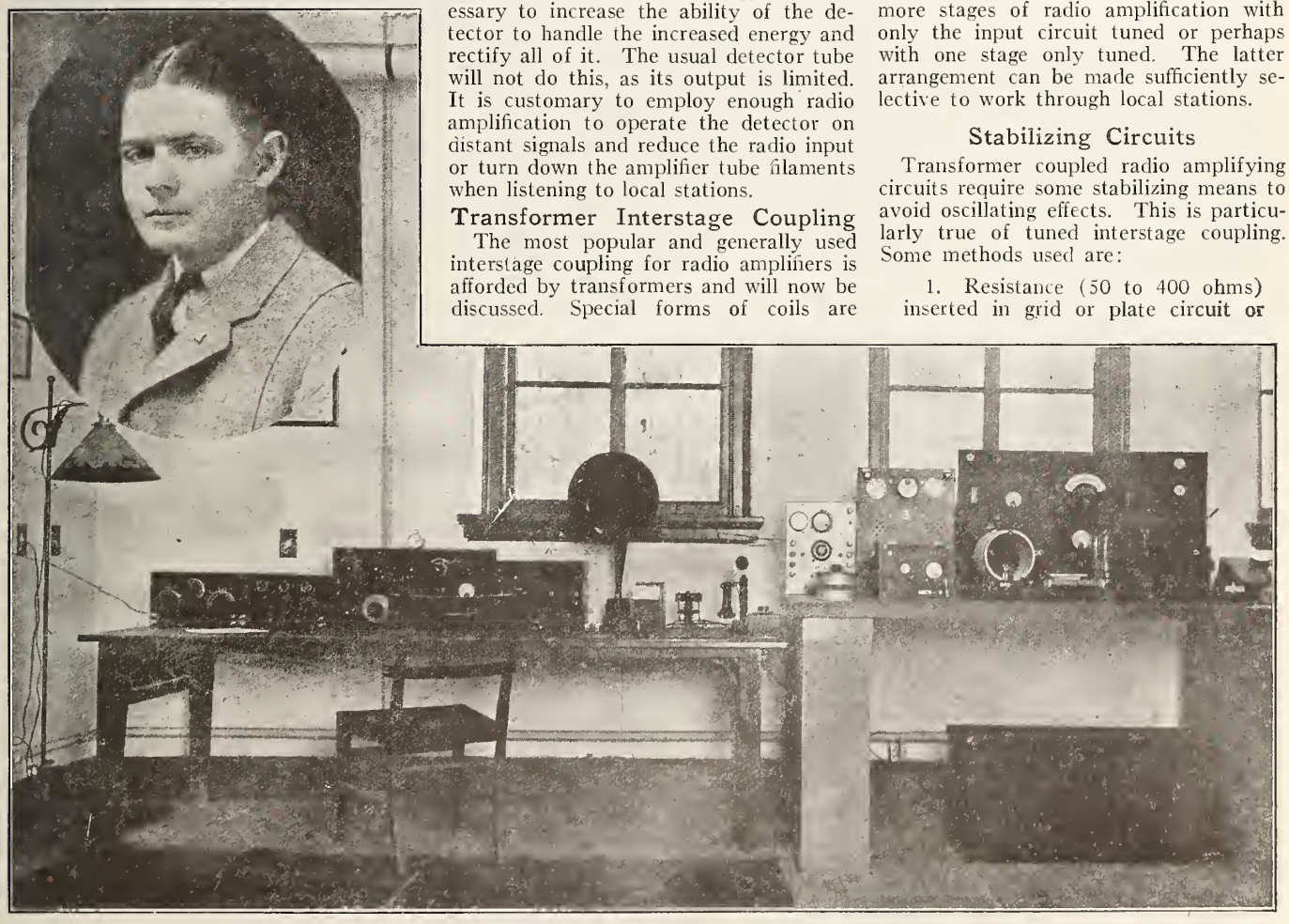
Tuned Transformer Circuits

Tuned transformer circuits afford very good frequency selection for tuning purposes. This is noticeable when only one stage is used and very marked when two tuned stages are employed. Some sets use three or more tuned stages but even when two stages are thus used, the control is complicated for a beginner's use unless some mechanical means is used to adjust two or more circuits simultaneously. A good design may use two or more stages of radio amplification with only the input circuit tuned or perhaps with one stage only tuned. The latter arrangement can be made sufficiently selective to work through local stations.

Stabilizing Circuits

Transformer coupled radio amplifying circuits require some stabilizing means to avoid oscillating effects. This is particularly true of tuned interstage coupling. Some methods used are:

1. Resistance (50 to 400 ohms) inserted in grid or plate circuit or



YOUNGEST STATION MAN

The interior of Station WABQ, broadcasting station of the HAVERFORD COLLEGE RADIO CLUB, Haverford, Pa. and (left inset) William S. Halstead, station manager and designer. Although only 20 years old, Mr. Halstead designed and personally supervised the building of this station. Mr Halstead started in 1912, experimenting with spark coils when 8 years of age, he is member Institute Radio Engineers. He is, no doubt, the youngest Radio Broadcasting manager in the world. Photo shows receiving table, speech amplifiers, and short wave transmitter (amateur call 3 BVN.) Left to right, main receiver and 2 stage amplifier used as "stand by" set for S.O.S. calls. The short wave receiver has brought in seven foreign amateurs, French 8AB on loud speaker, as well as eight Pacific Coast stations. Power amplifier, Horn, A. R. R. L. message file, change-over switch, telephone and wave-trap.

incorporated in windings of transformers.

2. Grid current established by applying small positive operating potential to grid of one or more tubes used. Potentiometers are much used for this purpose. A resistance of 50,000 ohms upwards might also be shunted across the grid and filament.
3. Absorbing circuits in grid or plate circuit. These work like a wavetrap or provide a parallel current path.
4. Reflex audio input, setting up variation potential in grid circuit.
5. Counter electromotive force applied to grid circuit. Reversed regeneration coupling does this.
6. Shunt resistance by establishing a separate energy using circuit between plate and grid circuits.
7. Critical adjustment of coupling values used.
8. Use of loose coupling with untuned primary and tuned secondary usually 7 to 10 turns primary and 50 to 60 turns in the secondary coil.
9. Divided circuits.
10. Neutralizing by sending opposing potential through small condenser to either grid or plate from either plate or grid circuit.

Some of these methods, as is obvious, are automatic and others require adjustment to fit different frequency values.

Air Core Transformers

Tuned transformers will usually be air core type and have variometer or shunted condenser form of tuning. It is usual to keep them of small size to avoid estab'ishment of extensive radio frequency fields. Sometimes this point is not regarded and interferences result from intercoupling between transformers or a transformer and a loop coil used with the set. It is desirable in reflex circuits to keep the capacity effect between the windings very small, so as not to pass considerable audio currents by condenser action. This is usually accomplished by separating the two windings. Air core transformers are sometimes used without adjustable tuning means and can be made to cover limited frequency bands efficiently. They are wound to have minimum self capacity and are made of small dimensions.

PORTO RICO IS BITTEN

Radio is fast becoming popular in Porto Rico. These native society girls are seen listening-in to concerts from the States. Left to right—Miss Lydia Rexach, Miss Adela Gomez, Miss Emilia Rexach.

Iron Core Transformers

Iron core transformers based on the suggestion of Mr. Latour use very thin laminated soft steel for a core. The iron is of tissue thinness. Its effect is to both concentrate the field and prevent external leakage, thus increasing the impedance for a range of frequencies, and also to supply a capacity effect for the coils. Some types of untuned transformers use powdered iron or powdered iron held in wax as a core. The effect is to broaden out the range of frequency response, but usually such transformers are better at one or two narrow bands of frequency than others. Some transformers are wound with fine or resistance wire to further broaden out the frequency range but this may reduce the energy transfer and mitigate against high amplification. The best results with such transformers are obtained when correct balance of the windings is obtained to fit in with the characteristics of the amplifying tube used.

The use of iron core transformers or other types of untuned transformers is seldom carried on beyond two or three stages. Combinations of one stage tuned transformer coupling with one or two untuned stages afford a simple and selective design.

Continuously Variable Couplings

The primary and secondary windings, one or both, can be made adjustable to fit different frequencies while maintaining good coupling for efficient transfer of energy. This is accomplished by double coupled variometers or sometimes by use of tapped coils.

Transformers also find use in complex circuits on the super-heterodyne principle, where amplification is cascaded at a particular frequency such as 100,000 cycles to which incoming frequencies are transferred by heterodyne methods.

Regenerating Effect

As used in some circuits, fixed or tunable transformers have regenerating circuit effects. Sometimes the non-regenerative amplification is mentioned as distinguishable from the combined amplification possible at radio frequencies.

Relative Value of Stages

One good stage of tuned radio amplification will sometimes equal two untuned stages. When two stages give good detector response on distant signals, a further stage is often no advantage. Just now, transformer coupled stages are performing fairly well but there is room for improvement. This may be in the transformers, the circuits, or the tubes used, one or all.

Practical Use of Transformers

The practical use of transformers requires care in wiring with minimum lengths of carefully insulated or spaced wiring. Very small condenser effects in adjacent wires can transfer radio energy away from the transformer. That is another reason why small dimensioned transformers are desirable, as the length of connecting wires is smaller.

Impedance Coupling

Impedance coupling as used in many sets is a form of transformer coupling in which only one winding is required. Re-

BROADCASTING PICTURES

Stewart W. Jenks, Raido Engineer, is seen at work in the C. Francis Jenkins studios, broadcasting radio pictures. This broadcasting station has a range of thirty-five miles and will transmit motion pictures, still pictures, and music. This is the latest development by Mr. Jenkins, after ten years of research.

Reflexing the R. F. Variometer Addition

By BRAINARD FOOTE

STILL further advantage may be taken of the radio frequency addition to the standard variometer regenerative set by means of employing reflex action on the radio frequency tube. This plan has a good many desirable features, although there is a drawback as well. The item of expense is not so serious, inasmuch as the reflex change-over merely means the insertion of an audio frequency transformer and another by-pass condenser.

In point of operation, several improvements are derived. In the first place, the volume received will be many times what it was with the straight radio frequency tube, sufficient in the case of most of the local stations to put on a loud speaker. The volume, it is true, is not quite as great as it would be were the first tube used straight, and an extra tube as plain audio frequency added after the detector. However, it is nearly so, and a worth-while saving in expense is the result.

Operating Characteristics

The reflex is not quite as stable a circuit as the straight radio addition, and when pushed past the oscillating point, is prone to howl quite unmercifully. The howl is caused by an audio frequency feed-back from the plate circuit of the R. F. tube to its grid circuit because of the fact that the tube is used not only as the R. F. amplifier but as the A. F. amplifier as well. The tendency to squeal is lessened by the use of a low ratio transformer—3 to 1 or 4 to 1.

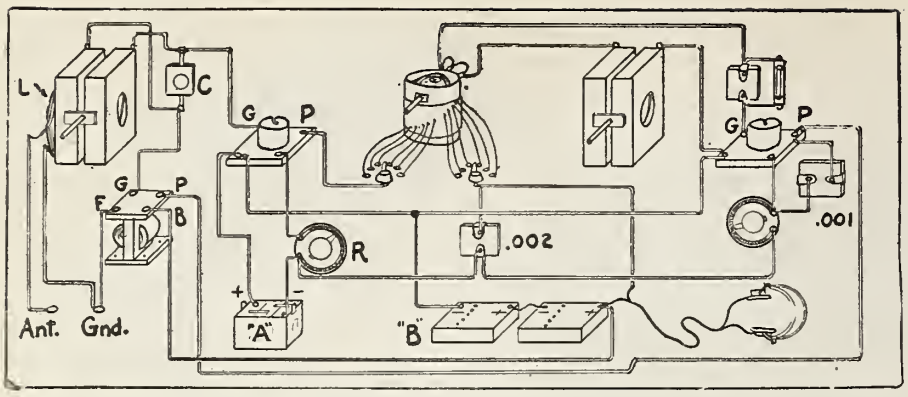
However, there is really no need to force the set into oscillation, for very little is gained in the way of sensitiveness by so doing, and all the DX stations that are heard without reflexing the circuit come in a good deal louder with the reflex added.

Little room is needed inside the set, and the audio transformer can be mounted somewhere in the vicinity of the left hand variometer—right behind it, perhaps. Besides the transformer, a .002 fixed condenser is needed. Figure 4 gives the complete wiring diagram, and points out the differences between the plain circuit of Figure 3. The phones are taken out of the plate circuit of the detector tube and are replaced by the primary connections of the audio transformer. The .001 by-pass condenser is just as necessary as ever.

Then the lead running from the switch lever of the coupler to the "B" battery positive is disconnected, and the phones inserted between these two points. Inasmuch as the phone windings offer a high impedance to the radio frequency currents flowing through the primary of the coupler, it is necessary to shunt them by a 002 fixed condenser, connected between the above-mentioned switch lever and the negative side of the filament.

How It Works

Then the "grid return" lead from the left hand variometer to the negative of the "A" battery is removed, and the secondary connections of the transfer sub-



stituted instead. Many reflex circuits show a large fixed condenser across the "G" and "F" posts of the transformer, but the experience of the writer is that this is poor practice in a single reflexed tube. It acts as a shunt condenser and lowers the voltage of the energy released from the secondary winding, thereby reducing the volume very noticeably.

It is usually stated that this condenser is required in order to cause oscillation, but with a vario-coupler as the R. F. transformer, there are so many extra turns available for feeding back the energy causing oscillating that it is easy to set the circuit very close to the oscillating point or in fact to cause it to oscillate. This is seldom done because of the howling spoken about already.

The energy traversing the antenna coupling coil (seven turns of bell wire—coil L of Figs. 3 and 4—coupled to the first variometer) is transferred to the variometer, whose effective wave range has been raised by a small shunt capacity "C" of the order of .0002 mfds. The voltage is applied to the grid, where it sets up a much stronger fluctuation of the plate current supplied by the 90 volt "B" battery. This in turn, passes through a portion of the vario-coupler's primary winding, from which energy is transferred to the rotor. The grid circuit of the detector is tuned by another variometer

The Tuning Method

The actual tuning is done by the two variometers, and the scale readings of one of them should be noted down for reference. There is only one position of the other variometer which corresponds to any particular setting of the first one, so that the adjustment of the set is easy enough. The switches are set to include enough turns of the coupler's primary winding to bring the set to the verge of oscillation without really allowing oscillations to begin. The rotor is left at maximum coupling all of the time

The best method for tuning the set, once a list of the dial settings for the stations most ordinarily heard has been written down, is to work from a simple graph. This is made on a sheet of cross-section paper, drawing a horizontal line near the bottom and dividing that into equally spaced divisions for the dial readings, and then drawing a vertical line at the left border. This latter is used for the wave length indications, from about 250 to 550 meters. The points of intersection for all the stations heard are marked down on the proper places, and a SMOOTH curve drawn passing through the points as evenly as possible.

Then it becomes easy to look up the dial setting for any other wave length and to tune for a desired station whose wave length is listed in the evening's programs, but which has not previously been heard. The graph also aids in the identification of an unknown station because it will tell the wave length of a station tuned in at some particular dial degree. Such a method of tuning cannot, of course, be followed with the ordinary double or triple circuit set because of the fact that the coupling variations upset the other dial readings, but with tuned radio frequency, the plan is highly satisfactory.

R C A Finances

Maj. Gen. G. Harbord, president of The Radio Corporation of America, has made the following statement:

"The Radio Corporation will, this year, pay the 7 per cent dividend on its preferred stock, which is cumulative from the first of January, 1924.

"It is anticipated that at the meeting of the stockholders to be held in May, the charter of the corporation will be amended so as to reduce the number of shares of authorized preferred stock from 5,000,000 to 500,000 and the authorized no par value common stock from 7,500,000 to 1,500,000 shares. The plan is to retain the capitalization of the corporation as at present authorized, but to create a par value of $50 for the preferred stock, to be known as 'A' preferred stock, for which the present preferred stock will be exchangeable at ten shares of the present for one share of the new stock and to exchange the present common stock at the ratio of five shares of the present stock for one share of the new or 'A' common stock.

"The exchange in cases where the present stock is not held in multiples of ten and five shares will be facilitated by the issuance of fractional shares of the new stock.

"The 'A' preferred stock will be entitled to receive 7 per cent dividends, payable quarterly, cumulative from January 1, 1924, the payment for the first two quarters of 1924 to be made in July. Shares of the present preferred stock not converted into the new, and fractional shares resulting from uneven multiples, will receive the 7 per cent dividend, payable, as may be determined by the board of directors, but cumulative from January 1, 1924. Stockholders who have not exchanged their preferred stock in time for a particular dividend date on the 'A' preferred stock, will be entitled to any accrued and declared dividends on said 'A' preferred stock after they make such conversion.

"The dividend rights of the preferred stock over the common stock, and the voting rights of each, will be preserved in this arrangement.

"After this change is effected, application will be made to list the 'A' preferred and the 'A' common stock on the New York Stock Exchange."

Spotting Interference

Hartford, Conn.—As the interruptions to broadcast programs from defective lighting circuits are common in nearly every city, the difficulties recently overcome here by radio amateurs in coöperation with the city electric light company, are of more than local interest. Complaints from listeners became so pronounced that the Radio Club of Hartford named a special committee to run down the source of trouble by means of a loop receiver.

This committee set out upon its task in a businesslike manner by preparing first a map of the section of the city from which it was believed most of the interference came. On the map pins were placed with numbered flags glued to them. Perry O. Briggs, local amateur, who devised the system, then placed a small loop set in an automobile and directed its movements.

These flags were shifted as the "buzzing" sounds came and went until all of the bad spots had been plotted out. When the results were given to the Hartford Electric Light Company it went so far in one case as to replace the entire circuit in one street. The improvement since this was done has been very gratifying

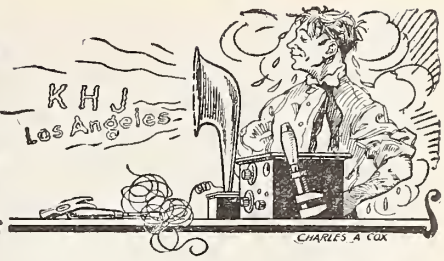
Slogans for WAAW

The Omaha Grain Exchange put on a slogan contest at WAAW recently, the slogan consisting of words beginning with the call letters of the station. The contest was not announced until 8 p. m. and a large stack of telegrams was on hand at 10 p. m., when the contest closed. First prize of $10 was won by Harvey C. Dendall, Lincoln, Neb., with the slogan: "Where Agriculture Accumulates Wealth" For the most amusing slogan a special prize of $10 was awarded to J. B. Fickel, of Hastings, Ia. His slogan was: "Was Adam's Apple Wormy?"

Bradleystat Chosen

The American Radio Research Corp., Medford Hillside, Mass., has adopted the Bradleystat and Bradleyleak as standard equipment in all their expensive console and table models. These two Allen-Bradley products were selected and adopted after extensive research by the Amrad engineers.

Pick-ups *and* Hook-ups *by our Readers*



In the February, 1924, issue we published a couple of photographs of Mr. T. J. Kennedy showing his trans-Atlantic receiver, and gave his address in the caption underlining the photograph. Permit us to direct your attention to the following letter, a reply to our publication of the photographs.

RADIO AGE,
Gentlemen:

Since you published a photo of my honeycomb receiver, I have been swamped with letters from your readers, and I am unable to answer all the inquiries, which would require several stenographers to attend to the mail.

I am enclosing herewith a complete account of the reception and set. If you care to publish same for the sake of your readers, you sure are welcome to it.

Yours for good radio,
THOMAS J. KENNEDY.
232 West 55th St., New York, N. Y.

The length of Mr. Kennedy's account of the set and record breaking reception is too great for our use, but we take pleasure in presenting herewith some of the high lights and pointers which seem to be the leading factors in Mr. Kennedy's accomplishment.

Mr. Kennedy, in contending that London and Los Angeles can be tuned in on an old-fashioned honeycomb coil set, using a detector and two stages of audio frequency amplification, points out that among the chief reasons for his remarkable success are the following:

After my first experiments with the customary crystal sets, which I soon found to be too limited, I made a three-circuit regenerative set, which consisted of two variometers and a variocoupler. I found that this too had limitations, and around February, 1923, made and operated my first honeycomb receiver.

Since then I have stuck pretty closely to this one outfit, perfecting it, making little changes here and there, with the object of making a more efficient receiver.

I use three honeycombs in the following manner: For the antenna I find that an L35 is effective, with an L50 for the secondary and I75 for the tickler. These honeycomb coils are seldom if ever touched, but are placed at a certain distance from each other and left there. The secondary is in the middle, with the primary on the left and the tickler on the right. The primary is just a little further away from the secondary than is the tickler coil. I use a 23-plate vernier condenser of General Radio make in both ground and secondary circuits. The ground condenser is used very little in tuning after being once adjusted. The secondary condenser and the filament rheostat for the detector are the major controls which I manipulate, once the preliminary adjustments have been made. The detector is a C301A and despite the general belief to the contrary, I find that it is highly efficient.

I have placed a 3-inch dial on the shaft of the detector rheostat which is of the best quality, and operate upon the dial, a vernier of the friction type, which gives me the closest possible control over the detector tube current. With this filament control and extremely accurate tuning with the secondary condenser, I am able to build up DX signals to the most astonishing volume. Occasionally a slight adjustment is necessary on the potentiometer, and less frequently a slight movement of one or two of the other controls. The potentiometer, by the way, is 400-ohm, graphite type, which I think is superior to the wire types, the latter causing noises in the headset.

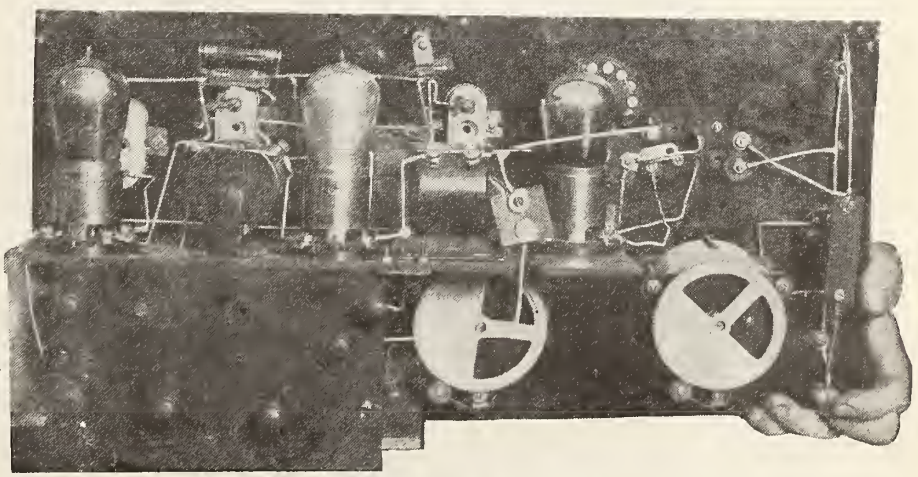
I am absolutely averse to jacks, feeling that they are responsible for nearly nine-tenths of the noises in circuits. I am even contemplating the removal of the jack in the last stage, as I feel confident that I can further improve the general efficiency

CONTRIBUTORS

T. J. Kennedy F. Robert Zeit Joseph W. Pfister

DIAL TWISTERS

Name	Address	Circuit
C. R. Williams	433 Milton Ave., Janesville, Wis	Zenith
H. G. Ende	1801 Sedgwick St. Chicago, Ill	Single Circuit
Joseph J. Oswald	433 Emory Ave., Trenton, N. J	Not Stated
Bennie Sivesind	Decorah, Iowa	Single Circuit
H. F. Willis	1209 Fairfield Ave., Shreveport, La	Single Circuit
J. H. Kulp	223 Clifford Ct., Madison, Wis	Three Circuit
John Tomlin	303 Madison Ave., Atlantic City, N. J	Not Stated
Bireley Ross	806 Brazos St., Graham, Texas	Not Stated
R. B. Hamilton	674 S. Capital St., Salem, Ore	Cockaday
Robert Signaigo	4170 Connecticut St., St. Louis, Mo	Crystal



A DISTANCE GETTER

Thomas J. Kennedy, 470 West 159th Street, N. Y., regularly receives 2-LO, of London, Eng., and KHJ, Los Angeles, with this simple three-circuit honeycomb regenerative set. He tunes with the secondary condenser and the rheostat of the detector tube, without moving the honeycomb coils or the ground condenser. Note how he uses condensers and grid leaks across the transformer secondaries to clear up signals. (Kadel & Herbert.)

A DISTINGUISHED RADIO FAN

HUDSON MAXIM, noted inventor, whose nephew Hiram Percy Maxim is President of the American Radio Relay League, listening in to the address of President Coolidge, from Hotel Belclaire.

of the receiver by making this change. I entirely disclaim this high ratio first stage transformer propaganda, and think that two low ratio transformers are better.

My main object in building and experimenting with this receiver was to eliminate all the usual set noises, and I went to a lot of trouble and expense to accomplish this. I found that a .00025 MF fixed condenser across the secondaries of each of the transformers assisted materially in this respect. I further found that by placing grid leaks across these condensers I was further able to eliminate noises, and in the course of my experiments found that a 2½ megohm leak on the first transformer and a 3 megohm leak on the second seemed to work best. This is, however, a matter of individual experiment, and is entirely up to the builder as to which is the most effective. Variable grid leaks are absolutely useless in any part of the circuit. The C battery should also be carefully adjusted

Another place which contributed to the noises in the set was located in the B battery leads and connections, so I ended them by soldering the leads directly to the posts on the batteries.

The set is not in a cabinet, being placed upon a table so that I have easy access to any unit should I decide to make experimental changes. Only the finest materials are used, and I considered the cost a secondary matter, because I knew that to get results, it was imperative that I procure reliable and low loss apparatus.

I always keep a log book, and jot down the settings of the secondary condenser dial for every station I hear. I attribute my success with the set to careful and long experiments, and contend that the only way to realize the utmost of any circuit is to learn every secret of its operation.

Mr. Kennedy on Sunday, Nov. 25, 1923, while amusing himself at the set around 10:10 in the evening caught the London, England, broadcasting stations which operates under the call of 2LO. The only thing which impeded his continued reception was the interference created by some nearby single circuit receiver which was being improperly operated. In the accompanying photograph, we are publishing views of Mr. Kennedy's set and himself.

Mr. F. Robert Zeit of 643 Garland Ave., Winnetka, Ill., sends in a list of data and specifications on a super-regenerative circuit which he has devised, which should be of interest to any fan who possesses a collection of miscellaneous apparatus with which to experiment. He would be pleased to have letters from fans who construct this circuit.

RADIO AGE,
Gentlemen:

The writer has been experimenting for some time with the various published hook-ups and simplifications of Armstrong's super-regenerative receivers with a view of using this wonderful discovery in a moderate way in a set which the uninitiated could use successfully.

All the published simplified circuits have taken one element after another away until Mr. Muhleman of the Radio *News* left only one 1250 turn inductance coil and two variometers as the result of long and laborious research.

This encourages me in submitting this modest and easily operated super, which tunes well to all the current broadcasting wave lengths, from 200 to 600 meters.

My hook-up removes even the last large element of the original circuit, which Mr. Muhleman (Autoplex) retained, the 1250 turn coil, requiring neither a power tube nor a very high plate voltage.

I enclose the circuit diagram of my single tube super-regenerative receiver which has tremendous volume and excellent selectivity. It outdoes any three-tube set I have used in volume and clear reception, tuning to all wave lengths from 200 to 600 meters with the greatest ease.

Any fan with two variometers and a hard, high vacuum tube (I use U. V. 201), can rig up a trial circuit in a few minutes and hear the music or talk many times louder than if he sat in the broadcasting studio; in fact, the amplification is simply tremendous.

Although I use a 0.006 M. F. fixed condenser across the tube any other value will do from 0.002 M. F. up.

It is important that the rheostat be connected in the negative filament lead, as per diagram of circuit, or the super-effect is lost.

No more than 45 volts should be used on the plate "B" battery unless the negative bias on the grid is increased by using a few cells of "C" battery in the grid return, but this is unnecessary because the volume with the 45-volt "B" battery is simply tremendous, providing sufficient filament current is used to heat the filament.

No ground wire should be used.

The aerial I used is an outside single wire 50 feet long.

An inside single wire 35 feet worked as well, even 10 to 15 feet single wire inside aerial works effectively.

Many different variometers were used and all worked but the loudest and clearest reception is obtained with variometers of large sized wire and about 60 turns on rotor and the same on stator. (High ratio of inductance.)

Variometers with a minimum insulating material will probably do better.

A standard Freshman variable grid leak with 0.00025 M. F. condenser was used and must be tried out for best results with the tube used. The pointer with my U. V. 201 between the fifth and sixth division line from the left worked best.

Operation is extremely simple. The tube filament is heated to give a bright light, about one-half of the 6-ohm resistance wire is used with a 6-volt storage battery.

The variometer dials (4-inch) are turned simultaneously and very slowly. After picking up a station the slightest move only is required to produce the super-effect. There is not much difference in the two dials settings when the super-effect is obtained and the same station can always be picked up again if these dial settings are logged.

All howls and whistles abate completely when a station is tuned in properly by very slowly moving both dials. A little practice on local stations is necessary before attempting to tune in distant stations. Local stations come in strong enough for a loud speaker. Distant stations come in with the volume of local stations on the regular regenerative set.

Body effects vary a great deal and may be entirely absent, sometimes very marked.

There are only two controls, the two variometers. Both hands are used. The super-effect is produced mainly by proper tuning with the grid variometer but the plate variometer is used at the same time, increasing the volume, finding thus with both dials the best position for the super-effect. It is very easy to pick up a station after which a very slight manipulation of both dials will produce terrific amplification with the utmost clearness. Failure to produce this super-effect means that the filament is not heated sufficiently.

The filament current, however, is not critical. After it has once been adjusted to give the super-effect it needs no further change for the whole range of wave length.

Tuning is sharp, and nearby, powerful home stations may be heard faintly until the station wanted is tuned in and super-amplification reached.

Not the slightest interference was noted by alternately tuning in a 345-meter station 40 miles away and a powerful 360-meter station 15 miles away and another 360-meter station 600 miles away.

Stations 1,000 miles away come in with fair volume. Five hundred-mile stations come in with the volume of a home station with the average regenerative set.

Two variometers with large sized wire and about 60 turns on rotors and stators.

6-ohm rheostat (without vernier.)

U. V. 201 tube.

Freshman variable grid leak and 0.00025 grid condenser.

Fixed mica condenser, 0.006.

Storage "A" battery, 6 volts.

"B" battery, 45 volts.

50-inch single wire aerial.

No ground wire.

Now that we have some of the choicest kinks and experiences, we will pass on to some of the most unusual pickup records that we yet have had. The following letters will, from inspection, reveal that some of the most unusual permutations with radio sets were used, and also some of the longest average records of any ever yet printed in this department.

RADIO AGE,

Gentlemen:

Noticing your "DIAL TWISTERS" column in the March issue, I thought I'd send in part of my log. I have a single tube set of my own construction, using a modified Zenith hookup, and with it I have accomplished some unusual reception. Only the most distant stations are listed here:

KHJ, KFI, KPO, KGW, KGO, KLX, KFAE, WKAQ, PWX, CFCN, CKCK, CKY, CFCA, CFCF, CJCM, KFAF, KFEL, KFFQ, and 156 others positively identified. The first five and WKAQ are heard regularly.

A friend of mine has a similar set with an additional two-stage audio frequency amplifier, and among other DX stations he logged 2BD at Aberdeen, Scotland, on the last night of the tests.

I am using a U. V. 201A for detector and 22½ volts on the plate. I find that it is the most sensitive and selective regenerative set I've ever tried, the stations coming in very loudly. At times WBZ and several others are heard with the phones off. KHJ, KFI, KGO, KLX, KPO, KGW, CFCN, CKCK, CFCF, and WKAQ were all heard on the same night recently. I hear KFI and KHJ very consistently.

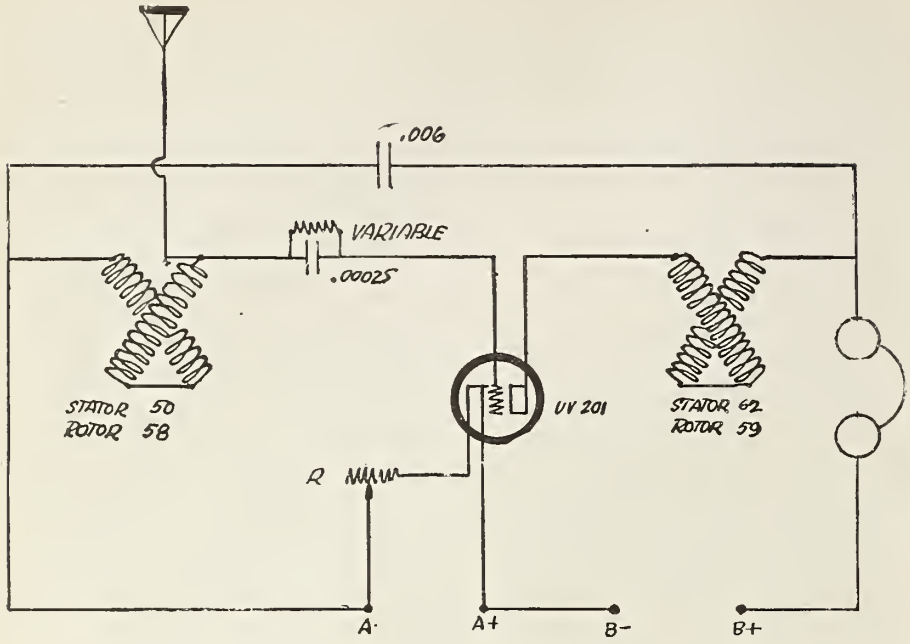
Sincerely yours,

CLARENCE R. WILLIAMS.

433 Milton Ave., Janesville, Wis.

AN EXPERT'S SUPER-HET

Photo shows Arthur H. Lynch, raido expert, placing a variable grid leak in the second detector tube which helps clear up the quality of the reception of a super-heterodyne receiving set he has built according to his own plans.



Mr. Williams seems to cater to foreign stations if we are to judge from his list. It looks to us as though he is the holder of a most enviable one-tube DX record. Good work.

From Wisconsin we jump to New Jersey with the following:

RADIO AGE,

Gentlemen:

I was looking over your fine little magazine, the RADIO AGE, and saw some of the lists of stations heard. I would like to see my list scanned, and incidentally wish to say that there may be a lot of skeptical fans when they see this list, but I can swear it is a bona fide one. I use a one-tube single circuit receiver. Enclosed herewith is the list of stations:

WGAD, Essinada, P. R
WKAQ, San Juan, P. R
SPC, Rio de Janeiro, Brazil.
2LO, London, England.
PWX, Havana, Cuba.
6KW, Tuninucu, Cuba.
CFCN, Calgary, Alta., Can.
CJCE, Calgary, Alta., Can.
CHOC, Vancouver, B. C.,

and some station operating under the call of PWB. My American receptions are:

KFIU, KFZ, KGW, KFAD, KGO, KPO, KFI, KHJ. KFIQ, KLS, KFDJ, KLP, KDYL, KFCY, KLZ, KFCK, KFKZ, KFIX, KFDL.

In all I have received 247 stations, about 73 being over 100 miles away.

Yours very truly,
JOSEPH J. OSWALD.
433 Emory Ave., Trenton, N. J.

Mr. Oswald's letter contains reception that by many would be deemed impossible. We would suggest that hereafter if reception of stations as distant as those of Mr. Oswald is accomplished, that fans immediately verify the log, as the stations operating are in search of data of that nature. It also is a means of producing evidence of actual long distance reception to those who are incredulous. The list covers tremendous distances, and is certainly a remarkable one. We congratulate Mr. Oswald on his unusual feat.

RADIO AGE,

Gentlemen:

After reading over my list of "stations heard" I think that you, too, will feel that I should be admitted to your Royal Order of Dial Twisters.

I have Q. S. L. cards from most of the stations listed and can vouch for the authenticity of my list.

I use a single circuit regenerative set—detector and one step. Local stuff comes in on the speaker, and last week when I picked up KGO for the second time in a week, I pulled him in on the speaker loud enough to make out what he was saying at five feet from the loud speaker. Remember—I use only two tubes!!!

Guess that's all now, and hoping to be a Dial Twister next month, here's my best.

73's OM,
H. G. ENDE
1801 Sedgwick St., Chicago, Ill.

Here's the list: WSY, KFAD, KYJ, KFI, KPO, KHJ, KGO, KFAF, DN4, 9ZAF, WDAL, WDAJ, WSB, WGM, KYW, WDAP, WGAS, WAAF, WJAZ, WBU, WMAQ, WWAY, WOAJ, WJAN, WTAS, WCBD, WTAY, WABA, WWAE, WBAA, WOH, WGAZ, WOC, WOI, WHAA, WBL, KFKB, WHAS, WGI, WBZ, WCX, WWJ, WWI, KOP, WLB, WLAG, WCAL, WMAT, WHB, WDAF, KSD, WOS, WOAL, WNAR, WOQ, WOAW, KFKX, WOR, WJZ, WGY, WGR, WHAZ, 2XI, WHN, WCAD, WHAM, WJY, WBT, WLW, WEAO, WSAI, WTAM, WJAX, WLAL, WKY, KDKA, WQAA, WCAE, WBAK, WDAR, WFAT, WDAA, WOAN, WMC, WBAP, WFAA, WOAI, WKAL, WPA, KZN, WHA, WAAK, WIAO, WPAH, PWX, CJCG, CFCA, CFCN, CKCK.

Yea, verily, do we inscribe thy name on the Dial Twisters list, for it is no small thing in these days to receive Los Angeles in Chicago on a loud speaker, with two tubes. Keep up the good work.

And, Mr. Printer, while ye are busily engaged in inscribing the name of Mr. Ende, stay thy hand and place also the name of the writer of the following letter, for he hath also done reception that commandeth great admiration:

RADIO AGE, Inc.

Dear Sirs:

I am a subscriber to RADIO AGE and always read the section "Pickups by Readers." I am sending in a list of the stations that I heard on Monday, February 11. I have a single circuit two-tube A. F. A. set. The stations I heard and logged were: WOC, WLAG, WBAH, WOAW, WEAF, WGY, WCBD, WSB, WDAF, WOS, WHN, WOR, WKY, KFKX, 5XW, KFKB, WBAP, WBAV, WHAZ, WTAS, KFFQ, KLZ, WGR, KFI, KFGD. I think this is a good "coast to coast" record for a set of this kind.

Yours truly,
BENNIE SIVESIND.
712 Maiden Lane, Decorah, Iowa.

HAW! HAW! ha, ha, ha, eh——

Y' know, fellows, Mr. Rathbun just stepped into the office and told us a good one about that little "Baby Heterodyne" of his. He says he's been chuckling for a week about it. It goes something like this:

Mr. Rathbun asked an editor of a well known daily newspaper as to how and what results he was getting with the Baby Heterodyne which had been built for him.

The editor replied: "Nothing can beat it. I did some of the most remarkable long distance last silent (Monday is silent in Chicago) night; you wouldn't believe it, but I got Louisville, Tenn., WHAS, on a loud speaker that night, and for one tube, it's sure some reception!"

Now, Mr. Rathbun, the inventor of the "Heterodyne Baby," waited for us to laugh—but, to tell the truth, he couldn't see the joke at all. After a period of strained looks and highly charged air he said:

"The joke is this: Monday night is certainly a fine night to do that kind of work. The only trouble is that it's silent night in Louisville on Monday, and *believe me it sure is some reception when you get a station that's not operating at all.* An' on the loud speaker to boot!"

Also, a fellow came in to this office and informed us that he wanted a back number of the August issue. We told him we were all sold out, but that he could get the information from the RADIO AGE

ANNUAL, and he promptly bought the book, saying:

"I had a copy of the August issue, from which I was building the Cockaday set, and when I turned my back the baby grabbed the most priceless radio periodical in the world and tore the thing into so many pieces that a whole Saturday afternoon and Sunday couldn't piece it together."

RADIO AGE,
Gentlemen:

I'm back again; this time with an S O S call. For goshsakes help me—! Since my address appeared in the March issue, I've been swamped with letters. I can't answer them, they are countless. If they come in as fast as they did this week alone, I'll be in a padded cell. I enclose my hookup and a set of rules for building and operating the set, hoping that you will find room enough to publish both.

I have now heard 185 stations with an aggregate mileage of over 158,000 miles. I have heard 40 stations 1,000 miles away; 11 of them over 2,000, the farthest being CYL of Mexico City, Mexico.

Mr. Boyenga is all wrong! The single circuit coupler condenser is by far the best receiver. Look at Kenneth Fischer's, Curtis Springer's and my record (ahem!). We single circuit boosters gotta' hang together. Just to show you what a single circuit will do—my friend Jack Gray of this burg got 80 stations in two and one-half months with about 60 feet of wire coiled up and hung on a nail in his room. If you don't believe it, write him. His address is West Ohio Street, Bay City, Michigan. By the way—he's using my hookup too.

Well, single circuiters, let's show 'em that we don't have to take dust from the Reinartz or any other receiver, including the "Super-het."

Yours truly,
RICHARD JONES.
300 N. Warner Ave., Bay City, Mich.

P. S.—Wise comeback, Pickups Editor, that was one on me! HI!

Dick gives us a list of rules to follow out with the set shown in the accompanying diagram. They are:

1. A good grid leak is the key to success. Use a good grid leak and experiment until you find the one that gives the loudest signals.
2. Solder all connections.
3. *Do not permit your set to whistle.* If it is built right it should pick up clear music within 200 miles. If you let it whistle you'll spoil your neighbors concerts. Keep the coupling near the spilling point, but don't let it spill over.
4. Be patient. If you can't pick up Hong Kong or Iceland the first night, don't be alarmed. Stick to it. (Think of the postage stamp—it goes a long way but sticks to the job until it gets there—The Ed.)
5. Use standard well made parts; not cheap stuff.
6. See RADIO AGE for January, 1924, page 21, about causing squeals. You can get just as good results by not letting the set oscillate as by making it do so. (Last night KGO could be heard with the phones several inches from the ears, without tuning with the set oscillating.)
7. If bothered by interference, build one of the wave traps in the January issue of RADIO AGE.

Good Luck!
RICHARD JONES.

And now that we've gotten this nonsense out of our systems—let's read on:

RADIO AGE,
Pick-Ups and Hook-Ups Editor,
Dear Sir:

I read the pick-ups by readers in your magazine each month and enjoy reading them very much.

I am especially interested in the single circuit receivers, as I own one from which I obtain very good results.

The following is a list of exactly forty stations received from 7 p. m. February 9 until about 1:30 a. m. February 10.

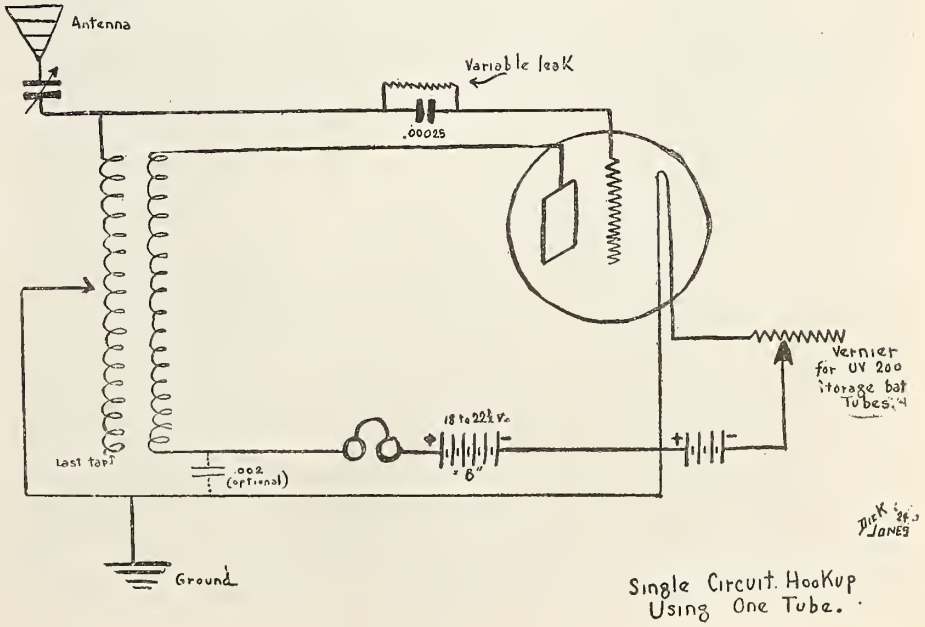
I am omitting perhaps a half dozen or more of whose location or call letters I am not sure:

WDAF, Kansas City, Mo.
KDKA, Pittsburgh, Pa.
WTAM, Cleveland, Ohio.
WTAY, Oak Park, Ill.
KFJW, Towanda, Kansas.
WOQ, Kansas City, Mo.
WJAM, Cedar Rapids, Iowa
PWX, Havana, Cuba.
WLAG, Minneapolis, Minn.
WSB, Atlanta, Ga.
WHAS, Louisville, Ky.
WSAI, Cincinnati, Ohio.
WMAQ, Chicago, Ill.
WCAE, Pittsburgh, Pa.
WFAA, Dallas, Texas.
WMC, Memphis, Tenn.
KYW, Chicago, Ill.
WEAF, New York, N. Y.
WGY, Schenectady, N. Y.
WTAS, Elgin, Ill.
KFMZ, Roswell, N. M
WOAI, San Antonio, Texas.
KFKB, Milford, Kansas.
WCAR, San Antonio, Texas.
WFAH, Port Arthur, Texas.
WDAP, Chicago, Ill.
KFMG, Coldwater, Miss.
KGO, Oakland, Cal.
KFLZ, Atlantic, Iowa.
KFFG, Angeles Temple, Los Angeles, Cal.
KFI, Los Angeles, Cal.
WJAZ, Chicago, Ill.
KHJ, Los Angeles, Cal.
WGR, Buffalo, N. Y.
WHAA, Iowa City, Iowa.
WBL, Anthony, Kansas.
WPAL, Columbus, Ohio.
WRC, Washington, D. C.
KPO, San Francisco, Cal.
WHAH, Joplin, Mo.

Please note that no stations were received in my home state, Louisiana, in the adjoining state of Arkansas and only one from the state of Mississippi and none from Alabama, making it necessary to receive stations from greater distances.

Sincerely,
H. F. WILLIS.
1200 Fairfield Ave., Shreveport, La.

We print herewith a copy of a log of one of our readers which is probably one of the most systematic and carefully arranged records of stations heard, as yet submitted by our readers. We certainly admire the method of Mr. Kulp's listing of the stations, and feel sure that our readers would be interested in seeing how the other fellow does it.



The above cut is an exact reproduction of the circuit as submitted by Mr. Jones, with which he gets such good results. It is nothing more than a simple single circuit hookup such as many of our readers are using with great success. Mr. Jones particularly warns against operating the set with the tube oscillating, as he contends that better results and signals can be heard without the set acting as a transmitter.

RADIO AGE,
Pick-Ups Department,
Gentlemen:

I have read several numbers of your magazine and have been especially interested in the records of the numbers of stations received in one night. Thinking that some of these records might be broken, I prepared to attempt this last night, February 14, with the result as shown on the appended sheet. From 6 p. m. until 1 a. m. a total of forty-five stations were heard, including ones from twenty different states and from two provinces in Canada, making up a total distance of twenty-five thousand three hundred and eighty (25,380) miles.

These were all heard on a three-tube set with no radio frequency amplification and practically all of them were audible on a loud speaker. My set is home-made and uses the regular Armstrong regenerative circuit. It is of the three-circuit type and consists of two variometers and variocoupler.

I am enclosing log of all stations received last night and the time that they were heard. This is no freak pick-up, as most of these can be heard any night on my set.

Yours very truly,
JOHN H. KULP.
223 Clifford Court, Madison, Wis.

Station	Location	Distance	Time
WOR	Newark, N. J.	805	6:00
WDAP	Chicago, Ill.	120	6:03
WDAF	Kans. City, Mo.	370	6:06
KDKA	E. Pittsb'gh, Pa.	575	6:08
WGR	Buffalo, N. Y.	490	6:10
WGY	Schenectady, N. Y.	800	6:20
WTAY	Oak Park, Ill.	120	6:33
KYW	Chicago, Ill.	120	6:38
WCX	Detroit, Mich.	350	6:40
WCAP	Wash., D. C.	720	6:56
WOAW	Omaha, Neb.	370	7:00
WBZ	Springf'd, Mass.	830	7:02
WOC	Davenport, Ia.	125	7:10
KOP	Detroit, Mich.	350	7:15
WHB	Kans. City, Mo.	370	7:20
WCAE	Pittsburgh, Pa.	575	7:30
WHAS	Louisville, Ky.	370	7:35
WBAP	Ft. Worth, Tex.	860	7:43
WJAX	Cleveland, O.	420	7:46
WWJ	Detroit, Mich.	350	7:55
WSB	Atlanta, Ga.	715	8:02
WSAI	Cincinnati, O.	400	8:07
KSD	St. Louis, Mo.	310	8:33
WFAA	Dallas, Tex.	825	8:40
WMC	Memphis, Tenn.	560	8:45
WBT	Charlotte, N. C.	700	8:57
WTAS	Elgin, Ill.	120	9:06
KFIX	Independence, Mo.	360	9:10
WEAF	New York City.	820	9:20
WCAL	Northfi'ld, Minn.	230	9:24
KFKX	Hastings, Neb.	480	9:45
CFCA	Toronto, Ont., Can.	510	9:50
WMAQ	Chicago, Ill.	120	9:54
WHN	New York City.	820	10:00
WJAZ	Chicago, Ill.	120	10:04
WLW	Cincinnati, O.	370	10:15
KGO	Oakland, Cal.	1,840	10:35
WFI	Philadelphia, Pa.	800	10:50
WDAY	Fargo, N. D.	460	10:56
WBAH	Minneapolis, Minn.	130	11:15
CKY	Winnipeg, Man., Can.	630	11:40
WKY	Okla. City, Okla.	720	12:05
KHJ	Los Angeles, Cal.	1,725	12:20
WIP	Philadelphia, Pa.	800	12:50
KFI	Los Angeles, Cal.	1,725	12:58

Total number of miles...25,380

GENTLEMAN JIM'S MISTAKE

When James J. Corbett recently spent an afternon with Willie Hoppe, the champion billiardist, the veteran fighter inspected Willie's radio set. Willie patiently explained to Jim that the little bulbs when lighted brought in the old DX, which gave Corbett an inspiration. If a little tube does distance, what will a big one do? Our photo shows James J. Corbett with his idea of a real "DX'er" while Willie tried to show him his mistake.

RADIO AGE,
Gentlemen:

After reading in your February issue the wonderful DX-ing done by the Dial Twisters, I find myself a bit discouraged. However, reviewing the circumstances I really can't say that my DX is so bad; hence this letter.

It is interesting to note that I am using the same fundamental hook-up employed by E. L. Laudell. I stumbled upon this circuit about nine months ago, and have been using it ever since with excellent results. During the summer months, I consistently logged Chicago, Atlanta and St. Louis in a location where other sets I had made refused to DX. During the campaign against reradiation, I "junked" this set, and have revamped it in the following manner. I use as an untuned primary coil a coil of 10 turns, a secondary of 60 turns shunted by a variable .0005 condenser, and a tickler of 50 turns, which is shunted by a .00025 variable condenser. All the coils are spider-web coils made by clamping the ends of 15 toothpicks between two circular discs as per the accompanying illustration (Figure 5) wound with No. 26 SC. The primary and secondary are permanently coupled to each other, while the tickler is adjustable. My record is as follows:

Using this set in an experimental state, with a C301A tube with 21 volts on the plate, an aerial of 40 feet flat top, with a 35-foot lead-in, and located in a comparatively poor spot for DX reception, I contrived to log the following stations with the locals all going full blast between 9:30 and 11 p. m.: WOO, WOS, WSB, WGY, WTAM, WDAP, KDKA, WLW, WKAR, PWX. The latter is my crowning achievement for both long distance and selectivity, as PWX operates on 400 meters and WOR operates on 405.

I don't know whether the above is sufficient to land me among the Dial Twisters this month, but if it is not then I'll have to try again with a different set.

Very truly yours,
JOS. W. PFISTER.
43 Menohan St., Brooklyn, N. Y.

To tell the truth, Mr. Pfister, I don't quite feel that your list warrants your name being put on the DT list—but I do find that your letter contains a valuable hint as to the winding of coils, and also the little circuit (Figure 6) which will show the fans how their single circuit sets can be made more efficient by the addition of this 10-turn coil which is used as a collector. This circuit is very much like that of the Simplifigon shown in the March issue in that respect, and does not radiate so violently. I am therefore putting your name on a list which I feel will carry more weight with readers, viz., the contributors' list, and hope that if you come across any other little kinks in the course of your experiments that you will let us hear from you. Come again.

Now the Pick-Ups Editor has a soft spot for "kids" and when a young chappy sends in a scrawl telling of his record he just gloats, especially if it beats some fellow about 45 years old with a 10-tube super-heterodyne. It seems that the young bloods have the patience to sit into the wee hours of the a. m.—if their indulgent parents permit them to—and then the next day they sit down and painfully write up the list—they probably get more sport out of the list and letter than the preparation of their next day's homework in 'rithmetic, and send it into the Pick-Ups Editor. And if he possibly can, he publishes them. Sometimes he has to, as in the case of Kenneth Fischer and Curtis Springer of Indianapolis, Ind. Anyhow—here's a list from another bug in his teens:

RADIO AGE,
Gentlemen:

I get your RADIO AGE every month, and I looked over your lists and I think I can better some of them. I am fifteen years of age, and in a little over three weeks that we have had our set I have received 103 different stations, some of which are nearly three thousand miles away, such as KPO, CFCI.

In one night I received these 45 stations: WCAD, WHAM, WTAY, WNAC, WIP, WDAR, WFI, WOO, WOR, WOC, WOS, WFAA, WHAS, PWX, KDKA, WCAE, WBZ, KYW, WHB, WGR, WHAZ, WEAF, WDAP, WGY, WJAR, WJAX, WSAI, WSB, WPAB, WJZ, WLW, WABB, WPS, WTAS, CHYC, WRC, WWJ, WCAB, KPO, WJAZ, WHN, WHK, WTAM, WDAF, WJAN.

Sincerely yours,
JOHN TOMLIN.
303 Madison Ave., Atlantic City, N. J.

From Atlantic City and its boardwalk we jump to the sunny clime of Texas in the following:

RADIO AGE,
Gentlemen:

I have been reading the Hook-Ups and Pick-Ups in your magazine and thought I would send in my records. All stations have been picked up in the last week and a half.

PWX, KFI, KDKA, KFFQ, KFKA, KFKX, KFKZ, KFKL, KGO, KHJ, KLZ, WAAW, WBAP, WLB, WCAL, WCAR, WCBD, WDAF, WDAP, WGY, WHAS, WHAZ, WHB, WJAM, WKY, WLW, WNAD, WOAI, WOAW, WOQ, WOS, WPAM, WSB, WTAM, WTAS, WTAY.

I am using one WD12 tube, and light socket for aerial. All stations heard more than twice and with enough volume to hear them plainly with one receiver.

The set I am using is one of my own make.

Yours truly,
BIRELEY ROSS.

RADIO AGE,
Gentlemen:

I have a crystal set of my own make, and here is a list of stations I picked up: KYW, WDAP, KFKX, WSAI, WLW, WCK, WJAZ, WJAM, WRAO, WSB, KSD, KDKA, WOAW and WMAV.

I think that makes me a Dial Twister—don't you?

Very truly,
ROBERT SIGNAIGO.
4170 Connecticut St., St. Louis, Mo.

P. S.—I can prove this any time you are in doubt.

And that's that. Now before signing off, we want to again come into the Pick-Ups department. C'mon in; the waves are fine.

ARMSTRONG'S SUPER-HETERODYNE

Maj. E. H. Armstrong, designer of the famous regenerative radio circuit, is here shown with the six-tube super-heterodyne outfit which he demonstrated at the Engineers Society of New York. The outfit uses dry cells and a tiny loop enclosed in the cabinet. He has heard 2LO, London, with the receiver. See other photograph.

RADIOTORIALS

SUBSCRIBERS, buyers of back numbers and buyers of our RADIO AGE ANNUAL, are hereby reminded that there are abroad in the land, a band of radio freebooters who pick up and carry off any good radio literature and illustrations they can find. They steal radio magazines from their neighbor's mail box in the apartment building vestibule. They pick them up from desks before the man to whom it was addressed can get even a glance at it. We mention this for the very good reason that many of our readers have been forced to ask us to change the address to which their magazine was mailed in order that they might be sure of getting it from the postman in person. All readers who miss an issue of the magazine or fail to receive their annual in a reasonable time are requested to investigate conditions under which the mail is delivered and guard against theft by radio-klepto-maniacs.

WE OWE apologies to Thomas J. Kennedy, 470 West 159th Street, N. Y. In our February issue we published a photograph of Mr. Kennedy and his famous three-tube honeycomb regenerative receiver. We also published a photographic back-panel view of the set. About three weeks after that issue of RADIO AGE was distributed over the United States and Canada we had a letter from Mr. Kennedy, saying that he was literally swamped with letters from RADIO AGE readers who wanted more information about his receiver. Mr. Kennedy said he could not possibly answer all these inquiries without a staff of stenographers. He sent us the wiring diagram of the circuit and you will find it in this issue of RADIO AGE. Just another of those incidents that prove we have a keenly alert and very extensive circle of readers.

RADIO comes so near being a public utility at the present moment that it is doubtful whether great financial interests could monopolize manufactures and broadcasting if they so desired and if they tried their level best to do so. With millions of Americans owning receiving sets for which they have paid a good round sum it is likely that it would be about as easy to take away their entertainment, or their free access to tubes, as it would be to deprive the babies of our American households of their milk bottles. When an art or an industry becomes so universal that conservative leaders estimate that about a quarter billion of dollars will be spent over the retail radio counters this year the business has outgrown private control.

It is a national utility. It is an international necessity. It is the source of entertainment and education for all peoples. It guides the mariner on his dangerous way in storm-swept sea lanes; it carries the message of the gospel on Sunday; it flashes news around the world when cables and telegraph wires, fail; it is the dancing master for rural swains and lassies; it tells the farmer when to get his hay in and when to sell his hogs at the top of the market. It signals the time to the punctual minded and it puts the children to sleep with bedtime stories.

Now how can you monopolize a force like that?

The American Telephone and Telegraph Company, one of the component parts of the giant Radio Corporation, denies it is attempting to control broadcasting. The company insists, however, upon its ownership of various patent rights on devices essential to broadcasting equipment. And the American Telephone and Telegraph Company demands certain fees from those of the broadcasters, whom it chooses to select as defendants to suits of injunction.

Taking the A. T. & T. at its word, the company's statement that it does not seek a monopoly of broadcasting, is reassuring. The agitation caused by the company's two lawsuits against broadcasters in the East, became so general that it was discussed officially by Secretary Herbert Hoover, of the Department of Commerce. Mr. Hoover said, "I believe it safe to say, irrespective of claims under patent rights on apparatus, that broadcasting will not cease and neither will our public policy allow it to become monopolized."

We are betraying no secret when we repeat that any effort to divert or control sales of tubes that are essential to several different makes of standard receiving sets is in restraint of the full development of what Mr. Hoover terms "an important incident of life." The Radio Corporation of America assures us that every effort is being made to keep ahead of the tremendous demand for UV-201 A tubes and that unfilled orders will be taken care of by April 1. That also will be reassuring to many thousands of fans who have been unable to go on with their operating and constructive work because they could not buy the necessary type of tube.

It is possible that the radio public is too nervous—that it shrinks at shadows. That very public apprehension, which has called forth these recent avowals from high places, is proof of the firm hold that radio has taken on our national life. As this magazine has said for two years: "Whoever is a friend of radio monopoly is no friend of radio."

White Radio Bill and Some Shadows

(C) Henry Miller News Picture Service, Inc.

PLANNING RADIO REGULATIONS

Congress has again undertaken the passage of a radio law that will take the place of the inadequate regulations in effect since 1912, when the radio art of today was scarcely dreamed of. Those in the picture, left to right, are the following members of the House of Representatives: Ladislas Lazaro, Louisiana; Schuyler Otis Bland, Virginia; Oscar J. Larson, Minnesota; George W. Lindsay, New York; Frederick R. Lehlbach, New Jersey; Wallace H. White, Maine, and Edwin L. Davis, Tennessee.

By FREDERICK SMITH

THERE is one vigorous objection raised by broadcasters, newspapers and radio fans to the new radio bill introduced in Congress by Representative Wallace White, of Maine. The point against which this opposition is aimed is the provision which would grant to the Secretary of Commerce full authority to regulate radio communication in the United State and its possessions.

With perfect faith in the fairness of Herbert Hoover, the present Secretary, it is still objected that nobody knows who his successors will be and that it is placing too much power in the hands of an individual.

A recent radio referendum on the wet and dry controversy, conducted by E. F. McDonald, Jr., at the Zenith-Edgewater Beach Hotel, Chicago, brought almost 50,000 paid telegrams into the station within about twenty-four hours. This remarkable incident is pointed to as an indication of the power of broadcast stations to reach the people.

It is held out as proof that such tremendous power, multiplied by 561, representing the number of stations now licensed, should not be placed in the hands of any individual. It is contended that the regulation of the vast force brought into being with the advent of radio-telephony, should be given over for regulation by a commission, just as railroad affairs are governed by the Interstate Commerce Commission.

Suing the "Independents"

Interest in the control of broadcasting has been centralized recently by the apparent effort of the American Telephone & Telegraph Company to demonstrate to the public that it alone controls patent rights that justify that company in demanding that all broadcasting stations shall, at the will of the A. T. & T., either pay the license fee demanded by A. T. & T. or be liable to suit for injunction to restrain those stations from broadcasting.

A. T. & T. has sued Station WHN, the jazzy entertainment center which holds forth in Broadway, N. Y. An injunction has been asked on the ground that WHN is using apparatus (as are all other broadcasters) on which A. T. & T. holds patent rights.

In addition to attempting to stop "independent" broadcasters from using the air the American Telephone & Telegraph Company proposes that broadcasters shall not use power or light wires for the transmission of "wired wireless." The telephone and telegraph giant therefore sued the North American Company in the New Jersey courts, contending that that $40,000,000 company had no right to serve

No Monopoly in Broadcasting Says Secretary Hoover

I AM in receipt of many requests for my views as to issues now before the courts bearing on the control of radio broadcasting. While it is impossible for me to express any opinion on particular issues that are before the courts or the Federal Trade Commission I can state emphatically that it would be most unfortunate for the people of this country to whom broadcasting has become an important incident of life if its control should come into the hands of any single corporation, individual, or combination. It would be in principle the same as though the entire press of the country was so controlled. The effect would be identical whether this control arose under a patent monopoly or under any form of combination, and from the standpoint of the people's interest the question of whether or not the broadcasting is for profit is immaterial. In the licensing system put in force by this department the life of broadcasting licenses is limited to three months so that no vested right can be obtained either in a wave length or a license. I believe it is safe to say, irrespective of claims under patent rights on apparatus, that broadcasting will not cease and neither will our public policy allow it to become monopolized.

"wired wireless" to those radio fans who preferred to get their radio joy by simply inserting a plug into the electric light socket and letting the big stations of the public utility corporation do the rest. In the latter suit A. T. & T. has a fight on its hands, if the fact that the North American Company has hired the best patent attorneys in the United States to contest the suit, may be taken as significant.

In New York City it is proposed to build a municipal station in defiance of A. T. & T., which company, it is claimed has persistently put obstacles in the way of the establishment of such a station. The new station is to cost $50,000 and the municipal authorities promise a "fight to the finish."

A Newspaper Opinion

The danger in the situation is pointed out by the Chicago *Daily News* in an editorial published on March 13, in which it says:

> Though the world may not owe any man a living, it does provide him with free radio concerts here in the United States. The bedtime story, the military band and other messages from the loud speaker, like air and sunshine, have escaped translation into the language of dollars and cents.
>
> Neverthless, certain kinds of radio entertainment are expensive. The waves in the ether set in motion by the golden voice of a famous operatic star may travel no farther than any other waves or exhibit superiority in any respect from a scientific point of view; still, they are costly, as a rule. Consequently an organization among radio listeners in New York is gathering a music fund for the purpose of making accessible the most expensive style of ether waves. In England it is necessary for a radio enthusiast to buy a license before acquiring his set.
>
> The radio public numbers now about ten millions. The ability of radio enthusiasts to pay for their concerts is a fact well considered by those interests which aspire to a monopoly of the air. If efforts strictly to limit or squeeze out the independent broadcasters should succeed these radio listeners doubtless would prove a richer concession than the famous Teapot Dome to any corporation obtaining control of the ether whether by patent rights or by other means.
>
> The White radio bill, now before Congress, upon which hearings are being held, must be carefully scrutinized and the public's rights against monopoly amply safeguarded if the measure is to pass. The people must demand protection against monopoly gained through bureaucratic favor and denial of the right of appeal. Here is a danger that apparently exists in the bill as it now stands.

Mr. Hoover's Views

As this issue of RADIO AGE goes to press the White bill is before the Merchant Marine and Fisheries Committee of the House. On March 11 Secretary Hoover made an address before this committee which sets forth his own views of the proposed methods of regulating radio communication and his attitude toward monopolization of the industry and his opinions about centralized private control of broadcasting. Because of its importance to all radio interests we publish the statement:

"It is urgent that we have an early and vigorous reorganization of the law in federal regulation of radio. Not only are there questions of orderly conduct between the multitude of radio activities in which more authority must be exerted in the interest of every user whether sender or receiver, but the question of monopoly in radio communication must be squarely met.

"It is not conceivable that the American people will allow this new born system of communication to fall exclusively into the power of any individual group or combination. Great as the development of radio distribution has been, we are probably only at the threshhold of the development of one of the most important of human discoveries bearing on education, amusement, culture and business communication. It cannot be thought that any single person or group shall ever have the right to determine what communication may be made to the American people. I am not making this statement in criticism of the great agencies who have contributed and are contributing so much to the development of the art and who themselves have been well seized with the necessities of its development and proper use, but I am stating it as a general principle which must be dealt with as an assurance of public interest for all time.

"Broadly, radio communication falls into two groups—that is, telegraphic communication by the use of the Morse code, and telephonic broadcasting.

"Telegraphic communication may be conducted from individual to individual and is highly adapted for personal communication parallel with and competing with our other forms of electrical communication. It may be found that some areas of communication can be best carried on by one single unit as experience has also shown to be the case in some other public utilities, but such cases should be conducted under Government control and supervision. Telephonic communication, however, is impossible between individuals from the point of view of public interest, as there are a very limited number of wave lengths which can be applied for this purpose and the greater usefulness of the available wave bands for broadcasting communication inhibits their use for personal communication. We cannot allow any single person or group to place themselves in position where they can censor the material which shall be broadcast to the public, nor do I believe that the Government should ever be placed in the position of censoring this material.

New Laws Needed

"The problems involved in Government regulation of radio are the most complex and technical that have yet confronted Congress. We must preserve this gradually expanding art in full and free development, but for this very purpose of protecting and enabling this development and its successful use, further legislation is absolutely necessary.

"How profound the changes in this method of communication have been since the regulatory Act of Congress approved in August, 1912, is indicated by the fact that the whole telephonic application is practically a discovery since the act was passed. At that time radio was in considerable use as a telegraphic method of communication, more especially with ships, but there was not a single telephone broadcasting station in the United States.

"Some indication of the development of the art is shown by the fact that at the time the act was passed 485 American vessels were equipped for transmission of telegraphic messages. There were 123 land stations, of which one was transoceanic. There were 1,224 amateur stations as I have said, all engaged in transmission of telegraphic signals. Today

(Continued on page 38)

What the Broadcasters are Doing

Inside the Studio

Battling in the ring amid the cries of thousands and attempting to deliver a short address over the radio amid the quiet surroundings of a broadcasting studio, are altogether different, according to Mike McTigue, world's light heavyweight champion boxer, who recently visited WGY, the General Electric broadcasting station at Schenectady.

Kolin Hager, chief announcer at the station, recalls it as one of the outstanding humorous events of the two years that the station has been in existence.

"He was scheduled to deliver a few words on boxing," explained Mr. Hager. "Naturally, he was the last man in the world that we expected would suffer a case of 'michrophone fright,' but he did. He stepped up to the pick-up device, but he could not talk. 'I would rather face Dempsey than talk into that thing,' he said. "The result was that his trainer, who accompanied him to the studio, was compelled to read the written address."

WGY is celebrating the second year of its existence. Mr. Hager has been in charge of the announcement since the institution of the station.

"I made my first announcement on the night of February 21, 1922—with many misgivings," said Mr. Hager. "I had rehearsed just what I was going to say, twenty-five or thirty times, and then, when the time for the announcement arrived I said something altogether different from that which I had intended."

The WGY studio is a comfortably furnished suite of rooms on the first floor of a new office building. The room from which come the songs and selections, the speeches and the readings, the comedies and the dramas, is furnished with nothing in the way of scenery such as is found in theaters, yet it was only a few days ago that the studio officials received a call from a traveling scenic artist who had been told that he might land a job at WGY painting scenery for the radio

"One day the phone rang rather vigorously," said Mr. Hager. "I answered it and received this message: 'My husband is dead, thank God, and I wish you would broadcast the fact.' "

Not so long ago the WGY players, a dramatic organization, built up for the broadcasting of plays, delivered the comedy, "Get Rich Quick Wallingford," in a most excellent manner. The story of the play has to do with the exploiting of an invention for "carpet covered carpet tacks" and it is really amusing, as all Wallingford stories are. Not long after the play was broadcast the studio received a visit from a woman who appeared very much excited.

"You have exposed my secret," she said. "I have been working for a considerable length of time on this proposition

Photo Topics.

N. Y. SCHOOLS ADOPT RADIO

Children of Public School 76, Manhattan, who gave vocal selections over the radio under the direction of Miss May O'Conner from the Board of Education Building.

SO THIS IS LONDON!

This interesting photograph is the first to be taken at the studio of 2LO Broadcasting Station in London, showing the orchestra broadcasting. Note the disc-shaped microphone at the right. This station is frequently heard in the United States.

and just as I get it perfected I hear you broadcasting it to the world, telling everyone about it."

"Absolute silence in the studio is most essential," said Mr. Hager, "and it is with the utmost difficulty that we are able to impress this upon the artists or speakers who may be on the program. This silence must be maintained after the song or speech has been finished until the power has been cut off. But very often a vocalist will turn about, immediately after finishing a song, and while standing in front of the microphone say, "Did I sing that all right?"

New Canadian Station

An epoch marking event in the history of radio in Canada—and one which very closely concerns local radio fans—is the opening of the largest and most powerful radio station in Canada, which went on the air in Ottawa on Wednesday evening, February 27th, with a complete and varied program of musical selections and a talk to listeners by Sir Henry W. Thornton, K.B.E., chairman and president of the board of directors. The new station expects to have a range beyond that of any station in Canada, due not only to its up-to-date equipment, but also to the height of its aerial, which stands on the roof of the Jackson Building and reaches two hundred feet above the ground.

The new station signs CKCH and broadcasts on a wave length of 435 meters. The initial program was relayed by station CHYC, Northern Electric, Montreal, on a wave length of 341 meters, so that radio listeners everywhere in Canada and the United States had no difficulty in receiving the program.

Mr. W. H. Swift, Jr., radio engineer for the Canadian National Railways, is responsible for the installation of the new station, which will undoubtedly have the most varied and interesting programs in Canada. Broadcasting will take place Wednesday and Saturday evenings, with occasional church services on Sundays. It is the intention to make the Wednesday evening programs of a serious nature, including music of the highest type, addresses, and possibly speeches in parliament, while the Saturday evening program will be in a lighter vein.

Station CKCH transmits news items as a part of its program, linking up with the radio receiving sets which have been installed in the observation-library cars of Canadian National Railways transcontinental trains. Arrangements have also been made whereby station CKCH will be at the disposal of the Canadian government at any time desired.

Longest Radio Program

It took only one concert, broadcast from the new studio of WJAX, Cleveland, Ohio, to prove to The Union Trust Company, which owns and operates this station, that WJAX was getting out over the entire country from its new station just as successfully, and perhaps more so, than from its old location in the Citizens Building.

The new studio is located upon the twentieth floor of the new 20-story Union Trust Building, the largest bank and office building in Cleveland, which is shortly to be occupied by The Union Trust Company itself.

The moving of the broadcasting station to the new building was simply the forerunner of the moving of the entire bank.

This first concert from the new studio, which was given upon the evening of Tuesday, February 26, was unique in many ways. In the first place, it probably set a record for length of any single radio concert. It began at 7:30 in the evening of Tuesday, February 26, and continued without interruption until about two minutes before 5:00 on the morning of the 27th.

This program was arranged entirely by the Cleveland *News*. About 125 performers appeared upon this program. Besides soloists of every description, both vocal and instrumental, there were four different dance orchestras, a male chorus of 35 voices, and an entire scene from a play, "Abie's Irish Rose," given by the players themselves, who came up to the studio after the show was over at the Colonial Theater, Cleveland.

Henry Ford's Station

Station KDEN, Dearborn, northern terminus of the Detroit, Toledo & Ironton Railroad radio system, now is operating in a new home with an installation of advanced design setting new standards of efficiency for its rating. For the last three weeks, more than 400 messages per eight-hour day have been handled by this equipment with reliability and dispatch in conjunction with the company's radio offices at Springfield and Jackson, Ohio, 200 and 300 miles distant on an air line, respectively. Capacity will be increased within a few months to 2,000 messages in eight hours by additional apparatus. An efficient printer telegraph system for relaying messages to the River Rouge offices automatically as they are typed by the receiving operator will be ready for use within a few weeks. Innovations further to increase completeness of the system may be expected from the continuous experimental work in progress.

Commercial radio telegraphy for use by railroads is proving itself a practical and efficient means of business communication between widely separated stations. More than that, it demonstrated during a recent heavy snowstorm an emergency utility for train dispatching which made possible operations of D., T. & I. trains on certain sections when land wires were down and service was disorganized on many railroads in the central states.

Extensive use of radio for D., T. & I. commercial work has been in progress for about two years, the former equipment at Dearborn consisting of an antenna of 70-foot mean height and transmitting apparatus of 150-watt power (increased last May from 50 watts). Now the antenna is 165 feet above the ground and the present use of 80 watts is far more effective than the larger output of the old station. Equipment now being connected

will increase the total output capacity to 1,500 watts, this being divided between two separate sending equipments of 1,000 and 500 watts capacity, respectively. D., T. & I. stations, WNA at Springfield and WJQ at Jackson, Ohio, now have 500 and 100-watt installations respectively. With the new equipment at Dearborn, direct communciation with Jackson is possible, although the Jackson station was designed for operation only as far as Springfield, whence the messages for Detroit have formerly been relayed north

At Dearborn three towers approximately 450 feet apart and 165 feet above the base are placed in the form of a triangle. Stretched along two sides of this triangle are the antenna wires, in sets of five wires each, and 360 feet in length. These furnish two transmitting or receiving aerials which may be used simultaneously If it is desired later to use triple equipment, the third side will be provided with wires. Antenna wires are of seven-strand No. 16 gauge phosphor bronze of superior strength and electrical efficiency. The antenna is held from sagging by 400-pound take-up weights.

Under the water of the lake, encompassed by the towers, more than a ton of copper wire is sunk paralleling the antenna wires above. This provides the ground counterpoise of the antenna system and is connected with the sending equipment.

D., T. & I. commercial stations operate on the heterodyne principle—that is, the receiving tube must be oscillating at a frequency in cycles per second slightly different from the frequency of the waves received. The resultant combination of waves reduces the frequency from radio to audio. For instance, the incoming wave from Springfield station may be 175,300 cycles per second, the Dearborn receiving set detector tube is adjusted to oscillate at 174,300 cycles per second and the difference between the two, 1,000 cycles, results in a signal having a clear high-pitched whistle in the receiving telephones. The heterodyne principle accounts for the fact that the Ford stations cannot be heard on a crystal or non-regenerative vacuum tube receiving set. The wave lengths used, 1,713 meters for Dearborn, 1,875 for Springfield and 1,934 for Jackson, are such that they interfere with no other commercial stations operating at the same time and are inaudible to receiving sets tuned in for radio broadcasting concerts.

In the South Seas

The American radio broadcasting station will, in the near future, act as a powerful educational influence on the backward civilization of the islands of the Southern Pacific, predicts Maj Gen George S. Richardson, administrator of Western Samoa, under a mandate from the League of Nations to New Zealand. This statement was made in a letter from General Richardson to KGO, the Pacific Coast broadcasting station of the General Electric Company at Oakland, California, after he had listened to the entire program as the guest of Quincy F. Roberts, American consul at Apia, British Samoa, on January 12.

The entire program came in so clearly 5,000 miles from the sending station that "Vailima," the old home of Robert Louis Stevenson, now the residence of Major General Richardson, has been named a "listening station" of KGO. The governor has become a radio fan and will equip his residence with a radio set.

Consul Roberts, in a letter to KGO, stated that he invited General Richardson and his family to listen in the KGO and his excellency was astonished at the strength and clearness of the signals coming from a station 5,000 miles away.

Major General Richardson's letter follow:

"This evening I, with my wife and family, have been most pleasantly entertained by your company, and we feel very grateful to you and the excellent performers who so kindly gave their services to transmit their talent through the medium of your wireless installation to us, and to thousands of others who are isolated from the outside world by their residence in the tropical islands of the Pacific."

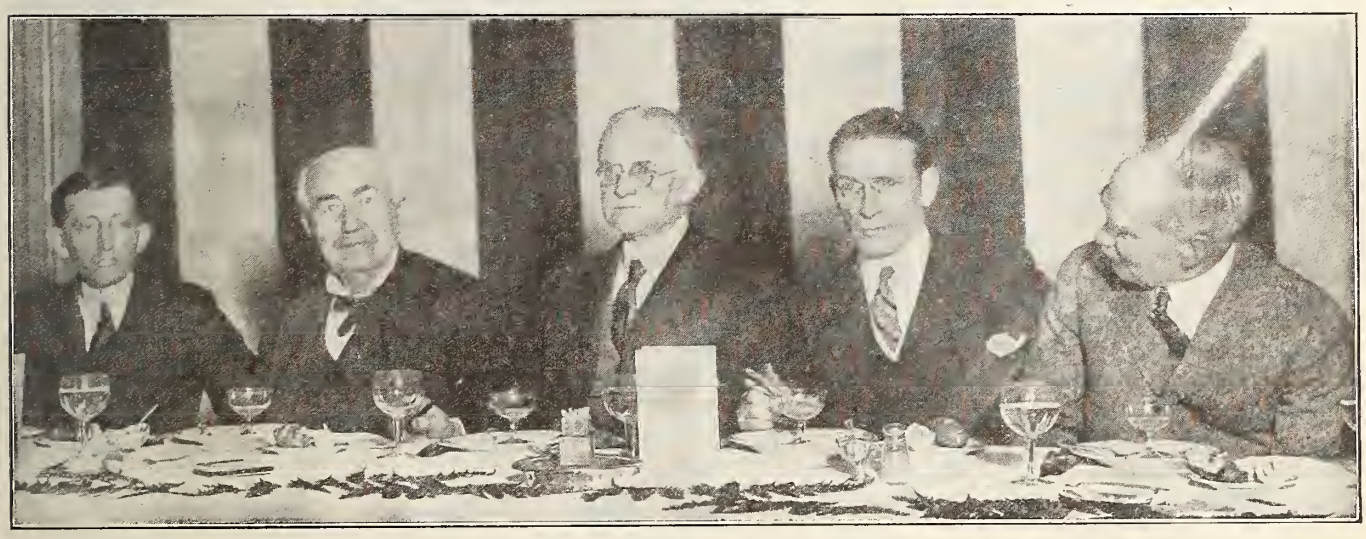
WBZ Teaches Music

So successful were the courses in Radio and Household Management broadcast last fall from Westinghouse Radio Station WBZ through the co-operation of the Massachusetts of University Extension, that a new course in Musical Appreciation was commenced Thursday, March 6. The course consists of eight weekly lectures given by Prof. Elisha S. Olmsted of Smith College.

A feature of the course is the use of actual examples for the lectures. In other words, the radio students taking the course are not only told about the different forms of music with explanations of their characteristics but they actually hear music to illustrate such points.

In order that a definite reaction can be had regarding the course, a fee of one dollar is charged to those wishing to participate. Each student receives printed information which assists him in learning the subject and in being able to differentiate between the different types of music that he hears over the radio, on the stage, and in the concert hall. The money received is given to the instructor for his time and effort and to defray the expense of sending the printed matter to the student.

In a course of this character that is broadcast, anyone having a receiving set can listen in but only those who send in the registration fee of one dollar will get the full benefit and receive credit at the end of the course.



CELEBRITIES AT A PARTY

Thomas A. Edison who celebrated his seventy-seventh birthday, February 11, was tendered a complimentary luncheon at the Ritz-Carlton Hotel, N. Y., by motion picture and other personalities. Photo shows, left to right—Will H. Hays, Thomas A. Edison, George Eastman, Senator Edward I. Edwards and Dr. Lee de Forest.

Rome to Washington

Since February 20th, the Navy Communication Service at Washington has been in daily touch with the San Paolo radio station at Rome. This circuit, closed as unreliable some time ago, was recently reopened with "IDO," San Paolo, a new radio transmitting station in Italy.

Radio Age Data Sheets

By JOHN B. RATHBUN

THERE has been a great demand for some form of radio reference work in which the more important features of radio engineering can be assembled in compact and easily accessible form, a sort of radio "pocket book," so to speak, which can be kept up to date by the addition of standard size pages cut from the successive issues of RADIO AGE. The old method of filing clippings cut from the regular reading pages was attended by many difficulties, for the clippings were irregular in size and difficult to file systematically. Again, there were often two different subjects on opposites of the page which made proper classification an impossibility, and worst of all, the matter would not fit a standard size binder.

In this issue, RADIO AGE starts a new and valuable feature, a series of radio data sheets having standard size pages and which are printed only on one side so that they can easily be filed according to subject matter. They can be placed in standard binder covers, and when the series is completed the reader will have a very complete and up to date pocket book which thoroughly covers the various fields of radio. In order to conserve space and to be of value as a reference work, the text will be as concise and short as possible, a complete radio library within the limits of two covers.

Indexing and Classification

Owing to the many branches of radio subjects and the many subdivisions contained under each of these general subjects, a comprehensive indexing system was somewhat difficult to arrange. Much study was given to this problem before a suitable system was devised, and after going through the several library cataloging systems it was considered best to fall back on the old reliable lettering method in which each general subject is given a definite letter while the sub-subjects under this head are numbered.

On the page opposite this introduction is an index of the general subjects covered, the indexing letters referring to the subjects being in the left hand column. The sub-numbers are not yet shown as they will be of little interest to the reader except that they are of service in keeping the sheets filed in their proper order.

As an example, we see from the index sheets that the subject of inductances and inductance calculation is under (F), hence when all the (F) sheets are assembled we will have a complete chapter or section on the subject of inductances. Under (G) will be found everything relating to aerials and aerial calculations, and so on. The number immediately following the letter refers to the location of the sub-subject or division under this number.

Taking the subject of inductances as an example, and honeycomb coils in particular, we will find that all data given in regard to honeycomb coils will be given under the number (20). Thus, the index for honeycomb coils will read: F-20, and all the F-20's must be collected together. Following the sub-number is the second number or page number by which the pages can be arranged to run in order under a given subject. Thus: F-20-8 indicates that the sheet is on the subject of inductances, that (20) shows that honeycomb coils are referred to, and that the page number (8) is located in the eighth place under the section number (20). This is easily understood after a little experience and is the only practicable method of filing.

SUIT CASE RECEIVER

Demand for good portable sets is going to be heavy from now on. The photograph shows Miss Claire Patton with a six-tube receiver which is exceptionally compact. A loop aerial is contained in the small case. With head phones this outfit picks up stations 800 miles distant. The receiver was exhibited at the recent radio show in New York.

Covers All Branches

In order to cover as wide a range of subjects as possible within the first few issues, the sheets will not be published in alphabetical order, but will be somewhat scattered in regard to subject. We cannot very well begin with the letter (A) and run through the list alphabetically, as this would prove tiresome and the sheets would have but little practical value until we got down to (G) or points beyond. We will attempt to give all branches as nearly equal representation as possible in the beginning so that the sheets will be of general interest.

Owing to the necessity for expansion, and for the addition of supplementary sheets made necessary by future developments, it will be necessary to allow for expansion gaps between the different sections. The radio industry is developing too fast to permit of running the sheets solidly in the order of their page numbers. Thus, if you receive sheets F-20-1 and then F-20-5, do not think that you have missed the pages 2, 3 and 4. It is likely that these pages have been left open for new matter that might develop later on and which was therefore not originally contemplated.

Beginners and Experts

It is our intention to include both technical and popular matter in these sheets, both for the engineer and student and for the reader who only has a general experimental interest in radio. Notes on "trouble shooting" in tabular form and practical hints on construction will be among the helpful data sheets issued for the novice in radio. For the advanced student and engineer will be formulae, tables and graphical charts for computations and laboratory test methods for determining the values of inductances, condensers, etc. We aim to cover the field thoroughly and in detail.

Starting with the letter (L) in the index and ending at (P) will be seen a very

(Continued on page 36.)

INDEX

RADIO AGE DATA SHEETS SUBJECT

By John B. Rathbun

(Letters X-Y-Z left open for future developments.)

RADIO AGE DATA SHEETS

By J. B. RATHBUN

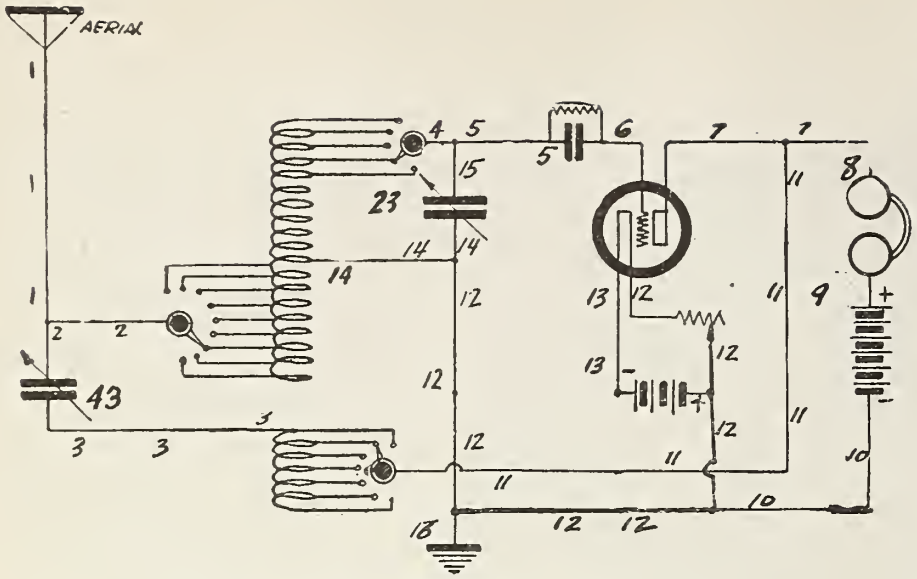


Figure 5. The Reinartz circuit illustrated on page 10.

(Continued from page 12.)
iar with tuning and has learned how to handle a set, or for other reasons wishes to go a little deeper into the subject, a single circuit tuner, using an audion detector, is suggested.

Ultra Audion Circuit

Many single circuit sets will be found on the market, but the most simple of these is perhaps that which is known as the "Ultra Audion." This set, instead of using a crystal detector, makes use of the vacuum tube, and is known to be extremely sensitive. Records show that distances of two thousand or more miles have been covered with it and the reception was good and clear. This also is a very inexpensive set and is very easily tuned. It must, however, be remembered that the same rule in regard to the aerial construction applys to this set as that of the crystal. Much will depend upon the location and the aerial. This arrangement will cost less than many other single circuit types, and if one wishes to assemble his own set, he will find it a very easy job. This circuit is shown in Figure 2, and for the benefit of those who wish to make their own set it is stated that instructions for its assembly have been published several times in previous numbers of this magazine.

If, however, one wishes to purchase the set complete he will find that there are several types of ultra audion receivers on the market. Some of these make use of a tapped coil for the inductance and some use a variometer. The purchaser is advised to select the latter for the reason that a much closer adjustment can be obtained with this form of inductance. He should also make sure that the variable condenser used has a vernier adjustment. This type of condenser and the variometer are not so important for local reception, but when tuning in long distance stations one will find them absolutely necessary.

Other single circuit tuners may be used, of course, but from actual experience, the ultra audion has proven to be the easiest to construct and the most satisfactory and reliable of the single circuit tuners. It is of the regenerative type which assures one of more volume than can be obtained from a non-regenerative set. If volume enough for a loud speaker is desired, this can always be obtained by adding two stages of audio frequency amplification.

Reinartz Is Popular

The next set to be described should cost but little more than the ultra audio and has been proven out by thousands of radio fans. This is the Reinartz tuner as shown in circuits No. 3, 5 and 6. This also has a reputation for very long distance reception and probably the beginner will find it a little more complicated than the ultra audion, but, in fact, it is no more so than many others. A careful study of the circuit will soon convince one of this fact. Complete sets of this type are for sale in the radio stores and full instructions for making it have been published in former numbers of this magazine.

The performance of this set is about on a par with the ultra audion, although there are many who claim it is better. The inductance is usually wound in the spiderweb form to cut down the effects of distributed capacity. Tuning is accomplished by means of two variable condensers and three switches as shown. This makes the tuning operation slightly more difficult because of the added number of controls, but these, of course, make it possible to get a much closer adjustment, although it may take a little more time to do it.

Regenerative Also Good

The standard three-circuit regenerative set is the next in line. In this set the aerial, grid and plate circuits are all adjustable and in this they are similar to the Reinartz. The standard three-circuit regenerative set is probably the oldest of all and there are many who consider it the best of the reasonably priced outfits.

The principal parts used are first the variocoupler, the primary winding of which is adjustable, and is connected in the aerial and ground circuit. The energy is transferred from this aerial coil to the grid circuit by induction and the inductance in the grid circuit is controlled by a variometer. Another variometer is placed in the plate circuit and is used to control regeneration. A study of circuit No. 4 will give a good idea of the arrangement of these parts. The standard three honeycomb coil circuit is also a three-circuit regenerative set and has the additional advantage of substituting coils, having a different number of turns for the purpose of adapting it to different wave bands. These coils are so arranged that they may be changed instantly and the set can be so adjusted that it will give reception on wave lengths of any range. For the beginner who is interested in spark reception and can read the code, a set of this kind will be very interesting.

Reflex Circuit

Coming now to the higher priced receivers for the man who cares not for expense, but wants to get good reception, there are many which can be recommended. Among these are the different reflex arrangements in which the tubes are made to do double duty, thus giving much more powerful reception with practically half the number of tubes required in other sets. One noticeable feature about these receivers is the fact that while vacuum tubes are used for the amplification, a crystal detector is used.

This is because the crystal is known to be the best detector so far as clarity is concerned and because of the many steps of amplification used, the signal is greatly strengthened by the time it is ready to be rectified. As the crystal is very efficient on signals of great strength, it has been found to be the best for this class of service. Receiving sets of this type will bring in long distance broadcast programs on the loud speaker very nicely.

If one builds his own reflex set, however, he must use considerable care to get the proper apparatus and to see that the right condensers are used in the proper place, otherwise the balance of the different parts of the circuit will be destroyed and the set will not function as it should.

Data Sheets

(Continued from page 34.)
considerable amount of space that is devoted to radio circuits or "hook-ups." This material will cover a great variety of receiver types and is arranged according to the class of circuit, whether regenerative, radio frequency, etc. Preceding each of these sections devoted to hook-ups will be explanatory matter on the principles of the circuits and data on their successful construction and operation.

Two broadcasting stations are attempting to solve the problem as to making broadcasting self-sustaining. They are WEAF, the American Telephone & Telegraph station in New York, and WHB, the Sweeney School, Kansas City In New York a group of financially responsible gentlemen has undertaken the raising of a fund contributed by broadcast listeners with which to pay high class entertainers. A fund for the same purpose is sought by the Kansas City station through the medium of the sale of imaginary seats in an invisible theater. The school finances the station sufficiently to conduct it, under this plan, and the broadcast listeners are asked to pay for the entertainment. The price of "seats" is from $1 to $10. One of the inducements to buy "seats" is the proposal to send out advance programs to all those who pay more than the minimum of $1 for their tickets.

The Music War

The National Association of Broadcasters gives out the following statement:

"The controversy between the American Society of Composers, Authors and Publishers and the National Association of Broadcasters, has broken out afresh and rapidly reached an acute stage.

"The incident which renewed this fight was the forcing of a license to broadcast their music by the American Society upon the Edgewater Beach Hotel of Chicago which they did not want and will not use Full details are given in the attached letter addressed to the American Society.

"Aroused by these high handed methods, John and Tracy Drake, proprietors of the Blackstone and Drake hotels of Chicago, called a meeting on February 6th at the Blackstone Hotel, which was attended by the principal hotels, moving picture theater owners, dancing academies, music schools and broadcasting stations, in the Chicago district.

"It was the first time in any part of the country that the interests have met jointly for the purpose of resisting the American Society.

"The Chicago meeting adopted plans designed to more effectively combat the increasingly unfair demands and tactics of the American Society. It is now felt that the measures adopted will check their avarice, and hold them strictly within the zone of fairly and justly administered enterprises.

"The objectionable, coercive methods used by the American Society are not approved by their more representative members. This is shown by the resignations of Waterson, Berlin & Snyder of New York, one of the six big publisher members, and Will Rossiter of New York, one of the oldest men in the music business, immediately upon their learning the facts Both letters of resignation are herewith attached. Henry Waterson sets forth his position in clear terms, and refuses to take part any longer.

"Radio listeners are intensely interested in this weakening of the American Society, indicating as it does the fast approaching time when five thousand American authors and composers and fifteen hundred American publishers will have an equal chance with the two hundred and seventy-seven combined foreign and American authors and composers, and the forty-six combined foreign and American publishers now constituting the American Society."

CLASSIFIED ADVERTISEMENTS

Six cents per word per insertion, in advance. Name and address must be counted. Each initial counts as one word. Copy must be received by the 15th of month for succeeding month's issue.

RADIO ODDS AND ENDS

No. 14 square tinned bus wire—2 ft. lengths—64 feet for $1.00. $1.20 set of 8 lettered binding posts—60c. Spaghetti—3 ft. lengths, red, yellow, green or black—7 lengths—21 ft.—$1.00. 50 assorted brass screws, nuts, washers, lugs, etc.—50c. All four items prepaid return mail—$3.00. Radio list for stamp—none free. Kladag Radio Laboratories, Kent, Ohio.

BOOKS

If you have not bought your Reinartz Book, fully illustrated with hook-ups and clear description of how to make this popular circuit, send $2.50 in money order or currency and we will send you the booklet "Reinartz Radio" and place you on the subscription list of Radio Age for one year. Address Radio Age, 500 N. Dearborn Street, Chicago, Ill.

15-20% DISCOUNT ON ALL STANDARD RECEIVERS, Fried-Eisemann Neutrodyne, $125.00; New Radiolas, etc. Thomas Radio Co., 111 Dex St., Muncie, Ind.

RADIO BATTERIES

Super Radio A and B Circuit Batteries, which bring in long distance reception. Sold for cash or on payment plan. Write for prices and details. Radio Battery Corporation, 501-B Industrial Bank Bldg., Flint, Mich.

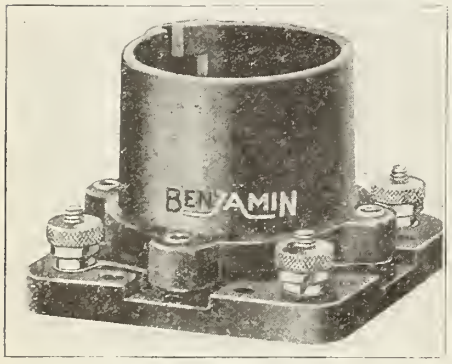
WITH THE MANUFACTURERS

CLE-RA-TONE SOCKET

The Benjamin Electric Mfg. Company, Chicago, is producing a socket for vacuum tubes called the Cle-Ra-Tone.

The tube-holding element of the socket floats on light springs which act as shock absorbers and neutralizes all interfering vibrations which ordinarily would cause "tube noises." The general effect is clearer reproduction.

Vibrations which interfere with clear reproduction by the radio tube are of two kinds: (1) that caused by jar such as might occur from striking the receiving set with the hand or clicking the switch lever from one point to another; and (2) probably the more offensive kind called microphonic These microphonic vibrations might be produced by footsteps in the same or adjoining rooms or by street cars passing nearby or other such noises which are often



in large cities, noticeable only by their absence as in the stillness of the night. Noises of this kind set the tube filaments in motion and are reproduced as very offensive disturbances over the 'phone. It is the ability of the new Benjamin Cle-Ra-Tone Socket to eliminate these microphonic noises which makes it of great value.

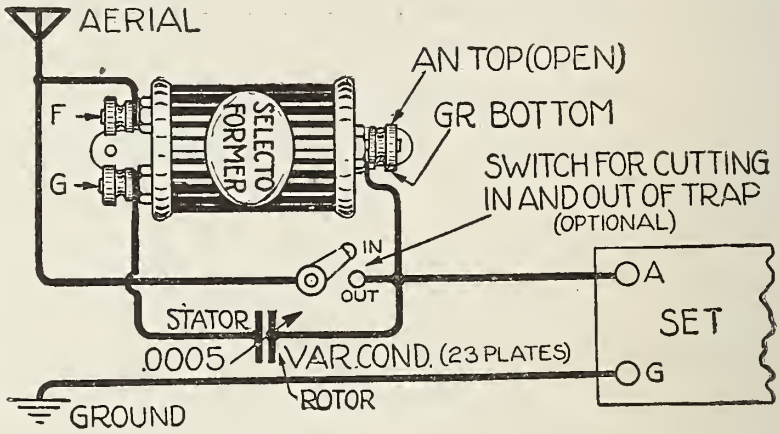
This shock absorbing feature also protects the lamp and is therefore excellent for portable receiving sets which are subjected to shocks in moving from place to place. The shock absorbing feature is in no way interfered with by stiff bus wiring because the wiring terminal base is separated from the tube holding element by the tight springs mentioned above. The socket is made in two sizes—one for standard base tubes and the other for UV199 types.

Variocoupler-Wave Trap

The Electrical Research Laboratories, better known as the ERLA Company, have placed on the market a unit of the same standard of engineering as prevails in their reflex sets and accessories.

This unit, known as the Selectoformer, is entirely in keeping with the general trend toward low loss, high grade tuning units which are now being marketed.

The unusual feature of the Selectoformer lies in the fact that it not only serves the purpose of a variocoupler, but also can be used effectively as a wave trap, enabling the owner to minimize the interference and cross talk caused by the many high power stations now in operation.



Due to the fact that this unit operates without taps, which every engineer knows causes losses in tuning circuits, its efficiency is very high both as an eliminator of interference and as a tuner. When used as a tuner, the connections are made much in the same manner as that of the fixed coupler of the Neutrodyne circuit, and when the operator desires to use the unit as a trap circuit for interference, the unit is shunted by a .0005 MF variable condenser, which should be of good design and low loss. The manufacturers claim that it increases the strength of the incoming signals when it is so used.

In the accompanying illustration the connections for using this unit as a preventer of interference are shown. W. J. Schnell, A. E., with the Erla Company, tells how this unit functions most effectively in the above circuit:

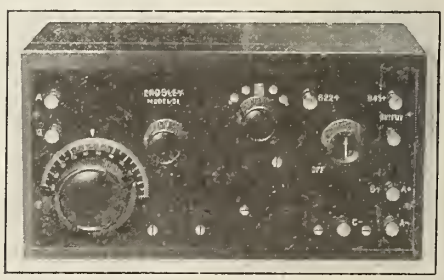
"In perfecting the Selectoformer, the engineering staff found that the design required also provided the means for an efficient rejector, or wave trap. It is not difficult to put an absorbing device in the antenna system to stop certain ranges of frequencies, but if such an absorbing device is not carefully designed it will, like the old variocoupler, add its resistance to the input circuit.

"As has already been demonstrated, this effect is found where very close inductive or conductive coupling is used. But in a wave trap closer coupling is necessary than would be used if the only object was the coupling of the two circuits for the transfer of energy, because it is desired to absorb energy from the antenna circuit, yet this absorbtion must not be so great as to absorb desired signals. Therefore, a different coupling co-efficient, as well as a different antenna coil constant, is necessary to get an efficient wave trap effect. Two separate and distinct requirements of a coupler and wave trap have been embodied in the Selectoformer by using two separate designs in one assembly."

Two-Tube Sets for $18.50

Simplicity of operation makes the new Crosley Model 51 Receiving Set very popular. It has detector and one-stage of audio frequency amplification, utilizing the Armstrong regenerative circuit. One multistat operates both tubes. It sells for $18.50 and is made by The Crosley Radio Corporation.

Reports have already been received from owners of this new set, one man going so far as to testify that he has received 68 stations so far and many of them came in so loud he was able to use a loud speaker. This little set is built in a handsome mahogany cabinet and makes an ideal receiver for placing in the living room or any other part of the home. Its operation is so simple that children can use it with ease and any type of vacuum tube may be used with perfect results.



Farm Radio Figures

REPLIES from 73 Illinois county farm bureaus in a radio survey just completed by the Illinois Agricultural Association, revealed that there are 20,845 radio receiving sets on farms in these counties. The survey would indicate that between 7 and 10 per cent of the rural population of the state have installed receiving sets.

"The survey was made for the purpose of determining the extent of the use of radio on farms, the type of programs most desired, practical benefits of the radio, and for the planning of programs to meet the demands of the constantly growing army of farm radio fans," state I. A. A. officials.

These farm radio sets tune in nightly on stations all over the United States. Chicago, Davenport and St. Louis are mentioned most frequently, because they are near and easy for a small set to pick up, but many reports were given stating that farmers tune in on Kansas City, Dallas, Ft. Worth, Jefferson City, Omaha, Pittsburgh, Philadelphia, New York and other broadcasting stations.

The counties near broadcasting stations naturally show the most sets. Madison county, in the vicinity of St. Louis, has 2,550 sets; Rock Island county, near Davenport, has 900, and in Henry county, also near Davenport, the report shows that nearly one-third of the entire farm population has sets.

Only about 25 per cent of the farmers owning radio sets make their own, the rest being manufactured sets, the survey shows.

One of the questions asked in the survey was, "What sort of radio programs do such gatherings use the most and like the best?" The almost invariable reply to this was, "Musical programs and occasionally good lectures."

Replies from most of the counties indicate that many farmers tune in on the weekly farm lectures broadcasted each Tuesday night from station KYW, Chicago, under the auspices of the American Farm Bureau Federation.

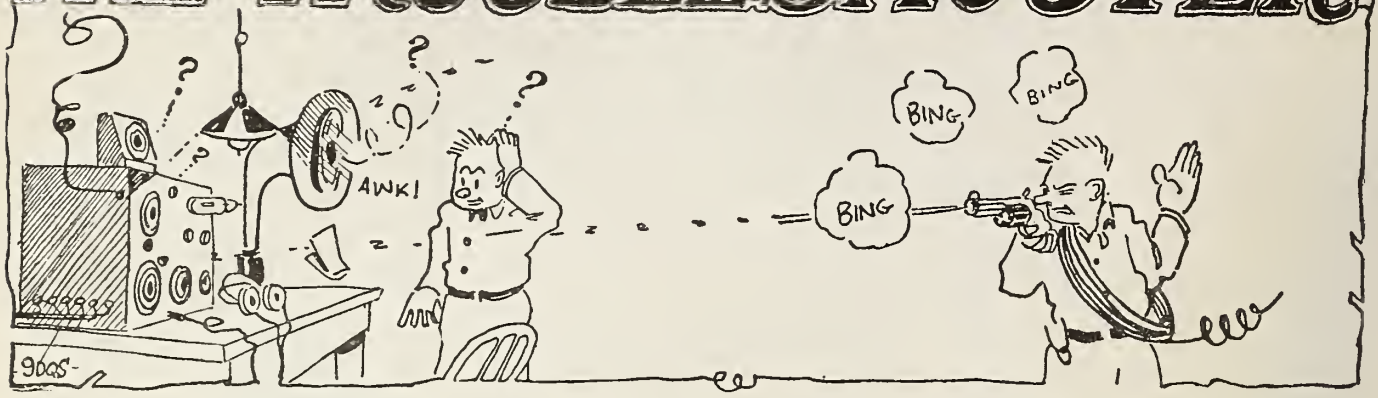
Individual farmers, farm bureaus and banks tell of practical benefits from the daily market and weather reports. Montgomery county, near St. Louis, furnishes this example:

"The First National Bank of Raymond, Illinois, has a radio set and gets the opening livestock market at 9:30 a. m. The manager of the co-operative shipping association keeps in close touch with the market report at East St. Louis, and several times has received the market report at 9:30, called in one or two cars of hogs and hit a good market at East St. Louis the next day. On several occasions this made the farmers from $50 to $100 per car more money for their hogs."

The returns from Madison county state: "The reports keep the farmers in closer touch with the markets and they are not the prey of buyers who may come along and offer below the market for hogs or cattle."

One point that was stressed was the necessity of having farm programs early in the evening, since the 10 o'clock programs are rather late for farmers.

THE TROUBLESHOOTER



B. C. L. Everywhere, USA.

Question: I desire to write your department for information, and would like to know the best way to go about it. Kindly inform me if there is a charge for this information. How many questions shall I ask in one letter? Is a stamped addressed envelope necessary with my inquiry? Please give me some information on the proper way to request the services of your technical department.

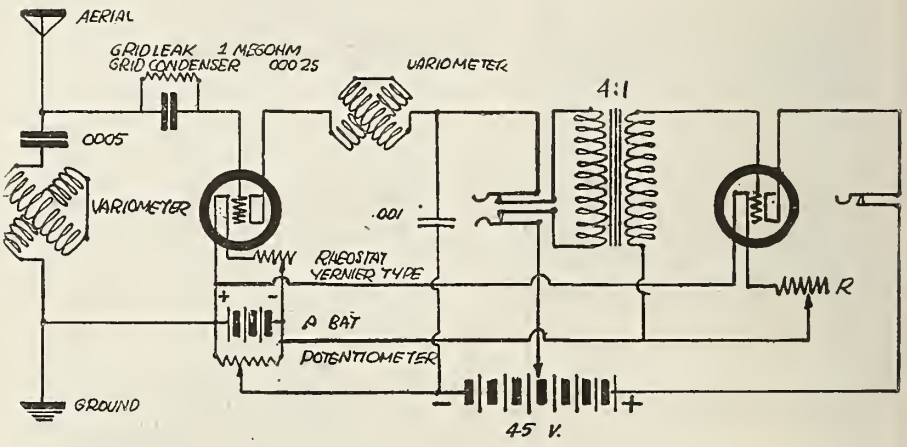
Answer: The Technical Office will be glad to answer inquiries of subscribers free of charge; if you are a non-subscriber we must request that you enclose fifty cents for each such inquiry as you send in, together with a *stamped addressed envelope.* We find that it is necessary to do this in order to assure proper attention to our regular subscribers. When writing, don't put down everything that comes into your head—stick to the particular subject you are asking about. If your question is about a set, enclose a diagram of the receiver to get the most accurate answer. Don't ask questions about commercial manufactured sets—write the manufacturer for that information. Before writing, always look back into your past issues of RADIO AGE (if you don't have them, you can get the ANNUAL to look them up) to see if your question has not been answered before. Write your questions on a separate sheet if they are to be sent to this magazine with a subscription or an order. Isometric sketches outside of those appearing in the RADIO AGE and the ANNUAL are not available. We will print popular circuits in isometric form from time to time. Write your inquiries on one side of the paper only; don't forget to enclose a stamped addressed envelope, and make them as brief as possible. We'll both save time that way, and you'll get your answer sooner. Address all your inquiries to RADIO AGE, Inc. Technical Office, Room 730—510 N. Dearborn St., Chicago, Ill.

Now, let's go!

C. S. Chicago, Ill.

Question: I made the Rosenbloom Circuit which was printed in the January issue of the RADIO AGE. I have received good results with respect to volume, but have not received distant stations. This does not bother me, however, as I am not interested in reception. The volume is so great that I think if I add one tube I could get at least the local stations on a loud speaker. Kindly show how this addition is made.

Answer: Inasmuch as so many fans are asking for this circuit amplification, I am showing in Figure 1, the proper connections for the addition of a one stage amplifier.



N. C. C., Ogden, Utah

Question: In your February issue of RADIO AGE, on pages 27 and 28, there are instructions on the making of a home made battery charger. This battery charger calls for a solution of phosphate of ammonium. Could not this be substituted for by common borax? How many lamps of what wattage should be used on a 6 volt storage battery? Can this rectifier charge B batteries?

Answer: I have used common household borax for rectifiers of this type myself, and would say that while the phosphate of ammonium (chemically as pure as procurable) is more desirable, the borax will do the work. The mixture should be made with distilled water only. The number of lamps used is to be determined on how fast you wish to charge your battery. It is not a wise policy, however, to overload the cells, as they will only overheat and boil. The more lamps used, the more current is passed, and consequently the faster your battery will charge. Would suggest that you start out with two lamps of about 60 watts apiece. Remember that it requires about 1.33 amperes current to put 1 ampere back into the battery. The charging of a battery with the Noden valve is a slow but effective method of charging your battery, so don't be impatient if the charge doesn't show in the hydrometer at once. The rectifier can be used to charge the B batteries, but smaller lamps should be used in the circuit so a less current is passed through the unit. The trouble with the fellows using this charger is that they think that the higher the number of lamps used the smaller the charging current. Be sure that the plates are well polarized before connecting the battery to the DC terminals.

J. J. H., Chicago, Ill.

Question: My neighbor has a key transmitter, and keeps the thing buzzing from 4:30 to 1:00 a. m. I would like to know if there is any way that I could stop him from transmitting. I have tried your best wave traps, but that will not kill the interference. I would appreciate hearing from you.

Answer: If your transmitting neighbor sends during the voluntary quiet hours (from 8 to 10:30) we would suggest that

you report his case to the Central Division Manager, American Radio Relay League, Mr. R. H. G. Mathews, 332 S. Michigan Ave., Chicago, Ill. If he observes the quiet periods, and transmits at other times there is nothing that you can do except ask him to co-operate with you, and if he is a *real* radio man he will be glad to do so, providing you don't ask him to stay silent all the time

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W. M. E., Mansfield, Ohio

Question: In the February number of RADIO AGE I noticed your drawing of a home made battery charger, and have built one. I gave it 10 hours' work on the forming of the plates. Used 4 one-quart jars, 2 lamps and was very particular in the wiring of same. Have used 2½ pounds of ammonium phosphate, and have tried it out. It fails to put any charge in my battery at all. Can you give me any suggestions as to what I should do? The charger cost me $3.02 to construct.

Answer: I would suggest that you use lamps of higher wattage to pass more current through the rectifier. You do not say what amperage your battery happens to be, but we would suggest that if it is one of the large type of storage batteries that it would take quite a long time to charge it if it is completely discharged. No other chemicals are needed, and if you have followed out the instructions, you should get results.

J. V., Chicago, Ill.

Question: Please send a hookup and all the data that can be obtained on the miniature receiver, built by Raymond Chassevent. Your magazine is great.

Answer: The photograph you mention was taken by our New York photographic service. For information concerning any of the photographs which appear in RADIO AGE which have the notation under them "Kadel & Herbert" we would like to suggest to you and others that you write these people direct at Kadel & Herbert, 153 West 42nd St., New York City, N. Y., for information. On other news items and features, your inquiry direct to this office will be forwarded to the source.

R. B., Racine, Wis.

Question: I have built an Eliminator as described in the January number, and I am experiencing a little trouble with it. It works quite well when connected in the aerial, but when connected across the A and G posts of my receiver, I cannot get a thing through the set. It cuts out everything. What is the reason for this?

Answer: I would suggest that your trouble lies in the fact that you are not tuning the Eliminator properly when you use it as an acceptor. The filter when used across the antenna and ground posts as shown in Figure 9 of the January, 1924, issue should be *tuned to the wave you desire* to listen to. The filter acts as a trigger, figuratively speaking, and pushes the desired signal into the set, while all the other frequencies are passed

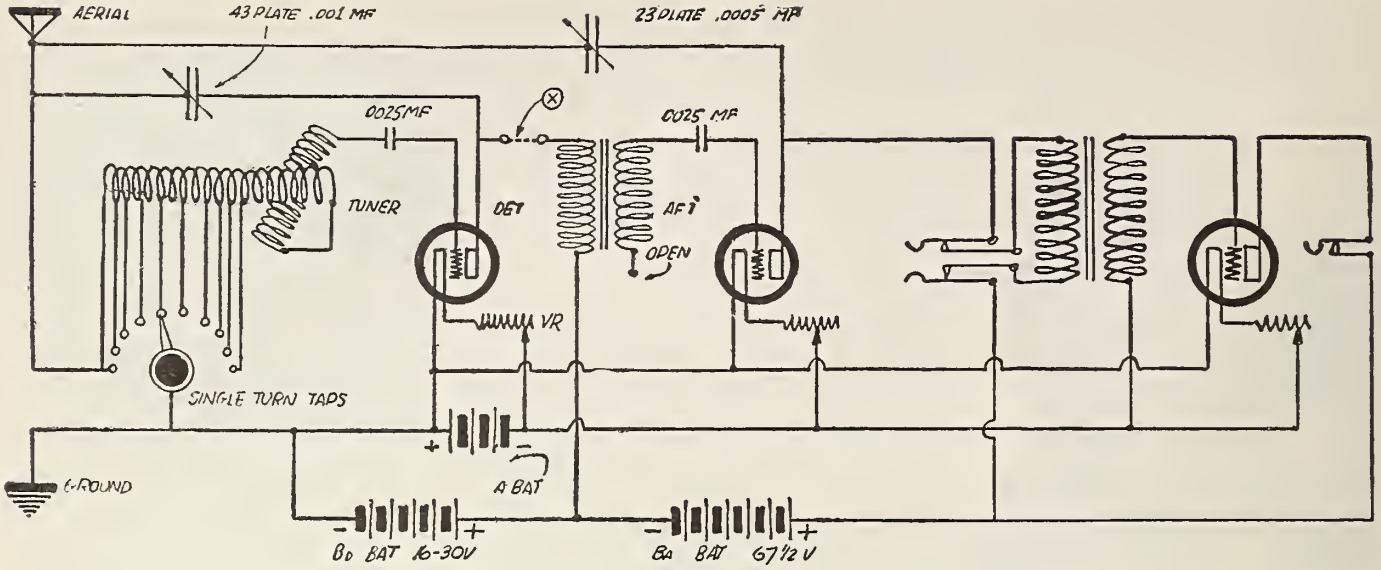

Figure 2.

off to the ground without entering the tuner.

B. J. G., Ostego, Mich.

Question: Kindly let me have some information regarding the super-heterodyne. If the first detector and oscillator tubes reduce the signal to audibility, what is the duty of the second detector. Also kindly tell me if a fully charged battery will discharge into a half charged battery when connected in parallel, the half charged battery being in the circuit.

Answer: You apparently do not understand the action of the super-heterodyne receiver with regard to the method of handling the signals and their rectification. In a super-heterodyne receiver, the incoming frequency is merely modulated or changed in frequency by the action of the first tube. The oscillator frequency is then superimposed upon or added to the frequency of the incoming wave, which is by no means audible. The two frequencies result in what is known as a "beat" frequency, the difference between the two, which is much lower in number of cycles, and which is by no means audio frequency, usually being around 60,000 cycles, which is much above the range of the ear. This beat frequency is passed on to the intermediate or radio frequency amplifiers, and is amplified. Amplification can be carried on more readily at higher wave lengths (lower frequencies) in radio frequency because there is less possibility of tube oscillations, and electrical losses caused by the use of these high frequency oscillations. When the signal has been put through the radio amplification factor of the receiver, it is passed on to the second detector where it is rectified and brought down to within range of hearing. If your ears were sensitive enough to respond to a frequency of 60,000 cycles, you would not need this second detector, but unfortunately we're not built that way. I would not recommend that you connect a charged and half charged battery in series, because electricity always seeks its own level in the same way as water, and the efficiency of the two would not be as great, due to the fact that the half charged battery really would act as a resistance.

V. P. M., Holyoke, Mass.

Question: In the February issue, you publish a new permutation for the Reinartz circuit under the title "Reinartz Audio Regenerator." I am tearing down my old Reinartz circuit to try out this new receiver, and am wondering if you could furnish me with a little additional information. I would like to install an additional lamp in this circuit, and would like to have you print a diagram showing how this is done.

Answer: I am printing in Figure 2 a circuit diagram showing how another tube can be added to the Regenerator as published in the February issue.

R. L. G., San Angelo, Tex.

Question: Please send me a spark transmitter hookup of a set that I could use on a ranch. with a source of power from storage batteries.

Answer: I am sorry to inform you that RADIO AGE does not handle transmitting questions, and would refer your inquiry to the American Radio Relay Leagues periodical QST at Hartford, Conn. We feel that this organization and publication amply covers the field of radio transmission, and do not desire to devote space to transmitting problems outside of general interest in RADIO AGE.

L. R. K., Bethlehem, Pa.

Question: I am about to build the

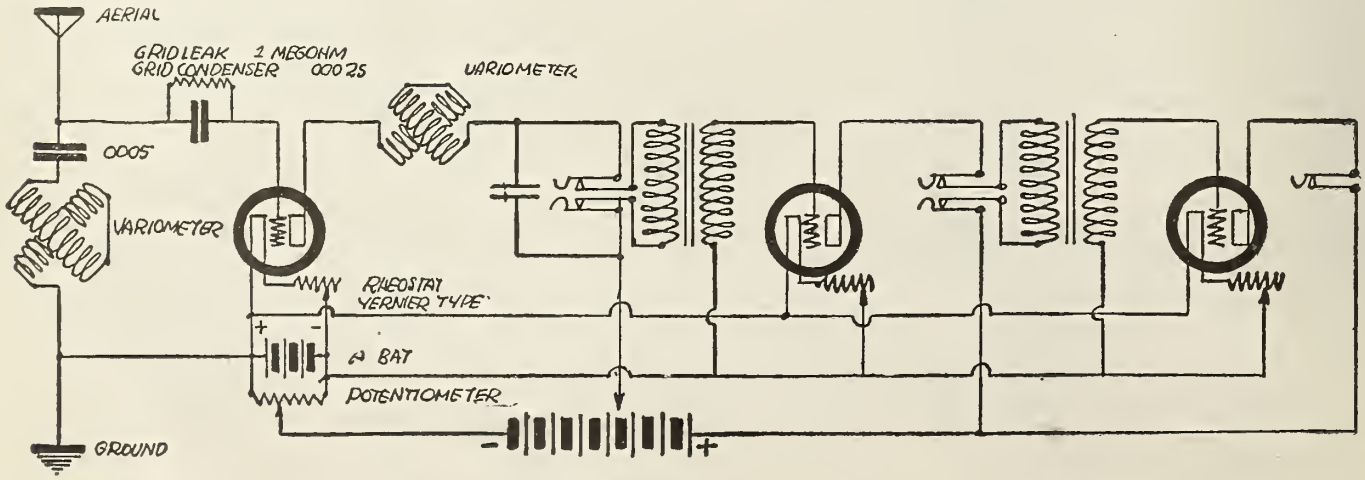

Figure 3.

super-heterodyne described in the March issue. Kindly advise me if No. 22 DCC wire would answer for the silk covered in the oscillator coils. I also find in my town that a .00015 MF condenser is hard to get. Will a .00025 condenser answer as well? Is it necessary to shield the panel?

Answer: The DCC wire can be substituted for the silk covered without loss of efficiency in the coils you mention, but it is necessary to carefully observe the condenser capacities as specified to get the best results. Stick closely to the specifications. If you observe the precaution of connecting the rotary plates of the condensers in the circuit to wires of ground potential shielding will not be necessary. By ground potential, I mean that the rotary plates of the condenser in the secondary and oscillator circuits should be connected to wires that do not go to the grids of the tubes. If this is done, no shielding is necessary.

K. W. M., Chicago, Ill.

Question: In your article on an "Inexpensive Battery Charger" appearing in the February issue, you mention a toy transformer. May I ask what this article is, and where it may be obtained, and under what name? How often does the solution of the charger have to be changed?

Answer: The transformer specified should be of the type used to operate toy electrical trains and motors; one with a variable voltage control switch mounted thereon, to enable you to control the input voltage to the rectifier. These transformers can be obtained at practically any electrical or hardware store, under various popular trade names. The primary is connected directly to the 110 volt source, while the secondary is connected to the rectifying jars.

D. C. T., Warren, Ariz.

Question: I have constructed a Reinartz Receiver (single tube) and have had some very good results, as Chicago and stations come in fine or rather did until a few days ago when a scratching and crackling in the phones at times completely drown out the signal. I am using a Bradleystat, but find it very critical to reduce the whistling and still hold enough volume to enjoy the programs. I neglected to say that Chicago is about 2500 miles distant. I am using a WD 11 tube on this set. Kindly tell me if a UV 199 could be used to more satisfaction, or if a 6 volt battery would give very much better results. Please give me your opinion about the noise in the phones. I am enclosing a diagram which I wish you would pass opinion upon and advise me if it is a good hookup for DX work. needless to say I am very much pleased with your magazine, especially the treatise on the Reinartz which found me a ready and eager reader. Also wish to thank you for your help in this case and all others.

Answer: Your limitations are without doubt caused by an incorrect value of grid leak, an important matter in the operation of vacuum tubes at their highest efficiency. Would suggest that you experiment with different values, starting with

A NEW CONDENSER

A variable condenser of an entirely new construction has been invented and developed by the Chas. Freshman Co., Inc., New York City. It has long been conceded by the foremost radio engineers that a variable condenser with mercury plates and a mica dielectric would be the most efficient and compact condenser made. This can be readily understood, as the mercury plates make very intimate contact with the mica dielectric. The inventor has not only achieved this fact but has also evolved a construction wherein the plates of the variable condenser actually vary in area. This is an engineering feat never accomplished before and is the basis of the patent application.

The dielectric is a heavy piece of India ruby mica and the housing is made entirely of bakelite. The variation in capacity is accomplished by rotating the entire structure on two shafts, which act as the terminals. The reservoir or chamber, which contains the mercury, is at the extreme lower portion, when the condenser is set for zero capacity. As the condenser is rotated, the mercury rides out of this reservoir into a thin circular chamber about one-sixteenth of an inch thick, forming a thin wall of mercury, which increases in size, until the reservoir is at the top part of the casing. At this point maximum capacity is attained, due to the fact that you have a complete circular plate of mercury which is opposite to the circular plate of mercury on the other side of the mica dielectric.

The workings of the condenser furnish a complete circular metallic plate, giving practically twice the capacity ever attained before in the same space, whereas in all other types of condensers only semi-circular plates are used.

In the official tests of the Electrical Testing Laboratories, 80th Street and East End Avenue, New York City, the condenser was found to withstand a voltage of 8,000 volts and to have a phase angle loss of less than one minute—the actual loss being too small to be measured accurately.

HOLLANDER HEARS WGY ON ONE TUBE

Imagine yourself in a country where it is practically impossible to obtain a bit of CW equipment, and added to this, a law prohibiting amateur transmission. So it is in Holland, where amateurs must be content with listening in, and hoping for better times. Our photo shows the neat and efficient lay-out of J. C. Nonnekens, who with his three sets has heard the signals of the Americans, using only RF and detector. WGY has been repeatedly received on one tube. Mr. Nonneken has heard from law, 1BCG, 1BCT, 2SZ, 2TJ, 3BT, 8TT, 8ATB, 9APE and Canadian 1AR and 3XN. With two AF stages many are heard clearly through the loud speaker. In the background to the left may be seen a set using 2RF and detector, regenerative, with tuned primaries. Phillips double-grid tubes are used employing six volts on plate. In center, the "Marine" receiver built by Netherlands Radio Industrie. Lower cabinet contains tuning apparatus, upper cabinet controls and plate variometers for oscillation. All inductances are either bankwound or wound in slots. The little set at right is the one on which most stations are copied. It is a short wave type using Corona coils (also mfg. by N.R.I) and this is the set that consistently brings in WGY on one tube, when conditions are not too bad. Generally the standard 3-coil circuit is used.

about 1 megohm, and increasing the resistance to as high as 7. The correct value once found will not need readjustment until another tube is substituted. If the signal sounds mushy, and difficulty is experienced in getting the tube to oscillate, it is usually due to too low a grid leak resistance, and if the tube knocks, screeches or whistles, and difficulty is experienced in controlling the spill-over it may be remedied by decreasing the value of the leak. A potentiometer used as described in the Pickups Section is also of great assistance in controlling spill-over of tubes. The circuit you submitted is a good one for long distance if good apparatus is used, and the set is properly operated. However, if you mistreat it, and operate it incorrectly, you are likely to cause trouble, as it re-radiates quite violently if permitted to do so by incorrect operation. You do not mention how much B battery you are using, but I would suggest that you try voltages from 16 up to 30 on the plate, in an effort to find which is the most effective working potential. The UV 199 and WD 11 are about the same in volume, with the exception that I prefer the WD 11 as detector. A six volt battery will without doubt be more desirable, due to the fact that louder signals can be obtained, and easier operation can be effected. When using a UV 200 as detector, a low value (about .75 megohm) grid leak can be used to advantage. These tubes are softer, and do not operate with high resistance leaks to good advantage.

J. F. R., Brooklyn, N. Y.

Question: Will you kindly print a circuit diagram of a two step amplifier in the next issue of RADIO AGE showing how two stages of audio amplification are added to the Rosenbloom circuit? Your Rosenbloom is a wonder.

Answer: I am showing the connections in Figure 3. The connections are made the same as in any other circuit.

W. R. M., Richmond, Ind.

Question: Will you please advise if there is any regulation concerning the use of spark sending sets?

Answer: I would not advise that you invest your time, money or efforts in the construction of any transmitter using damped (spark) waves for transmission, as they are considered obsolete, and a nuisance. There exists no regulation on spark other than public opinion and the feeling that spark sets are selfish because they hog the air when in operation. Spark sets in amateur hands are not allotted waves over 176 meters can operate with only 1 KW of input power. Even the ship stations are changing over to CW (undamped) waves. Would suggest that you refer to QST the amateur radio periodical dealing with transmitting problems, and get the information on the construction of a good low power tube transmitter (they actually cost less than spark) and save yourself the trouble of causing interference to broadcast listeners.

Saving Micro-Watts

One of the indications of the progress of the radio art is the increased attention which is being paid to the design of the individual parts which are used in radio receiving sets. Until quite recently most of this care was focused on the design of the coils and condensers alone. However, it is now realized that there are mile-wasting losses in poorly designed tube bases, tube sockets and other parts, as well.

A modern fairly efficient radio receiver will receive signals which have as low a pressure as .001 volts. Even in a very good antenna this will not produce an energy of more than .0000001 watts. It is hard to imagine such a small quantity of energy, but forty million receiving sets would produce just about power enough to light one ordinary 40-watt tungsten light.

The oldest manufacturer of vacuum tubes has recently greatly improved its product by eliminating the traditional metal shell which surrounds the base of their tube. This change reduces the internal capacity of the tube and at the same time eliminates the losses from eddy currents in the metal shell itself. While the saving of power thus accomplished is quite small when expressed in figures, it becomes of importance when compared with the minute currents received on the antenna.

Second only in importance to the vacuum tube itself, is the tube socket, for all the energy must pass through the socket before it reaches the tube. Indications are that the metal shell socket will soon become obsolete as the single slide tuning coil. The best radio engineering practice of today calls for the elimination of as much material as possible in the neighborhood of the parts of the radio set which carry the radio frequency current. This applies not only to metallic substances, but to insulating materials as well. The socket of the future will undoubtedly consist merely of a comparatively thin shell of some high grade insulating material, and a base only sufficiently large to accommodate the necessary contact springs and connecting posts.

Some manufacturers are already marketing sockets of this type. The necessary strength and durability is being secured by the use of Bakelite or similar material of uniform cross-section which assures thorough curing of the material, giving it the highest possible di-electric properties, as well as making it strong.

A further interesting fact that has been developed through research conducted by one of the largest battery manufacturers, is, that the "hissing" and "frying" noises often attributed to B batteries are, in reality, caused by poor connections, usually between tube terminals and the socket contacts. Their research shows that there are no noisy B batteries.

To prevent such noises and the shortening of many otherwise good concerts there are manufacturers who have not only provided sockets with the high insulating properties but have devised contacts that are of a wiping nature with dependable tension for each and every type of tube.

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers and broadcasters.

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh	326
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270
KDPT	Southern Electrical Co.	San Diego, Calif.	244
KDYL	Telegram Publishing Co.	Salt Lake City, Utah	360
KDYM	Savoy Theatre	San Diego, Calif.	244
KDYQ	Oregon Institute of Technology	Portland, Oreg.	360
KDYW	Smith Hughes & Co.	Phoenix, Ariz.	360
KDYX	Star Bulletin	Honolulu, Hawaii	360
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZE	Rhodes Department Store	Seattle, Wash.	270
KDZF	Automobile Club of Southern California	Los Angeles, Calif.	278
KDZI	Electric Supply Co.	Wenatchee, Wash.	360
KDZQ	Nichols Academy of Dancing	Denver, Colo.	360
KDZR	Bellingham Publishing Co.	Bellingham, Wash.	261
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	360
KFAE	State College of Washington	Pullman, Wash.	330
KFAF	Western Radio Corp.	Denver, Colo.	360
KFAJ	University of Colorado	Boulder, Colo.	360
KFAN	The Electric Shop	Moscow, Idaho	360
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif.	280
KFAU	Independent School Dist. of Boise City, Boise High School,	Boise, Idaho	270
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280
KFAY	W. J. Virgin	Medford, Oreg.	283
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Azbill	San Diego, Calif.	278
KFBE	Reuben H. Horn	San Luis Obispo, Calif.	360
KFBG	First Presbyterian Church	Tacoma, Wash.	360
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and the Chronicle News	Trinidad, Colo.	360
KFBU	The Cathedral (Bishop N. S. Thomas)	Laramie, Wyo.	283
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFCF	Frank A. Moore	Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)	Billings, Mont.	360
KFCM	Richmond Radio Shop (Frank T. Doeing)	Richmond, Calif.	360
KFCP	Ralph W. Flygare	Ogden, Utah	360
KFCV	Fred Mahaffey, Jr.	Houston, Texas	360
KFCY	Western Union College	Le Mars, Iowa	252
KFCZ	Omaha Central High School	Omaha, Nebr.	258
KFDA	Adler's Music Store	Baker, Oreg.	360
KFDD	St. Michaels Cathedral	Boise, Idaho	252
KFDH	University of Arizona	Tuscon, Ariz.	360
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	360
KFDL	Knight-Campbell Music Co.	Denver, Colo.	360
KFDO	H. Everett Cutting	Bozeman, Mont.	248
KFDR	Bullocks' Hardware & Sporting Goods (Rob. G. Bullock)	York, Nebr.	360
KFDV	Gilbrech & Stinson	Fayetteville, Ark.	360
KFDX	First Baptist Church	Shreveport, La.	360
KFDY	South Dakota State College of Agriculture and Mechanics Arts	Brookings, S. Dak.	360
KFDZ	Harry O. Iverson	Minneapolis Minn.	231
KFEC	Meier & Frank Co.	Portland, Oreg.	360
KFEJ	Guy Greason	Tacoma, Wash.	360
KFEL	Winner Radio Corp.	Denver, Colo.	360
KFEQ	J. L. Scroggin	Oak, Nebr.	360
KFER	Auto Electric Service Co.	Fort Dodge, Iowa	231
KFEV	Radio Electric Shop	Douglas, Wyo.	263
KFEX	Augshurg Seminary	Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining and Concentrating Co.	Kellogg, Idaho	360
KFEZ	American Society of Mechanical Engineers (F. H. Schubert)	St. Louis, Mo.	360
KFFB	Jenkins Furniture Co.	Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.	Pendleton, Oreg.	360
KFFO	Dr. E. H. Smith	Hillsboro, Oreg.	229
KFFQ	Marksheffel Motor Co.	Colorado Springs, Colo.	360
KFFR	Nevada State Journal (Jim Kirk)	Sparks, Nev.	226
KFFY	Graceland College	Lamoni, Iowa	360
KFFX	McGraw Co.	Omaha, Nebr.	278
KFFY	Pincus & Murphy	Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.	Dallas, Tex. (portable)	226
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	360
KFGL	Arlington Garage	Arlington, Oreg.	234
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFGV	Heidbreder Radio Supply Co.	Utica, Nehr.	224
KFGX	First Presbyterian Church	Orange, Tex.	250
KFGZ	Emmanuel Missionary College	Berrien Springs, Mich.	268
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHB	Rialto Theater (P. L. Beardwell)	Hood River, Oreg.	280
KFHD	Utz Electric Shop Co.	St. Joseph, Mo.	226
KFHF	Central Christian Church	Shreveport, La.	266
KFHH	Amhrose A. McCue	Neah Bay, Wash.	283
KFHJ	Fallon & Co.	Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.	Seattle, Wash.	270
KFHS	Clifford J. Dow	Lihue, Hawaii	275
KFHX	Rohert W. Nelson	Hutchinson, Kan.	229
KFI	Earle C. Anthony (Inc.)	Los Angeles, Calif.	469
KFID	Ross Arbuckle's Garage	Iola, Kans.	246
KFIF	Benson Polytechnic Institute	Portland, Oregon	360
KFIL	Windisch Electric Farm Equipment Co.	Louisburg, Kans.	234
KFIO	North Central High School	Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association	Yakima, Wash.	224
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIV	V. H. Broyles	Pittsburg, Kans.	240
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huelsman	Fon Du Lac, Wis.	273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	Seattle Post Intelligencer	Seattle, Wash.	233
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	252
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg.	252
KFJK	Delano Radio and Electric Co.	Bristow, Okla.	233
KFJL	Hardsacg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	229
KFJQ	Valley Radio, Div. of Elec. Constr. Co.	Grand Forks, N. D.	280
KFJR	Ashley C. Dixon & Son	Stevensville, Mont. (near)	258
KFJV	Thomas H. Warren	Dexter, Iowa	224
KFJW	Le Grand Radio Co.	Towanda, Kans.	226
KFJX	Iowa State Teachers' Collcge	Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	248
KFJZ	Texas National Guard, One hundred and twelfth Cavalry	Fort Worth, Texas	254
KFKA	Colorado State Teachers College	Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association	Milford, Kans.	286
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark.	224
KFKV	F. F. Gray	Butte, Mont.	283
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	341
KFKZ	Nassour Bros. Radio Co.	Colorado Springs, Colo.	234
KFLA	Abner R. Willson	Butte, Mont.	283
KFLB	Signal Electric Manufacturing Co.	Menominee, Mich.	248
KFLD	Paul E. Greenlaw	Franklinton, La.	234
KFLE	National Educational Service	Denver, Colo.	268
KFLH	Erickson Radio Co.	Salt Lake City, Utah	261
KFLP	Everette M. Foster	Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop	Little Rock, Ark.	261
KFLR	University of New Mexico	Albuquerque, N. Mex.	254
KFLU	Rio Grande Radio Supply House	San Benito, Texas	236
KFLV	Rev. A. T. Frykman	Rockford, Ill.	229
KFLW	Missoula Electric Supply Co.	Missoula, Mont.	234
KFLX	George Roy Clough	Galveston, Tex.	240
KFLY	Fargo Radio Supply Co.	Fargo, N. Dak.	231
KFLZ	Atlantic Automobile Co.	Atlantic, Ia.	273
KFMQ	University of Arkansas	Fayetteville, Ark.	263
KFMR	Morningside College	Sioux City, Iowa	261
KFMS	Freimuth Dept. Store	Duluth, Minn.	275
KFMT	Dr. George W. Young	Minneapolis, Minn.	231
KFMU	Stevens Bros.	San Marco, Tex.	240
KFMW	M. G. Sateren	Houghton, Mich.	266
KFMX	Carleton College	Northfield, Minn.	283
KFMY	Boy Scouts of America	Long Beach, Calif.	229
KFMZ	Roswell Broadcasting Club	Roswell, N. M.	252
KFNC	Alonzo Monk, Jr.	Corsicana, Texas	234
KFNF	Henry Field Seed Co.	Shenandoah, Iowa	266
KFNG	Wooten's Radio Shop	Coldwater, Miss.	254
KFNH	State Teachers College	Springfield, Mo.	236
KFNJ	Warrensburg Electric Shop	Warrensburg, Mo.	234
KFNL	Radio Broadcast Ass'n	Paso Robles, Calif.	240
KFNV	L. A. Drake Battery and Radio Supply Shop	Santa Rosa, Calif.	234
KFNX	Peabody Radio Service	Peabody, Kansas	240
KFNY	Montana Phonograph Co.	Helena, Montana	261
KFNZ	Royal Radio Company	Burlingame, Calif.	231
KFOB	Glenwood Technical Association	Minneapolis, Minn.	224
KFOC	First Christian Church	Whittier, Calif.	236
KFOD	Fern Peters	Wallace, Idaho	224
KFOF	Rohrer Electric Co.	Marshfield, Oregon	240
KFOH	The Radio Bungalow	Portland, Oregon	283
KFOJ	Moherly High School Radio Club	Moherly, Missouri	246
KFOL	Leslie M. Schafbush	Marengo, Iowa	234
KFON	Echophone Radio Shop	Long Beach, Calif.	234
KFOP	Willson Construction Co.	Dallas, Texas	268
KFOQ	Ora William Chancellor	Galveston, Texas	240
KFOR	David City Tire & Electric Co.	David City, Nebraska	226
KFOT	College Hill Radio Club	Wichita, Kansas	231
KFOV	Davis Electrical Corporation	Sioux City, Iowa	234
KFOX	Board of Education, Technical High School	Omaha, Nehraska	248
KFPB	Edwin J. Brown	Seattle, Wash.	224
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service	Portland, Oreg.	360
KGN	Northwestern Radio Mfg. Co.	Portland, Oreg.	360
KGO	General Electric Co.	Oakland, Calif.	312
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach	360
KGW	Portland Morning Oregonian	Portland, Oreg.	492
KGY	St. Martins College (Reb. Sebastian Ruth)	Lacy, Wash.	258
KHJ	Times-Mirror Co.	Los Angeles, Calif.	395
KHQ	Louis Wasmer	Seattle, Wash.	360
KJC	C. O. Gould	Stockton, Calif.	360
KJR	Northwest Radio Service Co.	Seattle, Wash	270
KJS	Bible Institute of Los Angeles	Los Angeles, Calif.	360
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	360
KLX	Tribune Publishing Co.	Oakland, Calif.	509
KLZ	Reynolds Radio Co.	Denver, Colo.	509
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif.	273
KMO	Love Electric Co.	Tacoma, Wash.	360
KNT	Grays Harbor Radio Co. (Walter Heinrich)	Aberdeen, Wash.	263
KNV	Radio Supply Co.	Los Angeles, Calif.	256
KNX	Electric Lighting Supply Co.	Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture & Mechanic Arts	State College, N. Mex.	360
KOP	Detroit Police Department	Detroit, Mich.	286
KPO	Hale Bros.	San Francisco, Calif.	423
KQP	Apple City Radio Club	Hood River, Oreg.	360
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	360
KQW	Charles D. Herrold	San Jose, Calif.	360
KRE	V C Battery & Electric Co.	Berkeley, Calif.	278
KSD	Post Dispatch (Pulitzer Pub. Co.)	St. Louis, Mo.	546
KSS	Prest & Dean Radio Co. and Radio Reasearch Society of Long Beach, Calif.	Long Beach, Calif.	360
KTW	First Presbyterian Church	Seattle, Wash.	360
KUO	Examiner Printing Co.	San Francisco, Calif.	360
KUS	City Dye Works and Laundry Co.	Los Angeles, Calif.	360
KUY	Coast Radio Co.	El Monte, Calif.	256
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	360
KWH	Los Angeles Examiner	Los Angeles, Calif.	360
KXD	Modesto Herald Publishing Co.	Modesto, Calif.	252
KYQ	Electric Shop	Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	536
KZM	Preston D. Allen	Oakland, Calif.	360
KZN	The Deseret News	Salt Lake City, Utah	360
KZV	Wenatchee Battery & Motor Co.	Wenatchee, Wash.	360
WAAB	Valdemar Jensen	New Orleans, La.	268
WAAC	Tulane University	New Orleans, La.	360
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	286
WAAK	Gimbel Brothers	Milwaukee, Wis.	280
WAAM	I. R. Nelson Co.	Newark, N. J.	263
WAAN	University of Missouri	Columbia, Mo.	254
WAAW	Omaha Grain Exchange	Omaha, Nebr.	360
WABA	Lake Forest College	Lake Forest, Ill.	266
WABB	Dr. John B. Lawrence	Harrisburg, Pa.	266
WABD	Parker High School	Dayton, Ohio	283
WABE	Young Men's Christian Association	Washington, D. C.	283
WABG	Arnold Edwards Piano Co.	Jacksonville, Fla.	248
WABH	Lake Shore Tire Co.	Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co.	Bangor, Me.	240
WABK	First Baptist Church	Worcester, Mass.	252
WABL	Connecticut Agricultural College	Storrs, Conn.	283

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

WABM	F. E. Doherty Automotive and Radio Equipment Co.	Saginaw, Mich. 254
WABN	Waldo C. Grover	La Crosse, Wis. 244
WABO	Lake Avenue Baptist Church	Rochester, N. Y. 252
WABP	Robert F. Weinig	Dover, Ohio 266
WABQ	Haverford College, Radio Club	Haverford, Pa. 261
WABR	Scott High School, N. W. B. Foley	Toledo, Ohio 270
WABS	Essex Manufacturing Co.	Newark, N. J. 244
WABT	Holiday-Hall, Radio Engineers	Washington, Pa. 252
WABU	Victor Talking Machine Co.	Camden, N. J. 226
WABV	John H. De Witt, Jr.	Nashville, Tenn. 263
WABW	College of Wooster	Wooster, Ohio 234
WABX	Henry B. Joy	Mt. Clemens, Mich. 270
WABY	John Magaldi, Jr.	Philadelphia, Pa. 242
WABZ	Coliseum Place Baptist Church	New Orleans, La. 263
WBAA	Purdue University	West Lafayette, Ind. 360
WBAD	Sterling Electric Co.	Minneapolis, Minn. 360
WBAH	The Dayton Co.	Minneapolis, Minn. 417
WBAN	Wireless Phone Corp.	Paterson, N. J. 244
WBAO	James Millikin University	Decatur, Ill. 360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex. 476
WBAV	Ermer & Hopkins Co.	Columbus, Ohio 390
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa. 360
WBAY	Western Electric Co.	New York, N. Y. 492
WBBA	Newark Radio Laboratories	Newark, Ohio 240
WBBD	Barbcy Battery Service	Reading, Pa. 234
WBBE	Alfred R. Marcy	Syracuse, N. Y. 246
WBBF	Georgia School of Technology	Atlanta, Ga. 270
WBBG	Irving Vermilya	Mattapoisett, Mass. 240
WBBH	J. Irving Bell	Port Huron, Mich. 246
WBBI	The Indianapolis Radio Club	Indianapolis, Ind. 234
WBBJ	Neal Electric Co., P. E. Neal	West Palm Beach, Fla. 258
WBBL	Grace Covenant Presbyterian Church	Richmond, Va. 283
WBBM	Frank Atlass Produce Co.	Lincoln, Ill. 225
WBBN	Blake, A. B.	Wilmington, N. C. 275
WBBO	Mich. Limestone & Chemical Co.	Rogers, Mich. 250
WBBQ	Frank Crook	Pawtucket, R. I. 252
WBBR	Peoples Pulpit Asso.	Rossville, N. Y. 244
WBBS	First Baptist Church	New Orleans, La. 250
WBBT	Lloyd Brothers	Philadelphia, Pa. 234
WBBU	Jenks Motor Sales Co.	Monmouth, Ill. 224
WBBV	Johnstown Radio Co.	Johnstown, Pa. 248
WBBW	Ruffner Junior High School	Norfolk, Va. 222
WBBZ	Noble B. Watson	Indianapolis, Ind. 227
WBL	T & H Radio Co.	Anthony, Kans. 261
WBR	Pennsylvania State Police	Butler, Pa. 286
WBS	D. W. May, Inc.	Newark, N. J. 360
WBT	Southern Radio Corp.	Charlotte, N. C. 360
WBZ	Westinghouse Elec. & Mfg. Co.	Springfield, Mass. 337
WCAD	St. Lawrence University	Canton, N. Y. 280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa. 462
WCAG	Clyde R. Randall	New Orleans, La. 268
WCAH	Entrekin Electric Co.	Columbus, Ohio 286
WCAJ	Nebraska Wesleyan University	University Place, Nebr. 360
WCAK	Alfred P. Daniel	Houston, Texas 263
WCAL	St. Olaf College	Northfield, Minn. 360
WCAM	Villanova College	Villanova, Pa. 360
WCAO	Sanders & Stayman Co.	Baltimore, Md. 360
WCAP	Chesepeake & Potomac Telephone Co.	Washington, D. C. 469
WCAR	Alamo Radio Electric Co.	San Antonio, Tex. 360
WCAS	William Hood Dunwoody Industrial Institute	Minneapolis, Minn. 246
WCAT	South Dakota State School of Mines	Rapid City, S. Dak. 240
WCAU	Durham & Co.	Philadelphia, Pa. 286
WCAV	J. C. Dice Electric Co.	Little Rock, Ark. 360
WCAX	University of Vermont	Burlington, Vt. 360
WCAY	Kesselman O'Driscoll Co.	Milwaukee, Wis. 261
WCAZ	Carthage College	Carthage, Ill. 246
WCBA	Charles W. Heimbach	Allentown, Pa. 280
WCBC	University of Michigan	Ann Arbor, Mich. 280
WCBD	Wilbur G. Voliva	Zion, Ill. 345
WCBE	Uhalt Radio Co.	New Orleans, La. 263
WCBF	Paul J. Miller	Pittsburgh, Pa. 236
WCBG	Howard S. Williams (Portable)	Pascagoula, Miss. 236
WCBI	Nicoll, Duncan & Rush	Bemis, Tennessee 226
WCBR	University of Mississippi	near Oxford, Miss. 242
WCK	Stix, Baer & Fuller Dry Goods Co.	St. Louis, Mo. 360
WCM	University of Texas	Austin, Texas 360
WCX	Detroit Free Press	Detroit, Mich. 517
WDAE	Tampa Daily Times	Tampa, Fla. 360
WDAF	Kansas City Star	Kansas City, Mo. 411
WDAG	J. Laurence Martin	Amarillo, Tex. 263
WDAH	Trinity Methodist Church (South)	El Paso, Tex. 268
WDAK	The Courant	Hartford, Conn. 261
WDAO	Automotive Electric Co.	Dallas, Tex. 360
WDAP	Board of Trade	Chicago, Ill. 360
WDAR	Lit Brothers	Philadelphia, Pa. 395
WDAS	Samuel A. Waite	Worcester, Mass. 360
WDAU	Slocum Kilburn	New Bedford, Mass. 360
WDAY	Radio Equipment Corp.	Fargo, N. Dak. 244
WDBC	Kirk, Johnson & Co.	Lancaster, Pa. 258
WDM	Church of the Covenant	Washington, D. C. 234
WDZ	James L. Bush	Tuscola, Ill. Star Store Bldg. 278
WEAA	F. D. Fallain	Flint, Mich. 280
WEAF	American Telephone & Telegraph Co.	New York, N. Y. 492
WEAH	Wichita Board of Trade	Wichita, Kans. 244
WEAI	Cornell University	Ithaca, N. Y. 286
WEAJ	University of South Dakota	Vermillon, S. Dak. 283
WEAM	Borough of North Plainfield (W. Gibson Buttfield)	North Plainfield, N. J. 252
WEAN	Shepard Co.	Providence, R. I. 273
WEAO	Ohio State University	Columbus, Ohio 360
WEAP	Mobile Radio Co.	Mobile, Ala. 360
WEAR	Baltimore American & News Publishing Co.	Baltimore, Md. 360
WEAS	Hecht Co.	Washington, D. C. 360
WEAU	Davidson Bros. Co.	Sioux City, Iowa 360
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Texas 360
WEB	Benwood Co.	St. Louis, Mo. 273
WEV	Hurlburt-Still Electrical Co.	Houston, Texas 360
WEW	St. Louis University	St. Louis, Mo. 261
WFAA	Dallas News & Dallas Journal	Dallas, Texas 476
WFAB	Carl F. Woese	Syracuse, N. Y. 234
WFAF	H. C. Spratley Radio Co.	Poughkcepsie, N. Y. 360
WFAH	Electric Supply Co.	Port Arthur, Texas 236
WFAJ	Hi-Grade Wireless Instrument Co.	Asheville, N. C. 360
WFAM	Times Publishing Co.	St. Cloud, Minn. 360
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn. 360
WFAQ	Missouri Wesleyan College	Cameron, Mo. 360
WFAT	New Columbus College	Sioux Falls, S. Dak. 258
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr. 275
WFI	Strawbridge & Clothier	Philadelphia, Pa. 395
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa. 248
WGAN	Cecil E. Lloyd	Pensacola, Fla. 360
WGAQ	Glenwood Radio Corp. (W. G. Patterson)	Shreveport, La. 252
WGAW	Ernest C. Albright	Altoona, Pa. 261
WGAZ	South Bend Tribune	South Bend, Ind. 360
WGI	American Radio & Research Corp.	Medford Hillside, Mass. 360
WGL	Thomas F. J. Howlett	Philadelphia, Pa. 360
WGR	Federal Telephone & Telegraph Co.	Buffalo, N. Y. 319
WGV	Interstate Electric Co.	New Orleans, La. 242
WGY	General Electric Co.	Schenectady, N. Y. 380
WHA	University of Wisconsin	Madison, Wis. 360
WHAA	State University of Iowa	Iowa City, Iowa 484
WHAB	Clark W. Thompson	Galveston, Texas 360
WHAD	Marquette University	Milwaukee, Wis. 280
WHAG	University of Cincinnati	Cincinnati, Ohio 222
WHAH	Hafer Supply Co.	Joplin, Mo. 283
WHAK	Roberts Hardware Co.	Clarksburg, W. Va. 258
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y. 283
WHAP	Otta & Kuhns	Decatur, Ill. 360
WHAR	Paramount Radio & Electric Co. (W. H. A. Pulus)	Atlantic City, N. J. 231
WHAS	Courier-Journal & Louisville Times	Louisville, Ky 400
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del. 360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y. 380
WHB	Sweeney School Co.	Kansas City, Mo. 411
WHK	Radiovox Co. (Warren R. Cox)	Cleveland, Ohio 360
WHN	George Schubel	New York, N. Y. 360
WIAB	Joslyn Automobile Co.	Rockford, Ill. 252
WIAC	Galveston Tribune	Galveston, Texas 360
WIAD	Howard R. Miller	Ocean City, N. J. 254
WIAF	Gustav A. DeCortin	New Orleans, La. 234
WIAH	Continental Radio & Mfg. Co.	Newton, Iowa 258
WIAI	Heey Stores Co.	Springfield, Mo. 252
WIAJ	Fox River Valley Radio Supply Co. (Quinn Bros.)	Neenah, Wis. 224
WIAK	Journal-Stockman Co.	Omaha, Nebr. 278
WIAO	School of Engineering of Milwaukee	Milwaukke, Wis. 360
WIAQ	Chronicle Publishing Co.	Marion, Ind. 226
WIAS	Paducah Evening Sun	Paducah, Ky. 360
WIAS	Home Electric Co.	Burlington, Iowa 360
WIAT	Leon T. Noel	Tarkio, Mo. 360
WIAU	American Trust & Savings Bank	Le Mars, Iowa 360
WIK	K. & L. Electric Co. (Herbert F. Kelso and Hunter J. Lohman)	McKeesport, Pa. 234
WIL	Continental Electric Supply Co.	Washington, D. C. 360
WIP	Gimbel Brothers	Philadelphia, Pa. 509
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas 360
WJAF	Press Publishing Co.	Muncie, Ind. 360
WJAG	Norfolk Daily News	Norfolk, Nebr. 283
WJAK	Clifford L. White	Greentown, Ind. 254
WJAM	D. M. Perham	Cedar Rapids, Iowa 268
WJAN	Peoria Star	Peoria, Ill. 280
WJAQ	Capper Publications	Topeka, Kans. 360
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I. 360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa. 250
WJAT	Kelly-Vawter Jewelry Co.	Marshall, Mo. 360
WJAX	Union Trust Co.	Cleveland, Ohio 390
WJAZ	Chicago Radio Laboratory	Chicago, Ill. 448
WJD	Richard H. Howe	Granville, Ohio 229
WJH	W. P. Boyer	Washington, D. C. 273
WJX	Deforest Radio Telephone & Telegraph Co.	New York, N. Y. 360
WJY	R. C. A.	New York, N. Y. 405
WJZ	R. C. A.	New York, N. Y. 455
WKAA	H. F. Paar	Cedar Rapids, Iowa 268
WKAD	Chas. Looff (Crescent Park)	East Providence, R. I. 240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Texas 360
WKAN	United Battery Service Co.	Montgomery, Ala. 226
WKAP	Dutee W. Flint	Cranston, R. I. 360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R. 360
WKAR	Michigan Algriculture College	East Lansing, Mich. 280
WKAS	L. E. Lines Music Co.	Springfield, Mo. 360
WKAV	Laconia Radio Club	Laconia, N. H. 254
WKAY	Brenau College	Gainesville, Ga. 280
WKY	WKY Radio Shop	Oklahoma, Okla. 360
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn. 417
WLAH	Samuel Woodworth	Syracuse, N. Y. 234
WLAJ	Waco Electrical Supply Co.	Waco, Texas 360
WLAK	Vermont Farm Machine Corp.	Bellows Falls, Vt. 360
WLAL	Naylor Electrical Co.	Tulsa, Okla. 360
WLAP	W. V. Jordon	Louisville, Ky. 360
WLAQ	Arthur E. Shilling	Kalamazoo, Mich. 283
WLAV	Electric Shop	Pensacola, Fla. 254
WLAW	Police Dept., City of New York	New York, N. Y. 360
WLAX	Putnam Electric Co. (Greencastle Community Broadcasting Station)	Greencastle, Ind. 231
WLB	University of Minnesota	Minneapolis, Minn. 360
WLW	Crosley Manufacturing Co.	Cincinnati, Ohio 309
WMAB	Radio Supply Co.	Oklahoma, Okla. 360
WMAC	J. Edw. Page (Olive B. Meredith)	Cazenovia, N. Y. 261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass. 360
WMAH	General Supply Co.	Lincoln, Nebr. 254
WMAJ	Drovers Telegram Co.	Kansas City, Mo. 275
WMAK	Norton Laboratories	Lockport, N. Y. 360
WMAL	Trenton Hardware Co.	Trenton, N. J. 256
WMAN	First Baptist Church	Columbus, Ohio 286
WMAP	Utility Battery Service	Easton, Pa. 246
WMAQ	Chicago Daily News	Chicago, Ill. 448
WMAV	Alabama Polytechnic Institute	Auburn, Ala. 250
WMAW	Wahpeton Electric Co.	Wahpeton, N. D. 254
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo. 280
WMAZ	Mercer University	Macon, Ga. 268
WMC	"Commercial Appeal" (Commercial Publishing Co.)	Memphis, Tenn. 500
WMH	Precision Equipment Co.	Cincinnati, Ohio 248
WMU	Doubleday-Hill Electric Co.	Washington, D. C. 261
WNAC	Shepard Stores	Boston, Mass. 278
WNAD	University of Oklahoma	Norman, Okla. 360
WNAL	R. J. Rockwell	Omaha, Nebr. 242
WNAM	Ideal Apparatus Co.	Evansville, Ind. 360
WNAN	Syracuse Radio Telephone Co.	Syracuse, N. Y. 286
WNAP	Wittenberg College	Springfield, Ohio 231
WNAQ	Charleston Radio Electric Co.	Charleston, S. C. 360
WNAR	C. C. Rhodes	Butler, Mo. 231
WNAS	Texas Radio Corp. & Austin Statesman	Austin, Texas 360
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa. 360
WNAV	Peoples Telephone & Telegraph Co.	Knoxville, Tenn. 236
WNAW	Peninsular Radio Club (Henry Kunzmann)	Fort Monroe, Va. 360
WNAX	Dakota Radio Apparatus Co.	Vankton, S. Dak. 244
WNJ	Shotton Radio Manufacturing Co.	Albany, N. Y. 360
WOAA	Dr. Walter Hardy	Ardmore, Okla. 360
WOAC	Maus Radio Co.	Lima, Ohio 266
WOAD	Friday Battery & Electric Corp.	Sigourney, Iowa 360
WOAE	Midland College	Fremont, Nebr. 360
WOAF	Tyler Commercial College	Tyler, Texas 360
WOAG	Apollo Theater (Belvedere Amusement Co.)	Belvedere, Ill. 224
WOAH	Palmetto Radio Corp.	Charleston, S. C. 360
WOAI	Southern Equipment Co.	San Antonio, Texas 385
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn. 360
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind. 360
WOAP	Kalamazoo College	Kalamazoo, Mich. 240
WOAQ	Portsmouth Kiwanis Club	Portsmouth, Va. 360
WOAR	Henry P. Lundskow	Kenosha, Wis. 229
WOAT	Boyd M. Hamp	Wilmington, Del. 360
WOAV	Pennsylvania National Guard, 2d Battalion, 112th Infantry	Erie, Pa. 242
WOAW	Woodmen of the World	Omaha, Nebr. 526
WOAX	Franklyn Wolff	Trenton, N. J. 240
WOC	Palmer School of Chiropractic	Davenport, Iowa 484
WOI	Iowa State College	Ames, Iowa 360
WOK	Pine Bluff Co.	Pine Bluff, Ark. 360
WOO	John Wanamaker	Philadelphia, Pa. 509
WOQ	Western Radio Co.	Kansas City, Mo. 360
WOR	L. Bamberger & Co.	Newark, N. J. 405
WOS	Missouri State Marketing Bureau	Jefferson City, Mo. 441
WPAB	Pennsylvania State College	State College, Pa. 283
WPAC	Donaldson Radio Co.	Okmulgee, Okla. 360
WPAH	Wisconsin Department of Markets	Waupaca, Wis. 360
WPAJ	Doolittle Radio Corp.	New Haven, Conn. 268
WPAK	North Dakota Agricultural College	Agricultural College, N. Dak. 360
WPAL	Superior Radio & Telephone Equipment Co.	Columbus, Ohio 286
WPAM	Auerbach & Guettel	Topeka, Kans. 360
WPAP	Theodore D. Phillips	Winchester, Ky. 360
WPAQ	General Sales & Engineering Co.	Frostburg, Md. 360
WPAT	St. Patricks Cathedral	El Paso, Texas 360
WPAU	Concordia College	Moorhead, Minn. 360
WPAZ	John R. Koch (Dr.)	Charleston, W. Va. 273
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa. 360
WQAC	E. B. Gish	Amarillo, Texas 234

Body Capacity

(Continued from page 16)

ground. *Figure 3* shows the arrangement with a three circuit tuner where a separate ground (g) is run from the (—A) line (Dotted). The stator (S) and rotor (m) of the condenser (C) are connected as before.

One of the gravest charges against the common type of multiplate rotary condenser is the connection of the shaft to the rotor plates with the consequent distribution of the plate potential in the front of the panel. The book type condenser with two small plates mounted on hinged plates of insulating material is free from body capacity effect. Further, the inherent capacity or initial capacity of such condensers is low and they can be reduced closer to zero capacity than the multiplate type. It is a wonder that more attention has not been paid to the development of the book condenser or equivalent types where the shaft does not form a part of the plate system or circuit. The Crosley book condenser is an extensively used device on the "store made" Crosley sets, but has not received the interest from home builders that it deserves.

Protection against phone cord capacity is had by means of a flexible wire shield around the cord conductors or by a third conductor woven into the cord and running parallel to the conductors. This shield or third wire is then grounded, and hence does away with the greater part of the capacity effect in this part of the circuit. At least one head set maker provides shielded cords as a regular part of his equipment. The home mechanic can wrap fine copper wire in the form of a coil around the outside of the cord to form a shield. One end of this coil is connected to the metal of the ear pieces while the other end is connected firmly to the ground post or to some other part of the circuit which is conected directly to the ground post. This shielding will prove quite a relief with Ultra-audions or similar circuits.

There is a little trick in tuning a set which often affords relief when one has not the time to make the necessary changes in the circuit, and while it is not always convenient yet the method reduces body capacity in the control system. Place the left hand in firm contact with the metal of the ground post or ground wire, and tune in with the right hand on the dial. When the station is tuned in. first remove the right hand from the dial and lastly remove the left hand from the ground post. By this procedure there is no change in the capacity conditions at the dial since we approached and left the dial at ground potential in both cases. Be sure that the hand is removed from the dial before you let go of the ground. This is not infallible, but it works in many cases.

Another stunt of the same sort is to place thin metal strips on the inside of the ear pieces so that they come into contact with the ears when the phones are put on. The strips are then grounded, and hence your body is also grounded as long as you wear the phones.

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

WQAD	Whitall Electric Co.	Waterbury, Conn.	242
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275
WQAF	Sandusky Register	Sandusky, Ohio	240
WQAL	Coles County Telephone & Telegraph Co.	Mattoon, Ill.	258
WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	360
WQAQ	Abilene Daily Reporter (West Texas Radio Co.)	Abilene, Texas	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAV	Huntington & Guerry (Inc.)	Greenville, S. C.	258
WQAX	Radio Equipment Co.	Peoria, Ill.	360
WRAA	Rice Insitute	Houston, Texas	369
WRAD	Taylor Radio Shop (G. L. Taylor)	Marion, Kans.	248
WRAF	The Radio Club (Inc.)	Laporte, Ind.	224
WRAH	Stanley N. Read	Providence, R. I.	231
WRAL	Northern States Power Co.	St. Croix Falls, Wis.	248
WRAM	Lombard College	Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	236
WRAO	Radio Service Co.	St. Louis Mo.	360
WRAV	Antioch College	Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRAY	Radio Sales Corp.	Scranton, Pa.	280
WRAZ	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	233
WRC	Radio Corporation of America	Washington, D. C.	469
WRK	Doron Bros. Electric Co.	Hamilton, Ohio	360
WRL	Union College	Schenectady, N. Y.	360
WRM	University of Illinois	Urbana, Ill.	360
WRR	City of Dallas (police and fire signal department)	Dallas, Texas	360
WRW	Tarrytown Radio Research Laboratory (Koenig Bros.)	Tarrytown, N.Y.	273
WSAB	Southeast Missouri State Teachers College	Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural College	Clemson College, S. C.	360
WSAD	J. A. Foster Co.	Providence, R. I.	261
WSAG	City of St. Petersburg (Loren V. Davis)	St. Petersburg, Fla.	244
WSAH	A. J. Leonard, Jr.	Chicago, Ill.	248
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	309
WSAJ	Grove City College	Grove City, Pa.	360
WSAL	Franklin Electric Co.	Brookville, Ind.	246
WSAN	Allentown Radio Club	Allentown, Pa.	229
WSAR	Doughty & Welch Electrical Co.	Fall River, Mass.	254
WSAT	Donohoo-Ware Hardware Co.	Plainview, Texas	268
WSAW	John J. Long, Jr.	Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory	Chicago, Ill.	268
WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	233
WSAZ	Chas. Electric Shop	Pomeroy, Ohio	258
WSB	Atlanta Journal	Atlanta, Ga.	429
WSL	J. & M. Electric Co.	Utica, N. Y.	273
WSY	Alabama Power Co.	Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAF	Louis J. Gallo	New Orleans, La.	242
WTAG	Kern Music Co.	Providence, R. I.	258
WTAH	Carmen Ferro	Belvedere, Ill.	236
WTAJ	The Radio Shop	Portland, Me.	230
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gordon & Son	Osseo, Wis.	220
WTAR	Reliance Electric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	275
WTAT	Edison Electric Illuminating Co.	Boston, Mass. (portable)	244
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	360
WTAW	Agricultural & Mechanical College of Texas	College Station, Tex.	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcasting Station	Oak Park, Ill.	220
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTG	Kansas State Agricultural College	Manhattan, Kans.	485
WWAB	Hoenig, Swern & Co. (John Rasmussen)	Trenton, N. J.	220
WWAC	Sanger Bros.	Waco, Texas	360
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	Alamo Dance Hall, L. J. Crowley	Joliet, Ill.	227
WWAF	Galvin Radio Supply Co.	Camden, N. J.	230
WWAO	Michigan College of Mines	Houghton, Mich.	244
WWI	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	517
WWL	Loyola University	New Orleans, La.	260
WYAM	Electrical Equipment Co.	Miami, Fla.	283
WYAW	Catholic University	Washington, D. C.	236

Canadian Stations

CFAC	Calgary Herald	Calgary, Alberta	430
CFCA	Star Pub. & Prtg. Co.	Toronto, Ontario	400
CFCF	Marconi Wireless Tcleg. Co. of Canada	Montreal, Quebec	440
CFCH	Abitibi Power & Paper Co.	Iroquois Falls, Ont.	400
CFCJ	La Cie de L'Evenement	Quebec, Quebec	410
CFCK	Radio Supply Co.	Edmonton, Alberta	410
CFCL	Centennial Methodist Church	Victoria, British Col.	400
CFCN	W. W. Grant Radio (Ltd.)	Calgary, Alberta	440
CFCO	Semmemhaack-Dickson (Ltd.)	Bellevue, Quebec	450
CFCQ	Radio Specialties (Ltd.)	Vancouver, B. C.	450
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCW	The Radio Shop	London, Ont.	420
CFDC	Sparks Co.	Nanaimo, B. C.	430
CFQC	The Electric Shop (Ltd.)	Saskatoon, Saskatchewan	400
CFRC	Queens University	Kingston, Ontario	450
CFUC	University of Montreal	Montreal, Quebec	400
CHAC	Radio Engineers	Halifax, Nova Scotia	400
CHBC	Albertan Publishing Co.	Calgary, Alberta	410
CHCD	Canadian Wireless & Elec. Co.	Quebec, Quebec	410
CHCE	Western Canada Radio Sup. (Ltd.)	Victoria, B. C.	400
CHCL	Vancouver Merchants Exchange	Vancouver, B. C.	440
CHYC	Northern Electric Co.	Montreal, Quebec	410
CJCA	Edmonton Journal	Edmonton, Alberta	450
CJGC	London Free Press Prtg. Co.	London, Ont.	430
CJCD	T. Eaton Co.	Toronto, Ont.	410
CJCE	Sprott-Shaw Radio Co.	Vancouver, B. C.	428
CJCI	Maritime Radio Corp.	St. John, New Brunswick	400
CJCN	Simons Agnew & Co.	Toronto, Ont.	410
CJCX	Percival Wesley Shackleton	Olds, Alberta	400
CJSC	Evening Telegram	Toronto, Ont.	430
CKAC	La Presse Pub. Co.	Montreal, Quebec	430
CKCD	Vancouver Daily Province	Vancouver, B. C.	410
CKCE	Canadian Independ. Telephone Co.	Toronto, Ont.	450
CKCK	Leader Pub. Co.	Regina, Saskatchewan	420
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	410
CKY	Manitoba Telephone System	Winnipeg, Manitoba	450

Cuban Stations

PWX	Cuban Telephone Co.	Habana	400
2DW	Pedro Zayas	Habana	300
2AB	Alberto S. de Bustamante	Habana	240
20K	Mario Garcia Velez	Habana	360
2BY	Frederick W. Borton	Habana	260
2CX	Frederick W. Borton	Habana	320
2EV	Westinghouse Elec. Co.	Habana	220
2TW	Roberto E. Ramires	Habana	230
2HC	Heraldo de Cuba	Habana	275
2LC	Luis Casas	Habana	250
2KD	E. Sanchez de Fuentes	Habana	350
2MN	Fausto Simon	Habana	270
2MG	Manuel G. Salas	Habana	280
2JD	Raul Perez Falcon	Habana	150
2KP	Alvara Daza	Habana	200
2HS	Julio Power	Habana	180
2OL	Oscar Collado	Habana	290
2WW	Amadeo Saenz	Habana	210
5EV	Leopoldo V. Figueroa	Colon	360
6KW	Frank H. Joncs	Tuinucu	340
6KJ	Frank H. Jones	Tuinucu	275
6CX	Antonio T. Figueroa	Cienfiegos	170
6DW	Eduardo Terry	Cienfiegos	225
6BY	Jose Ganduxe	Cienfuegos	300
6AZ	Valentin Ullivarri	Cienfuegos	200
6EV	Josefa Alverax	Caibarien	225
8AZ	Alfreda Brocks	Stgo. de Cuba	240
8BY	Alberto Ravclo	Stgo. de Cuba	250
8FU	Andres Vinnet	Stgo. de Cuba	225
8DW	Pedro C. Anduz	Stcgo. de Cuba	275
8EV	Eduardo Mateos	Stego. de Cuba	180

Turning On Our Loud Speaker

IT MAY be of interest to our readers to know that in every mail delivery that RADIO AGE gets (and we have five a day here in Chicago) the correspondence contains letters of appreciation of the contents of RADIO AGE.

Many contain not only a genuine expression of gratitude but they are crowded with interesting radio gossip. It gives us much pleasure to present the following communications:

Here is one reader who gets *RESULTS*.

I am an ardent supporter of your wonderful magazine, RADIO AGE, and especially of your isometric drawings of the hookups you publish. I have constructed the Stabilizer circuit (Cockaday 4 Circuit) tuner from your isometric drawing, and have obtained some wonderful results with this one-tube hookup. It brought in stations up to 1,800 miles, which I think is a record.

I am now contemplating the addition of two stages of amplification, and hope to add to both range and volume of the set.

Respectfully yours,
STEPHEN MOLNA.
420 Squire St., Cudahy, Wis.

And another writer who gets results from one of RADIO AGE'S hookups:

I am a constant reader of the RADIO AGE, and if I did not buy it each month, I would think I lost something valuable in my personal belongings. I eagerly await the coming of each month's new issue.

Why I am writing this letter is because I want to tell you about the "Baby Heterodyne" set of February's issue. It is, in my mind, the most wonderful one-bulb set that can ever be assembled—barring none!

The set does just as your publication said it does. On 25 feet of aerial wire consisting of No. 26 DCC (the same as I wound the coils with) I got WEAF, WJZ, WHN, WIP, WFI, and WGI. Remember—on 25 feet of No. 26 DCC strung from dining room to kitchen.

Here's what I did in a friend of mine's house a block away. He has a two-variometer, variocoupler set with 2 stages of AF amplification.

I stood my "Baby" on top of his set and connected it to his two-step amplifier, and we got all the above stations and 6 or 7 more without ground or antenna.

I can tune out stations either with the antenna or without it, and I can entirely eliminate WJZ from WJY and WHN from the rest. You may publish this letter if you wish—; my regards and thanks to Mr. Rathbun who put the set in RADIO AGE.

Very truly yours,
RICHARD SHY.
253 W. 68th St., New York City.

Please let me congratulate your Mr. Anderson on his splendid article in February's RADIO AGE on audio regeneration, as applied to the Rei-

nartz tuner. It not only contains a good bit of information, but also has the real working principle. I applied this to the old Reinartz and can say that it increases the distance and audibility by at least 50 per cent.

In all experimental work, I use either WD 12 or UV 199 tubes. In trying your hookup of audio regeneration I reached Los Angeles, Calif., and was on their concert from 1:22 a. m. until 1:28 (EST). This principle has been tried out on other regenerative receivers but has not given the results.

Instead of using the variocoupler I used the old "spiderweb" in this test as I believe it more selective. For instance, I tuned out WJAX in Cleveland (390) and tuned in on Los Angeles (KHJ) (395). If the modifications I've made in the old set continue to give equal results in further tests, I will be glad to send you my complete hookup for the interest of your readers.

CLARENCE B. GANNON.
1713 Ensor St., Baltimore, Md.

A coast to coast reception on a test for a set is certainly not poor receiving. Another fan from Michigan has also been doing coast to coast work. The following testifies:

Some time ago, in about December, you have sent me a hookup for a Reinartz with one stage radio frequency. I have had, and am having, some wonderful success in results. I experimented in various ways and connections and found that when the secondary of the radio frequency was coupled to the middle arm of the potentiometer, instead of the negative A as called for, it gives exceptional higher results. The machine is more sensitive, more far reaching and more easily tuned.

The volume and clarity of tone, I must admit, has not yet been equaled, in my estimation, to numerous high priced machines, that I have personally operated and heard. I am using a UV 200 for detector and UV 201 A for amplifier. I have wound my own coil entirely a different way from from what the regular directions called for in the Reinartz.

I am able to bring in stations from 175 meters to 600 and over if necessary. I have listened to every principal transmitting station in the U. S., from coast to coast, also including several stations in Canada. I have on a loud speaker the volume from New York to Atlanta, Georgia, Fort Worth, Texas, comes in with remarkable loudness; in fact, a person not knowing that it was a radio would believe that the original orchestra or singer or speaker were within the house.

I am writing you this fully appreciating your valuable assistance, and expressing my thanks to the RADIO AGE in initiating me as a radio fan.

I remain, very sincerely,
J. J. DREY.
Care J. J. Drey Co., Iron River, Mich.

Your Radio Problems Solved for 30 Cents in Stamps

IF YOU are constructing a receiving set, and you need help in the way of clear diagrams and full detailed descriptions you may have it by return mail.

We have laid aside a limited number of back numbers of Radio Age for you. Below we are listing the hook-ups and circuit diagrams to be found in these magazines. Select the ones you want, enclose 30 cents in stamps for each one desired.

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October, 1922
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—How to make an Audio Frequency Amplifying Transformer.

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—Design of a portable short-wave radio wavemeter.

January, 1923
—How to make a sharp-tuning Crystal Detector.
—Fixed condensers in home-made receiving sets.

May, 1923
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—How to make a portable Reinartz set for summer use

June, 1923
—How to build the new Kaufman receiver.
—What about your antenna?

July, 1923
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—How to read and follow symbols.
—Proper antenna for tuning.

September, 1923
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October, 1923
—Your First Tube Set.

November, 1923
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—A Three-Circuit Tuner.
—How to Learn Code.

December, 1923
—Building the Haynes Receiver.
—Combined Amplifier and Loud Speaker.
—A selective Crystal Receiver.

January, 1924
—Tuning Out Interference—Wave Traps—Eliminators—Filters.
The article which was announced from stations WJAZ, WOC and WOAW.
—A Junior Super-Heterodyne.
—Push-Pull Amplifier.
—Rosenbloom Circuit.

February, 1924
—How to make a battery charger.
—Improved Reinartz Circuit.
—Interference rejectors.
—Single Tube Heterodyne.
—How antenna functions.
—Adding two audio stages to selective receiver which began as a crystal set.
—Superdyne receiver.

March, 1924
—An Eight-Tube Super-Heterodyne.
—A simple, low loss tuner.
—Junior Heterodyne Transformers.
—A Tuned Radio Frequency Amplifier.
—How to make the Kopprasch Receiver.
—Adding Radio Frequency to the Variometer Set
—Simple Reflex Set.

RADIO AGE, Inc.

500-510 North Dearborn Street - - - - - CHICAGO, ILL.

Is Broadcasting Monopoly Possible?

IF THE American Telephone and Telegraph Company controls telegraph and telegraph wires throughout the United States, why cannot the company control rebroadcasting? All that is necessary, it seems, is to either refuse to permit the use of wires with which to transmit speech, song or music to the station desiring to rebroadcast.

There have been definite statements that the American Telephone and Telegraph Company seeks a broadcasting monopoly. The company has stations at New York, Washington and Providence, and these three stations were the only ones which broadcast President Coolidge's speech on Washington's birthday anniversary. Both broadcasters and broadcast listeners in the west and middle west complained loudly of this limitation of a national patriotic event.

One recourse for the independent broadcaster appears to be available. Through the use of equipment which will pick up broadcasts on one wave length and then retransmit it on another wave length it is expected that broadcasters at no distant day will be independent of the interests that control wires. More will be published on that subject later.

Newspapers all over the country printed the facts about the Coolidge speech incident. We reprint an article from the New York *Times*. Radio readers may judge for themselves of the justice of the complaints against the American Telephone and Telegraph Company and of the quality of their reply.

Following is the *Times* article:

"The complaint of Chicago radio listeners that they were barred from hearing President Coolidge's speech on Washington's birthday because the American Telephone and Telegraph Company quoted a $2,500 price, which they called a prohibitive fee, for furnishing that service, was answered yesterday by William E. Harkness in charge of the radio division of the telephone company. He explained that the price quoted to Chicago was fixed on a cost and not a profit basis.

" 'The whole story is this,' said Mr. Harkness. 'Several weeks ago the Chicago Rotary Club announced to all its members that on February 22, if they listened at receiving sets they could hear the speech of the President broadcast all over the world. They then came to us and asked if we could arrange it.

" 'We informed their representative, I believe it was Mr. Treadwell, that it would be a physical impossibility to make the necessary connections to enable President Coolidge's talk to be heard in every part of the world. We did explain, however, that we had already arranged to broadcast the President's speech over practically all the states east of the Mississippi through three broadcasting stations—those at Washington, New York and Providence.

" 'Later they came back and said they wanted us to broadcast the President's speech also through Chicago. They asked us to quote them a price. Our figure was $2,500. That was a cost proposition, not a profitmaking rate.

" 'We did not 'demand' an excessive rate from any other city that desired to broadcast the President's talk. We received an inquiry from St. Paul, Minn., desiring to know whether we would make them a low figure for broadcasting President Coolidge's speech. We advised them the cost of linking St. Paul to the broadcasting circuit would be prohibitive That's all there was to it.'

Radio Station Makes Charge

The Chicago complaint, which appeared in the Brooklyn *Eagle*, said in part:

" 'Chicago radio listeners were unable to hear President Coolidge's radio eulogy of George Washington last night because the American Telephone and Telegraph Company put a prohibitive charge on the use of a telephone wire between Chicago and Washington.

" 'This charge was made late last night over the air by the announcer of Station WJAZ, the Zenith-Edgewater Beach Hotel Broadcasting Station in Chicago.

" 'The cost of a ten-minute conversation between Washington and Chicago is about $14. As President Coolidge spoke for fourteen minutes, the cost would be a few dollars more. We were quite willing to pay a reasonable fee for this service.' "

"Discussing the cost Mr. Harkness said:

" 'We have to disrupt all our normal conditions and set up an entirely new service to broadcast. That can be done only when the normal service of the company is interrupted. We have to take certain circuits and disrupt them and set new circuits.

" 'Now to establish those circuits, special equipment has to be used. The installation must be done by special men. Special forces must be kept at all the repeating stations. In making the installations we have to wait until the lowest point of traffic of the day, which means after midnight. In turn that means that we have to pay our special men, who are high priced workers, for overtime.

" 'In undertaking to broadcast an important program we set up the circuits the day before. We must then take them out to make way for normal telephone service. When the time comes to broadcast we must put the circuits on again, and after the broadcasting is completed we must disrupt the special circuits.' "

Amateur Prize Winners

Hartford, Conn.—American operators report having heard thirty-seven European transmitters during the December tests in which Americans competed for prizes:

American prize winners have been announced as follows:

Grand Prize; Greatest Total Station Miles—R. B. Bourne, 1ANA, Chatham, Mass.

Group A: Greatest Mileage for Any Single Reception.

First—Norman S. Hurley, 5AC, Mobile, Alabama.....4750 miles
Second—William Moore, 9DES, Caney, Kansas.....4710 miles
Third—L. W. and T. E. Bryant, 4BL, Lakeland, Florida.....4540 miles
Fourth—Quentin Swigart, 9COL, Galesburg, Ill.....4310 miles
Fifth—Fred Marco, 9CD, Chicago.....4200 miles

Group B: Greatest French Mileage for Any Single Night.

First—Sheldon S. Heap, 1BDT, Atlantic, Mass.
Second—W. Coates Borrett, c1DD, Dartmouth, N. S.
Third—Lafayette College Radio Club, 3YO, Easton, Pa.
Fourth—Ed Scattergood, 3II, Cynwyd, Pa.
Fifth—M. H. Hammerly, 2BIS, Bronxville, N. Y.

Group C: Greatest British Mileage for Any Single Night.

First—J. L. Fenderson, c1AF, Jacquet River, N. B., Can.
Second—Bronx Radio Club, Bronx, N. Y.
Third—Robt. H. Sproul, 1GG, So. Hamilton, Mass.
Fourth—Richard S. Briggs, 1BVL, Dorchester, Mass.
Fifth—J. Van Riper, aAJF, Passaic, N. J.

Group D: Greatest Total French Mileage.

First—Levi G. Cushing, 1BCF, So. Duxbury, Mass.
Second—A. W. Greig, c1BQ, Halifax, Nova Scotia.
Third—R. W. Woodward, Hartford, Conn.
Fourth—Bernard J. Kroger, 3APV, Washington, D. C.
Fifth—Geo. H. Pinney, 1CKP, So. Manchester, Conn.

Group E: Greatest Total British Mileage.

First—A. A. Learned, Providence, R. I.
Second—A. R. Tabbut, Bar Harbor, Maine.
Third—Boardman H. Chace, 1BDU, Winthrop, Mass.
Fourth—Chester W. Sprague, 1AUC, Bar Harbor, Maine.
Fifth—Harold G. Riley, 1AUR, Livermore Falls, Maine.

1924 FORECAST

Did you dealers read what Roger Babson had to say about the radio business? His optimistic predictions deserve the greatest amount of consideration because he is known as one of the world's most noted authorities on business and financial conditions. Mr. Babson predicts that the radio business in 1924 will amount to more than $350,000,000. You will reap part of this harvest of gold if you watch your "P's" and "Q's" carefully—Crosley Radio Weekly.

If You Sell Radio Merchandise By Mail

Radio Age Covers the Continent.
183,000 copies printed and distributed in the first three months of 1924.

JANUARY.....50,000 **FEBRUARY.....63,000** **MARCH.....70,000**

Radio Age is an applicant for membership in the Audit Bureau of Circulations, a fact that will interest advertisers who insist upon **verified** circulation.

Radio Age has wholesale distributors and news dealers in every important center in the United States and Canada.

Radio Age advertising produces results. National advertisers are signing up for time contracts. **They know.**

Rogers Radio Co., Pittsburgh, Pa., wrote us recently as follows:

"Enclosed please find check for $2.50 to cover our February "ad." We received more inquiries from this "ad" than from the $25.00 ones we have been running in (Here was named a magazine claiming to lead the field.) Therefore we want to run the enclosed "ad" in the next issue of Radio Age. We should have been in your January issue."

Advertising rates in Radio Age are based on 25 cents a line for 25,000 circulation. The rate is to be advanced to 40 cents a line, effective April 15, 1924.

Every buyer of Radio Age is a radio fan. The magazine offers a highly specialized circulation. Advertisers reach exactly the circulation they are paying to reach.

Can we send you a rate card?

RADIO AGE, Inc.

506 NORTH DEARBORN STREET

CHICAGO, ILLINOIS

Crosley Model 51
$18.50

In 24 Days the Crosley Model 51
Became the Biggest Selling Radio Receiver in the World!

On Monday morning, February 4th, Powel Crosley, Jr., returned to his desk after a two weeks' hunting trip in Mississippi. He brought with him the idea of an entirely new Radio Receiving Set to be added to the Crosley line.

A short conference with his engineers followed. On Tuesday morning, February 5th, a model had been completed and tested. These sets were put into production immediately after the model was approved.

On Tuesday afternoon, February 5th, night letters were sent to the leading distributors of The Crosley Radio Corporation announcing this new model which had been called MODEL 51. Wednesday afternoon, the orders commenced coming in, showing the faith of the distributors in anything brought out by this Company. Announcements were made in leading metropolitan newspapers of the country on Saturday and Sunday, February 9th and 10th. Shipments commenced about February 13th, and were immediately followed by an avalanche of complimentary letters and orders, and have increased steadily ever since.

Production started at 50 a day—was increased to 200—then 300—and on February 28th, just 24 days after the thought of this set had been put into being, the production reached 500 a day. Orders were received on February 26th for 1,115 of these sets—every effort being made to increase the production to 1,000 sets per day to supply the phenomenal demand for this new model.

This message was written on February 29th in the face of promises of an even greater record than is indicated here.

The demand for this set has not in any way lessened the sale but has increased the orders on various other models in the Crosley line.

Now what is this set that has made such an enviable record which in 24 days has, we believe, become the biggest selling Radio Receiving Set on the market?

It incorporated a tuning element made famous in the Crosley Model V, the $16.00 set used by Leonard Weeks of Minot, N. D., in his consistent handling of traffic with the MacMillan Expedition at the North Pole; a genuine Armstrong regenerative tuning and detective circuit.

Now, to this has been added a one stage of audio frequency amplification. With the well-known Crosley Sheltran 9 to 1 ratio transformer, giving an unusual volume. Thus, this set uses two vacuum tubes.

It is the ideal all-around receiver. For local and nearby broadcasting stations, it will operate a loud speaker, giving phonograph volume in the home. Under reasonably good receiving conditions, it will bring in stations up to 1,000 miles, with sufficient volume for the average size room.

When receiving conditions are bad, however, head phones should be used on distant stations.

This Receiver is unusually selective—it incorporates standard sockets so that all makes of tubes can be used. The various units are mounted on beautifully engraved grained panels, and mounted in a hardwood, mahogany finished cabinet, which completely encloses all parts and tubes.

A glance at this beautiful instrument sells it, and the results it gives creates many friends for it. Perhaps the most startling thing of all is its price—$18.50. Add 10% west of the Rocky Mountains.

Licensed under Armstrong Regenerative U. S. Patent No. 1,113,149.

THE CROSLEY RADIO CORPORATION
Powel Crosley, Jr., President
Formerly
The Precision Equipment Company and Crosley Manufacturing Company
463 Alfred Street Cincinnati, Ohio

CROSLEY
Better—Cost Less
Radio Products

RADIO AGE

The Magazine of the Hour

MAY
1924

Outdoor Radio Number

How to make portable receivers for motorists and campers.

How to build small, compact sets for the traveling man.

Complete, illustrated article on an ideal vacation outfit.

Radio Age Data Sheets.

Complete, corrected list of U. S., Canadian and Cuban broadcasting stations.

Pick-Ups and Hook-Ups by Our Readers.

Other valuable features.

More picture-diagrams.

Lost, One Pal

Let Our Hook-ups Be Your Guide

Price 25 Cents

Your Radio Problems Solved for 30 Cents in Stamps

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—Superdyne receiver.

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—A simple, low loss tuner.
—Junior Heterodyne Transformers.
—A Tuned Radio Frequency Amplifier.
—How to make the Kopprasch Receiver.
—Adding Radio Frequency to the Variometer Set.
—Simple Reflex Set.

April, 1924
—An Efficient Super-Heterodyne (fully illustrated).
—Selecting the Right Receiver.
—A Ten-Dollar Receiver.
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—Reflexing the Three-Circuit Tuner.
—Index and first two instalments of Radio Age Data Sheets.

RADIO AGE, Inc.

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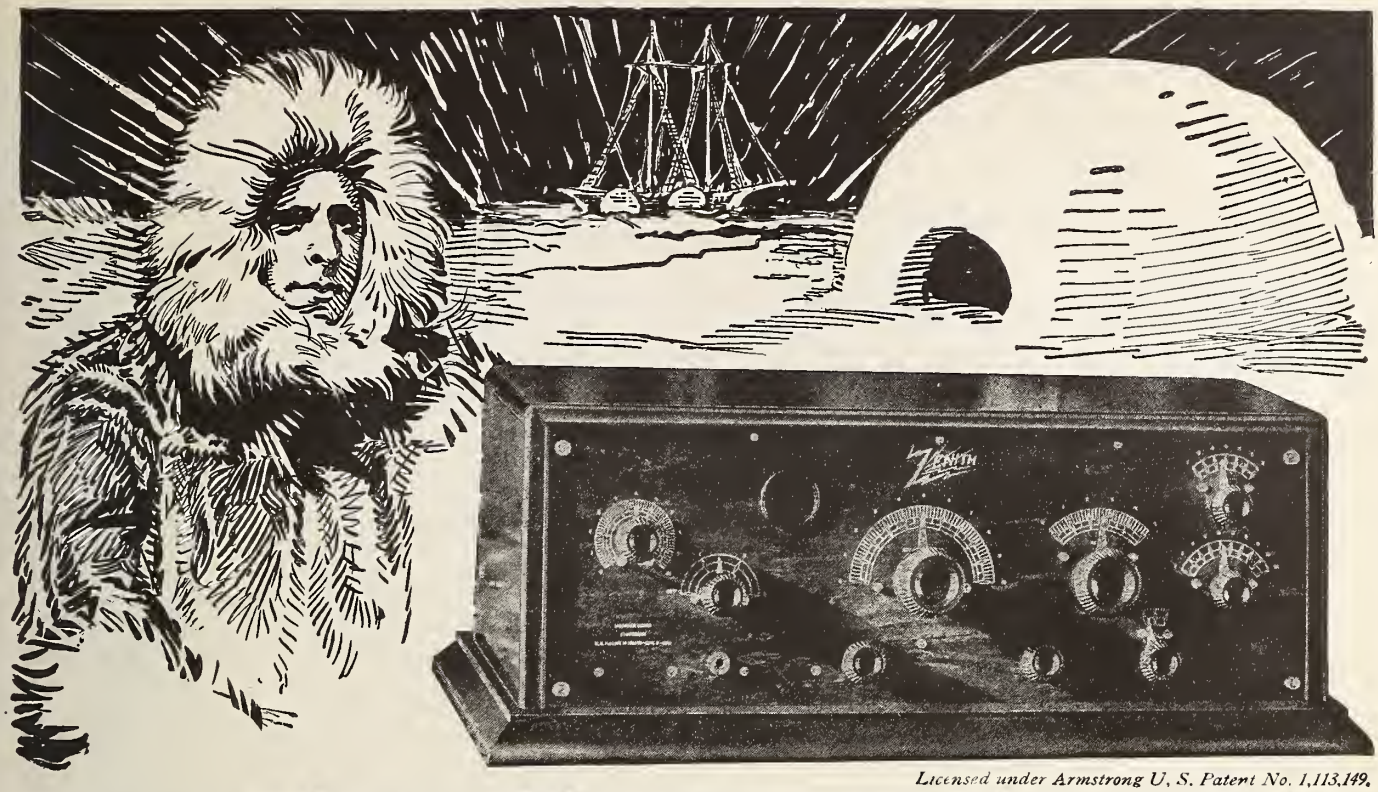

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Using

ZENITH

TRADE MARK

Long-Distance Radio

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—"MacMillan"

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RADIO AGE

The Magazine of the Hour

Established March, 1922

Volume 3 *MAY, 1924* *Number 5*

CONTENTS

Radio Age is published monthly by
RADIO AGE, Inc.

Editorial and Publication Offices, Boyce Building.
500 N. Dearborn St., Chicago

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Advertising forms close on the 15th of the month
preceding date of issue.
Applicants for membership in A. B. C.

Issued monthly. Vol. 3, No. 5. Subscription price $2.50 a year.
Entered as second-class matter April 4, 1924, at the post office at Chicago, Illinois, under the act of March 3, 1879

A Chat With the Editor

THIS May issue of RADIO AGE marks the beginning of the magazine's third year. Our first number was published in May, 1922. The thing of which we are most proud in connection with that first issue is the fact that it was a tangible evidence of our faith that radio would grow to immense importance. We believed the public would support a radio periodical which gave accurate, clear instructions on how to build receiving sets and how to operate them.

Now that we have achieved a circulation that has attracted attention of publishers, advertising men, manufacturers and news dealers the country over, we are just as confidently going forward with the purpose of doubling the present figures within the fiscal year. At the rate of increase in the last four months this will not be a difficult or a surprising accomplishment.

This magazine has only one office rule: "Put sufficient value in the book to make radio readers want it, and need it, and when they buy it they will become friends." We recently sent out large numbers of announcements to readers that their subscription terms had expired. In response we got the renewals of a great many subscriptions, together with the assurance from old readers that they would not care to miss a single number.

We have been helped on many occasions by suggestions from readers as to how to improve RADIO AGE. We have accepted the criticisms, whether favorable or adverse, as sure proof of interest in the magazine, and we have tried to adjust the material produced for our pages to the wishes of the readers. It is probable the readers are to be congratulated on the progress of RADIO AGE rather than its editor and publishers. We said the same thing a year ago, and we venture to say you will find the same sentiment in this column in our issue of May, 1925.

Frederick Smith

—Editor, RADIO AGE

Get ready *now* for summer radio

Your radio batteries have served you well and faithfully over the long winter months. Now a great radio summer is at hand. To enjoy summer radio at its best, equip your receiver with the best batteries you can get. Put in new Eveready Radio "B" Batteries and see what wonderful, long-lived service they will give.

Made especially for radio use, Eveready "B" Batteries will operate the loud speaker at maximum volume for long or shorter periods, depending on how rapidly the current is taken out of them. Packed full of pep and punch and go, Eveready "B" Batteries pour out their power the moment you turn on the tubes. Scientifically made for long-lived radio service, the cells renew their vitality when idle—responding instantly with fresh vigor.

Eveready "B" No. 767 is the standard amplifier "B" Battery, and gives 45 powerful, dependable, zippy volts. Five sturdy Fahnestock Clips make this big "B" Battery available for soft detector tube use as well—varying the voltage from 16½ to 22½ as required.

Insist on Eveready "B" Batteries, remembering that they are the product of thirty years of experience and know-how in battery making. Designed and made under the supervision of the finest electro-chemical laboratory known to science, the quality and efficiency of Eveready Radio Batteries are assured. For maximum battery economy and service, buy Eveready Radio Batteries—they last longer.

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Headquarters for Radio Battery Information
New York San Francisco
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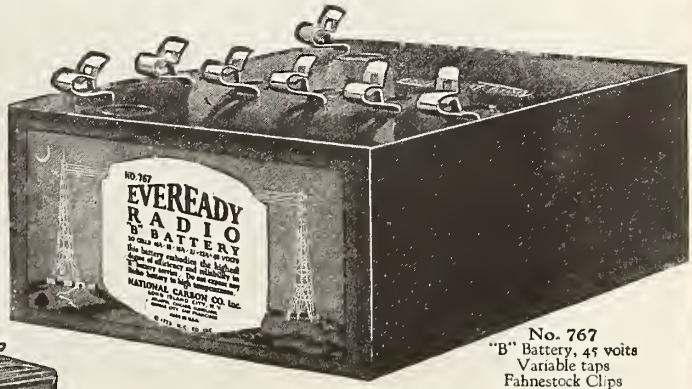
Informative and money saving booklets on radio batteries sent free on request. If you have any questions regarding radio batteries write to G. C. Furness, Manager, Radio Division, National Carbon Company, Inc., 202 Orion Street, Long Island City, N. Y.



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The Space
Saver
Vertical
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"B" Battery

Eveready
"A" Dry Cell
The best
battery for use
with dry cell
tubes

No. 766
"B" Battery, 22½
volts. Six Fahne-
stock Spring Clips

No. 771
"C" Battery
Clarifies tone
and prolongs
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life

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–they last longer

RADIO AND THE OPEN ROAD

This is to be a radio summer in more ways than one. The picture above shows how two motor-tourists have made a receiver an important part of their roadside camp. Portable sets are easily made or purchased.

RADIO AGE
The Magazine of the Hour

M. B. Smith
Business Manager

A Monthly Publication Devoted to Practical Radio

Frederick A. Smith
Editor

The Construction of a Simple Portable Set

By FRANK D. PEARNE

TO THE real live wire radio fan, the value of a good, convenient portable set taken along on the summer vacation is well understood, but there are some who think it might be interesting, but it means an added load of baggage and much fussing around to get it installed in the camp or wherever he may decide to locate. This latter type of fellow doesn't know what he is missing, and as to the extra load he would have to carry he need have no fear, because a perfectly good portable set can be made in such a way that it is hardly any larger than a good sized camera and does not make a bulky package.

It is not necessary to carry any aerial material, or wires of any kind; just the smallest kind of a suitcase about 11 inches square carries the whole thing; and when it is placed in operation all one has to do is to open the case, plug in the phones and listen. Place the phones on the head and carry the case in the hand on a hiking trip, in the boat while fishing, or any other place and the entertainment is always there.

The greatest trouble seems to be in making the other fellow understand how little trouble it is to have the convenience of a radio set with him all the time, and that this is the time when the radio set is appreciated for the reason that he has plenty of time on his hands and can while away much of it lying under a tree and keeping in touch with the outside world, just as well as if he were back in the city. However, once he tries it out, he will never go to the country again without his little companion. The writer must confess that he, too, had this idea of a portable set being a lot of trouble, until one day when Mr. J. V. Steinborn walked into the electrical department of the Lane Technical High School and placed a small sized suitcase on the table, opened it up and plugged in the phones. Three different stations happened to be broadcasting at this time, and any one of the three could be brought in very nicely and the others excluded. Upstairs and down, through halls lined with steel girders, this set was carried and the music and market reports came in anywhere it might be placed, demonstrating that here was an ideal arrangement for the traveler

The circuit, which is a modification of the super-regenerative circuit, has all the peculiarities of the original, with perhaps the exception of the difficulty in tuning which is the most simple part of the set described.

Constructing the Loop

The receiver is operated by a loop aerial, which is entirely within the case, and this is the first part to be constructed. It consists of a flat box-like frame, constructed of four pieces of pine,

FOR TRAVELS

Figure 1. Compact, portable set described by Mr. Pearne in the accompanying article. Miss Lenore Hill carrying the vacation outfit.

each 11 inches long, 5 inches wide and ⅜ of an inch thick. This frame should be fastened together by setting in dowel pins and glue. No iron nails or tacks should be used. If one does not care to fasten it together this way he may use flat-headed, brass screws, making sure that the heads of the screws are drawn in below the surface of the wood, so that there will be no chance of the wire coming in contact with them. Around the outside of this frame, 20 turns of No. 24 single silk insulated wire are wound, each turn being separated from the next by a distance of ⅛ of an inch. The ends of the loop so formed are brought to the inside of the frame by drilling two small holes through one of the flat sides of it, these holes being located near the place where the two adjustable spider web coils are mounted. All of the apparatus shown in the schematic photograph of the outfit is placed inside of this frame.

Next cut out a bakelite panel, which is to be placed over one end of the frame. It should be a little more than 11 inches square, as it should extend just far enough over the edges of the frame to come even with the outside of the winding all around. Now another frame is made to fit over the outside of the loop winding. This may also be made of pine ½ inch thick and 6 inches wide. The length of the four pieces will have to be just right to make a nice snug fit around the panel, and because it is 1 inch wider than the inside frame, it will extend 1 inch over the panel when the other edges are equal. A flat piece of wood, approximately 12 inches square, is placed over the back of the two frames, to form the back of the case. This should also be ½ of an inch thick and should be just large enough to fit even with the outside of the outside frame all around. It is fastened in place with small brass screws, so that it may be removed during the construction of the set. The general construction of these two frames is plainly shown in Figure 4.

The Spider Web Coils

Two spider web coils are necessary. From a piece of 1/16-inch sheet fiber, cut out two discs 3½ inches in diameter. Draw a circle 1 inch in diameter in the center of each and cut 17 slots 1/16 of an inch wide from the outside edge to the edge of the circle, spacing them evenly, by first dividing the outside edge into 17 parts. The first coil is wound in one slot and out the next, until 10 turns have been wound. The other disc is wound with 50 turns, with taps taken off at turns 10, 25, 32, 44, and 50. This is the stationary coil, and the ends of the taps, as well as the final end of the winding, are connected to the switch contacts. The 10 turn coil is wound with No. 28 single silk-covered

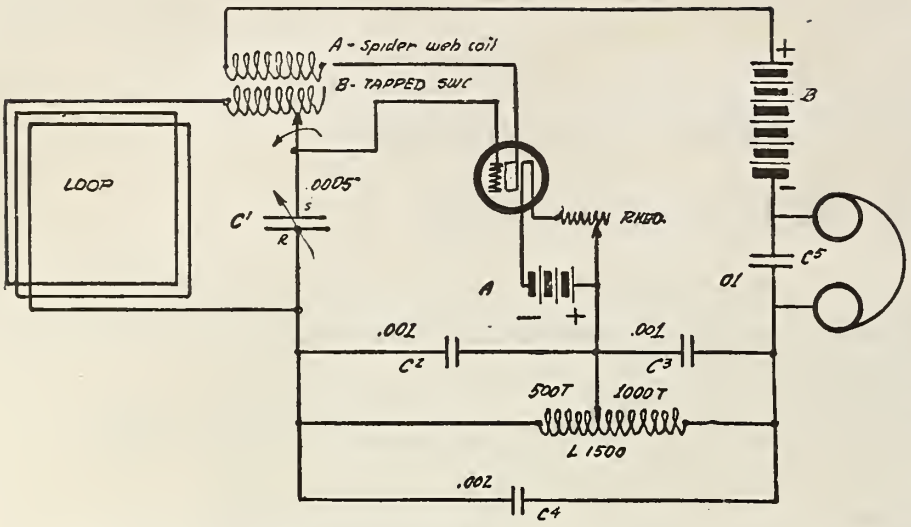


FIGURE 5

The wiring diagram shown above gives the connections for the receiver described by Mr. Pearne in the accompanying article. The set is a very efficient and compact receiver for use by people who travel during the vacation season.

post on the socket after passing through the 10-turn spider web coil "A".

The remaining loop aerial terminal is connected to the terminal of the spider web coil "B". The tube used in this set is a UV-199 and the filament current is supplied by a 3-cell flashlight battery. The rheostat should be of the high resistance type, not less than 25 ohms. Because of the low current consumption of the filament in this type of tube, this small battery will operate it continually for a great many hours. The plate battery consists of the smallest type of 22½-volt plate battery, and this, too, has a long life. The fixed condenser C5, which is connected across the phones, is not very critical, as its capacity may be anything between .005 and .01 M.F. In the set constructed by Mr. Steinborn he used a filament control jack, so that the rheostat may be set and left in one position. When the phone plug is removed the current is automatically cut off from the filament.

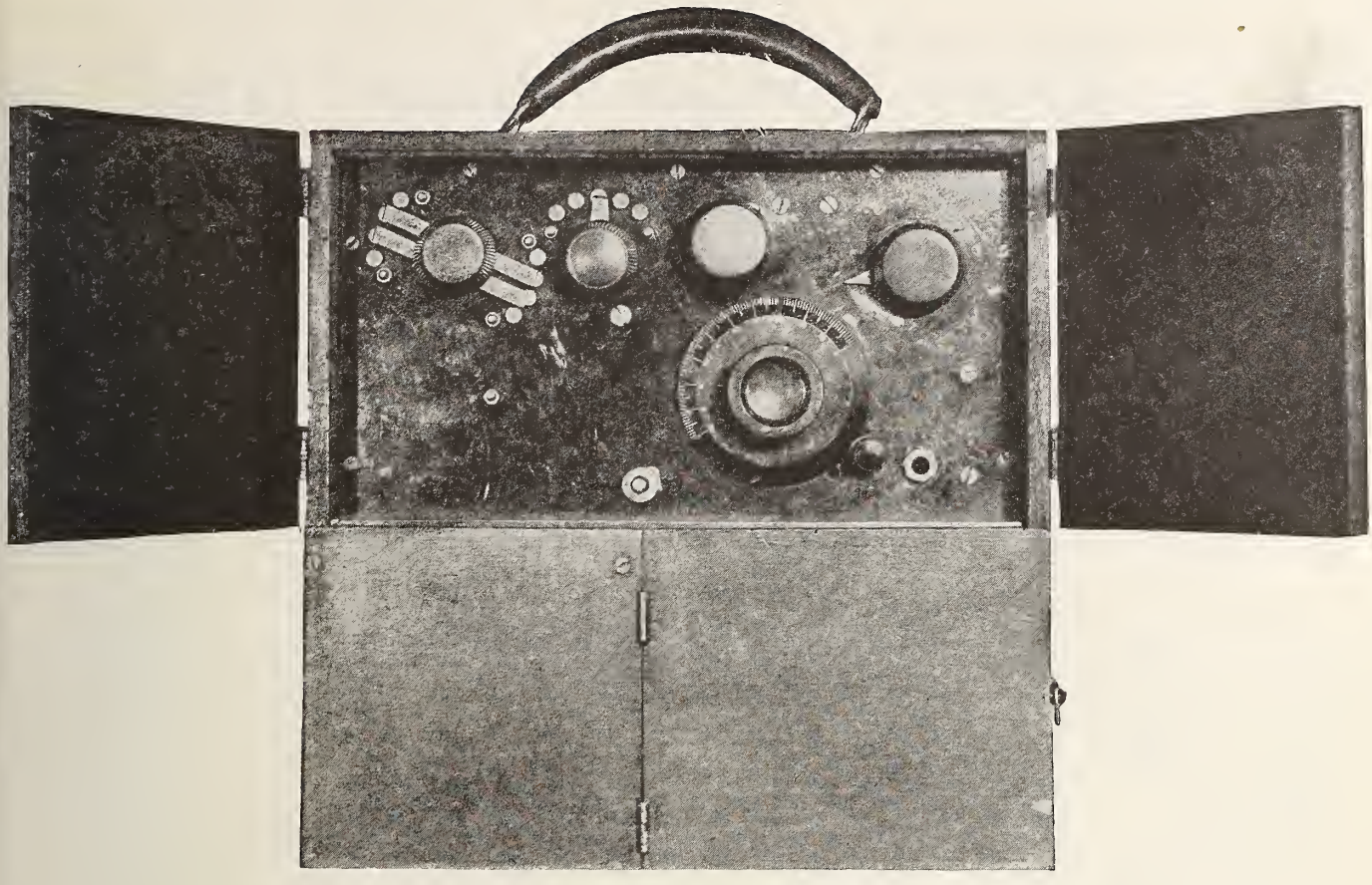
If, when the set is first connected up, it fails to give the expected results, re-

wire and the 50-turn coil is wound with No. 24 single silk-covered wire. The coil containing the taps is mounted stationary in the position shown in the photograph, Figure 3, and the 10-turn coil is mounted on a flexible spring mounting, in such a way that the spring serves to keep it close to the other coil. It is so arranged that a threaded brass bar, which is supplied with a knob, extends through the panel, and as it is moved in and out by turning the screw the small coil will change its position and relative inductive value, with respect to the 50-turn coil.

The movable coil is shown in Figure 3. The 1,500-turn honeycomb coil shown in the cubbyhole below is tapped at a point 500 turns from the inside end, this tap being connected to the junction of the two .001 condensers and the positive terminal of the filament battery as shown in Figure 1. This coil should be mounted at least 5 or 6 inches away from the spider web coils, to prevent any energy being transferred between them. Varying the position of this tap on the honeycomb coil will make considerable difference in the reception, and while it is stated that the tap should be taken off at 500 turns from the inside, one should experiment and find just where it will give the best results. It will, however, be found somewhere near this point, and when once located, the connection is made permanent. The inside end of the honeycomb coil is connected to the variable grid condenser. The other side of this condenser is connected to the switch lever and to the grid binding post on the socket. It is a 23-plate variable condenser. It will be noted that the inside end of the honeycomb coil also connects to one end of the loop, to one of the .001 fixed condensers, and to one side of the .002 fixed condenser. The outside end of this coil is connected to the other side of the .002 fixed condenser, to one side of the .001 condenser, and to one side of the phones. The other side of the phones is connected to the negative side of the "B" battery, the positive side of which connects with the plate binding

ARRANGEMENT OF PARTS

Figure 3. Inside of cabinet of portable receiver. This has been thrown together roughly to indicate compact arrangement. The batteries and aerial are self-contained in the small box. Compartment at the left shows how the head phones are stowed away when not in use.



FRONT OF CABINET

Figure 2. The portable receiver, with hinged doors opened to show panel arrangement.

verse the connections to one of the spider web coils, as this is the only chance one has of making a mistake. Solder all connecting wires and see that everything is well insulated, so that there will be no chance for short circuits. A slight whistle is usually present when the set is in operation. This is not pronounced enough to cause any interference, but is an indication that the set is working as it should. The position of the tap on the honeycomb coil will determine the strength of this whistle; it can be made to disappear entirely if the tap is correctly located. In the photograph of the front of the set it will be noticed that a series-parallel switch is shown. This should be eliminated, as it has been found to be of no service whatsoever, and consequently is not shown in the schematic drawing.

While the distance reception is not so marked with the built-in aerial, it will operate a WE10-D loud speaker on local stations. If a loop outside of the set is used it will pick up distant stations very nicely.

As to selectivity, the set was operated at the entrance to the Drake Hotel, Chicago, while their station was broadcasting, and this station was cut out and the other stations brought in without the least trouble. As shown in the photograph, the receiver was not mounted in a suitcase, but merely in a roughly constructed wooden case, as described, but it can just as well be placed in a suitcase if desired. Ample room for mounting all the parts will be found inside the frame.

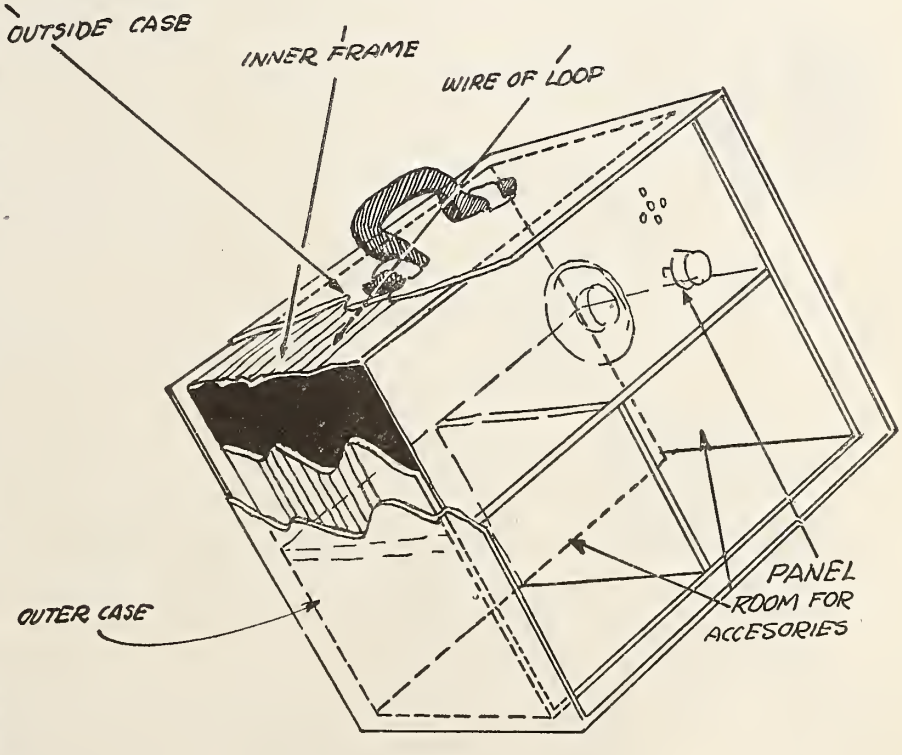
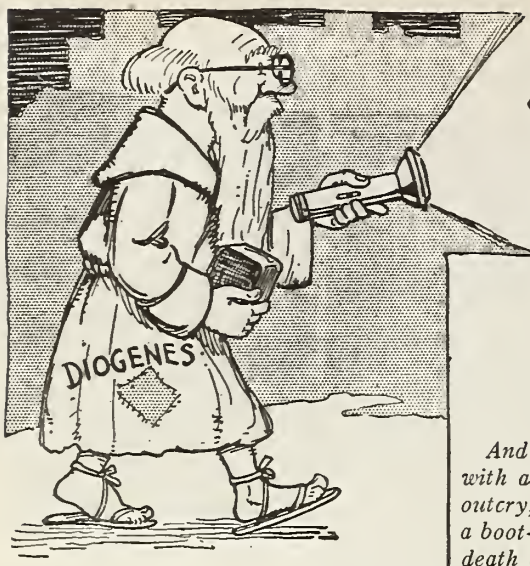


FIGURE 4

A small sketch showing how the various parts of the set are arranged into the cabinet. The loop is wound around the frame, which supports the entire receiver and batteries. This frame is in turn covered by another larger wooden box, which protects the entire set.



You may not believe it BUT—

Robert J. Casey

The Vest Pocket Anthologist

And into the marts came one Diogenes with a flash lamp, bewailing with a loud outcry, that one Kunopos had sold to him a boot-leg C battery that had now died the death and that there was no honest man in all Athens, for that matter in the restaurants of the world, whither the men of Athens had betaken themselves. And he paused in his wailing, for two men awaiting the 5:15 to Thermopylae had begun to talk.

IT WAS Ben Hecht, the talented radio engineer, who first undertook to broadcast the story of milk delivery via the ether. He did not make a point about the ether. He was willing to concede that it may have been delivered via the heavyside layer. But as for the milk he had read in the Scientific Whoosit about a Newark genius who hoped to bring about a radio revolution in the milk business.

"All matter is made up of groups of electrical charges," he quoted from memory. "Positive whatchacallits and negative so-and-sos. These charges are held together by some sort of silly attraction, but they are in a state of constant motion. It doesn't seem to be much of a step to guess that everything in nature has its own vibratory frequency — its fundamental wave length, as it were. Nobody thinks it odd now that sound is split up into segments and transmitted through the air on an electric flash. Already the transmission of pictures—or light—by radio is common enough performance. Why, then, may we not split up other things into their positive whatchacallits and negative so-and-sos and transmit them over a magnetic wave to distant points.

"This man I was reading about has succeeded in broadcasting a quart of milk—"

"Yes," said the literary person who had not followed him. "And I daresay it was very disconcerting for folks in the neighborhood to get an earful of milk out of their head phones. There is no telling what is in the air———"

The sad voiced young scientist interrupted with no show of impatience.

"The apparatus was fairly simple" he said. "Professor Whatsisname of Newark used a tremendously high voltage to modulate the milk. But basically it was the same trick that is being turned every night in any broadcasting station. The theory of the thing was so sound that I couldn't help telling my friends about it. And there was Mike, you know Mike, who always had a sort of electrical impulse. Mike was convinced right away that this would be a great thing—no milkman, no deposit of 5 cents a bottle with the delicatessen; nothing but milk delivered on a piece of clean wire. He tried it and—well, there's no doubt its going to be a great thing for the cows and everybody."

"He actually worked it?"

"Well, yes and no. You see, he didn't have the high voltage so he thought to run the modulated milk from the filament of the tube to the plate by sending it through the storage battery first. He poured it in to a dry-charged battery and then dumped the electrolyte on top. He broadcast the milk all right, but the results were a bit local."

"But he received it on his set?" The inquirer had become excited.

"That's the peculiar part of it," said the sad faced young scientist. His set is a reflex and the milk got stirred up so going back and forth through the tubes that the loud speaker was full of creamery butter."

Diogenes, the philosopher, waited to hear no more. He threw away his flasher and horned in:

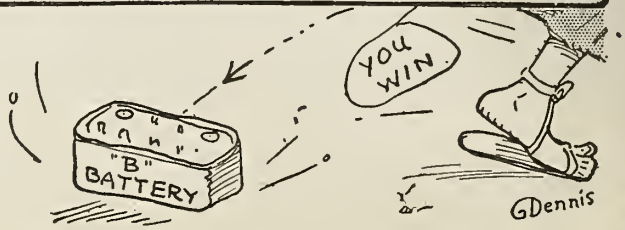
"Say, fellows," he said, "did I ever tell you how I tune out local stations and get Los Angeles on the loud speaker on one tube?"

They didn't listen. They had heard that one before.

BROADCASTING STATION C.O.W. CALLING M.O.O.

GIVE YOUR ORDERS GENTS

POLLY PUT THE LOUD SPEAKER ON AND WE'LL ALL HAVE BUTTER



An Ideal Radio Set for the Summer Camper

Can Also Be Adapted to an Automobile

J. A. CALLANAN

AWAY from the city, when camping in a lonely spot, a radio set affords a pleasureable pastime for the summer evenings. The camper has a decided advantage over the person in the city with its steel buildings, power lines, etc.

Even with an antenna of hasty erection, a ground of doubtful character and a set of mediocre sensitivity the distances received are practically always greater than when in the city. The set used may be equipped with an amplifier and a loud speaker to afford amusement to the entire camping party.

Antenna

The first step is to consider the antenna equipment. A small insulator to serve as a weight and one hundred to one hundred and twenty-five feet of single strand lamp cord is required. This equipment affords a wide variety of uses. The weighted end swung over a tree limb with the other end connected to the set makes a good antenna.

Of course, if no tree is convenient a telegraph or fence post serves, although not quite as effectively. Excellent reception is often obtained by merely winding the cord around the car as near the top as possible.

Ground

The ground equipment consists of a heavy metal rod, pointed at one end, about five feet in length and more lamp cord to serve as a lead with a clip to make connection with rod as systematic as possible. Many make the mistake of soldering the wire to rod. This soon breaks off through rough usage and the camper finds himself in a poor position to resolder connection. When camping near a stream the rod can be merely laid in a shallow part, saving the trouble of driving it into the ground.

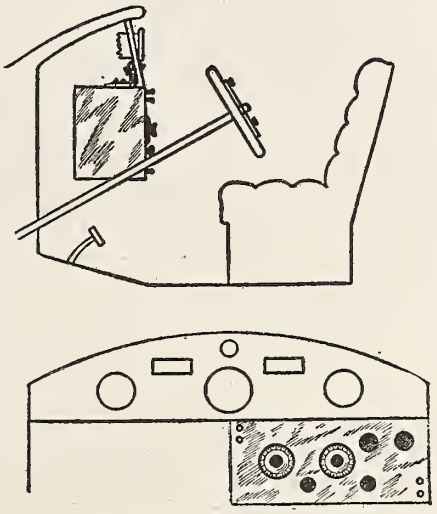


Figure 2. Sketches showing method of mounting receiver under the dash of automobile.

The Set

Last year found campers using every conceivable type of set and certainly having their troubles. This season we should be able to profit by those bitter experiences and use a set of simple, yet effective construction. After listening to experiences of last year, two circuits seem to stand out pre-eminently as reliable for camping use.

The De Forest ultra audion and Armstrong single circuit regenerative seem to have performed most consistently, the latter leading slightly because it is more easily adapted to almost any form of antenna. Each has only two tuning controls, is fairly selective and gives good volume.

We recommend the single circuit regenerative set as the most adaptable. The principal source of trouble in it seems to be that some couplers will not reach all wave lengths, unless used with a certain antenna. We suggest securing a ruggedly built coupler, with pig-tail connections on rotor, having between seventy-five and one hundred turns on primary and fifty or more on secondary (rotor). Only one set of switch points is necessary, so if the coupler has two sets of taps merely omit the fine ones.

The tuning condenser, a twenty-three plate vernier variable, should be able to withstand knocks and jars.

Another trouble which we recall is that the tubes were jolted so hard as to break their elements. This makes the new "gang" sockets with rubber suspensions especially desirable as they absorb sudden shocks, preventing damage to the tubes.

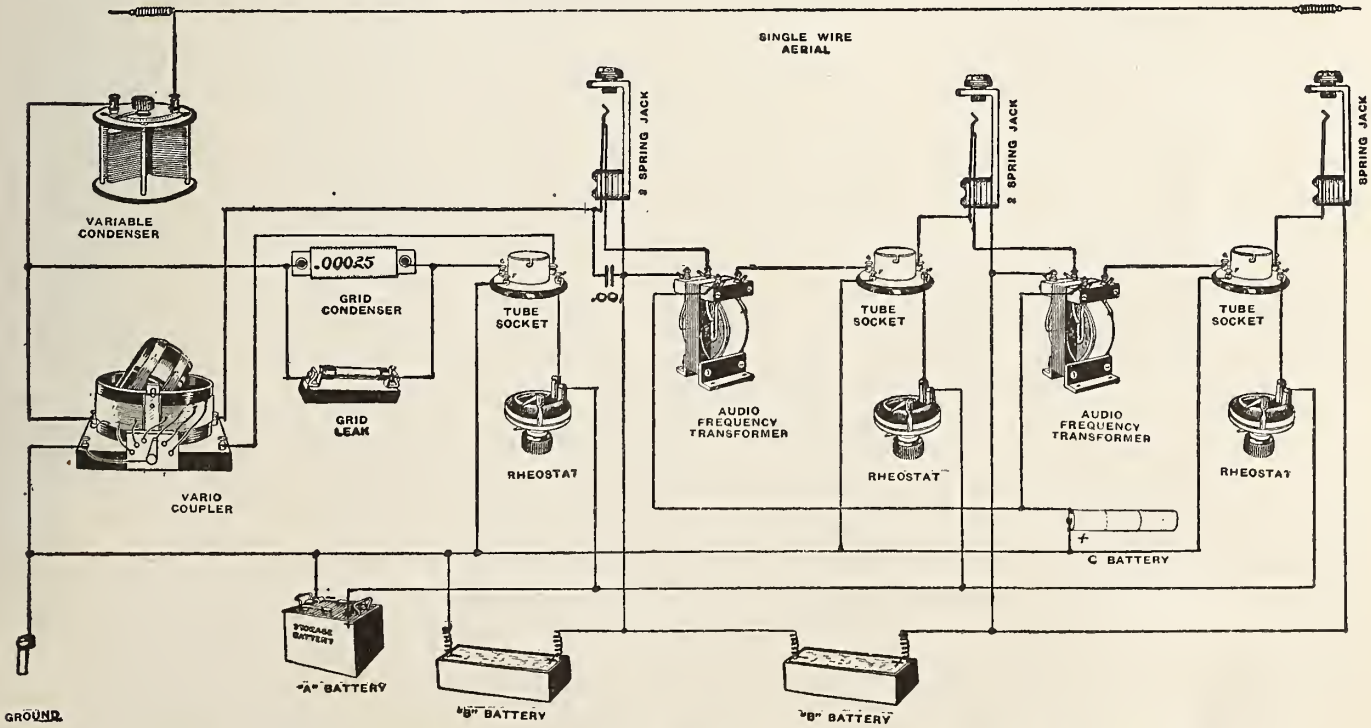


Figure 3. Schematic diagram of circuit used in the portable receiver for campers and motorists

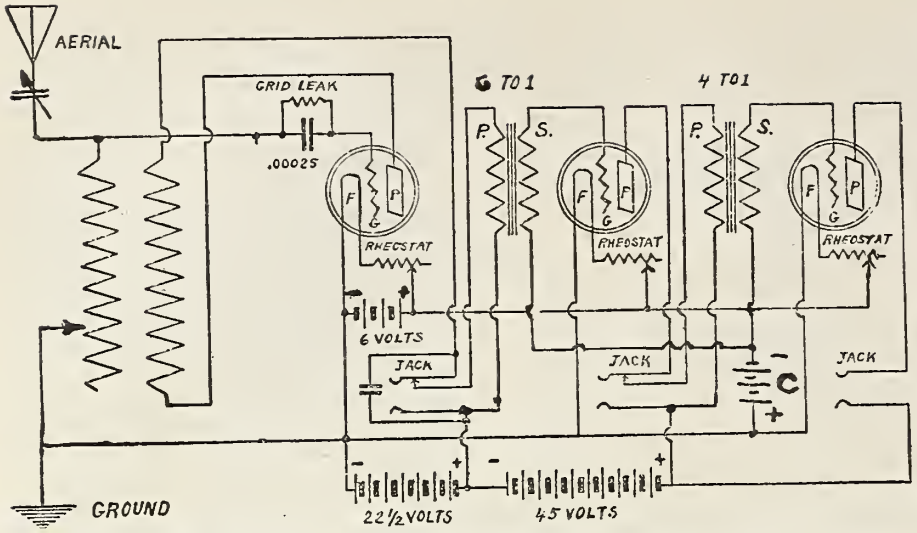


Figure 1. Picture diagram of apparatus for portable receiving set specially designed for campers and motorists.

Panel Layout

The panel layout is very simple as only two tuning controls (the coupler and variable condenser), the rheostats and one set of switch points are mounted on panel. A panel layout is omitted because the camper will no doubt desire to make it fit some part of his car or haversack. The old rule still holds "make leads of fairly heavy wire and run them as direct as possible." The picture diagram will be helpful in laying out circuit.

Installation In a Car

Figure 2 illustrates how the set can be mounted under the instrument or dash board. Two angle brackets will serve to secure set to the board. This method of mounting is generally the best, as it places the set in a convenient position for operation by either the driver or a passenger. It is also advantageous in that it is convenient to the storage battery, which can be used for filament current. On one car we noticed that the "A" battery leads were equipped with a plug which could be inserted in the dash board light socket. Another effective idea, where it is desired to use set both in and out of car, is to use UV199 tubes, tapping the storage battery at four volts for their supply when in car and using three dry cells when set is taken into a hotel, etc. These tubes will not give the volume of the UV201 A's, but for a really portable set seem more suitable. If desired, three stages of amplification can be used to awaken other campers in the vicinity.

Tuning

As there are only two tuning controls and the adjustment of rheostats is not critical, the set becomes quite simple to operate. Adding turns by means of taps and turning in the condenser plates increases the wave length, the opposite decreases it.

Tuning the rotor from a position at right angles to parallel with primary increases regeneration.

If the diagram is followed there will be no body capacity on the set. We would be pleased to hear of your results upon your return from your summer vacation.

Radio Pays Farmer

Most radio fans find that their radio sets pay dividends in entertainment and instruction, but the farmer who tunes in WGY and other stations sending out produce market reports is in a preferred position. The farmer, on occasion, may turn radio market information into cash and make such information pay him dividends on his set. One such farmer is reported by F. R. Cozzens, of Roxbury, Ohio, in the Southern Ruralist, recently.

John Weldon, a farmer of my vicinity, recently got a tip from the air which yielded him $19.60. The "tip" was an unexpected raise in the live stock market, coming at a time when Weldon was preparing to sell a shipment of hogs to a local buyer.

As a result, he got in touch with the city market and $19.60 was his profit over the local buyer's quotations, after all shipping expenses were paid.

This was not a streak of luck, however, for Weldon gets such tips frequently, and they are a part of his plan for making his radio pay its way.

"When I installed my outfit in 1922, I determined to get something from the air besides music," Weldon told me, recently. "I could receive reports from two large city markets and a number of smaller ones, and to keep tab on these I bought a ledger.

"At the top of each blank page I wrote down the city where the market was located and names of the principal dealers therein, with their addresses. This book is kept on the table where the radio is located, and when I have something to market I get in touch with one of these cities and write down quotations as I receive them. Then I 'tune-in' for another city, and get their prices. Afterward, I go over these reports and compare them.

"It is a simple matter then to estimate distance, shipping cost and so forth, and from this I can select my market.

"Dealers in these cities are aware of my method and I have made arrangements with them by letter to accommodate my shipments at any time. This not only applies to live stock, but to poultry, eggs and butter. The latter articles are shipped by parcel post the morning after the quotations are received.

"I have a wide range of markets to select from, where formerly I was compelled to depend upon a local buyer's quotations, or those in the newspaper, which were always two days late.

"And the radio offers another advantage: By getting weather reports and crop conditions from different parts of the country I can guess pretty accurately the trend of the market.

"From the news reports I learn beforehand about railroad strikes, freight tie-ups, grain pools, and many other conditions which are likely to affect the price of products grown upon my farm. I have a ledger filled with information of this sort, and it has become a habit with me to keep it open for new 'tips' whenever an evening's program is broadcast.

"It is not difficult to make a radio pay dividends when rightly handled, and scarcely a week passes without my outfit yielding me something of value."

Beacon to Guide Ferry Boats

The crossed coil radio beacon developed at the Bureau of Standards has been suggested as a means of guiding ferry boats across San Francisco Bay in fogy weather, and the bureau believes it will prove very useful for that purpose. This type of beacon marks out a line in the ether and a boat equipped with an ordinary receiving set can tell whether or not she is on that line, and to which side she is off.

The San Francisco ferry boats traverse a distance of three and a half miles and carry a very large proportion of the city's commuting population as well as all through passengers from the east and north. At times the fog is so thick that one end of the boat can scarcely be seen from the other, and strong tidal currents are encountered.

The crossed coil beacon consists of two coil antennas crossing each other at an angle of 135 degrees. A coil antenna gives its loudest signal in the plane of the coil and its weakest signal in a line perpendicular to that plane. On a line bisecting the 135 degree angle the signals from the two coils would be of equal intensity, while if the receiving set is moved to either side the signal from one coil becomes louder than the other. The coils are connected alternately to the sending set and one of the two signal letters is sent over each coil. The operation is automatic, the letters alternating rapidly.

The RADIO AGE data sheets printed on pages 37 and 39 should be carefully filed away as described in the preceding issue.

In a comparatively short time these sheets will represent a world of valuable information and reference.

Don't fail to save them.

For Traveling Men Only

By FELIX ANDERSON

THIS story is for traveling men only—if you're not a traveling man, don't dare to read another word further!

All right, Mr. Traveling Man, let's proceed.

This issue of RADIO AGE seems to be featuring portable receivers for motorists, campers, tourists and all other non-essential travelers—and it comes to the notice of the writer that probably the greatest travelers of the beaten paths, the nomadic salesmen, are being neglected.

The writer has had the opportunity to travel on various journeys, and can appreciate being stowed away in some town where a hotel, general store and post-office form the business district. Yea, verily, we all agree that the life of a traveling man, while it has its compensations, it has also its tribulations, and about the worst one the writer can think of is to get hung up in Snake Center or Banana Hills for a day or two until the only means of transit or escape finally decides to pay what seems to be a semi-annual visit. Usually these sentiments can be expressed in the following words, addressed to some fellow sufferer on the train:

"Wotta place; wotta place!"

Don't be alarmed and think that we've invented some new plan on how to round up your sales. What we've got is a plan that will make that time you spend waiting around a little town seem too short altogether. It even makes you want to sit up nights.

Consider the possibilities—now wait until we start over again.

A tip from us—take a radio set along with you! What could be more simple and enjoyable than to sit in some village hotel with a pair of phones clamped on your bean listening to a dandy review coming from a nice big theater in your favorite town VIA RADIO! Never thought it possible, did you? Neither did we until some one put us wise to the idea—FOR TRAVELING MEN ONLY!

We know only too well the arguments against the radio end of the thing—you don't want to drag a box about the size of a trunk around with you, and it's too much trouble to bother with if it's going to cost too much.

The Set

If you think you can convince yourself that it is worth while to carry a small box about the same size as your sample case (if not smaller), which will make those long, dreary, lonesome evenings seem about ten minutes, read on.

Materials Needed

First of all (if you're sold on the proposition), drop down to the handiest radio store and get the following apparatus:

1 variometer—split type.
1 23-plate variable condenser, with vernier.

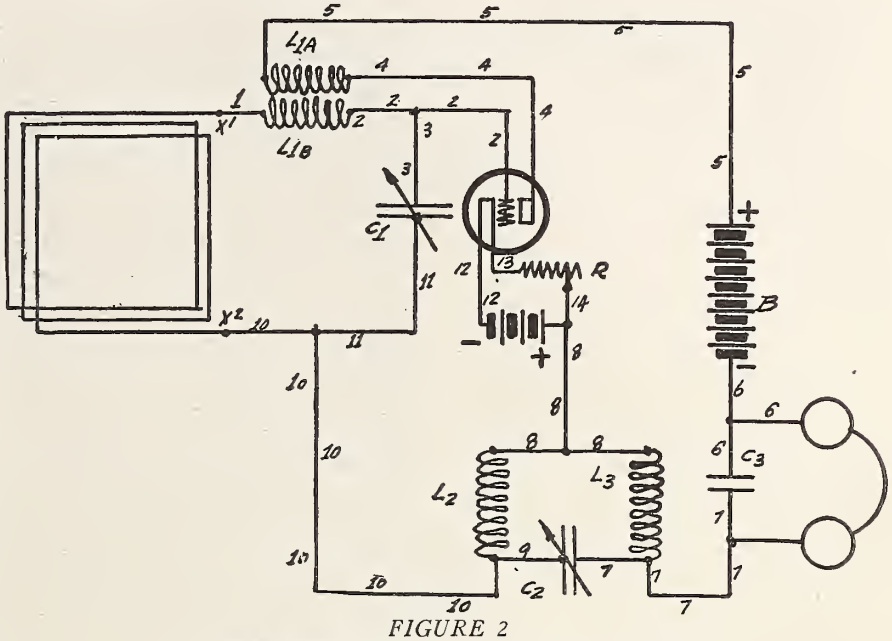


FIGURE 2
The wiring diagram of the Traveling Men's receiver.

1 43-plate variable condenser.
1 tube socket.
1 vernier rheostat.
1 1250 turn honeycomb coil, unmounted.
1 1500 turn honeycomb coil, unmounted.
1 piece of tubing to mount coils.
1 .002 fixed condenser.
4 binding posts.
20 feet copper bus bar connecting wire.
1 lb. bell wire.
1 cabinet.
1 panel.
1 pair phones.
1 45 volt B battery (small size).
1 UV199 tube.
1 filament battery for UV199.
Screws and other junk from the old hell box in the basement.

Construction

First of all, a slide should be arranged in the cabinet so as to allow you to raise the mounting board high enough to put the batteries under the apparatus. A glance at Figure 1 shows what we mean, the mounting board raised enough inside of the cabinet to allow room for the batteries.

Move the panel supporting bevels far enough back into the cabinet so that you can put a wooden, leather or canvas front on the receiver without touching the knobs; the panel of the set should be set back far enough into the cabinet to permit this. If you don't feel equal to the job, a cabinet maker will do it reasonably to your specifications.

Drill the panel and mount the assortment of apparatus you have collected in the manner shown in the accompanying sketch. We won't give template instructions, due to the fact that you will probably buy apparatus which can be obtained in your locality, and the mounting arrangement will probably vary in accordance with your own individual taste. Outside of keeping the leads reasonably short, the layout shown does not necessarily have to be followed.

Wire the set according to the diagram shown in Figure 2, which has the wires numbered to correspond with the sketch wires for your convenience.

Now check over the whole business.

Operation

If possible, your initial test should be carried out near some broadcasting station.

Wind the pound of bell wire on the outside of a suitcase (should be empty if possible) and connect the terminals to X1 and X2. Now turn up the tube near maximum. Set C1 at 0 and turn the rotor on the variometer to an angle of about 60 degrees. With the phones on your head, set C2 all the way in. Cut C1 in slowly until in connection with the variometer the sound like escaping steam is heard loudest. Now vary C1 until a whistle is heard, and clear up the signal with C2 and the variometer. It is often necessary to give the filament rheostat a twist to accomplish clearest reception.

It will probably take a little patience to get this tuning procedure down pat (but salesmen and traveling men must have patience) and to get the maximum results.

(*Continued on page 14*)

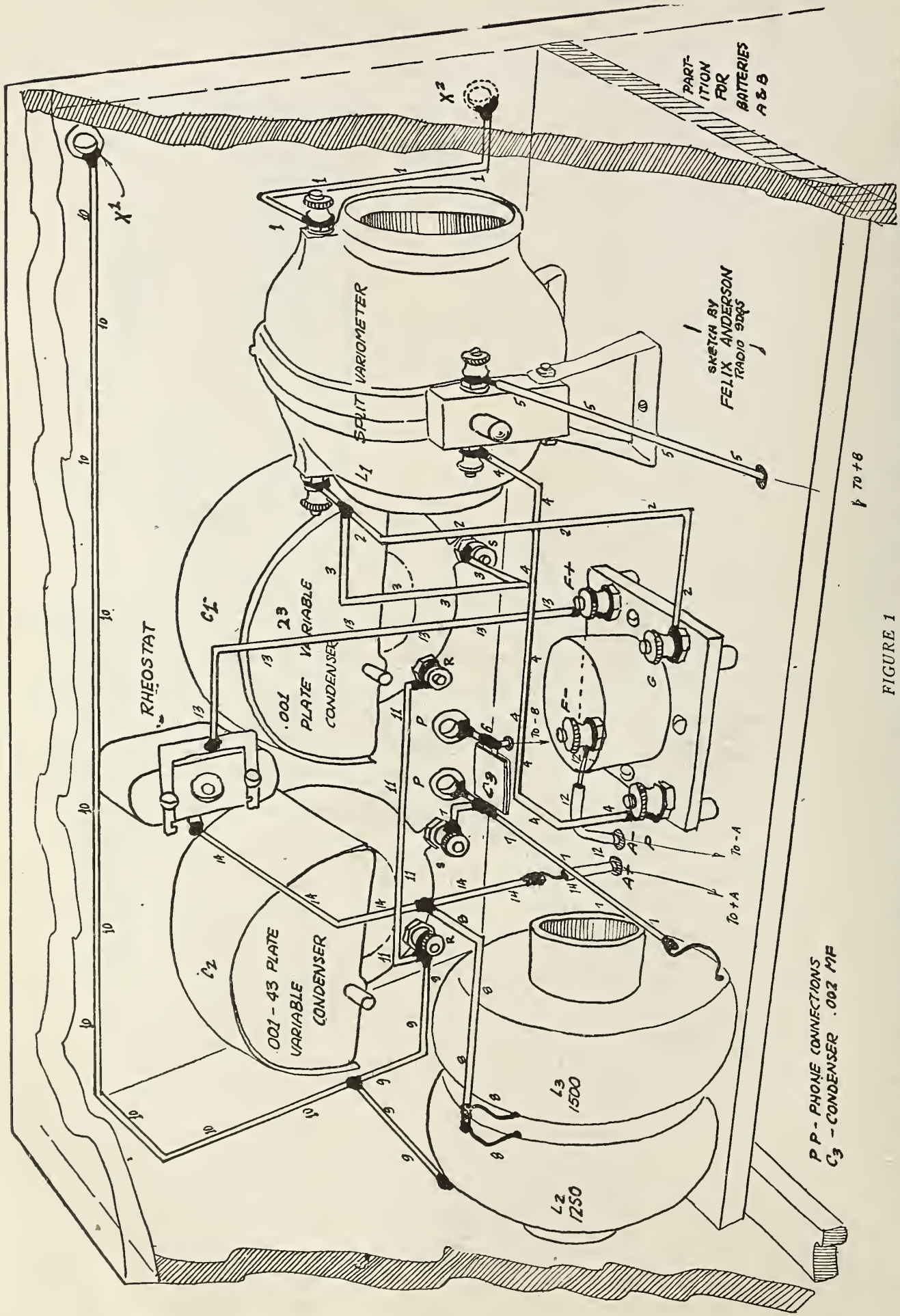


FIGURE 1

This receiver is for traveling men only. The set shown is built into a cabinet, holding the receiver, batteries and other accessories below the main part of the receiver as shown. The panel should be set back into the cabinet to allow the panel to be shielded by a leather or wooden front. The mounting board is arranged on two slides, to permit the varieties and phones to be placed below as shown. The numbered wires correspond to those shown in Figure 2.

Radio Panels

By JOHN B. RATHBUN

VERY few amateurs or even experienced radio set builders give the panel the attention that it deserves, and while it forms the backbone of the receiver yet the many important factors which enter into its selection and handling are generally neglected. Its very simplicity obscures its real importance to the proper working of the circuit, and as a result many troubles that are ordinarily charged up to the variable condensers, tubes and tuning inductances can be traced directly back to the panel due to leakage or static accumulations on its surface. The primary purpose of the panel is to provide a support of high insulating value for the apparatus mounted on its surface, hence it is evident that any defect in this insulation will immediately reduce the efficiency of the circuit or cause troublesome noises.

Radio frequency currents, however low their potential may be, are very leaky propositions and pass readily through materials that would ordinarily be high grade insulation against direct currents or low frequency commercial alternating currents. Pencil marks, surface dampness, dust, decomposed oil or even finger prints often serve as excellent conductors for radio frequency currents which may cause short circuits or grounds between adjacent metal current carrying parts. Organic matter or metallic dust imbedded within the body of the panel is also frequently the cause of short circuits, and the same applies to carbonized materials after being subjected to high temperatures.

Probably the most important panel materials are the commercial products listed under the "Phenol resin compounds" such as bakelite, Formica, condensite, and similar materials. Next comes hard rubber of which "Radion" is the most prominent example. All of these panel materials are dense materials which will not absorb moisture, and in addition having a considerable mechanical strength are easy to cut and drill. Glass and porcelain are excellent insulators but are impracticable for the radio amateur because of the difficulty met in drilling and cutting such hard and refractory solids. Unless thoroughly dried out in the oven and then impregnated with paraffine at high temperature, wood is out of the question for panels. It is hygroscopic, that is, absorbs moisture, and has a tendency toward warping that often results in trouble. Moisture is the enemy of insulation.

On the other hand, a panel may have too high an insulating value for the proper operation of the set. This may sound paradoxical, but it is true, nevertheless. If the surface insulation is exceedingly high, then static charges will be retained on its surfaces which are likely to make the set noisy or even cause reversed polarities on the tube grid bias. Modern tubes are very sensitive to the slightest electrical charges, and if small patches of static exist over the surface of the panel it is certain that they will have an appreciable effect on the operation of the set. In cold weather, when there is little condensation on the surface, I have often found that rubbing the panel with a woolen cloth would set up static charges which caused a tremendous squealing and howling in the phones. There is no doubt but what noisy operation is often due to the retention of static charges on the surface of the panel.

Photo by Pictorial Press

'OFT IN THE STILLY NIGHT"

An up-to-date night watchman in London, who has rigged up a portable wireless receiver and listens in while on duty.

To make a long matter short, I might say that the ideal panel should have sufficient insulation resistance to prevent the transfer of radio frequency currents across its surface, and yet at the same time should be of such nature that static charges are quickly dissipated. This does not mean that we must necessarily provide a leakage path for the grounding of the static charge. This can be eliminated by roughening the surface of the panel or "graining" it by means of fine sandpaper. The graining of the panel provides a multitude of fine sharp points which discharges the static into the atmosphere and hence without any effect on the insulation of the radio frequency currents. Body capacity shielding on the rear of the panel also rapidly disposes of the static if the shield is thoroughly grounded.

Graining is not only for the sake of appearance. It also has a material effect on the performance. For the best results, the fine sandpaper should be rubbed back and forth in a direction parallel with the length of the panel while the panel is perfectly dry. After all the shine is removed, the panel can be dusted off and then mineral oil is rubbed in thoroughly to fill the depressions or scratches. Animal or vegetable oils should not be used for this purpose as they decompose rapidly and produce acidulous products which reduce the insulating value. Linseed oil should be particularly avoided, owing to the compounds which are formed by the oxidization of this oil.

With the possible exception of wood, the worst material for a panel is untreated vulcanized fiber. This material not only contains considerable moisture, but also frequently contains fine metal particles imbedded in the mass of the material which will absolutely short circuit radio frequency currents. As an experiment, the writer assembled an Ultra-audion set on a fiber panel using the same condensers, coils and tubes that had proved satisfactory on another set. After completion, the set was tuned in on a strong local station, but without results. Only the faintest indication of music could be heard where ordinarily the volume was nearly great enough to operate a loud speaker.

After trying in every way to tune in without success, the set was placed in a warm oven and was allowed to dry out for six hours. Without any further adjustment, the stations came in with their usual volume, thus proving that the trouble was entirely due to the moisture contained in the fiber panel. After allowing the Ultra to stand around the room for 24 hours, and subjected to the moisture of the air, it was again tuned in but with no better results than in the first experiment. During the 24 hours, the fiber had re-absorbed enough moisture to again completely short circuit the condenser! Drying the fiber and then coating it with shellac and varnish had no effect upon its tendency to absorb moisture. The moisture goes through a varnish coating like water through a sieve.

Layout and Drilling

In laying out the positions of the holes on a panel, it is best to make the layout on a piece of strong manila paper and to avoid marking on the panel itself. The paper template can then be attached to the panel and can be marked through by means of a center punch.

Very frequently trouble is caused by laying out the holes on the panel with a lead-pencil unless the pencil marks are removed after punching the centers. If allowed to remain on the panel, the pencil lines cause a multitude of conducting paths, just like so many grid leaks, and this, of course, results in short circuits and grounds. It is surprising how much current can be carried by a heavy pencil mark and how greatly this will affect the operation of the set. A thorough rubbing with a gasoline saturated rag is the only sure method of

Kadel & Herbert Foto

COMPACT PUSH-PULL

This photo shows the interior of a push-pull amplifier designed and built by Sidney Kasindorf, well known amateur of station 2-ATV. On extreme left is the first audio transformer and tube while on the extreme right is the pair of push-pull transformers mounted close together. The small flashlight batteries shown in the center are used as "C" batteries. Note how simple this layout is (lower photo). Upper photo shows Sidney Kasindorf and the panel arangement of his push-pull amplifier. Note by the ruler that it is only ten inches long

taking off these marks, and this method can only be employed on the phenol type panels, as gasoline affects the finish of a hard rubber panel.

Deep scratches used for laying out the holes soon fill with dust and dirt and very frequently with fine metallic particles which are worn off from the rheostats or potentiometers. This, of course, results in leakage and grounds, and while not in evidence in the beginning, gradually decreases the signal strength and range. Your attention at this point is called to the great quantity of metallic dust produced by the continual rubbing of the contact finger on the wire coils of the rheostats. It is often accountable for many cases of gradual declines in signal strength when accumulations form on the various insulations.

In all cases, no matter what the material may be, the panels must be drilled dry without the use of oil or water. If oil is used on the drill it dries out very slowly on the completed panel and has a strong attraction for dust. This dust in combination with the oil may be the cause of short circuits when the holes are very close together and in any event does not add to the appearance of the job.

After drilling or cutting the panel should be freed from burrs and rough edges to insure that the screws and washers will seat properly when they are screwed up and so that they will not have a tendency toward causing loose connections. Certain insulating materials, particularly the phenol products, are very likely to split if the drill is fed too fast, and they will always flake off on the back of the panel or on the far side if the drill is not run fast enough or is "punched through" the work. A high drill speed and a comparatively low speed are necessary for these panels, and the drill should in all cases be applied to the front face rather than to the back, as the greatest chipping and burring takes place at the point where the drill finally breaks through.

Hard Rubber Panels

Hard rubber panels have many advantages and some disadvantages over the phenol compounds. They drill very easily with a hand drill and are not subject to breakage or burrs on the far face when the drill is fed rapidly. This makes the rubber panel very desirable for hand drilling. They have a high insulating value and are not hygroscopic in the slightest degree.

However, they are likely to "bloom" with age unless properly manufactured and this iridescent bluish glaze which forms on the surfaces of the rubber will in time greatly reduce the insulating value. With modern processes this is not so likely to occur as formerly, but a careful examination should be given to the rubber occasionally to see whether there is any evidence of the bloom. Another bad feature of the rubber panel lies in the fact that it is more easily affected by the heat of the soldering iron than the phenol panels, and that a very hot iron will cause the rubber to shrink around the soldered connection if the soldering iron has been held on this part for too long a time. It is always safest to go over the screws after soldering and tighten them up a second time to make up for the shrinkage.

Traveling Men's Receiver

(*Continued from page 11*)

If you get a big room, take the wire and drape it around it from corner to corner and connect it to one of the aperiodic couplers as described in this issue. This will increase the range, but is not always successful when residing in a hotel that is 99 per cent steel. If this fails to get you a signal, connect the one end of the coupler to the bed spring, and the other to a water pipe, and try again. Usually this gets them. As a last resort, carry one of those light socket radio plugs with you (they're very compact), and if the place you're stopping at has electric light, try the lighting system in connection with the coupler just mentioned. We'll bet that you'll get signals then or never. Note: Wooden bed slats won't work

Aperiodic Antenna Coupling

By FELIX ANDERSON

THE term "aperiodic antenna coupling" may seem a bit technical to the average reader, and heretofore may have been classified as one of those mysterious radio terms which should only be used by engineers. Basically it is very simple. The underlying principle is the same as that of the ordinary variocoupler, inasmuch as the system takes advantage of the induction phenomena of transferring energy. It can be easily distinguished from ordinary coupling, due to the fact that there is usually present a connection from some part of the filament circuit to the coupling coil.

By using the term aperiodically coupled antenna, we mean that the aerial is not acting as a part of the tuned circuit of the set, but is merely doing the work of a collector of energy, and is transferring this collected energy to the remainder of the tuned circuit by the action of a coil. In using the system, one merely converts a conductively coupled receiver into a two-circuit or inductively coupled set.

Advantages

The advantage of a system of this kind are many. Primarily, it increases the selectivity of the receiver, a factor which should make it desirable from this standpoint alone. Further, it makes the receiver more stable, because the antenna does not affect the tuning circuit materially, and changes in the aerial system are not so easily transferred to the tuned circuit of the receiver.

The system, when used on sets of the regenerative type, which are prone to oscillate strongly, cuts down the nuisance of squeals inflicted upon neighbors, due to the fact that the low ratio of coupling between the tuning circuit and the antenna circuit is very low, and does not permit the transfer of any great amount of energy. The use of aperiodic coupling does not, however, stop the nuisance entirely; it merely lowers its intensity.

How Coupling Is Done

The installation of this type of tuning is very simple indeed. It merely consists of a coil of a small number of turns placed in inductive relation to the tuning system of the set, its terminals being connected to antenna, ground and filament circuit respectively. A little explanation in the way of reference to the accompanying sketches and diagrams will not be amiss. Referring to the isometeric sketch, Figure 1, you will notice that familiar First Tube receiver, designed especially for beginners, and which was described in detail in the October, 1923, RADIO AGE. Originally, the antenna was connected directly to the terminal of the variometer that goes to the plate of the receiving tube.

This connection, while efficient, has the disadvantage of inserting a very high resistance into the tuned circuit—with disastrous affects upon the selectivity of the receiver. Any time you connect the antenna directly to the tuning circuit of the receiver, you will cause broadened reception, interference, and if the receiver is one of the regenerative type, will transmit energy causing interference. You will probably wonder how this can be avoided. If the connection is not placed there, the set will not work.

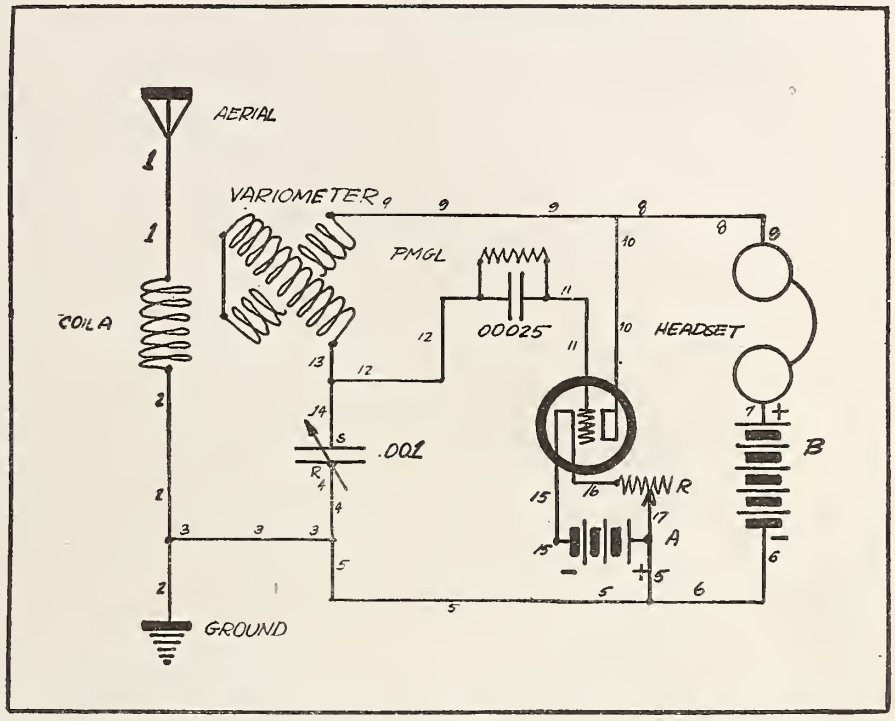


FIGURE 2

The wiring diagram of the First Tube Receiver, illustrated isometrically in Figure 1. The wires as numbered check up with the sketch wires as numbered to correspond.

The addition of the coil shown wound on wooden pegs (reed can be used) directly on the side of the variometer solves this problem admirably. The signal current collected by the antenna, traveling through the coil sets up a field, which cuts through the windings of the variometer. When the variometer and circuit is tuned to resonance with this incoming signal, the interaction is greatest, and the greatest possible transfer of energy takes place, without having the disadvantage of broadening the tuning of the circuit by inserting the antenna system into the circuit. This action is also only noticed when the coupling coil of the antenna and the winding of the variometer run in the same direction.

Constructing the Set

The construction of the set itself is very simple, and the actual dimensions of the cabinet and panel are not important. However, a 7x12-inch cabinet allows ample room for all the parts, and makes a nice looking receiver. A bill of materials was published in the October, 1923, issue dealing with the construction of the receiver using conductive coupling, and the only deviation from the original description lies in the variometer, which should be either of the wooden or molded type for the maximum results. If a wooden variometer is used, about 14 turns is made upon pegs, which should be glued into holes. If the antenna used is a short one, the number of turns can be increased to 20 with a slight loss in selectivity, but gain in volume. The winding should be in the same direction as that of the variometer stator, and if the 12-turn combination is used, should be placed as close to the wooden form as possible.

If a molded variometer is used, the arrangement shown in Figure 3 under 1 is effective, and can consist of a cardboard tubing dried and doped, and wound with the required number of turns. This tube should be slipped on, screwed or fastened with sealing wax to the molded form of the variometer as can be best accomplished with the design of the variometer used. It is often possible with certain types of variometers (basketweave, molded type with smooth outside form and tube type) to wind the aperiodic coil directly over the variometer coils themselves. In this case the smallest number of turns should be used, due to the fact that with the smaller coupling distance between the coils, the smaller number of turns should be used.

The size of wire of the coupling coil is not important, but it is not advisable from an electrical standpoint to use wire

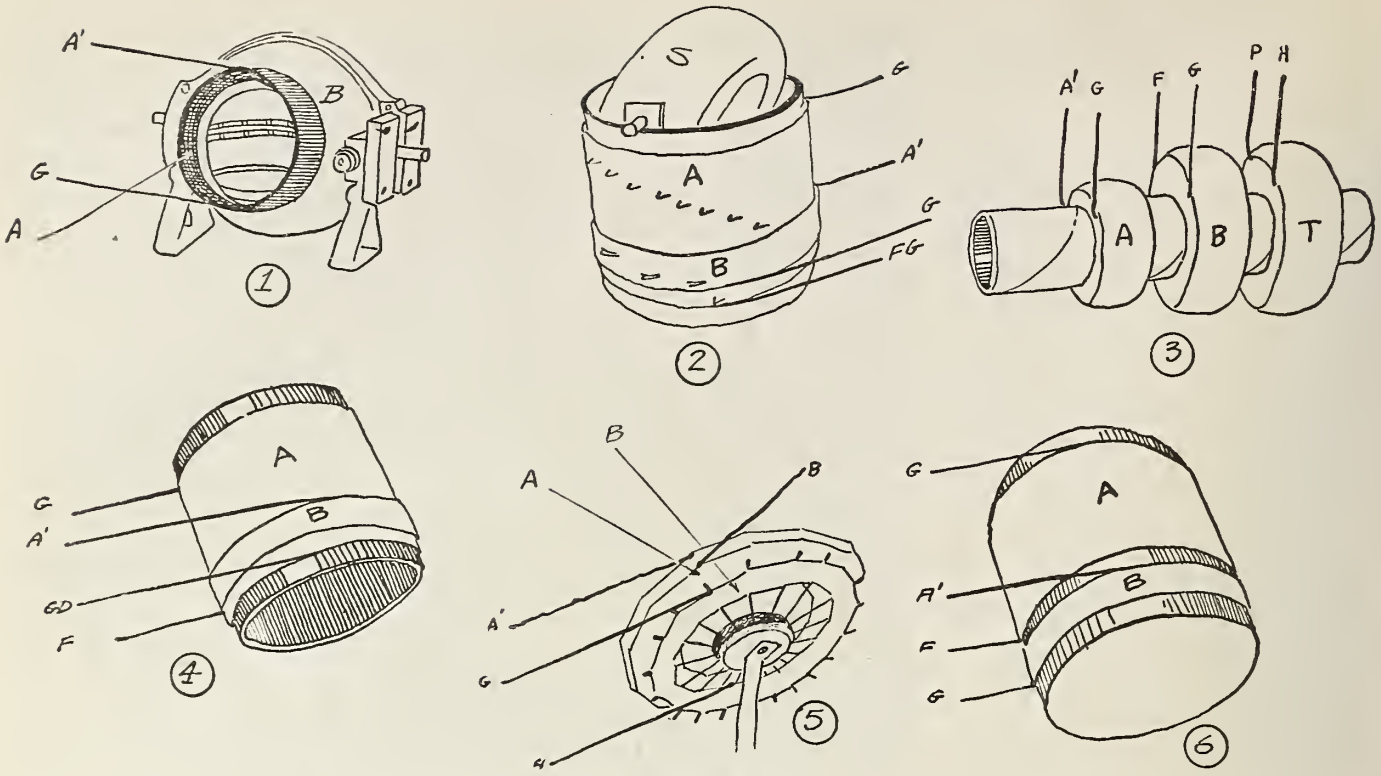


FIGURE 3

The above sketches show different possible permutations, which can be used to obtain aperiodic antenna coupling with simple receivers. (1) shows how to arrange the coil on a moulded variometer, (2) shows the method used on a variocoupler, (3) shows how honeycombs may be used to obtain loose coupling, (4) shows tight aperiodic antenna coupling, (5) the method used with pancake coils, and (6) the method of looser coupling shown tightly coupled in 4.

not smaller than No. 24, and, personally, the writer prefers No. 18 or 20 double cotton or double silk covered for this purpose.

Single Circuit Receiver

Many users of single circuit regenerative receivers have been complaining of the lack of selectivity of their receivers,

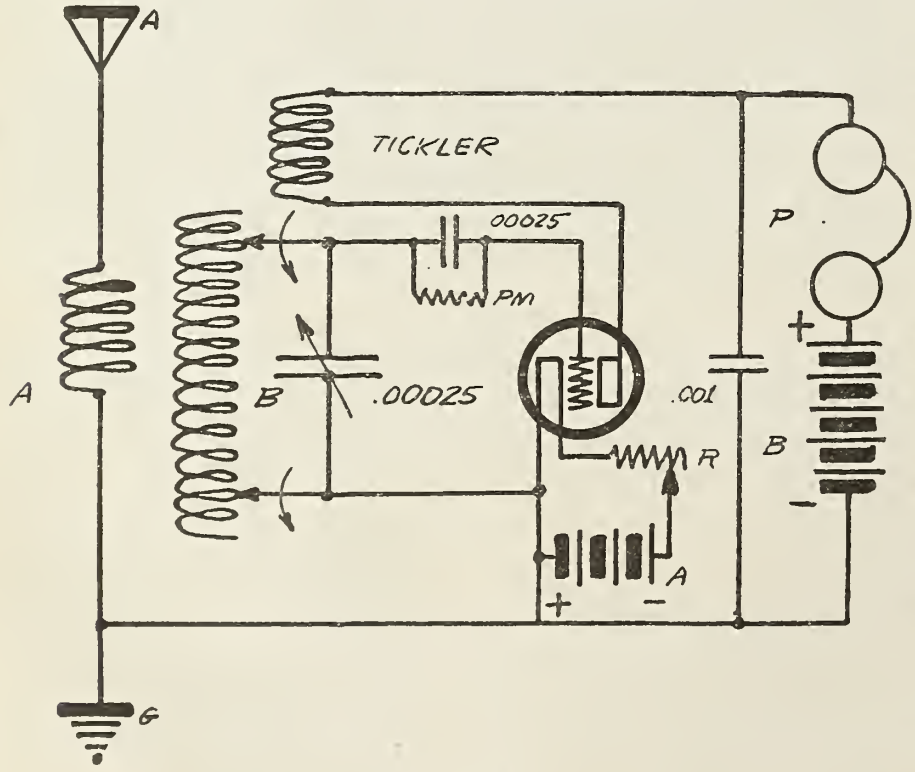


FIGURE 4

The aperiodically coupled single circuit receiver. A condenser of 11 or 23 plates should be connected across the two switch levers for the best possible results

and the addition of a coil of wire as shown in Figure 4 will materially increase the selectivity, reduce the nuisance of squeals and further increase the range due to sharper tuning. The coupling coil should be wound directly over the primary of the variocoupler as shown in Figure 3, illustration 2. It should consist of from 6 to 20 turns of No. 20 wire, double cotton insulated, the number of turns depending upon the size of the antenna as aforementioned. However, for all-around purposes, 15 turns will do nicely. The switch levers of the coupler connect to the grid and filament circuits of the set, and can be used to advantage to tune the circuit, and if difficulty is experienced in tuning the receiver, a 23 plate condenser should be shunted across the switches to help the tuning.

Ultra-Audion Receivers

The ultra-audion receiver, one of the broadest tuning sets now in existence, can be made highly selective by adding an aperiodically coupled antenna coil as illustrated in Figure 5 and Figure 3—sketch 5. The principle is the same as is used for the First Tube Circuit, but the arrangement will vary with the type of coil used. If a honeycomb is used as an inductance, the mounting may be carried out in the manner shown in Figure 3, illustration 3. In this case, there would be no tickler coil present, and only the antenna coil and aperiodic coil would be mounted on the mailing tube. The antenna coupling coil can have about 25 turns, and the space between the two should be varied until the best results are obtained. (*Continued on page 18*)

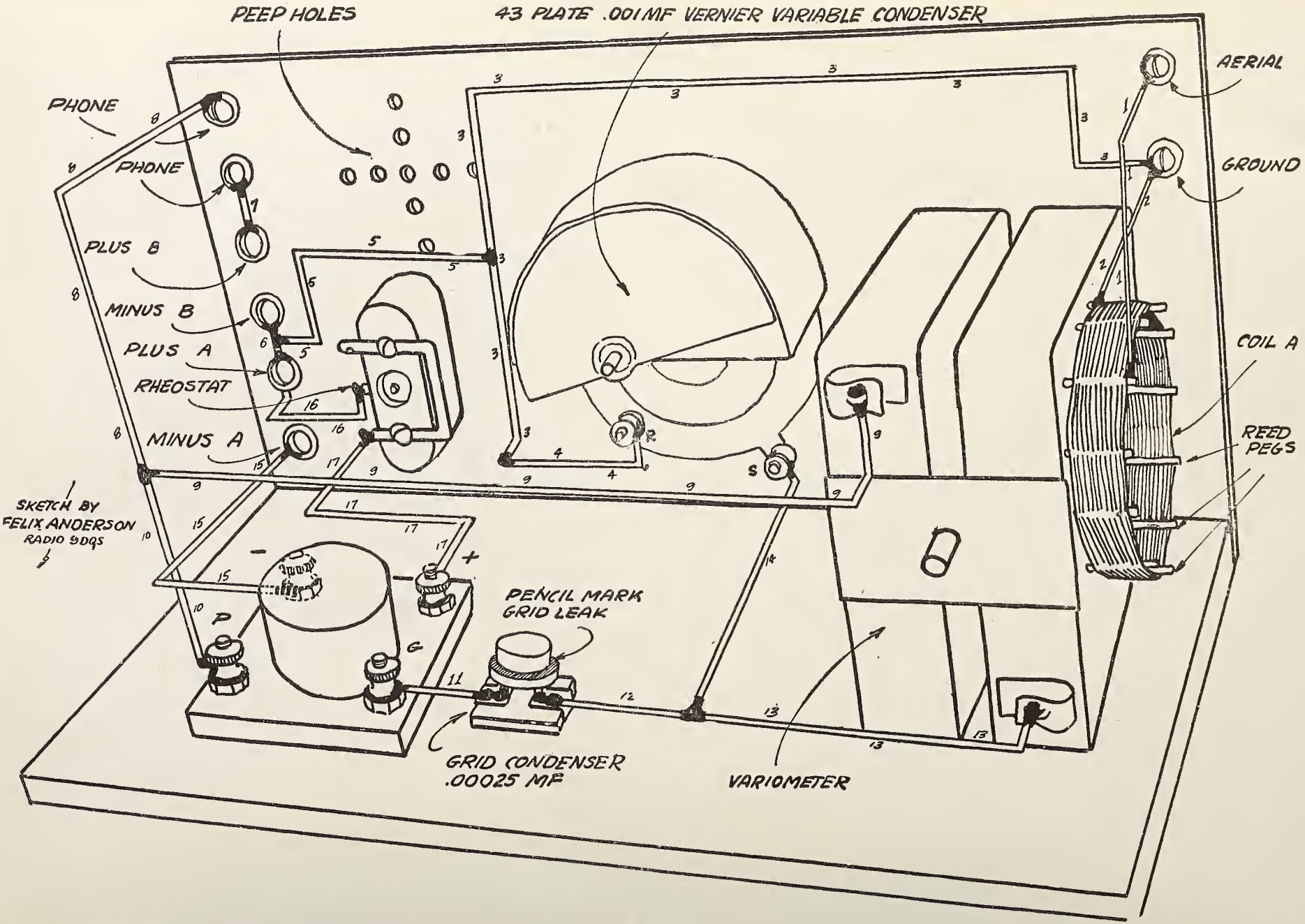


FIGURE 1

This shows the method of loose coupling the First Tube Receiver, as described in the October, 1923, issue, to obtain the highest possible selectivity, the least possible radiation, and increased range. The wires are numbered to correspond with the wiring diagram shown in Figure 2.

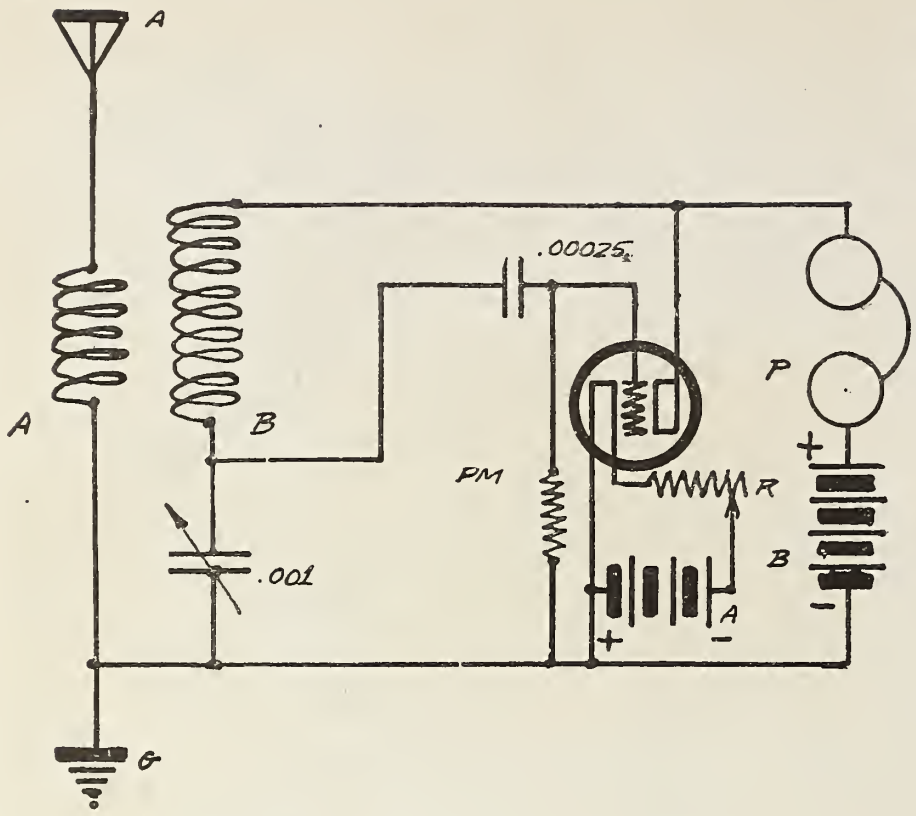


FIGURE 5

The diagram above shows the Ultra-audion receiver as it should be connected when loose antenna coupling is employed.

(*Continued from page 16*)

Honeycomb

The honeycomb coils are very good mediums for carrying out these ideas, and can be arranged in the manner shown in Figure 3, illustration 3. A circuit diagram for their connections is given under Figure 6. The receiver described in the March, 1924, issue (How to Make a Low Loss Tuner) is basically the same, the difference lying in the manner in which the coil is wound. At any rate, the honeycombs should have the following values: A, 20 turns; B, 50 turns, and T, 55 turns or less. The tickler of the receiver in the March issue (The Low Loss Tuner)

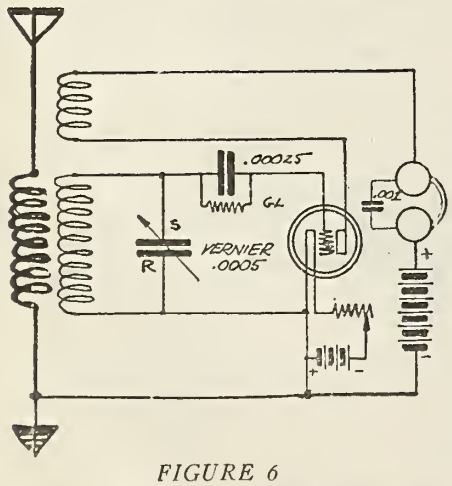


FIGURE 6

A wiring diagram for the honeycomb coils shown in Figure 3, Illustration 3.

can, by the way, consist of as high as 35 turns, with a gain in efficiency.

Figure 3, illustration 4, shows what is meant by close coupling, and is used in neutrodyne, super-heterodyne and other circuits as a coupler. In this case, coil A should not have more than 8 turns for the greatest possible effectiveness. More turns will broaden the tuning and defeat the purpose of this type of coupler. If more turns are desired for the primary or A coil, the windings should be separated as shown under illustration 6, which provides a space of variable distance between A and coil B. The Wizard $10 receiver uses this type of coupling. (The Wizard was described in the April, 1924, issue.)

This covers about all methods of coupling as far as sets go with the exception of Figure 3, illustration 5, which shows how the loose coupling idea may be carried out with flat coils. Two circular discs are cut out of bakelite or heavy cardboard or wood, and 15 toothpicks (the number of toothpicks is not important except from a mechanical standpoint) are clamped between these two discs, which are held together by a *brass* screw. The coupling coil is wound or rather woven on these toothpick supports, and is placed in inductive relation to the main coil of the set as shown. The connections should be made as shown in the circuit of Figure 5.

Just a hurried trial of one of these systems will probably greatly surprise the average reader as to their effectiveness. These suggestions are valuable in cases where a tuning system for a receiver is necessary with but a few materials at hand. The unit shown under Figure 3, illustrations 4 and 6, are especially handy, as they can be used as wave traps couplers (fixed) and can be used on loop aerial receivers instead of the loop.

The writer will be glad to offer suggestions to interested readers.

Requiescat

THE following letter is sent to us from Mrs. Ada Richardson who says it came from "our boys in Indianapolis" and she wanted RADIO AGE readers to know about it:

Dear Home:

Thought I would write you and tell you about a very sad event which befell us yesterday. To wit:

A great calamity has fallen upon our home, our transformer mourns, and cannot be comforted.

It was only yesterday our tube smiled up to us with sweet and confiding reassurance. But long before dawn it passed into that great beyond from which no tube ever returns. We shed a tear for our vanished playmate, and showered curses upon the terrible "B" battery, whose powerful current no self-respecting filament can long withstand.

A strange calm is visited upon our radio. The strains of beautiful music which once poured softly forth from its inmost recesses have died away completely. Even the variometer has become strangely grim and silent.

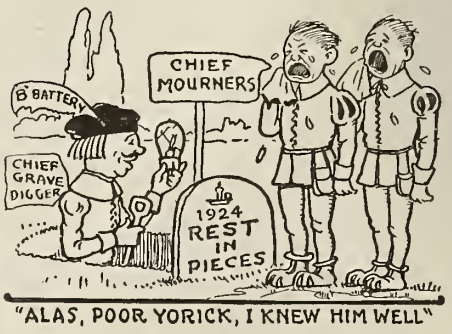
Our grief is more than we can endure; we are breaking under the strain.

It was vengeance, horrible vengeance, but the "B" battery has been paid in full. No longer can it hold a grudge against us for dropping it downstairs. We pray it shall have no mercy, and may it have to atone to the fullest extent for its destructible sin before it can find peace and everlasting happiness.

I thank you!

Well, it was tough luck and a tube only costs five dollars, so be careful! I have found out that "B" battery doesn't work worth a cent in the filament.

RALPH.



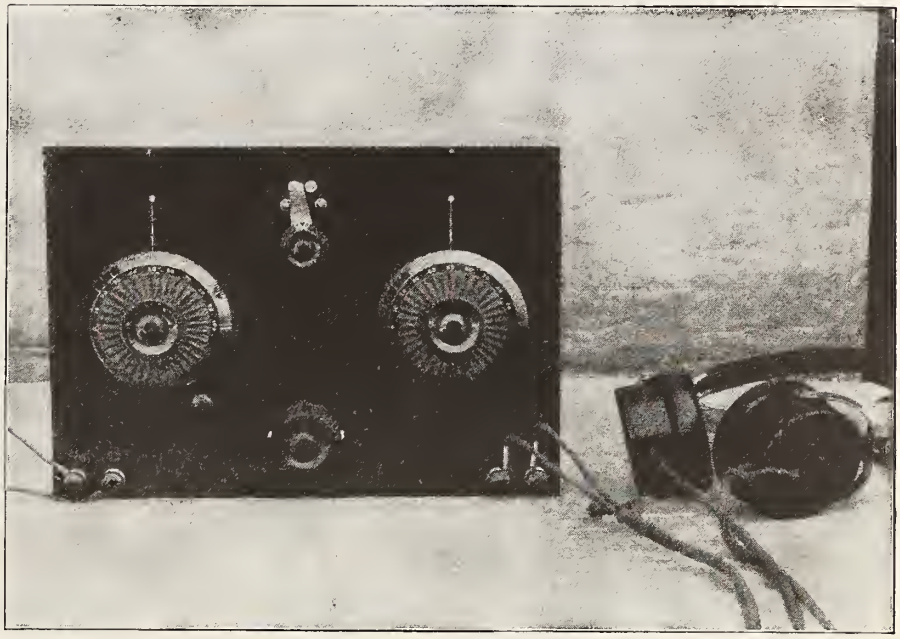
Doubling The Usefulness of Your Condenser

Converted Single Circuit Will Surprise You For Selectiveness and DX

By BRAINARD FOOTE

DESPITE the persistent outcropping of this or that "new circuit" the simplest one of all continues to hold its place as the most popular. This is the single circuit tuner and it is without question the equal of any other one-tube receiver when it comes to distance. Its chief failing is its serious interfering radiation and its annoying lack of selectiveness. Another drawback lies in the large variation of tickler coupling which is requisite on account of the varying absorption by the antenna with varying coupling between set and aerial as controlled by the series condenser.

With all of these objections, its sensitivity and its simple control have maintained it at the head of the list. Lately there have been several substitute tuners advocated in its place, all of them involving the addition of a simple and untuned antenna coupling coil and a modification of the tuning circuit consisting in shunting the variable condenser across the outer coil of the vario-coupler. This plan is highly desirable for several reasons. In the first place, and most important, it gains most remarkable sharpness of tuning without the slightest loss of volume. Next, the removal of the antenna from the tuned circuit removes the absorbing influence of the antenna on regeneration. With fixed coupling between aerial and set, the regeneration control is almost the same for all wave lengths. Then again, the fact that the antenna circuit is not tuned means that the radiation from the set while tuning is a great deal less than before—although still present in some degree, it is true.

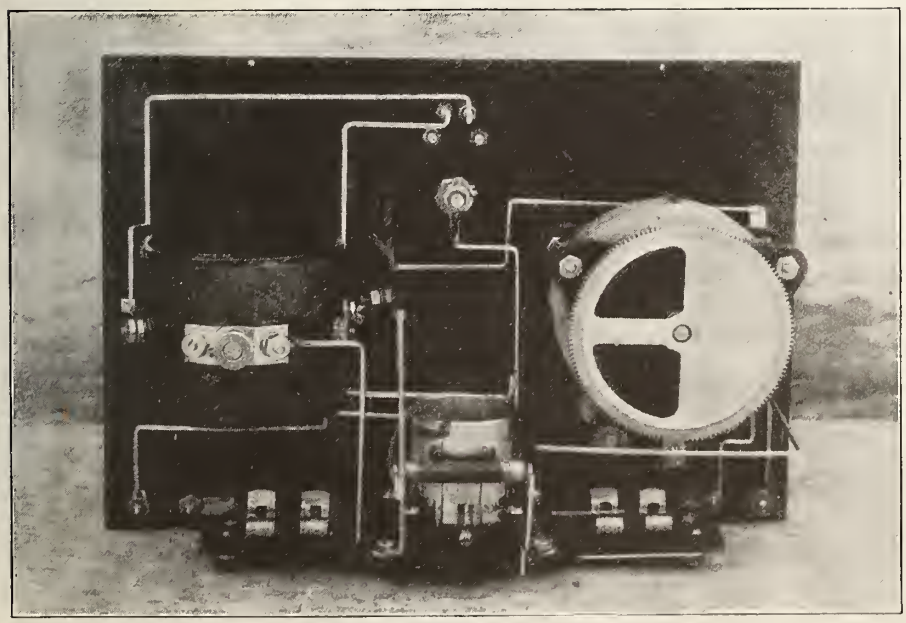


PANEL VIEW

Figure 1. Neat design and selective sensitivity marks this coupled circuit tuner. The inductance coil is tapped and the tuning condenser has plenty of "room" between dial settings on low wave lengths.

The Two-Range Feature

With all of this great gain, there is one objection which holds not only in the case of this converted coupled circuit receiver, but as a matter of fact in every case where the entire broadcast tuning range is covered by a fixed coil and a variable condenser. While the tuning is easily done on waves about 400 meters, and the stations do not seem to be crowded together seriously, on the lower wave lengths the case is far different. Operators of the Neutrodyne and other tuned R. F. receivers will agree with me when I say that there is not enough latitude in the movement of the variable condenser for low waves. This is due to the fact that the value of inductance is too great for easy tuning on low wave lengths, and because of this that I am suggesting a slight alteration which I know will be of untold benefit to you in your short wave reception—say between 200 and 360 meters.

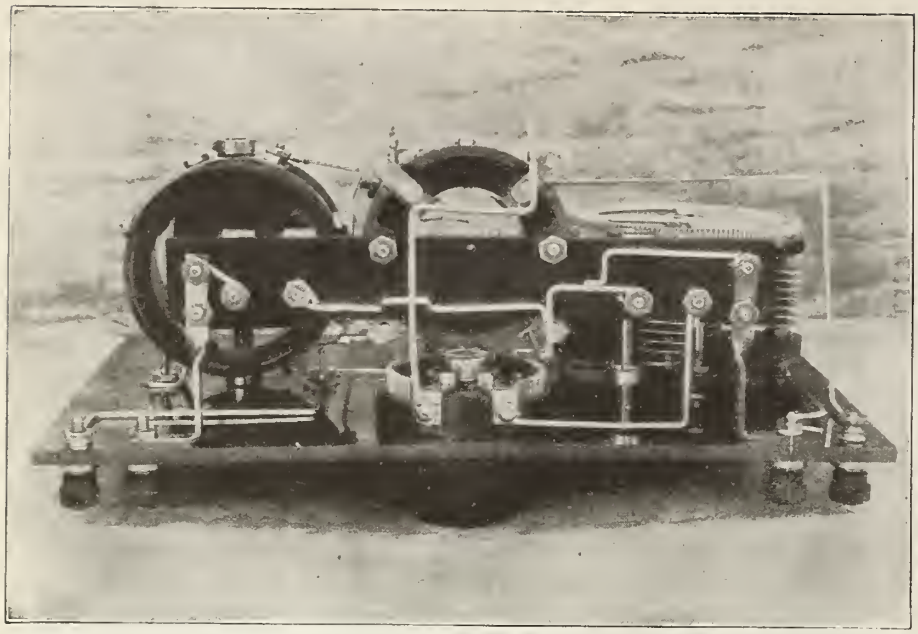


ASSEMBLED SET

Figure 2. And it works as well as it looks. You can remodel your old single circuit set in a few moments, or if you'll like to make a new one, here's a suggested arrangement.

I am going to start off by telling you what can be done with a double range circuit and then to tell you later on how you can either build yourself such a set or modify your own single circuit receiver to give equally pleasing results. Figure 1 gives the panel view of the circuit in question—the three-circuit tuner entailing untuned antenna coupling coil, tuned secondary and tickler for regeneration.

Let us start off first by moving the switch lever to the right, where the entire secondary winding of 80 turns is in shunt to the condenser, the 600-meter commercial stations come in at 85 on the left hand dial. The highest broadcast wave length, 546 meters, is that of KSD, and is tuned in 66. Coming down, we find WWJ at 58, KYW at 62½, WCAP at 44, WJZ at 40, WMAQ at 38½, WOR



ANOTHER VIEW

Figure 3. Looking from beneath. See the coupling coil at the left, just inside the vario-coupler? The binding posts you see are as follows: Phones; "B" battery; "A" battery; ground and aerial.

at 27½ and WDAP at 19. Still lower, KDKA comes in at 12. Now, you may say, doesn't that cover pretty well? Yes, you may tune lower than KDKA and hear several low wave stations. But the slightest touch of the vernier of the left hand dial will tune past a weak station so fast that you'll never notice the station at all

The Second Range

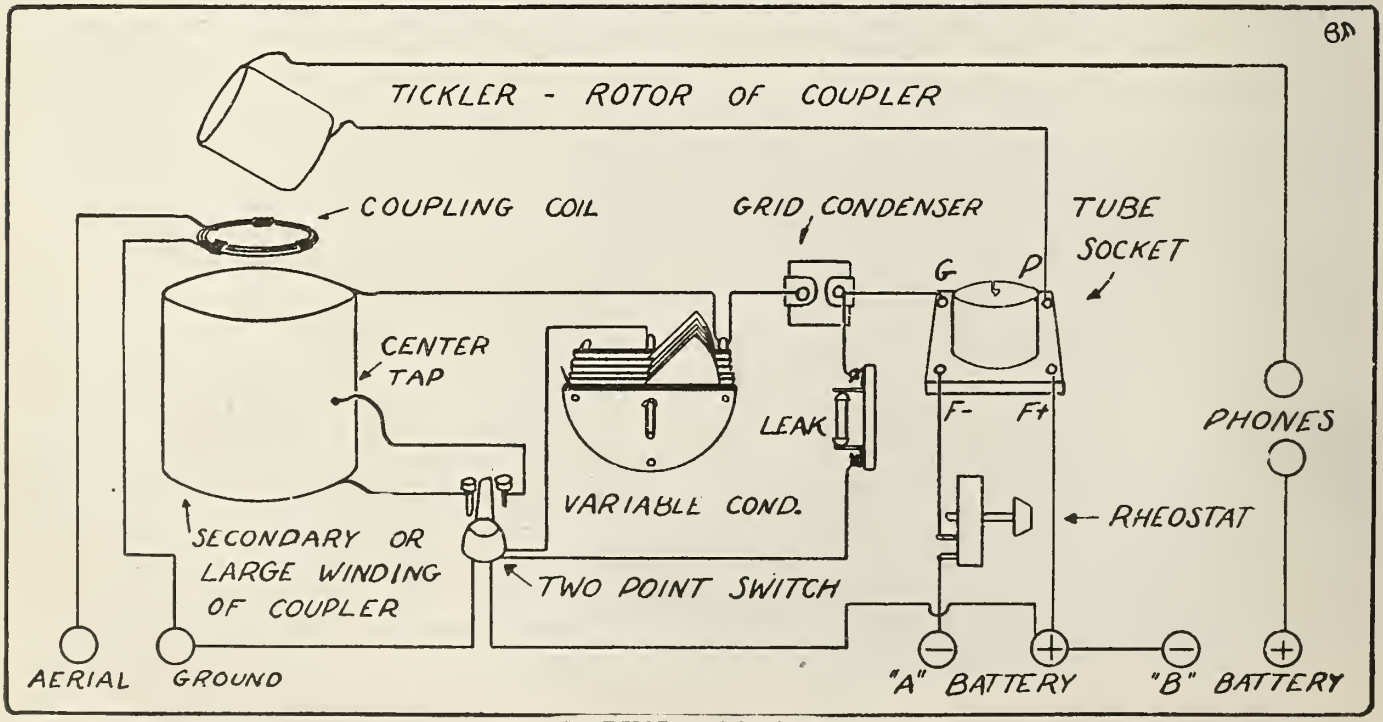
At this juncture, let's snap the switch to the left, where only one-half of the vario-coupler winding is in shunt to the condenser. Now a surprise awaits you On the upper range, WOR and WDAP, for instance, were only 8½ dial degrees apart. How do you think you might easily tune in stations between those two —like WKAQ, WDAR, WGY and the like? But on scale No. 2 WOR comes in at 91½ and WDAP at 68. There are 23½ dial degrees between them now! Think what this means in ease of control!

Now you'll find no trouble in getting WHAS of Louisville, for WHAS comes in at 88½ and WOR tunes in at 91½. Likewise, there is plenty of "room" in between the other stations so that none of them seem to overlap. WTAM, WHAZ and other stations in that neighborhood come through with ease. I am not trying to claim, mind you, that tuning is sharper and that you get less interference on the lower range—but what I do mean is that the dial settings are so thoroughly spread out that you can set the dial at the exactly right position in a jiffy. The other range would do, perhaps, if you had a "vernier of verniers" to control it. But even then you couldn't tell just where the dial was set, because a change of a quarter of a degree would tune a certain station in and out again.

A case in point to illustrate what I mean by ease of control is that of WNAC and WEAN, the Shepard Stores of Boston and Providence, transmitting on wave lengths of 278 and 273 meters respectively. With the ordinary tuner, you'd most likely get both of them at once, or at least hear WNAC and tune right past WEAN without noticing that station at all. Of course, I am assuming that you do not live within local range of those stations and that these are both weak DX stations as far as you are concerned. With range No. 2 of the set illustrated you can tune in WNAC on 26½ and WEAN on 23½, giving three degrees of separation. And right between the two, on 25½, comes WRW of Tarrytown.

A movement of a degree on the main dial is a "cinch" when you have a good vernier control, and there are those stations all within five meters and you can tune any one of them in and out with perfect ease. On the usual type of condenser

(*Continued on page 56*)



WIRING DIAGRAM

Figure 4. The hookup. The antenna coupling coil is being recognized as superior to either single circuits or double tuned circuits for coupling the antenna to the set. Note the tapped secondary—the "kink" which gives the condenser its double range.

How to Build a Basket Wound Variocoupler and Variometer

By W. E. KESSLER

THESE instruments are practically of the self-supporting style, doing away with supporting frames and losses due to masses of dielectric and reducing distributed capacity by basket winding. They are very light and compact, being especially suitable for small portable sets.

Materials needed: About ten feet of No. 3 reed, such as is used for weaving baskets in schools. (If reed cannot be secured, common parlor matches will do for the variocoupler, but because of the necessary curving of the rotor of the variometer reed must be used for this rotor); a rubber band; about a foot of strip brass 5/16 inches wide by about No. 14 B. & S. gauge; a 3/16 inch piece of brass tube for a shaft; necessary No. 26 D. S. C. wire for variocoupler and No. 24 D. S. C. wire for variometer; cylinders to wind the coils on. For the coupler one cylinder of 2¾ inches in diameter and one of 3½ inches in diameter will be needed. These can easily be made by cutting two discs from heavy cardboard or cigar box board and wrapping very heavy wrapping paper around these discs to make a cylinder.

Cut the reed in 2-inch lengths. For the rotor you will need 20, for the stator 23. Mark well these numbers or the winding will not come out right.

Snap a rubber band around the larger of the cylinders, then insert one end of the reed under the rubber band, spacing the reeds evenly around the cylinder—see Figure 1. This will hold reeds in place around the cylinder until the winding starts. Now take your No. 26 wire and start winding. Raise the ends of two reeds slightly, slip the wire under these two, then turn the wire over one reed and then under two again. Continue this way until you get the number of turns desired—see Figure 1. I find that 90 turns on the primary and 54 on the secondary the best for a three-tuned circuit. For single circuits you will need fewer turns. When you have wound half the number of turns desired, skip a place 5/16 inches wide so support for the shaft can be fastened on the reed.

When coil is wound slip off of cylinder and then by catching the windings between the first finger and the thumb (the finger, of course, being between two reeds), squeeze the wires tightly together and tie with a thread. Tie at four or five different places. Cut off all reeds excepting four close to the wire; these four are to hold the leads of the primary and secondary. Dip the coil in melted paraffin and it will become very rigid. Clamp the supports on the reed. The supports are flat strip brass 5/16 inch wide, bent as illustrated and clamped on the reeds between the two halves of the winding. The shaft is fastened to the rotor by a drop of solder between the brass support

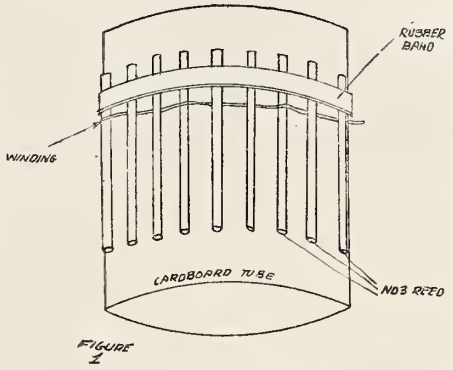


FIGURE 1

and the brass shaft. Note that because of the spacing of the reeds, the hole for the shaft may not come at a point half way between the ends of the brass strip used for supports—see Figures 2, 3, 4.

Repeat the above procedure, using the smaller cylinder, then insert the shaft, fasten rotor to shaft and the instrument is completed except for the pig tail wire which comes out through the hollow shaft. Two holes should be drilled through the shaft at each end just inside of the brass supports for the stator. Pins inserted in these holes after the instrument is assembled centers the rotor. By providing pins in the brass support for stator the pin in the shaft will engage the pin in support and so form a stop so rotor cannot be turned all the way around. If the shaft is made in two pieces, the ends fastened together inside the rotor by some insulating material, wood will do, all body capacity will be done away with.

By winding the coil without a space in the middle for supports and then placing supports at edge of coil, a 180-degree coupler can be made.

To build a variometer: Use No. 24 wire for this instrument. Make the stator the same as variocoupler, except that 80 turns are used in place of 90.

For the rotor: Wet the reed and wrap around a rod about 1 inch in diameter. Let reed dry on this rod. When taken off it should spring out to a coil about 3 inches in diameter. If it does not, work it over a cylinder about 3½ inches in diameter while dry. Let it remain there for a while and it should then be about the size desired. Cut this coil into 20 curved lengths 2 inches long. Be very careful and cut all the same length. Now cut a disc from a cigar box board 3 1/16 inches in diameter and cut a hole in the center 2⅜ inches in diameter. Use some small brads and tack the 20 curved pieces of reed to the edge of this disc. See Figure 5. Do not hammer brads clear in up to the head, as they must be removed later. A 2⅜-inch cylinder should be placed through the hole in the disc. If it has been made right the ends of the reeds should just touch this cylinder.

Start 3/16 inches from the center and wind toward the ends of the reeds that touch the cylinder. Use same kind of winding as for the variocoupler; that is, two under and one over. When both sides have been wound with 40 turns each, 80 turns for the rotor, solder the ends together in the center, dip in hot paraffin, then remove from the cylinder. Pull out the brads and then break the disc so it can be removed.

Make the supports the same as for the variocoupler.

Jefferson Electric Co.

On the first of April, Mr. Paul Green, formerly Advertising Manager for the Cole Manufacturing Company took over the duties of Advertising Manager and Director of Sales Promotion for the Jefferson Electric Manufacturing Company, 426-430 South Green Street, Chicago, Illinois, manufacturers of transformers including a full line of radio transformers and ignition coils.

Mr. Green undertakes this work with a background of more than fifteen years of experience in advertising and merchandising, a very large part of which covered electrical and mechanical lines.

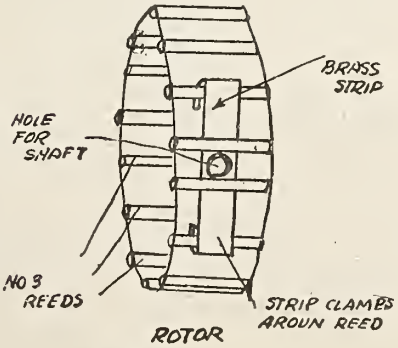


FIGURE 2

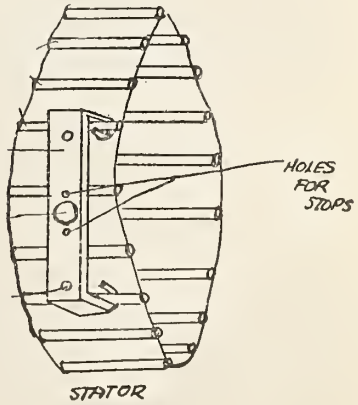


FIGURE 3

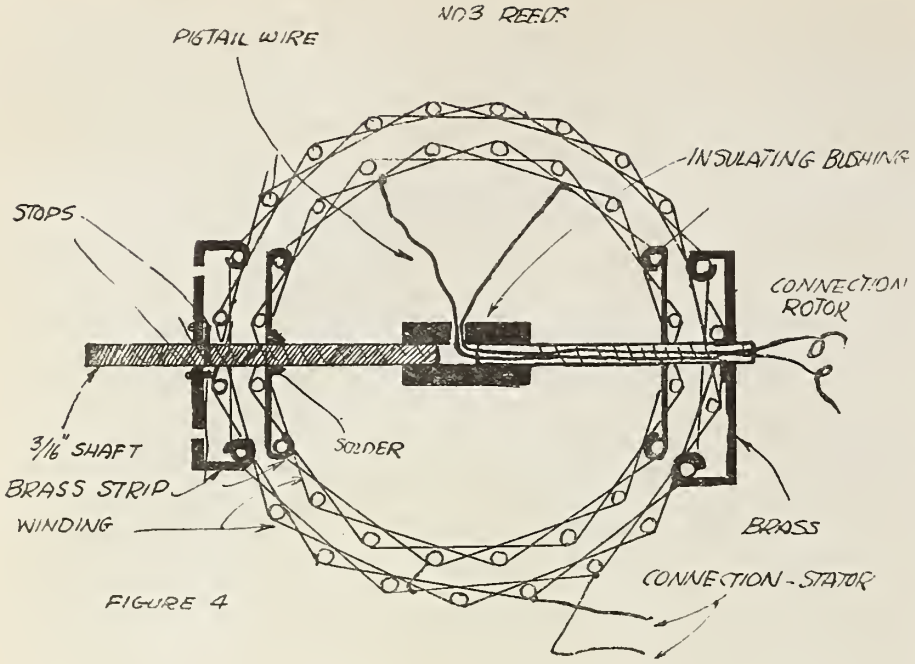


FIGURE 4

How the "SOS" Originated

The origin of the distress call of ships at sea, familiar to all operators and many fans, has caused considerable curiosity, and in order that a complete report could be made, the Bureau of Navigation of the Department of Commerce asked the International Bureau of The Telegraph Union at Berne for a resumé of the origin and history of "SOS."

According to advices just received from M. Etienne, director, the first suggestion of a distress call for ships was made by the Italian delegates to the preliminary conference on wireless telegraphy at Berlin in 1903. They urged the adoption of a universal signal, "SSSDDD," to be sent by ships in distress, explaining that all stations and ships should be obliged to receive the following messages, suspending their other communications and passing immediately to reception. The other delegates agreed to the need for such a signal, but left the final decision to a special conference.

Soon after this suggestion, the Marconi Company recognized the need for a distress call, and on February 1, 1904, the famous call "CQD" was instituted on all their ships by a general order. This signal was a combination of the general call "CQ" coupled with the letter "D," to signify distress. It was used only at the order of the captain of a ship in distress, or a station retransmitting the signal. All stations were to recognize the urgency of the call and make every effort to establish satisfactory communication without delay. The dismissal of operators was to follow the misuse of the call. Several countries, including the United States, adopted "CQD" and used it until the Berlin regulations were ratified.

At the Radio Telegraphic Conference in Berlin in 1906, the German Government submitted the following suggestion relative to a standard distress call: "Ships in distress will make use of the following special danger signal: . . . - - - . . . (SOS)."

Previously German ships desiring to communicate with all vessels in their proximity without knowing their names of calls would send an inquiry signal, "SOE." Germany planned to suggest this signal as the international signal, but as the last letter, "E," represented by a single dot, was not believed sufficiently characteristic, being easily susceptible to loss, especially during atmospheric disturbances or in heavy traffic, or when carelessly transmitted, the delegates in 1906 suggested the final letter as "S," thereby having the honor to define what became the universal signal, ". . . - - - . . ." "SOS."

Interpretations such as "save our souls," "save our ships," given the call, the Berne Bureau points out, should be accepted with reserve. The Italian proverb: "If it is not true, it is well invented," they suggest is applicable to the literal translations offered. In a similar manner, Berne reports, the Marconi signal, "CQD," has been interpreted to mean "come quick danger "

The distress signal, "SOS," was adopted officially and put into effect by the International Radio Telegraphic Convention of Berlin in July, 1908. It was a matter of keen regret to the Marconi operators that their old signal, "CQD," was not adopted, and many continued to send "CQD" as well as "SOS" when accidents occurred. "CQD," however, was gradually forgotten. In 1912 the United States adopted "SOS" when the international agreement was accepted.

The signal today is "SOS" without spaces, the Berne Bureau explains, and should *not* be sent . . . - - - . . . , but . . - - - . .

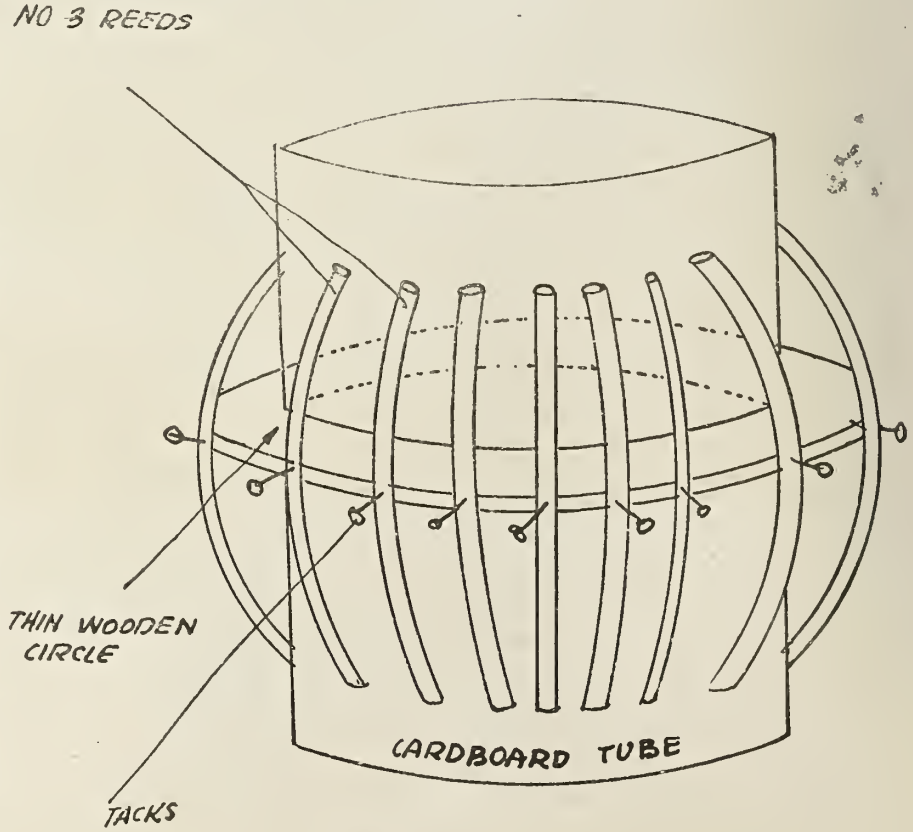


FIGURE 5

What the Broadcasters are Doing

ON THE AIR—OFF THE STREETS

Boys of today are going to be the radio engineers and experts of the future. The Chicago Boys' Club knows that the little chaps have keen minds and is doing all it can to encourage them in the study of radio. Out of the Radio Department of the Chicago Boys' Club, at Club No. 2, 1725 Orchard St., there is a complete radio laboratory and workshop, where the little fellows are given an opportunity to build and test receiving sets and experiment with various parts. The boy in the picture is a typical Boys' Club enthusiast.

The Dill Bill

The National Association of Broadcasters made a vigorous canvass during April in favor of the bill fathered by Senator Dill in Washington which proposes amendment of the copyright act. The bill proposes that copyrighted music used by broadcasting stations shall be free from tax by owners of the copyrights. It does not seek further to limit the privileges enjoyed by owners of copyrights under the existing law. In enlisting the aid of the public in pushing this bill along the National Association of Broadcasters sent out a broadside of letters to editors, accompanied by forms containing a protest against taxation of music, which it requested should be distributed among radio readers with the suggestion that these forms be signed and sent to the senate committee which had the bill under consideration. Broadcast stations which are members of the association also went on the air with the request that telegrams,

HOW THEY MAKE IT REAL

In order to make radio plays more realistic and give the necessary atmosphere the above pictured bell board containing door, telephone, clock alarm and tap bells and also buzzer, all connected to batteries and operated by the pressure of buttons, are all used to produce sound atmosphere in radio drama. Photo shows Edward H. Smith, director of WGY radio station players with apparatus.

letters or post cards be forwarded to Washington in an effort to sway the senators against the taxation view. Almost countless thousands of messages went to Washington as a result. The Congress and the American public are fast awakening to the realization that radio wields a power in reaching the people that no other agency can approach.

Spanish Programs

Programs in Spanish to better entertain the thousands of Central and South Americans and the people of Mexico who nightly obtain their entertainment from KDKA, will be transmitted at intervals from the world's pioneer station operated by the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa.

New Chicago Station

During the month just passed several new stations were opened. One of these was WES, operated in Chicago by the Sears-Roebuck Agricultural Foundation. The station operates on a wave-length of 345 meters. It is proposed to make the programs from this station of special interest to farmers and one of the first things decided upon in establishing the new center of entertainment and instruction was that all its program features were to be of the highest class. Edgar L. Bill is director. The Chicago Herald and Examiner is cooperating with the Agricultural Foundation in the production of quality programs.

WJAZ, Chicago, changed its name to WGN and its wave length to 370. The Chicago Tribune made an arrangement with the Zenith-Edgewater Beach Hotel interests whereby it assumes control of programs. The Edgewater Beach Hotel station now has a wave length only ten points above that of WDAP, the Chicago Board of Trade Station. The result of this proximity has caused Chicago fans some grief and it is believed that WDAP's wave length will soon be changed.

Radio Helps Theater

It was announced by the Studebaker Theater, Chicago, on April 5th, that the broadcasting of the play "Abie's Irish Rose" had brought the sales of seats for that performance to such sudden activity that extra help had to be employed to handle the advance business. Many hundreds of men and women who had heard all or part of the farce over the radio and had heard the gales of laughter with which the play was greeted by the audience in the theater, went to the theater in person, telegraphed or wrote, demanding tickets. The management of the playhouse said the rush of business was something unprecedented and that it was due entirely to the broadcasting of the piece.

In view of the fact that there has been some dispute as to whether the broadcasting of opera, musical numbers and plays helps or hinders box office and counter sales, the incident is interesting.

French For Children

As part of the children's hour program beginning at 6:30 every Friday evening, WGY, the Schenectady, N. Y., broadcasting station is offering children's stories in French by Aime Le Blanc. Mr. Le Blanc is a direct descendant of Daniel Le Blanc, who settled in Acadia (Nova Scotia) in 1650 and whose family story is immortalized by Longfellow in the poem "Evangeline."

The introduction of Mr. Le Blanc on the children's program a few weeks ago brought congratulatory telegrams, telephone calls and a great many letters to WGY. Many of them were from French people and others from those who are studying French and who found the stories excellent instruction. French-Canadians were particularly enthusiastic with the new children's feature.

New Providence Station

George Spink, local playwright and theatrical producer, will be entertainment director of WKAP, new broadcasting station in Providence, R. I., which will be opened in the Narragansett boulevard home of Dutee Wilcox Flint. Concerts will be broadcast twice a week. Both classical and popular compositions will be played on Mr. Flint's $2,200 pipe organ, which will be used not only for solo work but will also be made the basis of the orchestra music on Wednesday and Sunday nights.

RADIOTORIALS

TWO years ago we printed the first issue of RADIO AGE. As an experiment we planned to run off a thousand magazines with which to test public interest in the then very youthful diversion. We asked newsdealers if they could use such a publication and their answer caused us to make that first issue ten thousand, instead of one thousand. Since then we have grown steadily until last month's total issue, if laid one magazine upon the other, would make a pile of paper approximately as high as the tip of the Woolworth Building tower.

With this number we celebrate our second anniversary. We have found radio fans to be pleasant company in these two busy years. They are an earnest, good-natured lot. They have determination and they are thorough. Many of our readers have mastered every circuit from the crystal set up to the multiple-tube receivers and the radio knowledge of the average fan as revealed by canny questions and criticisms is something to be marvelled at.

Only by sitting at the editorial desk and reading the vast volume of correspondence from all parts of the United States and Canada, not to mention the letters from places beyond seas, may one realize how firmly radio has taken hold of the world.

The editor's aerial, which once enjoyed a dignified solitude upon the editorial roof, now has so many companions that when we gaze upon the maze of wire we are reminded of certain places on the West front whence the Germans had withdrawn, leaving their entanglements behind them. In our first issue, May, 1922, we mentioned the fact that there were 600 radio fans in Cincinnati. It was intended as a statement which would prove the popularity of the art. At the present writing the Crosley Radio Corporation in Cincinnati is endeavoring to bring its production of only one of its various types of receivers to a total of 1,000 sets a day! Chicago had one broadcasting station and it now has eight. The boy who was rigging up a coil and a crystal is now building one of the super-sets and is not satisfied with anything less than coast to coast reception.

We took the liberty, a year ago, of making a prediction as to the future growth of radio. We were optimists then and so are we on this birthday anniversary. And so are about seven million operators of receiving sets in our forty-eight states. In short, RADIO AGE is glad it was born at about the time broadcasting was beginning. The progress of popularized radio is something worth while having been associated with

MORE and more is radio to lose its seasonal aspects and, like the automobile, it will be a year-round necessity. Early in the life of the industry it was taken for granted that the public would not carry receiving sets with them when they fared forth on summer travels. But the portable outfit has changed the situation. Nowadays a radio enthusiast may carry his or her receiver in a compact case and whether the journey is to be by automobile or boat it will be easy to take one's music and other entertainment and enjoy them in camp or at the summer resort hotel or cottage. In this number we offer a variety of suggestions for making and installing receivers particularly adaptable for the outing season. Manufacturers are preparing to supply the demand for compact portable outfits. We predict that the trade will be agreeably surprised at the way radio holds up from now until autumn.

This is to be radio's greatest year. Broadcasting will not be interrupted. On the contrary all stations will be on the alert for best means of responding to the national interest in the approaching election. Sports, as never before, will receive attention of the fans. Many a cigar store and corner pharmacy will have a receiver installed with which to get earliest intelligence as to whether the Red Sox scored on the White Sox. The ear phones and the loud speaker will supplant the newspaper scoreboard in many instances. Radio's lightning speed will not be overlooked when the public is interested, and it will become the universal servant of the great American curiosity.

RADIO has called out the landswehr. As in the war the younger recruits first answered the call to the colors, then those more mature, then the middle-aged and finally the elders. Grandfather is one of us. He has been through the various phases, including the buying of a crystal set for the grandson, the giving of a tube outfit to his daughter, and now he has his own distance-getter installed in the living room or the library and he rolls his own when it comes to tuning in.

He isn't going to miss any political speeches this summer—not if the tubes and batteries stand up! And if some of the baseball scores are announced when he is listening in he is not going to resent it. A few minutes of stock quotations or grain market figures will not annoy him. And, later on in the evening, if some studio songster sings "Silver Threads Among the Gold" or "When I Think of the Days That Are Gone, Maggie," well, the Old Boy is not going to miss his erstwhile game of cribbage or his editorial page very, very much.

Granddad probably will not devote so much time to winding coils and hooking up a circuit as some of the rest of us, but the radio set has taken its permanent place beside the big easy chair and Grandma is there near him. Mr. Announcer and Mr. Program Director will do well not to forget them. Bedtime stories and jazz music, if you will, but let us give them in full measure the best that youthful radio has for the old 'uns.

Measuring Time and Distance by Radio

SOME well informed radio engineers and many blasé radio fans were electrified and even astounded to observe the radio time and speed experiments of Captain R. H. Ranger of the Radio Corporation, conducted at the Cosmos Club in Washington before a section of the Association of Electrical Engineers. He not only transmitted a radio message 4,250 miles to Warsaw, Poland, and got a reply in approximately three minutes, but he measured the time required for a single radio impulse to make the round trip as .046 second. The latter experiment was to show that contrary to a popular conception, radio is not instantaneous.

"The fact that a radio impulse traveling over a given distance negotiates this space in a definite and fixed time may set a new standard against which time and distance may be measured, giving a degree of accuracy and reliability surpassing even the accepted methods of astronomical observations," Captain Ranger declared.

"What does he mean?" some of the uninitiated immediately inquired. He meant that since it takes appreciable and measurable time for a radio signal, a dot in this instance, to travel a given distance, we have a new standard measuring instrument which will remain the same for centuries, and, with continued use, our ability to measure even small lapses of time will increase. Practical applications include aids to the mariner, until recently dependent upon dead reckoning when the sun was invisible and no radio beacons ware available.

"Radio," Captain Ranger said, "will be the answer to civilization's demand for greater accuracy." Already this system makes it possible to check the accuracy of automatic relays and in the future we may expect more useful applications—for example, to check time differences between two distant points. With a globe-encircling chain of powerful stations, the world time could be carefully calibrated. The radio "dot" can eventually be made to act as a very accurate check on longitude determinations.

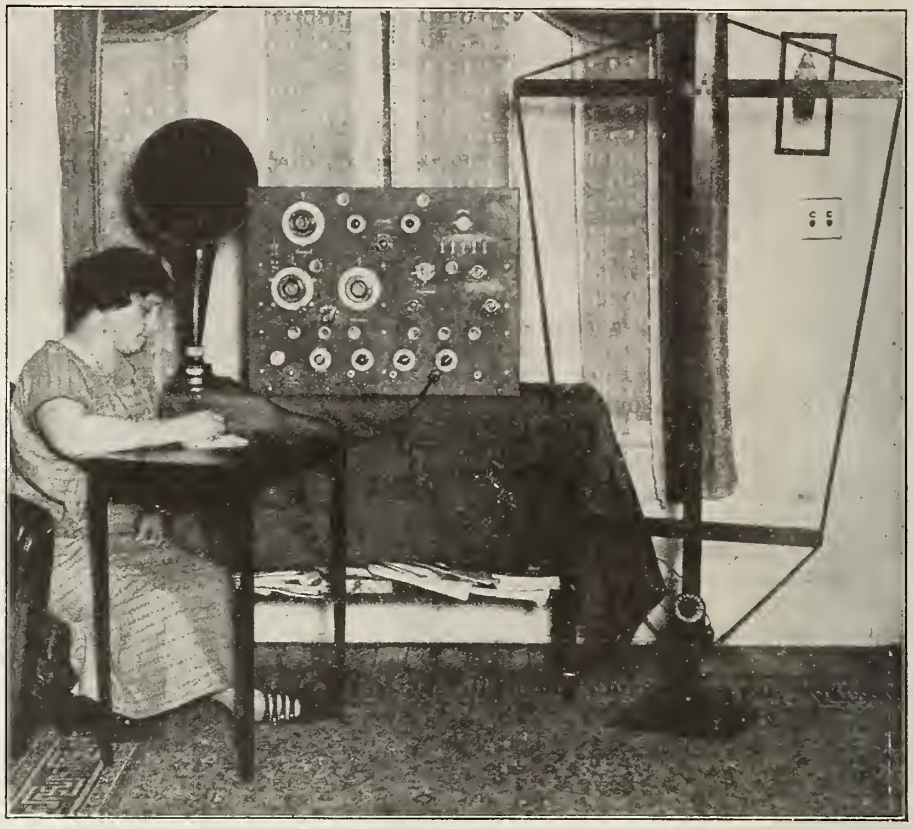
By way of exposition, Captain Ranger said: "Suppose clocks at Warsaw and New York are geared accurately to the sun's time at each locality. Then transmit Warsaw's sun time to New York. The difference in the two clocks, in New York, gives the portion of the day or revolution of the world between the two, which is the difference in the longitudes." With the present advances in radio, the least accurate part of such measurements comes in the solar observations, but in spite of this, he said, accuracies below fifteen feet in the 4,250 miles covered are in order. When the round-the-world radio "robin" has checked the speed of radio waves to the final degree, radio alone will give the actual distances between any two points, according to this engineer.

The actual experiments at the Cosmos Club were conducted by coupling the transmitting key in Washington to the Radio Corporation's New Brunswick transmission station by a land line, thence by radio to Warsaw, a distance of 4,250 miles. The return circuit was by land wire from the Polish receiving station thirty-five miles to the transmitter and back via radio to the River Head, L. I., receiving station; from there to Washington thorugh the radio central by a land line. A 14-tube receiving set in the club was tuned in on the New Brunswick transmitter, but the signals picked up were shown visibly through the pulsations of a small electric light instead of on a sounder. By this means, code experts could read the transmissions emanating from New Brunswick as controlled by the senders' key in the club, and observe the messages sent Poland, en route as it were. Once the circuit was set up messages and replies were exchanged from Washington to Poland within three minutes, and later the single dot signals were calculated, with certain corrections, to have made a round trip of 8,500 miles in .046 of a second. This indicated the actual speed of radio as roughly 185,000 miles a second, due to some errors not possible to correct in the makeshift apparatus used.

Another experiment established the possibility of using a radio system to determine the location of ships at sea, serving the purpose of a radio log. If a ship sails in a straight line between two ports, it will be possible and practical with proper recording apparatus to know just how far a ship had sailed in radio waves. With refinements, this would actually be a "radio speedometer," it was explained. We may come to speak of a ship traveling at "twelve wave lengths an hour" instead of twelve knots. A radio instrument in the pilot house will give the navigator his speed at a glance, as well as his distance from port.

Captain Ranger also covered the uses of radio in polar flights and in establishing the position of air and sea craft both aboard the vessels and at the land compass stations taking the observations, thus preventing any "faking" of positions in the future. Scientific expeditions, he said, could be furnished with accurate time, essential in navigation, by radio, or be actually guided by radio from base stations.

Concerning the possibility of communicating with Mars, the captain was skeptical, due to the fact that the earth's envelope acts as an impervious electric mirror and reflects radio waves to the earth. This "heavyside" layer, he explained, would also tend to deflect any signals emanating from Mars.



Kadel & Herbert Foto

THREE-STORY SUPER-HETERODYNE

Mrs. Henry Brinkman, Pelham, N. Y., tuning in with the receiver by Mr. Brinkman. Note the non-capacitant loop aerial which, by bunching wires, improves selectivity and eliminates capacity effect in tuning. Ten turns of wire, tapped at each turn, can be used collectively or separately.

Pick-ups and Hook-ups by our Readers

Now here's a communication that is beautifully characteristic of the spirit which prevails among the transmitting amateurs and which is taking hold on the broadcast listeners with astonishing rapidity. It is this spirit which is the secret of the united efforts and success of the transmitting amateurs organization, the American Radio Relay League, who progress by unselfishly exchanging experiences

RADIO AGE,
Gentlemen:

Having been a reader of your magazine whenever we were able to obtain it from the news stands, we wish to say that we greatly appreciate the valuable articles it contains, and especially the feature of boosting the Reinartz circuits. Have been interested in the spiderweb coil circuits to a great extent myself, but since we have not the advantages of expert personal advice, etc., we have followed a great many of the suggestions in your magazine to advantage.

I am enclosing an article and diagram which might be, in our estimation, worthy of printing, and if you believe so, you are at liberty to print it.

Very truly yours,
H. HARDMAN.
Atty. at Law,
Lake Andes,
S. D.

Mr. Hardman's article follows:

My partner, Dr. C. L. Farrell, and I have been interested in the Reinartz spiderweb coil circuit and some of its modifications, and we believe that it is the most efficient, simplest controlled and cheapest set for the average fan to build.

Many fans give up in disgust after they have tried out some circuit or other and lose interest in it and take on something else, because they could not make it work out. Had they carefully checked up the circuit they would have found their greatest trouble due to the fact that had a change, which they did not consider vital, been made here and there in the circuit or instruments they were directed to follow and use their results would have been different. It is most vital to the proper functioning of any circuit to follow strictly the instructions and circuit, otherwise the "blamed thing" will not always do what it is capable of doing.

Your attention is called to the circuit diagram accompanying this article (Figure 1). You will notice that it is not the regular Reinartz circuit, but if you fall down on the real circuit, try this one, and you will be greatly surprised at what the change of a couple of wires will do to make you have a real good set. We find it selective, very constant in its settings, and simple of control.

While the vernier condenser is not really necessary for fine tuning it is indispensable. Always get good substantial parts, not necessarily the highest priced. It is cheaper to buy than to make them, for the ready-made are always tested and you really know what you have.

The one thing that we had our greatest trouble with in these circuits hereinbefore mentioned was the use of the "A" tube. We desired to do away with the 200 type soft tube which was such a large consumer of our battery, and replace it with a tube which would give it longer life without recharging, and that was the "A" tube or D. V. 2 tube. We were unable to learn how to control the spill-over of these tubes from any literature sent out by the makers, and in this we believe that they have made a great mistake, when the suggestion is so simple when once learned, and by them it must be known, for what I have to say about the manner of controlling it is not new but what every electrical engineer must well know, but no doubt takes for granted that everyone else knows as well, and that it is not necessary to say anything about it.

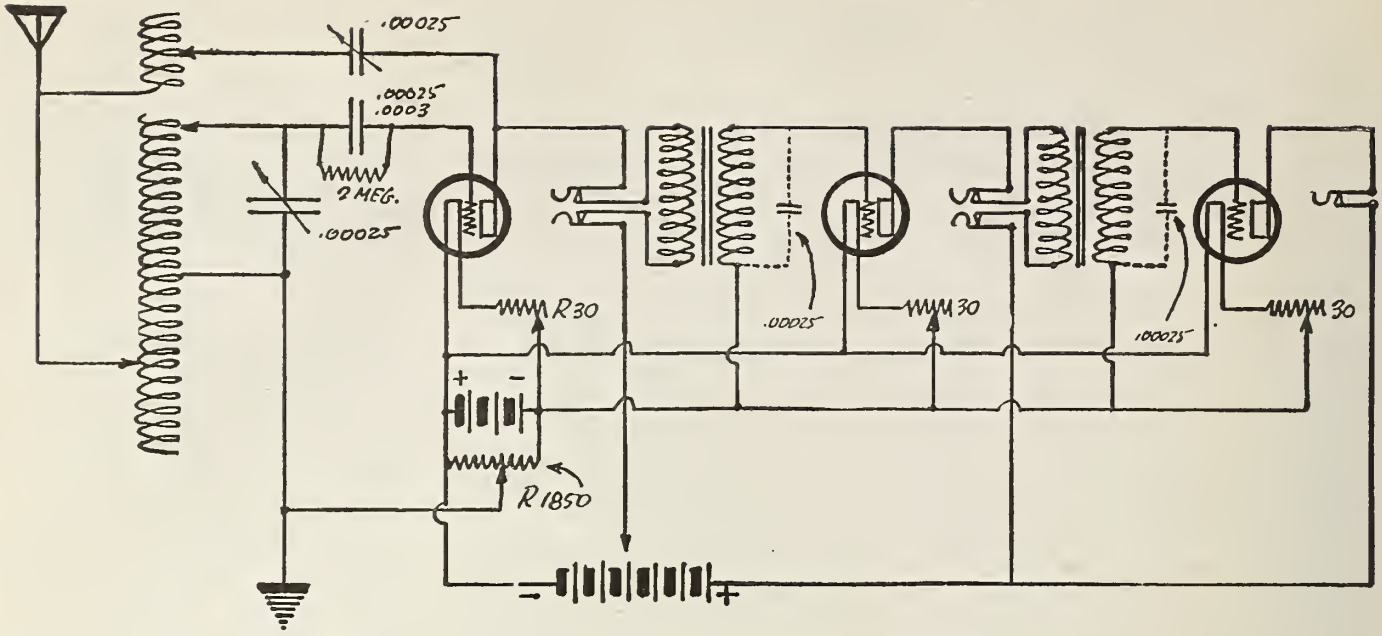
We asked several reliable persons how to overcome this feature, however, and they each told us that the "spill-over" was a characteristic of that type of tube. However, we kept at our task of getting it under control, and after trying out fixed and variable condensers and grid leaks, choke coils, and various other resistances and leaks in every conceivable manner on the circuit without avail, we happened to place a 400-ohm resistance potentiometer in the circuit as shown in the diagram, which very effectively solved our difficulty and stopped the spill-over of the tube, although I will add it must be used with discretion, and must not be overworked.

In every set we have tried a potentiometer on we have increased its volume, and we believe that it will increase the volume in set used with any of the tubes now in general use, either the soft or the hard type. The purpose of the potentiometer is to add and subtract and therefore equalize the A and B battery currents, and the higher the resistance of the potentiometer the less the current consumption, and less drain on the batteries. We therefore placed an 1,850-ohm resistance type on our instrument, which would be such a small drain that it can be effectively used with an ordinary dry cell "A" battery.

From our central location in the United States we have been able to hear broadcasting stations of the A and B class from nearly every state in the Union, and provinces in Canada. In a test we made with our set after installing the potentiometer we

DIAL TWISTERS

Name	Address	Circuit
R. Lewis Cohen	5603 Waterman Ave., St. Louis, Mo	Single Circuit
Fred Becker	Newtonville, Mass.	Clapp-Eastham
O. Bell	73 Haring St., Bergenfield, N. J	Not Stated
Miss L. L. Butz	Dwight, Ill.	Single Circuit
Richard Jones	300 N. Warner Ave., Bay City, Mich	Single Circuit
Lawrence Berry	1406 Washington Ave., Alton, Ill.	Kennedy
Warren G. Henry	535 N. Leamington Ave., Chicago, Ill	Reinartz
R. V. Hammer	216 N. Walnut St., Creston, Ia	Three Circuit
Albert J. Sylk	4113 W. Cambridge St., Philadelphia, Pa	Not Stated
Earl Fetty	Tekamah, Neb.	Ultra-Audion
Hudson Potter	1201 N. Main St., Rockford, Ill	Crosley
Robert Hindman	172 E. N. Broadway, Columbus, O	Not Stated
William F. Bird, Jr	860 West Avenue, Buffalo, N. Y	Single Circuit
Edward Brechel	3447 N. Seeley Ave., Chicago, Ill	Cockaday
Verlin Shinn	1121 W. Sycamore St., Kokomo, Ind	Not Stated
H. Winkle	835 Bordeaux St., Montreal, Que., Can	Reinartz
J. Harrod Hill	East Falls Church, Va	Neutrodyne
Lee Maxey, Jr	4153 Drexel Blvd., Chicago, Ill	Not Stated
H. A. Kunitz	417 Lexington Ave., New York City	Revised Grebe
Arthur Banke	Route 8, Lawrence, Kan	Reflex
Russell Aikens	Grimsby, East Ontario, Can	Single Circuit
Paul A. Dunn	512 River St., Elyria, Ohio	Short 54
Donald Buechner	322 Dwight St., Syracuse, N. Y	Single Circuit
George F. Schaaf	707 Linden St., Lima, Ohio	Simplifigon
Julian Franke	451 Dewald St., Fort Wayne, Ind	Erla Triplex



had excellent reception on an ordinary magnetic type of a loud speaker from the following stations, to-wit: WDAY, KDKA, WCAE, WOR, WOO, WTAM, PWX, WHAS, WDAP, KSD, WGY, WMC, WOC, WSB, WFAA, WBAP, KFI, KHJ, CFCN, WOAW, WLAG, KGW, KPO, WOS, WCAP, WHAA, as well as a number of other signals from other stations we did not try to bring in, especially those under 360 meters. Last winter we received the station from the agricultural school at Las Cruces, N. M., which, to us, was the best the set has done, inasmuch as they used only two 10-watt tubes in their transmitter, and this was accomplished on the detector alone.

We try to belong to that body of radio fans called the "help each other society," which has not yet been duly organized, but which seems to be in general use among the fraternity of bugs, and that is the object of this little article, so we pass it along to you for what it is worth, and hope it will be of some advantage to someone.

And now that Mr. Hardman has so kindly explained the use of this mysterious radio control, "the potentiometer," we trust that fans will profit by his experience, and govern their future receiver plans therefrom. We certainly are indebted to him for his generous and concise description of its use.

By the way—are there any experimenters who have had experience with the Super-Heterodyne receiver, and could give up fans some pointers on operation and construction? It certainly would be timely, and the boys would sure appreciate it. Information of this kind with reference to the Super-Heterodyne is very scarce, and the readers of this department would certainly profit by it. Come on you Super-Heterodyne addicts—kick in!

The Pickups Editor believes he has about the best records he has yet seen with regard to long distance reception with simple receivers. In this month's department we have receptions (which the contributors say are confirmed) records from foreign countries, excluding Canada.

That's what the Pickups Editor calls hot stuff. Do you know—it almost follows up the footsteps of the American Radio Relay League men, who are now transmitting and receiving on low waves, to France, Great Britain and Holland. They're ahead of us we'll admit—but we're right on their heels when it comes to receiving. And they claim the distinction of being the best radio men in the world. Now they've been in the game for ten years or more, and when a comparative infant in the radio game masters reception difficulties so well as to get trans-oceanic reception, we think its mighty keen work. We'll be picking ohms off antennas if it isn't. Here's the first one:

RADIO AGE.
Gentlemen:

I read the pickups section of your magazine in every issue. I am fifteen, and have built my own set. A single circuit Regen with two steps of audio. I built it last September, but could not get her working till a few months ago. But when she started, you had to watch its smoke!

From November to March, I have received 237 stations. My best record is KDYX of Honolulu, Hawaii, from which I have a letter confirming reception!

On March 7, 1924, I pulled exactly forty-five stations out of the ether. Two local stations were broadcasting between 7 and 10 p. m., viz., KSD and WCK, two powerful stations. The stations heard were:

KYW, WGY, WOC, KDKA, WOC, KFKX, WDAP, KFKB, WCAE, WDAR, WTAY, WIAK, WEAF, WGR, KFGC, WFI, WBZ, WJAD, WOAI, WHAS, WWJ, WOR, WOAF, WOO, NAA, KFDY, WAAH, WRC, WOAW, WMC, WDAF, WBAP, WFAA, WJAZ, CYB, CFAC, CKCK, WMAQ, KPO, WLAG, KHJ, WJZ and KGW.

I think this set is finer tuning than any other I know of.

Yours truly,
Ralph Lewis Cohen.
5603 Waterman Ave., St. Louis, Mo.

At one time, a Chicago newspaper was running a daily cartoon under the title of "Radio Ralph"! This must be the guy. Just think it over, from St. Louis, over the Rockies, deserts, and then over a vast expanse of water, his receiver reached out and wham!—in comes the soft twang of Honolulu music. That's radio. The Pickups Editor is putting your name on the list, of Dial Twisters, and wants to know when you are going to pick up Turkey. We'd like to be around when some of that harem dancing music comes through.

Mr. Fred Becker of Newtonville, Massachusetts, ranks about an even tie for the laurels this month with a list of stations, sixty-one in all, which he received on March 17. Those over a thousand miles distant are as follows: WHAS, KSD, WAAF, WSB, WTAY, WDAP, KYW, WJAM, WQAM, WLAG, WCBD, WOS, WOAW, WMC, WBBF, KFKB, KFKX, KGW; making an aggregate mileage of over 41,000 miles, including the other forty-three stations which are under 1,000 miles.

This in itself is quite a feat—over sixty stations in one night. However, here is the meat of his letter. He writes:

"I have received the Pacific coast twelve times, KHJ six times, KPO twice, KFAR once, KLX once, KJS once and KGW once. I have also received British stations 2LO, 5WA and 6BM. If anybody can beat this record, let's see them."

The only thing that prevents us from giving Mr. Becker first place is that he does not say that his reception of the English stations is confirmed. In these

days we don't say that anything is impossible in radio.

Now, here's one that's just as good as Mr. Becker's list (those eastern bugs certainly make a fine showing), but has to take a lower rating because his list of stations for one night is smaller:

RADIO AGE,
Gentlemen:

Having read Mr. Boyenga's request for pickups of Reinartz owners, I am enclosing my record, which I think ought to get me in the society of Dial Twisters. My total amount of stations received on one tube in 125 stations, *which includes 2LO of London, England.* I have a confirmation of reception from that station. My record night with one tube was forty-four stations. Stations I have heard are:

WEAF, WJZ, WOR, WAAM, WBAN, WHN, WWJ, WBS, WRW, WDAP, WBZ, WOC, WSAP, WGY, WIP, KDKA, WLAG, WSB, WOS, KSD, WFI, WDAR, WPAL, WLW, WBT, WBAY, WLAW, KYW, WHAS, WHAZ, WCAE, WNAC, WJAZ, WLAK, WGR, WCX, WDAJ, WMAK, WOO, WDT, WJAX, WRC, WBAK, WOAW, WCAP, WQAO, WMAQ, WMAF, WSAI, WJAR, WCBD, WGI, WCAU, WJY, WHAM, 6KW, WEAN, WTAS, PWX, WNAV, WSAD, WGAW, WQAN, WTAM, WRK, WJAS, WBAV, 9CE, WOI, WOAV, WFAB, WPAD, WMC, CKAC, WDAF, WSAY, WFAA, WHB, WOAI, KOP, WBAP, CFCN, WBBA, WPAB, WDBC, WMAY, WNAP, KFKX, WIAS, WAAW, WHK, KFKB, WEAM, WHAA, KFIX, WPAH, KQV, WAAF, WWAE, WIAD, WRM, WJAN, WCAL, WMAJ, WABT, CHYC, NAA, WCAD, WBAH, WEAO, KFIZ, WOQ, WABL, CFCF, WSAJ, WCK, WOAO, WTAT, WTAY, WJAK, WTAB, WIAO, KHJ, KGO, WBL, WBBH, WABQ, KFMZ, WBBF, WKAR, WSAR, WEAJ, WMAV, WCAS, WRAN, WBBG, WOAM, WBBR, WCAH, WGAL, CKCH, KFNF, KFLZ, WCBC, WQAE, KFMX, WJAM, WABM, WWAO, WABI, WTAQ, WBBM, WMAH, WDAY, CJCM and KFI.

The above list comprises the total number of stations received on one and two tubes, totalling 156.

Yours very truly,
O. Bell.
73 Haring St., Bergenfield, N. J.

Now Mr. Bell is so enthusiastic about his Reinartz that he wants to organize a national body of Reinartz owners, which he says ought to be called the Reinartz Booster Club. If the gang is in any way inclined along those lines, Mr. Bell would appreciate hearing from them at the above address. He says he will send in the list of names he receives and suggests that we print them. (Which we will if the list does not get too big.) At any rate, the Pickups Editor wishes to thank Mr. Bell for his suggestion and hopes he will hear from him again

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Boys, we have a YL (young lady) or DG (dear girl—that's what the transmitting amateurs call them)—in our midst. WHOEE! Just read over her letter. The only thing we hold as a drawback from giving this OW (old woman—another term used by transmitting amateurs for the female of the species) — the position of chief Dial Twister is that she didn't state whether her DX reception was verified or not. If we were she, we'd get it confirmed. Now for the letter:

RADIO AGE,
Gentlemen:

After having read your magazine for quite a time I have decided it is one of the foremost, if not the foremost, radio periodical published. I take pleasure in submitting to you a list of radio stations I have heard. My radio is a single circuit using a UV199 tube. Before this I used WD12's, but I had bad luck—burnt 'em out. The UV199 seems to do better than the WD12, judging from the results I get. My record consists of over seventy stations, but I shall set down here only those of distance:

WSY, WIK, WJY, WKY, WFAJ, WOR, WBZ, WEAF, WOAW, KPO, WHJ, WFI, KGO, KGW, KDZE, KFAF, CKCK, CHYC and PWX.

The four California stations I can get in any time they are operating, and all except KPO come in very plain.

The stations I think almost impossible to receive with a single circuit in the middle west are foreign ones, yet mine has done it. *I have heard Melbourne, Australia, and London, England (2LO).*

When I got Melbourne, I believed myself to be hearing something that was impossible, but my radio chart has Melbourne down for a station, and I know my ears didn't fail me. The signals were weak, but I got the name Australia announced three times, and Melbourne once. I tuned in London one cold, dark, but not cloudy night: fading was moderate. but I made sure before I logged them.

Another time I heard the name Salt Lake City announced, but could not get the call letters, so did not log them. Before Christmas I got WKAH, West Palm Beach, Florida, but they seem to be off the list now.

As you say, everyone can try for the Dial Twisters. I hope that my list will stand a show, as I know all are given due consideration.

(Miss) Luez L. Butz.
Dwight, Ill.

The Pickups Editor does not happen o be married—but even at that he knows better than to argue with a YL. To be utterly frank, we wish Miss Butz would have confirmed her receptions before letting us hear from her—but as we said before, we take all letters at face value, and if the writer happens to be an Isaac Walton we don't assume any responsibility. The point is—confirm your extreme long distance receptions. We are glad to have the ladies visit our department (notice the *OUR),* and we would like to hear from more of them—it adds zest to the game to know that there are YL's interested.

Miss Butz has submitted a most unusual list, and we hope she will continue the good work. You gentlemen mechanics take a gallery seat; you've gotta' go some to beat that.

Back in the March issue one of our fellow DT's insisted that we correct his address, which was given as Milwaukee, Wisconsin, instead of Bay City, Mich. He also stated that he would like to see everybody in the country get as good results

STATIC PUNCTURING CONTEST

CAN old man static stop you or can you stop old man static? We offer the following prizes to DTs for the five best records submitted during the months of June, July and August. The contest is open to any reader of RADIO AGE, and any type of set. The Pickups Editor reserves the right to pick the winners.

We will be especially interested in lists submitted by persons making their receptions on portable receivers.

For each month, June, July and August, a different set of the same prizes are offered.

The baseball season is open—who will be the ones to sock old static for a home run? Wot sa, DTs?

PRIZES for June

A year's subscription to RADIO AGE for the second best list submitted showing receptions made during the month of June.

A year's subscription to RADIO AGE for the second best list submitted showing receptions made during the month of June.

For the third, fourth and fifth best lists, we will award a copy of the RADIO AGE ANNUAL to the contributor of the winning list.

If any transcontinental or transatlantic reception is accomplished, confirmation of such reception is necessary.

as he has and would answer all letters directed to him. We gave him fair warning that he would be avalanched with mail—and corrected his address. In the April issue we printed his hookup and the instructions he follows in operating the set, but—let him tell the story:

RADIO AGE,
Gentlemen:

Can't you sneak out the April issue a few days (or weeks) ahead of time? If you don't, I'll be in a padded cell trying to answer all the letters I'm getting from fans all over the country (He evidently hit the right medium when he sent his list and offer into RADIO AGE—Pickups Editor.) For heaven's sake—hurry! I have several letters that cannot be translated, these I have to pass up, hoping their writers will see the coming issue of RADIO AGE. Those who didn't send stamps, I cannot answer. It would cost me a fortune in stamps, and I don't know whether I'll be able to answer all of those who did send stamps.

Mr. Boyenga, in the March issue, said he was sure only a Reinartz would pick up twenty-five stations in two and one-half hours. Here you are, Mr. Boyenga—thirty-six (count 'em) in *TWO* hours:

KDKA, WGR, WLW, WKAR, WTAS, WEAN, WIAD, WEAF, WOC, WCX, WCAE, WCAP, KFI, CFCR, WOR, KHJ, WDAF, CFCA, WTAM, WOAN, WBAP, WHN, 8DAT, WDAR, JSD, WNAQ, CFCB, JYW, WKAG, WHAZ, KPO, WDAP, KFLZ, WOS, KGO, KFKB

How's that for a single circuit bottle outfit? Can a Reinartz do this? If it can, then I'll go out for another and better record.

And that's that. You single circuit bugs—let's up and at 'em!

Very truly yours,
Richard Jones.
300 N Warner Ave., Bay City, Mich.

Mr. Jones got just what he asked for. Nearly everybody in the United States wrote him—at least from his letters he thinks so—but he should see the technical department of RADIO AGE. He'd think his mail was a mere handful compared to the Troubleshooters. Anyway. Dick, thanks for your letter and information We hope to hear from you again.

Mr. Lawrence Berry, 1406 Washington Avenue, Alton, Ill., wants to be put on the DT list. He encloses a list of thirty-six stations heard in two hours—and Mr. Jones will have to share honors with him. At least, Mr. Jones, there is the consolation that it wasn't a Reinartz that accomplished Mr. Berry's work, as he uses a Kennedy receiver. Lawrence says that if we know of any hookup that will beat that—he'd like to have the circuit.

The following is a letter from a Dial Twister who has grown fond of his "little ole radio," as he terms it. You know, fellows, it actually gets that way—you learn to love it:

RADIO AGE,
Gentlemen:

I'm giving the "little ole radio" a party tonight—it's one year old. I thought I'd send in my year's labors to your interesting department.

I'm not at home to run the set every night, maybe four of the week; but I do get in on the air either early supper hour or early milkman hour and catch some odd ones now and then. I think this is a pretty good record for a Reinartz and next year I hope to pass it as we learn to know each other better every day, especially in respect to tuning.

I can tune as low as 187 meters and as high as 600 without loading coils. The low wave length range accounts for the number of "ham" phone transmitters I have heard.

As a rule silent night nets around ten to twenty-five stations on the average. Oh, if I only lived a few miles out of Chicago, with this set I don't know if this plasters the name of Dial Twister on me or not—but here's hoping.

Respectfully,
Warren G. Henry.
535 N. Lemington Ave., Chicago, Ill

The RADIO AGE data sheets printed on pages 37 and 39 should be carefully filed away as described in the preceding issue.

In a comparatively short time these sheets will represent a world of valuable information and reference.

Don't fail to save them.

March 12, 1924—"Little Old Radio's" first birthday. Reinartz detector and two-step audio, standard hookup, double inverted L aerial, WE phonograph attachment.

The result:

CFCN, KFI, KHJ, KFKB KDPM, KDKA, KFKX, KSD, KFDL, WBAH, WBAP, WBAV, WBZ, WCAE, WCAL, WCAP, WCAS, WCAY, WCBD, WCK, WCX, WDAF, WEAF, WEB, WFAA, WGR, WGY, WHA, WHAA, WHAS, WHAZ, WHB, WIAO, WIAU, WJAD, WJAX, WJZ, WKY, WLAG, WLW, WMAK, WMC, WNAD, WOAV, WOAW, WOC, WOI, WOO, WOR, WOS, WPAB, WPAH, WRC, WSAI, WSB, WSY, WTAM, WTAP, WTAS, WTAY, WWAE, WWJ, WBBM, WSAA, WCT, WAAP, WDAJ, WBU, WAAY, WPAD, (Chicago's) KYW, WMAQ, WSAH, WJAZ, WDAP, WAAF, WTAY, Amateur voice mikes (I can't read code) 9AAD, 9AB, 9AIX, 9AOL, 9ASH, 9AVE, 9AX, 9BA, 9BCB, 9BEF, 9BFF, 9BNA, 9BQA, 9BRN, 9BYA, 9CAX, 9COW, 9CR, 9DMN, 9DNI, 9DOZ, 9DQS, 9EAS, 9ED, 9EFY, 9EIX, 9HL, 9PO, 9US, 9YK, 9XN, 9XU, 9CVF, 9CVS, 9CW, 9CX, 9CYD.

Covering twenty states, District of Columbia and Canada.

We know how hard it is to log amateur voice "mikes." They growl and sputter and hum and fade—the voice sounds as though it were being run through a meat chopper. We appreciate Mr. Henry's list, and hope that when the "little ole radio" is two years old his list will have doubled itself. Come again, Mr. Henry.

Now here's a fellow who feels the same way toward his three circuit Regen—two variometers and a coupler—and who sends in a list of stations much similar to Mr Henry's:

RADIO AGE,
Gentlemen:

I have been reading the records sent in by the various DT's and have come to the conclusion that I have one or two records that will place my name near the top of the list.

I use a home-made two-variometer 3-circuit regenerative set with one-stage amplification, although I have heard practically all the following on the detector only. It will be two years in August since I have had my set and to date I have logged 318 stations in 36 states, Canada, Cuba, Porto Rico and Mexico. In addition to the above I have heard 48 amateurs on phone, which I will not list.

Below I list just the stations of 800 miles and more from Creston:

CALL	LOCATION	DX MILES
WKAQ,	San Juan, Porto Rico	2,400
6KW,	Tuinucu, Cuba	1,600
6BY,	Cienfuegos, Cuba	1,575
KPO,	San Francisco, Calif	1,575
CYB,	Mexico City, Mexico	1,565
CYL,	Mexico City, Mexico	1,565
PWX,	Havana, Cuba	1,560
KLX,	Oakland, Calif	1,550
KGO,	Oakland, Calif	1,550
KGW,	Portland, Oregon	1,535
KFI,	Los Angeles, Calif	1,450
KHJ,	Los Angeles, Calif	1,450
KFSG,	Los Angeles, Calif	1,450
CJCA,	Edmonton, Alta., Canada	1,290
WNAC,	Boston, Mass	1,250
WEAN,	Providence, Rhode Island	1,235
WJAR,	Providence, Rhode Island	1,235
CHOM,	Calgary, Canada	1,220
CHBC,	Calgary, Canada	1,220
CFAC,	Calgary, Canada	1,220
CFCN,	Calgary, Canada	1,220
WBZ,	Springfield, Mass	1,170
CKAC,	Montreal, Que., Canada	1,125
CHYC,	Montreal, Que., Canada	1,125
CFCF,	Montreal, Que., Canada	1,125
WMAF,	Dartmouth, Mass	1,150
WHAZ,	Troy, N. Y	1,120
WBBR,	Brooklyn, N. Y	1,100
WEAF,	New York City, N. Y	1,100
WJZ,	New York City, N. Y	1,100
WDT,	New York City, N. Y	1,100
WJY,	New York City, N. Y	1,100
WHN,	New York City, N. Y	1,100
WGY,	Schenectady, N. Y	1,100
WOR,	Newark, N. J	1,090
WEAM,	N. Plainfield, N. J	1,050
WRAX,	Gloucester City, N. J	1,040
CKCH,	Ottawa, Ont., Canada	1,030
WDAR,	Philadelphia, Pa	1,000
WCAU,	Philadelphia, Pa	1,000
WIAD,	Philadelphia, Pa	1,000
WFI,	Philadelphia, Pa	1,000
WIP,	Philadelphia, Pa	1,000
WOO,	Philadelphia, Pa	1,000
CFRC,	Kingston, Ont., Can	970
WCAP,	Washington, D. C	960
WRC,	Washington, D. C	960
WHAM,	Rochester, N. Y	905
WCAD,	Canton, N. Y	900
WSAC,	Clemson College, S. C	900
WCAR,	San Antonio, Texas	875
WOAI,	San Antonio, Texas	875
WBT,	Charlotte, N. C	860
WHAB,	Galveston, Texas	850
CKCK,	Regina, Sask., Can	850
WMAK,	Lockport, N. Y	845
WGR,	Buffalo, N. Y	835
WCAG,	New Orleans, La	830
WGV,	New Orleans, La	830
WTAF,	New Orleans, La	830
CKCE,	Toronto, Ont., Can	820
CFCA,	Toronto, Ont., Can	820
CFCR,	Sudbury, Ont., Can	800

NOVEL RADIO CALLS SUGGESTED

What would you say if you had to tune your ear musically before you could tune your set to a broadcasting station, and if all announcers sang their calls in musical notes?

As a substitute for the call letters of different broadcasting stations, which are sometimes confusing and unintelligible, the use of musical notes sung by the announcer has been suggested to Secretary of Commerce Hoover.

Dr. Charles M. Swingle of Cleveland, Ohio, who recommends this practice as an improved method of designating radio stations, says: "These notes should be sung by the broadcasters thus: 'do, me, sol, do, sol, me, do' might designate WJAX." The call of this station in announcements would then be: "WJAX, do, me, sol, do, sol, me, do," he explains, suggesting that later, only the notes be used.

More than one value would accrue by this method, he believes; more certainty of being understood, training of the broadcasters' voices, and encouragement of vocal music. "It is a psycological fact that one who hears only a few notes, is almost impelled by the musical instinct to sound them over, whereas this is not true of a complete song" he writes. This old instinct, according to Dr. Swingle, can be encouraged and again made to function for all.

In his reply to Dr. Swingle, the Commissioner of Navigation explained that the Government is forced to follow the rules of the International Bureau at Berne in assigning call letters to radio stations, and numerical designations for amateurs according to their districts. All of which makes the suggested change practically impossible.

WABT, Washington, Pa.	800
WEAY, Houston, Texas	800
WEV, Houston, Texas	800

The above list of stations have all been heard since the first of the year. If the list is too long for publication cut it down to the 1,000 miles and up.

If this does not put my name in the list of Dial Twisters, how about the list for one day's work which you will find on a separate sheet?

If anyone doubts the veracity of the above, I have communications from nearly every one of the stations listed verifying the fact that I heard them on certain evenings.

Yours for D. T,
R. V. Hammer.
216 N. Walnut St., Creston, Ia.

The following stations were heard Monday, January 21, 1924. This list was published in the Des Moines *Sunday Register* January 27th. I heard one complete announcement and number from each station.

Heard During Daylight, up to 6:00 P. M.

	Miles
WMAJ, Kansas City	150
WAAW, Omaha	90
WOI, Ames, Iowa	90
WFAV, Lincoln, Neb.	120
WBAH, Minneapolis	285
WIAK, Omaha	90
WHAS, Louisville	520
WOO, Philadelphia	1,000
WJZ, New York City	1,100
WMAQ, Chicago	370
KFLZ, Atlantic, Ia.	45
KYW, Chicago	370
WHB, Kansas City	150
WOS, Jefferson City, Mo.	225
WOC, Davenport	205
WDAF, Kansas City	150
WGY, Schenectady	1,100
WHK, Cleveland	680
WCX, Detroit	610
WJP, Philadelphia	1,000
WRC, Washington, D. C.	960
WSB, Atlanta	770

Heard From 6:00 P. M. On.

WFI, Philadelphia	1,000
WOR, Newark	1,090
KDKA, Pittsburgh	790
WCAE, Pittsburgh	790
WLAG, Minneapolis	285
WGR, Buffalo	835
WIAO, Milwaukee	375
WDAP, Chicago	370
WTAQ, Osseo, Wis.	350
WWJ, Detroit	610
WEAF, New York City	1,100
WCAP, Washington, D. C.	960
WDAR, Philadelphia	1,000
WOAW, Omaha	90
CFCF, Montreal	1,125
WBZ, Springfield	1,170
KFKB, Milford, Kans.	220
WPAB, State College, Pa.	790
CFCA, Toronto	820
WOQ, Kansas City	150
WCK, St. Louis	285
WHA, Madison, Wis.	345
WBAP, Fort Worth	625
WMC, Memphis	490
WBAV, Columbus, Ohio	625
WHAZ, Troy	1,120
WCBD, Zion, Ill.	350
WLW, Cincinnati	560
KFJL, Ottumwa, Ia.	140
KSD, St. Louis	285
WTAS, Elgin, Ill.	350
KFIZ, Fond du Lac	385
WFAH, Port Arthur, Tex.	795
KFKX, Hastings, Neb.	200
KPO, San Francisco	1,570
CKCK, Regina, Sask.	850
WOAI, San Antonio	875
WIAB, Rockford, Ill.	295
KHJ, Los Angeles	1,450
WBAK, Harrisburg, Pa.	955
CFCN, Calgary, Alt.	1,220
KFI, Los Angeles	1,450
WSAJ, Grove City, Pa.	810
KFMT, Minneapolis	285
5XAJ, Dublin, Tex.	600
WJAX, Cleveland	680
9MM, Converse, Ind.	440
9BXZ, Des Moines	50
9HK, Clinton, Ia.	210
9AAQ, Ackley, Ia.	125
9AKE, Eagle Grove, Ia.	150
9DA, Eagle Grove, Ia.	150

74 stations and 42,720 miles.

The lists (either of them) would put Mr. Hammer's name on the prized DT list, because both of them are characteristic of a good operator. The point that tickles us is that Mr. Hammer uses a three-circuit regenerative receiver — the one our friends say is too hard to tune. Here's to Mr. Hammer and his far reaching receiver. Our hats are off to him—and may his signals never fade.

Albert J. Sylk of 4113 West Cambridge Street, Philadelphia, Pa., deserves the title of Dial Twister for his coast to coast reception in tuning in KFI of Los Angeles. Mr. Sylk uses two WD11 tubes in a circuit which he does not name. He encloses a list of other stations heard on February 10th, together with KFI, making a total of 20 stations, the second best being KLZ at Denver. FB, ol' man.

Earle Fetty of Tekamah, Neb., writes a chummy little letter as follows:

RADIO AGE,
Gentlemen:

I am only a new subscriber to your wonderful magazine, but I have bought single copies before and I gathered from these that your policy was honesty. I am not casting aspersions by any means on Curtis Springer and Kenneth Fischer (more power to them), but who on earth ever heard of stations KFSB, WDI and KFSG? Most likely in their enthusiasm of getting a wonderful list of stations for one night, they misunderstood the announcer. But if they are good readers of this magazine they will turn to the up-to-date list of stations in the back of the book. Also I may be mistaken, but I believe that WOS, WCBD and KSD are silent on Saturday nights. Notwithstanding all this, they still have a wonderful record that is hard to beat, but this is my list of stations heard on a single tube ultra-audion receiver, every station heard since January 15th.

KFLZ, WBAP, WCAH, WCAL, WHK, WIAK, WJAG, WOO, WOQ, WPAH, WSB, WWJ, KFLE, WBAH, WCAE, WGR, WHA, WHAA, WKY, WOI, WTAY, KFFQ, WOAI, WCAP, WEAF, KFI, KYW, WJAZ, WDAP, WTAS, WMAQ, WCBD, WOS, WOR, WDAR, WTAM, WLAG, KDKA, WGY, WOC, WOAW, WCK, WHAZ, WOR, WSAI, WHAS, WFAV, WEAU, WLW, WHB, WAAW, KSD, WCX, WCAJ, KFKB, KFKX, WNAC, WMAY, WDAR, KFNF, (this station just opened so it may not be found in the list) WRM, KEEQ, WBZ, KFFZ, KGO, CFAC and PWX.

Possibly not good enough for the DT list, but fair for one tube, don't you think? I marked the position of PWX on the dials and have gotten them two or three times since. I have not yet received my Reinartz book, but I suppose there is a great demand for them. When I get it I am going to build a two-stage amplifier, and then I'll hope to send in a list enough to choke a goat. Possibly a little suggestion from you will have these DT's check up their list by your lists and save time and slight embarrassment. Hoping to get your book soon, I am

Yours respectfully,
Earle Fetty.
Tekamah, Neb.

P. S.—I might add for the benefit of any prospective crystal set buyer out here that if some salesman says he'll guarantee to get KDKA, East Pittsburgh, he means KFKX, Hastings, Neb. Keep a wary eye open.

Brother Earle's letter contains some very good suggestions—fellows might be glad to know that we feel the same way about being careful about your DT lists. Casting no reflections on anyone or anybody, we wish to say that we always be-

(*Continued on page 41*)

Radio and Talking Machines

MUSIC dealers and manufacturers of musical instruments sometimes express concern lest the vigorous but youthful radio giant trespass upon the elder industry. It is said that radio is cutting into the phonograph business. There is not much doubt that radio is distracting attention from phonographs but the radio receiver is here to stay and the music men would better absorb it than to try to battle with a fact.

Some phonograph makers have had the foresight to make their cabinets and tone arms in such a manner that they will allow for space for a radio receiver within the cabinet, and so that a special tone-arm may be easily connected to a device which will turn the sound chamber of the phonograph into an excellent loud speaker.

Several manufacturers already have demonstrated for RADIO AGE the merits of a special radio tone-arm for phonographs and it seems likely this is to become an important line.

The phonograph is always ready to play any desired selection at any time, while the radio is dependent upon the broadcasting stations. Then, too, if the battery happens to be run down, the phonograph will furnish entertainment until it is recharged.

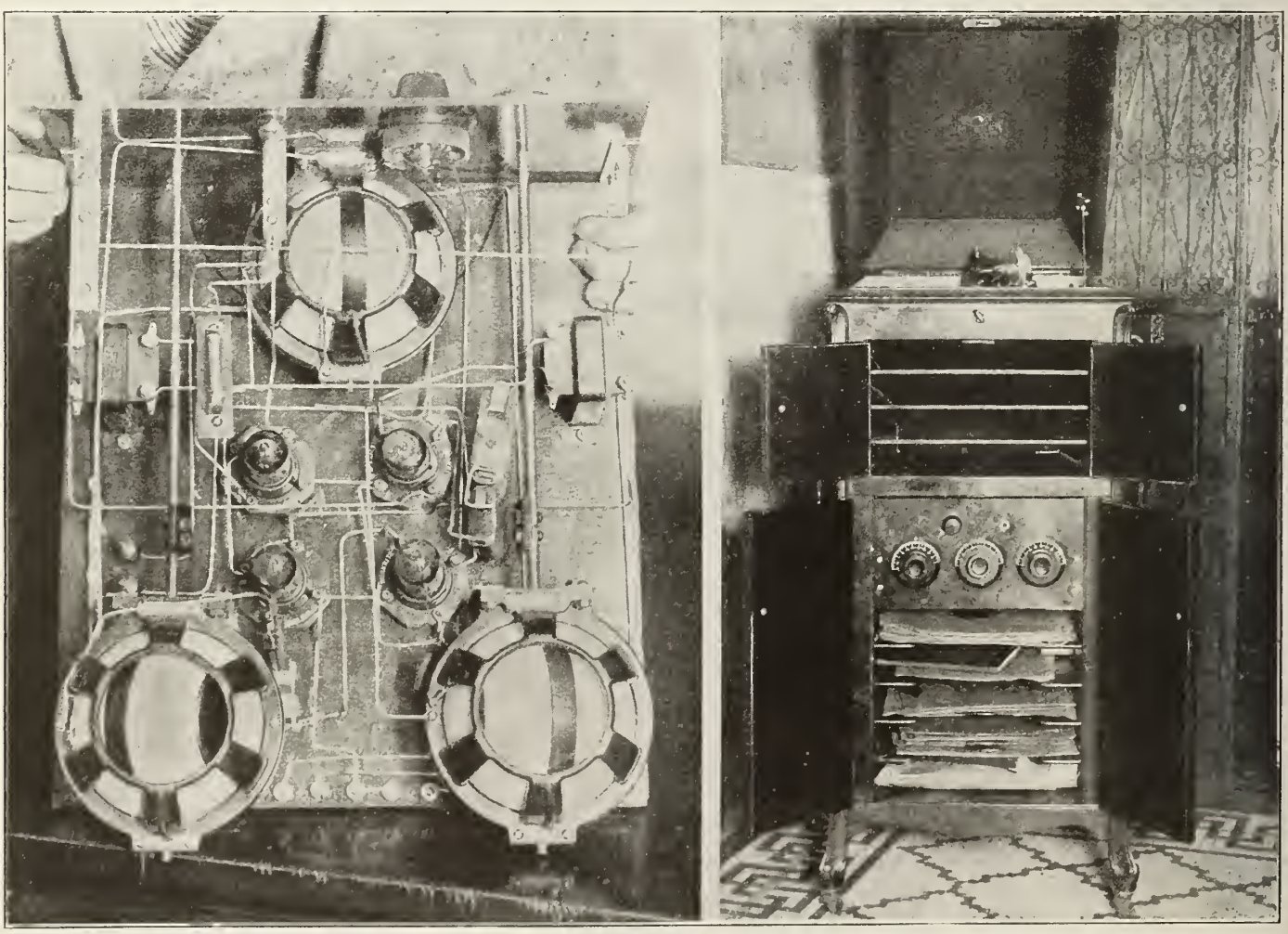
Combining both of these instruments in one cabinet would save considerable space in the small apartment which is one very important item. Some manufacturers are beginning to appreciate the demand for something of this kind, but the great difficulty seems to be that because there are so many different types of radio sets, and many fans like to build their own, that they hesitate in making a selection.

However, if the cabinets were made with the regulation phonograph equipment, and a blank panel mounted in a convenient place, they would find a ready sale for it. Such an arrangement would be a great help to both the radio and phonograph business.

"All-American" Moves

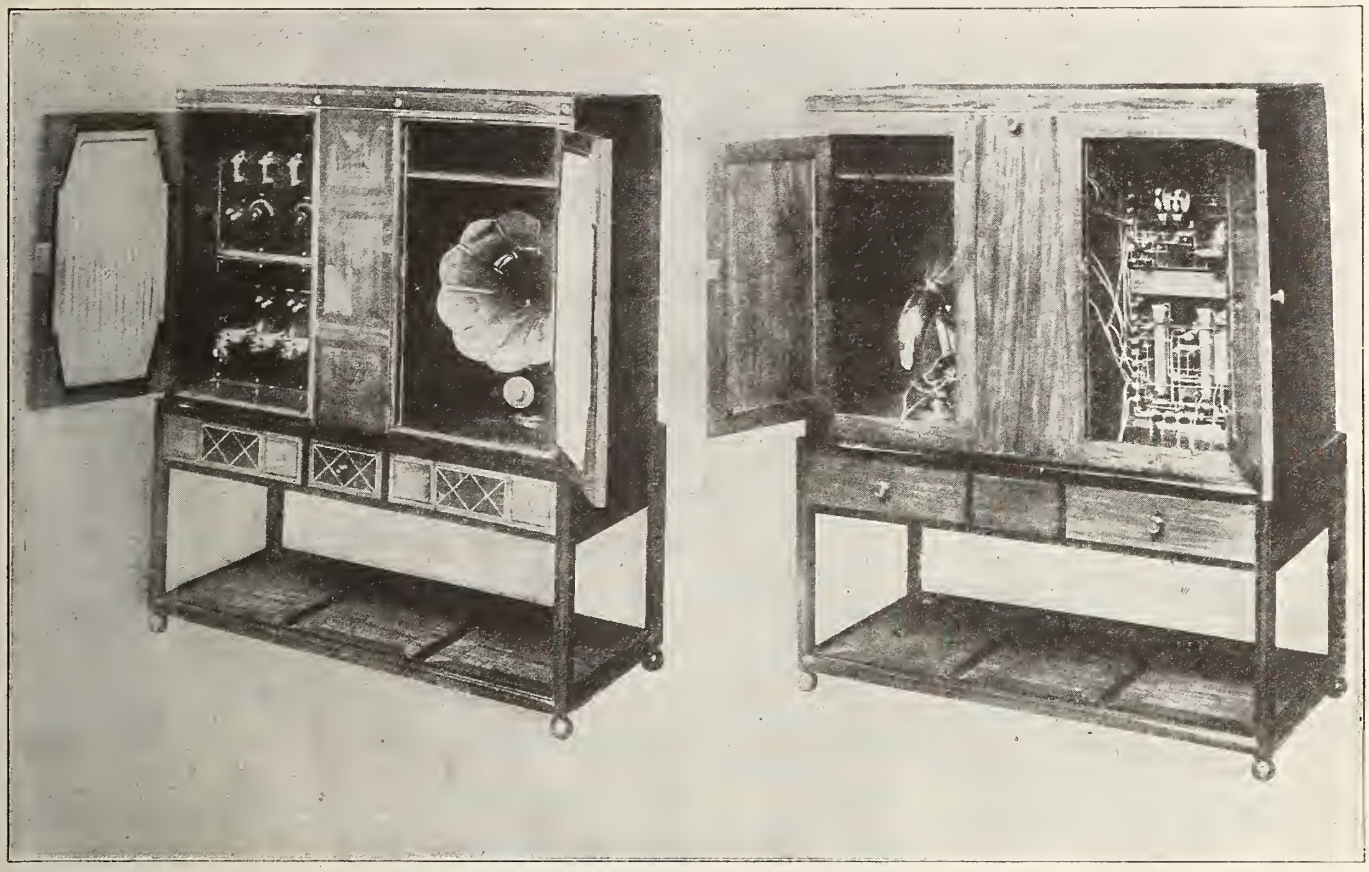
Increased business has compelled the Rauland Manufacturing Company to remove from its former quarters to a large new and modern steel and concrete building at 2650 Coyne Street, Chicago. The company reports that it is doing ten times as much business as it carried a year ago, although it had a good volume of business at that time. The company makes the "All-American" Transformer.

The new quarters not only provide much more manufacturing and office space, but the location is ideal for the laboratories, having been especially chosen with a view of avoiding electrical disturbances. Incidentally the laboratory is one of the most complete and up-to-date ones in the country. There will be available in the new factory every modern device for manufacturing precision radio and electrical apparatus



RADIO FOR THE PHONOGRAPH

An unusually effective and compact outfit, designed to fit a phonograph cabinet or small radio cabinet. Made by Richard Carlisle, president C. C. N. Y. Radio Club, it is a specially built four-tube Superdyne, using the upper variometer as a vario-coupler, the rotor coil being split, half being used as feed-back. The wiring is unusually neat, and the set is a wonder for DX, when used on a small aerial or loop. At the right is a photograph of the set installed.



KING GEORGE'S OUTFIT

As they would say in England, it is a "seven valve" instrument. The description of the receiver, as written in London, asserts that it is "complete, with aerial and earth." The cabinet is inlaid with ivory and mother of pearl. The cabinet is made in three compartments, the left compartment containing the tubes, the center one the battery and the right, the loud speaker. Photo on left shows the front doors open and the other shows the back doors open. The set is capable of receiving signals from all parts of the world.

Radio Views on the White Bill

By CARL H. BUTMAN

WASHINGTON, D. C.—Congressman Wallace White's radio bill stood up well under fire of several objectors during a four-day hearing before the radio sub-committee of the House Merchant Marine and Fisheries Committee. It is the general impression that the sub-committee will now report favorably to the full committee and that early action in the House will follow. Secretary Hoover is sanguine as to the eventual passage of the needed legislation by the House, but no one dares prophesy on the attitude of the Senate, due to the multiplicity of investigation and urgent measures before that body. Following the conclusion of the hearings last week, Secretary Hoover said there seemed to be a general "unanimity of opinion" that the bill was a good one basically.

Appearing before the sub-committee at the opening of the session, Secretary Hoover read a report reviewing the radio situation and indicating the legislation needed by the Department if proper administration was to be continued. Chairman White of Maine, author of the bill, presided at the hearings, assisted by Representatives Lehlbach, Free, Bacon, Davis, Bland and Larsen.

Pointing out the imperative need for legislation, although admitting that no law would be a "panacea," Secretary Hoover said in part:

"The tremendous development in electrical communications is to a large extent due to the fact that individual initiative has not only been unhampered by the Government but has been encouraged to the extent of the Government's ability and regulated so as to give the maximum service. The further legislation needed should in my view regulate only to the extent that is necessary in public interest for the development of the science itself; for the service of those who make use of it. It seems to me, therefore, that the fundamental thought of any radio legislation should be to retain possession of the ether in the public and to provide rules for orderly conduct of this great system of public communication by temporary permits to use the ether. It should be kept open to free and full individual development, and we should assure that there can be no monopoly over the distribution of material.

Vital Public Interest

"Radio communication is not to be considered as merely a business carried on for private gain, for private advertisement or for entertainment of the curious. It is a public concern impressed with the public trust and to be considered primarily from the standpoint of public interest to the same extent and upon the basis of the same general principles as our other public utilities."

He also indicated the need for definite authority for the Secretary of Commerce to exercise "discretionary power" in accordance with the public interest in licensing stations, and not be forced to issue licenses to all applicants. While in sympathy with the provisions of the bill to prevent monopoly, Mr. Hoover said that in his opinion the determination of whether or not a concern was attempting monopoly illegally was not an administra-

tive one but a judicial one.

The Commerce head also referred to radio monopolies and told the committee that it was inconceivable that the American people would allow this new-born system of communication to fall exclusively into the hands of any individual, group or combination. In discussing the matter of payment for broadcasting, he said that he did not favor the placing of a license or tax on receiving sets.

Calling attention to the inadequacy of his facilities, he said that one of the great difficulties in the effective efforts of the Department has been the lack of funds, and that the attempt to police 20,000 stations with a total field force of 29 inspectors was obviously an absurdity.

Navy Voices Objections

Mr. Hoover was followed by Commander D. C. Bingham, of the Naval Communication Service, who said that the bill in general was satisfactory, but he voiced the same criticisms, opposing the licensing of any operators and the charging of fees for such licenses. He asked that station licenses be made for fifty years instead of ten, which appeared to be in opposition to the sentiment of the committee. He further explained that he was opposed to the advisory committee provided for in the White Bill.

In reply to the suggestion of the fifty-year license, Scretary Hoover said he was absolutely opposed to more than ten-year periods, as fifty-year terms would tend to create monopolies in the air.

Charles Caldwell, of New York City, who appeared on behalf of the Radio Broadcasters Society of America, was very emphatic in his reference to the American Telephone & Telegraph Company as the "radio monopoly." He said that in general his society favored the White Bill. Mr. Caldwell referred to the "big five," which he said included the American Telephone & Telegraph, The Radio Corporation of America, The General Electric, The Western Electric and the Westinghouse Electric companies. He took up the matter of patent rights which he said was a vital matter in the entire radio situation of today. He said that he favored the schedules of fees as provided for in the bill, but thought a fee of $100.00 should be provided for entertainment stations. Mr. Caldwell believed that the decisions of the Secretary of Commerce, as provided for in the bill, should be reviewable by the Courts.

C. B. Cooper, representing the Radio Trade Association, endorsed what Mr. Caldwell said, saying that his association wants to support the bill with the changes suggested.

Railroads Interested

One of the interesting witnesses was A. R. Belmont, vice chairman of the Radio Committee of the American Railway Association, who suggested some radio possibilities for the railroads. He particularly desired the insertion of a clause which would allow the construction of radio equipment on "mobile railroad equipment."

Raymond Asserson, Broadcasting Supervisor of New York City testified on the efforts of the City of New York to purchase a radio broadcasting set from the American Telephone & Telegraph Company. He said that the city of New York has wanted a sending station for the past three years but that it has been balked by the Telephone Company.

Joseph A. Devery, assistant corporation counsel of New York City, suggested that the authority to grant licenses, etc., should be lodged in some kind of a board or commission instead of with the Secretary of Commerce. At this point Representative Davis of the Committee said that a Communications Board might be organized for the regulation of radio, similar to the Interstate Commerce Commission for the railways, which would set rates and have other regulatory powers.

Another witness, Paul B. Klugh, executive chairman of the National Association of Broadcasters, told the committee that his organization represented 78 of the leading broadcasters of the country. This organization approves the bill "in spirit" he said. He favored the appointment of the Advisory Committee as provided in the bill, but recommended the appointment of a board or commission, rather than leaving the whole affair in the hands of the Secretary of Commerce. The personnel of the Advisory Committee, he thought, should include amateurs, manufacturers and the broadcasters. Speaking of monopolies he referred to the American Society of Composers, Publishers and Authors as an "inquisitious monopoly."

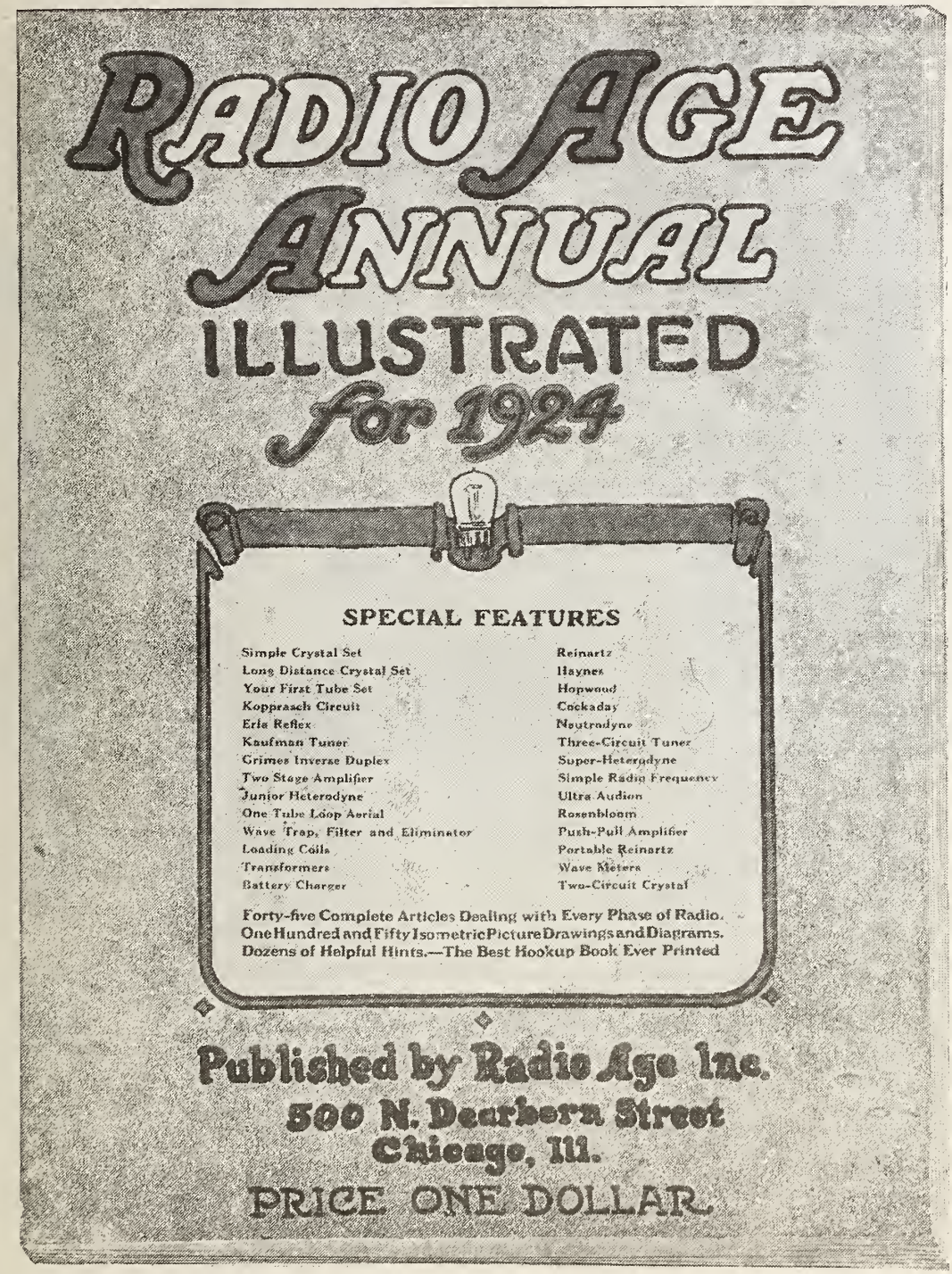
E. S. Wilson, Vice-President of the American Telephone and Telegraph Company, appearing before the Committee at the second days' hearings, said that his company had "No intention or desire to monopolize the air," as had been charged. He said that in general his company was in favor of the White Bill, but made a few suggestions, indicating that an appeal should be allowed from the decision of the

Kadel & Herbert Foto

SMALL 8-TUBE SET

Photo shows Chas. Murphy with the smallest 8-tube receiving set built by Leo Johnson of 2CTG, at Radio Show Hotel Pennsylvania, New York.

Here's the Best Hookup Book Ever Printed!



Detach this Coupon, fill in, pin a Dollar Bill to it and mail TODAY!

If Paying by Check Add 5 Cents for Exchange.

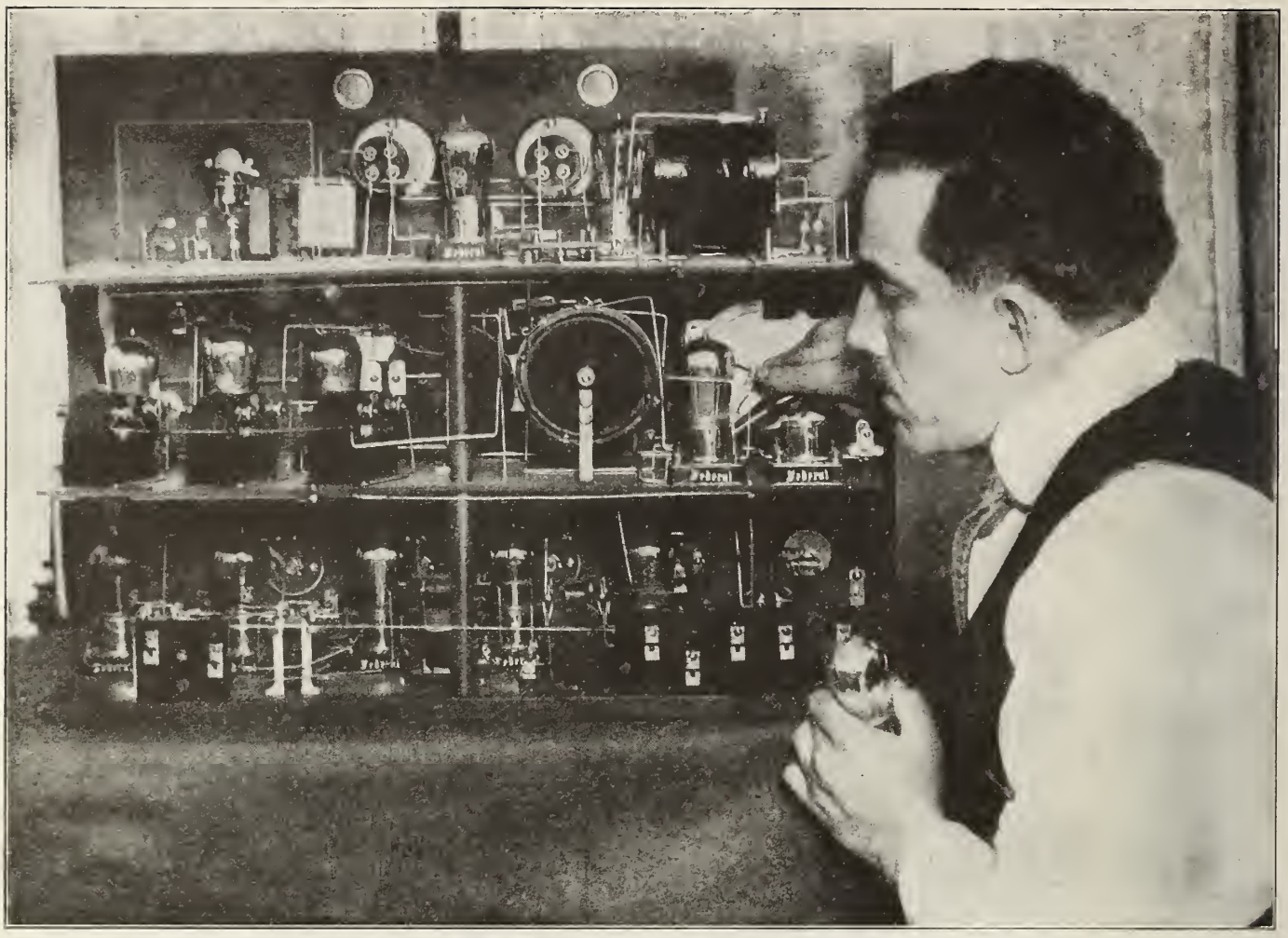
RADIO AGE, Inc., 500 N. Dearborn St., Chicago, Ill.

Gentlemen: Attached find One Dollar ($1) for which kindly forward me by return mail one copy of RADIO AGE ANNUAL FOR 1924. If not satisfied with it I will return it to you within three days and you will refund my money.

Name.....

Address.....

City.....State.....



Kadel & Herbert Foto

UNIQUE SUPER-HETERODYNE

Henry Brinkman, Pelham, N. Y., has built his distance getter in three compartments. The top shelf has two stages of vario transformer tuned radio frequency. On second shelf is first detector, oscillator and three stages intermediate radio frequency. On third shelf is second detector and two stages amplification plus one stage of push-pull amplification. By cutting out top shelf with the two stages of vario transformer tuned radio frequency you then have a 10 tube super-heterodyne controlled by panel switches. Stations 2LO, London, and CWL, Mexico City, come in very clear when weather conditions permit.

(Continued from page 34)

Secretary of Commerce in the matter of granting licenses to broadcasting stations. In the event the Secretary of Commerce is about to revoke a license for any reason, he believes that the offender should be allowed to remedy any violation of the law before the license is revoked. No objection was made to the monopoly provisions provided in the bill. When Mr. Wilson's attention was called to these provisions, he stated that his company was thoroughly in sympathy with them. Answering questions of members of the Committee, Mr. Wilson stated that the Telephone Company had licenses for a number of stations for broadcasting, and that the Western Electric Company had sold 49 broadcasting stations equipment.

For Broadcast Advertising

William E. Harkness, who followed him on the stand, stating that he was Broadcasting Manager of the American Telephone and Telegraph Company, said that while no definite advertising poli y has yet been adopted by the company, a rate is now being charged of $100.00 for 10 minutes or $400.00 per hour. In connection with the broadcasting of advertising, Mr. Harkness explained that it had to meet with the approval of "listeners in." He said that the company was desirous of presenting both sides of a controversy during the same evening, if possible. The company does not favor any political party or any particular propaganda in its broadcasting, he declared, and made no effort to conceal advertising.

When Judge Davis, a member of the Committee, asked Mr. Harkness if he did not favor the appointment of a board or commission to have jurisdiction over radio communication rather than the Department of Commerce, he replied that he had no preference in the matter. Judge Davis, however, said that in his opinion the Government would have to do something of the kind. Broadcasting from WEAF Mr. Harkness advised cost approximately $250,000 last year, while the company did not receive half that amount through advertising. He told the committee broadcasting stations were spending anywhere from $10,000 to $100,000 a year. The Telephone Company has no plans for charging for receiving amusement programs and does not contemplate such a step in the future, he added.

Amateurs Oppose Bill

K. B. Warner, Secretary of the American Radio Relay League, said that from the standpoint of his association the present law was satisfactory, and to that extent it is opposed to the new White Bill. He asked that a provision be inserted referring specifically to amateur radio operators, explaining that they would need protection for the future. The league is anxious to secure definite recognition for amateurs, he continued. Taking issue with Commander Bingham of the Navy, Mr. Warner said that he favored licenses for operators since they made for efficiency. He also favored fees for these licenses since this would allow more frequent inspection by the government and better enforcement of the law.

L. L. Lee, chief of the Radio Division of the Fleet Corporation, and John Nicholson of the Legislative Committee of the Shipping Board, appeared before the committee, opposing both the issuance of licenses to operators and the collection of fees for the same.

Mr. Lee told the committee that if the White bill is enacted into a law, it would

(Continued on page 38)

TROUBLE CHARTS (Q-20-21)
VACUUM TUBE TROUBLES

TUBES—Continued.

(5) GRID LEAKS. Most detector tubes are very sensitive to the value of the grid leaks, and for this reason a variable leak is to be preferred to a fixed leak. If the leak value is too high or too low, the signals will be weakened and the tube may become noisy and distort the signals. When the resistance of the leak is too low, then the signals are weakened. When the resistance is too high, or a defective leak is used, there will be much noise and distortion, and the tube will be very critical on the controls.

(6) RHEOSTAT DEFECTS. When the resistance of the filament control rheostat is too low, then we have all the effects of excessive filament voltage. The instant that the tube is lighted, you will hear a "click" and the signal will either be much distorted or else the tube will start howling. Use the rheostat specified in the tube direction sheet.

A rheostat having too high a resistance for the tube crowds all the control over to one end of the rheostat so that the adjustment is difficult. In such a case, the filament glows dimly on the first steps of the rheostat, and then suddenly brightens up after the rheostat has been moved more than half way over the scale.

In many circuits, a vernier rheostat is necessary for the control of the detector tube. A plain rheostat is not sufficiently accurate for this purpose. The carbon disc types are excellent for the control of detector tubes. Amplifier tubes are not as critical as detector tubes, hence a plain rheostat of the proper resistance can be used for the amplification stages.

(7) BIASING. For the best results a constant voltage should be maintained on the grid by means of a "C" battery placed in the grid line or by a potentiometer. In the case of detector tubes and radio frequency amplifier stages this should generally be a positive charge, while with tubes where audio frequency amplification is necessary, the grid should be given a negative charge. With circuits of the super-regenerative types where the detector tube also amplifies at audio frequency, a negative charge will be required on the detector.

Where radio frequency amplification is employed, and where trouble is had from free oscillations of the tubes, the application of a positive bias charge on the grid will generally stop the oscillations and produce maximum amplification in these stages. It is for this reason that a potentiometer is generally employed in the first radio stage, the potentiometer affording a simple means of controlling the bias on the first radio tube.

A small flashlight battery called a "C" battery is employed to hold a negative bias charge on the grids of audio amplifying tubes when the plate voltage much exceeds 45 volts. At 45 volts the biasing battery has not much effect, but at 90 volts it will be found that a "C" battery voltage of from 4.5 to 7 volts will give the maximum volume and freedom from distortion. The "C" battery biasing voltage increases in proportion to the plate voltage or "B" battery voltage.

COMPILED BY
J. B. RATHBUN

INDUCTANCES (F-20-25)
HONEYCOMB OR DUOLATERAL COILS

GIBLIN-REMLER COILS. In the following table is given the electrical dimensions of the Giblin-Remler inductance coils. The wire in these coils is layer wound but to reduce the distributed capacity, threads are woven in zig-zag fashion back and forth through the turns so that adjacent turns are staggered. These air spaces between the turns reduce the distributed capacity to the lowest possible point, considerably below that of the conventional honeycomb coils with the diamond winding. The method also reduces the length of wire for a given number of effective turns, and hence also reduces the electrical resistance. It is said that tests reveal 200 per cent less distributed capacity with the Giblin-Remler coils than with honeycomb coils having an equal inductive value.

PROPERTIES OF GIBLIN-REMLER INDUCTANCE COILS

NO. OF TURNS (RATING)	INDUCTANCE (MILLIHENRYS) AT 1000 CYCLES	NATURAL WAVE LENGTH (METERS) (COIL ALONE)	DISTRIBUTED CAPACITY IN M. M. F.	WAVE LENGTH RANGE WITH CONDENSERS .00004	.001	R. F. OHMS AT 500 METERS
20	.030	39	14.3	63	334	1.1
25	.041	47	15.2	75	389	1.5
35	.083	87	25.4	128	550	3.5
50	.169	114	21.6	185	785	8.8
75	.377	163	19.8	266	1170	28.3
100	.666	217	19.9	358	1550	80.3
150	1.503	281	14.8	512	2320	
200	2.680	374	14.7	690	3110	
250	4.200	424	12.1	860	3880	
300	6.110	494	11.2	1030	4680	
400	11.040	618	9.7	1380	6300	
500	17.500	747	9.0	1730	7900	
600	29.200	1024	10.1	2260	10250	
750	39.000	1249	11.3	2660	11850	
1000	71.600	1620	10.3	3570	16000	
1250	108.000	1930	9.7	4380	19700	
1500	159.800	2300	9.3	5300	23800	

In the "wave length range" column above, a 0.001 variable condenser is assumed with a minimum initial capacity of 0.00004 microfarads. Since the latter capacity exists with the plates completely out of mesh, this minimum initial capacity of the condenser determines the lowest wave length which of course is greater than the natural wave length of the coil. The initial capacity of the condenser acts just like a fixed condenser of 0.00004 m. f. capacity connected constantly across the ends of the coil.

Comparison with the ordinary commercial honeycomb coils shown on sheet F-20-10 shows that the distributed capacity of the Giblin Remler coils is very low, and as a result the natural wave lengths of the Giblin-Remler coils is also somewhat lower due to the lower distributed capacity. The distributed capacity of the coil acts just like a fixed condenser connected across the ends of the coil, and hence the wave length of the honeycombs is correspondingly higher for a given number of turns.

COMPILED BY
J. B. RATHBUN

(Continued from page 36)

prevent the use of radio by Shipping Board vessels, except at an additional expense of about $200,000 a year. He pointed out that radio is a very great help in the saving of life at sea and should be kept free from as much additional expense as possible. He thought that even freighters should be equipped with radio, but he objected if the Government proceeded to levy a tax on vessels properly equipped with radio in the interest of safety and in accordance with the law. He told the committee that as far as he had been able to learn, no foreign country charged fees for its vessel's radio equipment, adding that the fees provided for in the White Bill for vessels were most "unusual."

Major J. O. Mauborgne, of the Army Signal Corps, read a letter to the committee from the Secretary of War protesting against several features of the bill as being "prejudicial to the national defense of the country." He pointed out the need for leaving the regulation of wave lengths for the army in the hands of the Secretary of War instead of the Secretary of Commerce, and asked for special recognition of the Army in the bill.

During the course of his testimony, he said that the Department of Commerce stands on the policy that it represents the commercial radio interets of the country as against the interests of the government departments. With the exceptions noted in his testimony, Major Mauborgne said that the War Department is in sympathy with the White Bill.

Radio Corporation

The appearance of David Sarnoff, Vice-President of the Radio Corporation, was heralded with considerable interest. Advocating the need for legislation, Mr. Sarnoff pointed out that a "common sense compromise" between the benefits of private initiative and the evils of destructive competition must be found. He believes in the freedom of radio and the freedom of speech in broadcasting, he explained. It is his conviction that broadcasting can be made commercially practicable without collecting from the receiving end; its value lies in its universility and its ability to reach all, and he objects to selling it to a few, which he said would become "narrowcasting."

The R. C. A.'s ambition, he indicated, is to put radio within the reach of everybody, and the Corporation will support efforts of the Congress to enact legislation in the public interest and will not hamper further radio development.

Likening broadcasting to a bar at which causes may be pleaded before public opinion, he pointed out that if there had been broadcasting in 1858 there might have been no Civil War; the Lincoln-Douglas debates might have been broadcast to the whole nation, and Lincoln might have achieved his peaceful program.

Those appearing on the last day's hearings included: Judge S. B. Davis, Solicitor of the Department of Commerce; J. Harry Covington, representing the Tropical Radio Telegraph Company: and C. Francis Jenkins, inventor, of Washington, D. C.

Giving the Movies a Voice

DR LEE DE FOREST, famous scientist and inventor of the Audion, which makes radio broadcasting and receiving, long distance telephone and wireless possible, has at last succeeded in producing talking motion pictures, so uncannily realistic that a new art, differing as much from ordinary motion pictures as the latter does from the spoken drama—a combination of the two—has been created.

Dr. DeForest calls his latest invention the Phonofilm. By actually photographing sound waves on the same strip of motion picture film with the action, he is now able to produce absolutely perfect synchronization of sound and movement, the one thing that always proved the stumbling block in previous attempts to put the voice in movies.

Years ago Edison attempted to make talking motion pictures by combining the ordinary pictures and the phonograph. But he never succeeded in sychronizing them. Always the action was a jump ahead or a lap behind the sound, with consequent ludicrous results. Finally he gave up the effort. Then DeForest took up the problem and achieved success by combining the radio and the motion pictures. By a miracle, too, he has eliminated the metallic "ground" sounds so prevalent in the phonograph; so that the voice in the talking pictures is the same as a voice over the telephone.

In making a phonograph record, which was a component part of all previous talking pictures, the artist spoke or sang directly into a horn. By this process, the sound vibrates a diaphragm, which actuates a stylus, generally made of a sapphire. This sapphire cuts into a disc of soft wax a record of the sound waves. From this soft wax, a cast is made, and from this cast, the finished records are moulded in hard wax.

All of this process, as will be seen, is purely mechanical, from start to finish. In addition, the metallic effect is increased because of the artist, of necessity, speaking into the horn.

In making the Phonofilm, Dr. DeForest permits the artist the same latitude as to distance and action that he has on the stage. No recording horn is used. Concealed somewhere on the stage is a microphone, so delicately attuned that it picks up every sound, no matter how infinitesmal. If a telephone rings, it is recorded; or a knock on the door or the striking of a clock. The sound waves picked up by this microphone pass through a series of Audion amplifiers to a photo-electric cell located in a special attachment which can be placed on any motion picture camera. The lights from this gas-filled electric cell fluctuate in exact accordance with the volume of sound emanating from the actor's lips. This light then passes through a fine slit and makes delicate lines upon the photographic emulsion of the film, at the same time that the action is being photographed on the film.

From the negative thus made, a positive print is made in the usual manner. Dr. DeForest has invented a special attachment that fits into any projection machine. The usual arc light is used in projecting the picture. In the special attachment is a small incandescent lamp, which causes a pencil of light to penetrate the delicate lines which have been made by the sound waves, this pencil of light taking the place of the metallic needle used on the phonograph. The high lights and shadows fall upon another tube, known as a thalofide cell, which converts these photographic light waves back into sound waves. Then as the picture, on the same strip of film is projected on the screen, the sound is likewise projected. For this purpose a wire is run from the projection machine to a loud speaker behind the stage and the sound is thrown either on the screen or through its fine meshes. Thus it will be seen that no mechanics enter into the recording or reproducing of the sound waves, as both are accomplished by means of light.

The photographic reproduction of the sound waves occupies a space only three-thirty-seconds of an inch on the left hand side of the film, next to the sprocket holes, where it does not interfere with the pictures of the action. If the film should break, in the middle of a sentence, it is patched in the usual way. For the numbers of "frames" to a word are so many (just as they are in a scene) that two or three or even four may be eliminated without causing a noticeable break in the conversation.

One of the most remarkable talking pictures made by Dr. DeForest has just been completed of Chauncey M. Depew, venerable statesman, diplomat and after dinner speaker, 90 years old this month. Every word he utters, even an occasional cough, is faithfully recorded, in perfect synchronization with the movement of his lips and his gestures.

Fifty Million Audience

Radio broadcasting's greatest feat was performed the night of March 7 when stations located in San Francisco, Hastings, Neb., East Pittsburgh, Pa., Schenectady, N. Y., New York City and London, England, broadcasted simultaneously the Annual Alumni dinner given in New York City by the Massachusetts Institute of Technology. Engineers who had been working many months to perfect a radio relay or repeating system between San Francisco and London, a distance of more than 7,000 miles, had the satisfaction of knowing that their efforts had been rewarded by radio waves covering a million and a half square miles and that 50,000,000 people had been estimated as the number of available listeners

Microphones placed in the main ball room of the Waldorf-Astoria Hotel in New York were the starting point in the radio repeating and broadcasting system. It was here that the speakers addressed directly their audience.

VACUUM TUBES (JJ-5-20)
VACUUM TUBE CONSTRUCTION

FILAMENTS. When heated to a state of incandescence by the low voltage "A" battery, the filament of the tube gives off the electrons which act as the carrier stream for the plate current. This filament is generally of the "bair-pin" type often seen in the low voltage battery lamps, but in most cases is made of a different material than that used for the lamps in order to obtain the maximum electron emission per watt of battery current. The current consumption of a tube is of the greatest importance and every effort is made to cut this down to a minimum so that dry cells can be used with satisfactory results in place of the more expensive and troublesome storage batteries.

Among the more common filament materials are pure tungsten wire, pure platinum wire, thoriated tungsten (XL Filament) and the oxide coated wire. The last two are the most generally used at the present time because of the greater electron emission efficiency and their lower operating temperatures. The pure metal filaments ordinarily operate at a very high temperature, generally a brilliant white state, while the treated filaments glow with a deep red color, sometimes almost invisible except in the dark.

PURE TUNGSTEN FILAMENTS. The pure tungsten filament is the same as that used in the ordinary incandescent lamp, and operates at a very high temperature with a comparatively low electron emission. Owing to the comparatively low cost and the simplicity in exhausting the tubes, this filament is the one frequently found in the cheap bootleg tubes. The older tubes were of this type also, but within the last year the legitimate makers have practically discarded the pure metal filament for the more efficient treated types.

PURE PLATINUM. Pure platinum is used under the same circumstances as the pure tungsten, and has the same general operating characteristics. Like the pure tungsten filament, the filament operates at a very high temperature, has a comparatively low electron emission, and is only used in the pure state in the cheaper tubes. Like the tungsten, it is a good manufacturing proposition and can be made very uniform in regard to voltage and current consumption with little expense.

(XL) THORIATED TUNGSTEN FILAMENT. This differs from the pure tungsten filament in having a small percentage of a thorium compound mixed in with the tungsten to form an alloy before the wire is drawn. During the course of operation, the thorium gradually evaporates until at the end of the useful life of the filament, only the tungsten remains. Thorium gives off electrons at a very much lower temperature than pure tungsten or platinum, hence the electron emission per watt is very much higher than with a higher temperature. Furthermore, the filament has a longer life. The emission remains fairly constant until the thorium disappears, whereupon the tube assumes the characteristics of a pure tungsten filament requiring a bigber operating temperature.

The electrons are emitted from the outer layer of thorium or "skin" which is only one molecule deep. As this skin evaporates under normal conditions it is continually replaced by the thorium in the interior which gradually soaks through and merges with the outside layer. Should the temperature of the filament be raised to the point where tbe evaporation is greater than the rate of supply, then the emission will soon fall off or the tube will cease to function altogether until the temperature and evaporation are reduced to wbere tbe supply of tborium from the interior equals the rate lost by evaporation from the surface.

VACUUM TUBES (JJ-5-21)
VACUUM TUBE CONSTRUCTION

THORIATED TUNGSTEN—Continued.

If the excess temperature and filament voltage are not applied for such a long period that all of the thorium is exhausted, then the filament can be restored by heating the filament at the normal temperature for from 15 to 20 minutes with the plate current off (without "B" battery). This allows the thorium in the interior to soak through to the outside to form another emitting film. This treatment is effective providing that all of the thorium has not been exhausted by prolonged overheating.

The UV-201A and the C-301A are examples of tubes having thoriated tungsten filaments. This accounts for the small current consumption of these tubes and their high efficiency in terms of emissivity. The old UV-201 and the C-301 having pure tungsten filaments are much less efficient than the later type. The emissivity of the UV-201 or C-301 is approximately 1.6 milliamperes (plate current) per watt of filament current. The emissivity of the UV-201A and C-301A is approximately 36 milliamperes per watt of filament current or over twenty times that of the old tubes with the pure tungsten filaments. This means that the newer tubes do not exhaust the "A" battery so rapidly, or what is the same thing, more tubes can be used with the same rate of battery discharge.

In comparison with other filaments, the thoriated or XL filament is best adapted for low current tubes as it can be made in smaller sizes than the coated filaments, and again it is capable of withstanding high voltages which makes it well fitted for use in power tubes. A special method of exhaustion is used with the thoriated filament tubes if necessary, in order to maintain a high degree of vacuum throughout the life of the tube. This method of removing gases from the interior of such tubes leaves a deposit on the glass which causes the discoloration or silvery coating seen on the bulbs of the UV-201A, C-301A, UV-199 and C-299 tubes. This method causes the vacuum to improve during the life of the tube and thus reduces one cause of rapid decline toward the end of the useful life experienced in straight exhaustion. The pressure inside of a completed XL tube is less than one-half millionth of the atmospheric pressure.

COATED FILAMENTS. A coated filament is used where a very low voltage "A" current is desired as with the WD-11 and WD-12 tubes where a single dry cell of 1.5 volts is employed. In a few cases, notably with the Western Electric tubes, a coated filament is also used for power tubes, but this is the exception rather than the rule.

A coated filament, as the name suggests, is a built up structure. It consists of a metallic platinum wire on which a coating of highly emissive oxides is applied. Such tubes operate at a very low temperature, even lower than that of the thoriated or XL filaments, and should be kept at a very dull red that usually can only be well seen in the dark. As with the XL filament tubes, a "clean up" chemical agent is also employed in creating and maintaining a high vacuum, but this agent does not cause discoloration of the bulb as with the thoriated tubes, although a small deposit may be seen occasionally on the interior glass stem support.

The coated filaments give a very high emissivity at the beginning, and the initial efficiency is often greater than that of the XL type, but this falls off gradually as the coating evaporates. There is not the same uniformity among tubes of the same make and type with coated filaments as with XL filaments, and hence there is much variation in the results obtained with the individual tubes. It seems difficult to produce a uniform coating.

The Loop Antenna

By R. H. LANGLEY,
Radio Engineer, General Electric Co.

THE loop antenna is a very interesting device. It is unique different in its method of operation from the outdoor antenna. The outdoor antenna is in effect nothing more nor less than a condenser. It is a very large condenser to be sure so far as its physical dimensions are concerned, but electrically it is a relatively small condenser. The loop on the other hand is an inductance. This fundamental difference between the two is the reason why it is necessary to use different methods of tuning in the two cases.

Let us examine this special form of inductance, which we call a loop and see why it serves as a pickup device for radio signals and how it should be made to be effective.

There is a very close parallel between the ordinary direct current generator or dynamo and the loop antenna exposed to passing radio wave. In the dynamo a number of coils corresponding to the loop antenna are rotated in a powerful magnetic field. The purpose of rotating them is in order that they may move with respect to the field and thus have a voltage generated in them. The amount of this voltage depends, of course, upon the strength of the field and the speed at which the wires are swept through it.

In the radio case, the coil stands still, but the field moves swiftly past the coil, thus accomplishing the same result. The speed at which the field moves cannot, of course, be varied and is always the speed of light, that is 186,000 miles per second.

Let us see now what form of loop would have the greatest voltage generated in it by a passing radio wave. Let us think of this radio wave as very much like great smooth waves on the ocean, which, of course, also move forward with a very definite velocity. The turns of wire on our loop antenna are necessarily in series with each other, that is to say, they form a continuous winding. If the maximum voltage is to be generated in any one turn of the loop, then the voltage generated in the two sides of this turn should be in opposite direction so that they may add and not oppose each other. If the voltage generated in both sides of the loop were in the upward direction at any one instance, then these two voltages would cancel each other, but if the voltage on one side of the turn was up and on the other side of turn, it was down, then they would add and if the loop were connected to a receiver, a current would flow around the turns of the loop. This is, of course, exactly what we wish to have happen.

Now in order to have the voltage generated on one side of the loop in the opposite direction to that generated on the other side of the loop, the loop would have to be one-half a wave length long, that is to say it would have to be long enough in the horizontal direction so that one side was in the crest of the wave when the other side was in the trough of the wave. Since the distance between the crest of the wave is the wave length itself, then the distance from the crest to the trough is one-half the wave length.

The higher the sides of the loop are, that is, the longer the vertical wires are, the greater will be the voltage generated, and of course the voltage generated in each turn is added to the voltage generated in all the other turns.

But a loop one-half a wave length long is quite out of the question. It would be as long as a steamship and almost as difficult to handle. The loops which we are using every day are of quite reasonable dimensions. They are only a few thousandths of a wave length long. How do they function? In order to answer this

(*Continued on page 43*)

Pickups & Hookups

(*Continued from page 31*)

lieve our contributors to the very word—if they take advantage of our faith in them—and the other fellows kick enough we will have to require confirmations from very distant station. We don't want the Pickups fans and DTs to be dubbed a bunch of "radio liars," so let's be a little careful about putting the name and call of a station down before we are quite sure.

I am sure that his warning against dishonest salesmen will be appreciated.

The Pickups Editor can remember way back when he used to jump with glee and joy when a code signal first came in through his "radio receiver," consisting of an 80-foot antenna, one pair of phones (they looked more like Indian clubs), a mineral detector and a phone condenser—what a contrast the following presents:

RADIO AGE,
Gentlemen:

I am submitting the list of stations received from March 1st to March 9th on my Crosley set:

WCAL, WOAW, WOS, WHAS, KOB, WMC, WOR, WHAA, WHB, WDAR, WBZ, WCAE, KFKB, WCX, WCBD, WGY, CKCK, WJAZ, KFI, WCAP, WSB, WBAP, WFAA, KYW, WMAQ, WAAF, WOC, WMAJ, KFKX, WOR, KDKA, WIP, WWJ, WTAS, WEAF, CFCH, WLW, WSAI, KOP, WJAX, WTAY, WOAG, WLAG.

I am 11 years old.

Very truly yours,
Hudson Potter.
1201 N. Main St., Rockford, Ill.

Beginners in the game refuse to get a thrill out of listening unless they hear at least a dozen outside stations the first time they operate. Nowadays an eleven-year-old boy gets 19 stations in nine days. Wot r we cuming to?

William F. Bird, Jr., of 860 West Avenue, Buffalo, N. Y., wants to be put on the DT list. He got 34 stations in one night on a single circuit, and says, "It's everything it's cracked up to be." He has picked up 92 stations, including PWX, 6KW and WKAQ. Tts FB, OM.

Edward Brechel of 3447 North Seeley Avenue, Chicago, Ill., wants to help the Cockaday title along. He says:

"I built the Cockaday according to the diagram in the RADIO AGE last August. It was my first attempt at radio. Talk about sharp tuning—it's like taking candy from a baby."

To substantiate his claim, he encloses a list of 83 stations heard over a period of seven weeks.

Verlin Shinn of 1121 West Sycamore Street, Kokomo, Ind., has a list of stations, 30 in all, including KHJ, 3 Canadians, and others which puts him on the DT list.

RADIO AGE,
Gentlemen:

I have been a reader of your magazine for some time now and it certainly is the "goods." The Pickups Department is a very good idea and that is the first thing I look at when I get RADIO AGE, but I have never seen any pickup records from Montreal under this heading. Wake up, Montreal fans, show our friends in the United States that you, too, can get distance and pile up stations. Here is one who wants to see what you are doing. Come on, now, send them in.

The following is a list which almost everyone who owns a one-valve set in Montreal should be able to duplicate and perhaps better. This list was received in four days, averaging two hours per night, on a Reinartz one-tube receiver, using the famous Northern Electric No. 215A peanut tube; using a Freshman "Antenella" in the lamp socket and a bedspring for the ground. I received excellent results with this arrangement, music and speech coming in very clearly. The stations marked with a star (*) are received whenever they are broadcasting.

Station	Location
*CKAC	Montreal, Que.
*CFCF	Montreal, Que.
*CHYC	Montreal, Que.
WHAZ	Troy, N. Y.
*WTAM	Cleveland, Ohio
WOR	Newark, N. J.
*WEAF	New York, N. Y.
WJZ	New York, N. Y.
*WJAX	Cleveland, Ohio
WFI	Philadelphia, Pa.
WCAE	Pittsburgh, Pa.
*WRC	Washington, D. C.
*WCAP	Washington, D. C.
*KYW	Chicago, Ill.
*WDAP	Chicago, Ill.
*WJAZ	Chicago, Ill.
WDAR	Philadelphia, Pa.
*KDKA	Pittsburgh, Pa.
*WGY	Schenectady, N. Y.
*WBZ	Springfield, Mass.

Now for a correction in the March number of RADIO AGE. Under the Pickups Department, H. S. Frederickson, 406 Howard Street, Charles City, Ia., lists "35, Station CKAC, Calgary, Canada." This is an error, as station CKAC is the Lapresse Publishing Company's station, Montreal, Que., Can.

Here is a suggestion. Being troubled by interference from a local station and not being able to tune him out, I connected an old crystal receiver to the valve set, and it acted as an excellent wave trap, enabling me to tune out the interfering station completely and tune in KYW and WJAZ, Chicago, Ill., in less than ten minutes. This was the first time that I tuned in the two above mentioned stations, but have tuned them in often since. Not a bad idea, I think.

Will you kindly publish this letter in your Pickups Department, if it will not take up too much space, and then get ready for a shoal of letters from Montreal, with distance records.

Very truly yours,
H. Winkle.
835 Bordeaux Street, Montreal, Que., Can.

All right, Mr. Winkle—we'll brace ourselves for the mail. We'd like to hear more from our Canadian friends.

Before signing off, we want to call your attention to our little summer vacation portable receiver contest—let's see who can get the biggest pickup record on a portable receiver.

A. E. H., Chicago, Ill.

Question: I made one of your Low Loss Tuners as described in the March, 1924, issue of RADIO AGE, and I find it highly selective, just as you say it would be. I do not, however, get the long-distance stations I am seeking, and would like to have you suggest what my trouble might be. I use a 125-foot antenna, single wire, about 40 feet off the ground. Wound the coils as specified, putting 22 turns on the tickler. Fixed grid leak 2 megohms with UV199 tube. I am using an 11 plate condenser across the secondary.

Answer: Would like to suggest that you rewind the tickler with a smaller wire about No. 24, and make it have 25, 28 or even 35 turns. The tickler in connection with the grid leak (which I think has too low a value) should be adjusted so as to effect a delicate control of the regeneration. Would advise the use of a pencil mark grid leak, which can be easily adjusted to maximum effectiveness after a little experimenting. You might try varying the B battery voltage, but I am sure that this is not necessary if the set is adjusted with respect to the tickler and grid leak, which are very important units of any set.

J. J. B., Toronto, Ont., Canada.

Question: I constructed one of your Baby Heterodyne receivers and have been getting very good results with it, hearing many long-distance stations. I desire to add two stages of amplification, and would like to know if you think that it will operate a loud speaker. I am getting signals with good volume on the detector unit now as it is. Please let me have a diagram.

Answer: I am printing a diagram of the Baby Heterodyne as described in the February issue in Figure 1. The connections shown require a separate B battery. The set should operate a loud speaker on stations of about 500 miles using average power.

M. R. C., Los Angeles, Cal.

Question: I have constructed one of the Baby Heterodyne receivers as specified in the February, 1924, issue of RADIO AGE, and do not seem to be getting the results I should. I followed the specifications as closely as possible, but still find that it does not work. The set is not selective, only gets local stations without much volume, and has much body capacity. It is often afflicted with a high pitched squeal, which cannot be varied by turning the condensers, and no amount of tuning will remove it.

Answer: I have referred the matter of troubles with the Baby Heterodyne personally to Mr. Rathbun, the designer of the set, who suggests the following cures for troubles with the receiver: First of all, make sure that all your coils are wound in the same direction. If they are bucking each other, the set will not work. Try reversing one of the terminals of the M and N coils. Do not reverse both coils or you will still have the same trouble. Mr. Rathbun failed to state in his article that coils M and N should be bank wound, which gives rise to the many questions as to how these coils should be wound into the small space shown in the isometric sketch. Further, I would suggest that you substitute a set of honeycomb coils of the proper number of turns for coils M and N, as later experiments with the set prove that they are just as effective as hand-wound coils. These honeycomb coils should be mounted on a piece of mailing tube, and the coupling between them should be varied until the greatest effective position is found. Start with about ¾-inch coupling, and vary until you find it operates easiest and with the greatest clearness. WD11 or WD12 tubes do not give the best results due to their respective construction of grid and plate, which makes them a poor tube at audio frequencies in this circuit. The dry cell tube of the UV199 or UV201A type is much to be preferred. The characteristics of the WD tubes also give rise to the presence of body capacity in the circuit. One way of remedying this defect is to reverse the connections of the secondary condenser. The rotary plates should be connected to the filament, and the stationary plates should go to the grid circuit. The high pitched squeal is no doubt caused by the grid leak not being properly adjusted. Use a pencil mark type grid leak and adjust it until the highest efficiency is obtained. Instructions on the

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IMPORTANT NOTICE
Regarding Technical Information Service

AFTER May 1st, 1924, the Technical Office of RADIO AGE will operate under the following rules:

(1) Before writing, search your files of RADIO AGE, and you will without question find answers to your inquiries there.

(2) Do not ask us to compare advertised products. Information of this nature should be obtained from the manufacturers and not RADIO AGE.

(3) Don't expect the Technical Office to devote its entire efforts to your questions by asking a great number of them—stick to the subject you are puzzled about, and don't put down everything you can think of. Also do not request information that would require a large amount of work; give the other fellow a chance.

(4) Put questions in the following form:

A—A standard business size (not freak party invitation or correspondence) stamped. self addressed envelope must be enclosed. A stamp alone will not get you an answer.

B—Write with typewriter or ink, and on one side of the paper only. Pencil letters will not be considered. Most all radio men write a terrible "paw," so if possible use a typewriter.

C—Make diagrams and questions on separate sheets, and fasten all correspondence together. Label your diagrams carefully. Failure to fasten your correspondence usually results in losing some part of your letter when the mail is sorted. Put your name and address on each sheet.

D—Write orders for back numbers, subscriptions and the ANNUAL on separate sheets. You'll get an answer sooner if you take the time to write your questions on separate sheets, as above specified.

E—Keep a copy of your letter and diagrams so that we can refer you to them.

F—Address all requests for information to RADIO AGE, Inc., Technical Office, 500 North Dearborn Street, Chicago, Ill.

CLASSIFIED ADVERTISEMENTS

Six cents per word per insertion, in advance. Name and address must be counted. Each initial counts as one word. Copy must be received by the 15th of month for succeeding month's issue.

RADIO CIRCUITS

If your Neutrodyne won't "Neut" o. k., send 10c for Details of Kladag Coast to Coast circuit, bill of materials, etc., to change over your Neut into a set that will bring them all in from Mexico City to Tunucu, Cuba, on a loud speaker. Or send $5.00 for all extra parts, blue print, etc., you need to do this. Stamps accepted. Radio list for stamp. Super Heterodyne specifications, 10c. Kladag Radio Laboratories, Kent, Ohio.

RADIO EQUIPMENT.

Harkness circuit two tubes take place of four or five; Detector 2 R. F., 2 A. F. Complete, genuine parts including set of Flex-o-formers, Rheinhold detector and 201-A type tubes, $23.50. Range, 1,000 to 1,500 miles on loud speaker. New Catalog 64 on request. Royal Manufacturing Co., 206 Broadway, Dept. D, New York.

TRANSMITTING SET

For Sale: 10 Watt Set for Key or Broadcasting. For particulars write to A. E. Schilling, 108 Elm St., Kalamazoo, Mich. Will send photo on request. Station WLAQ.

15-20% DISCOUNT ON ALL STANDARD RECEIVERS. Fried-Elsemann Neutrodyne, $125.00; New Radiolas, etc. Thomas Radio Co., 111 Dex St., Muncie, Ind.

RADIO BATTERIES

Super Radio A and B Circuit Batteries, which bring in long distance reception. Sold for cash or on payment plan. Write for prices and details. Radio Battery Corporation, 501-B Industrial Bank Bldg., Flint, Mich.

Loop Antenna

(Continued from page 40)

question let us ask ourselves how we would build a coil of wire in order that absolutely no voltage should be generated in it by the passing wave. The only way in which this could be accomplished would be to so build the coil that the same voltage would be generated in both sides of it and that the voltages generated in the two sides would be opposed to each other.

This would give a complete cancellation and no voltage at all at the terminals of the loop or coil. It is obvious that the only way in which this could be done would be by so arranging the loop that it had no length at all. That is to say, arranging it so that the two sides were exactly in the same position in space. This would mean that the horizontal wires across the top and bottom of the loop would cease to exist and the loop would become nothing but a wire laced up and down between pegs on the plain surface of a board.

If there is any distance at all between the two sides of the loop, then there will be some difference not in the amount of voltage generated in the two sides, but in the time at which this voltage is generated and there will consequently be some voltage at the terminals of the loop since complete cancellation of voltages cannot occur.

If the loop is rotated so that its horizontal wires are at right angles to the direction in which the signal is coming, then the loop has no length so far as those signals are concerned. The passing wave strikes both sides of each turn in the loop at exactly the same instance and the voltages generated are therefore equal and opposed and there is no terminal voltage. This is, of course, the fact which gives the loop antenna its very useful directional property. It is to be noted, however, that if the loop is turned ever so slightly from this zero position then the voltages no longer cancel and there is a voltage at the terminal. This means that the zero position of the loop is very sharp, but the maximum position is very broad.

In applying the loop antenna to an actual radio receiver, it is necessary that provision be made to tune it to resonance with the desired signal. This is accomplished by means of a variable air condenser and since this condenser has a very definite maximum capacity, the amount of inductance which the loop can have is also limited. This maximum inductance with the maximum capacity of the variable condenser must give resonance to the longest wave to be received. The specification for the best loop antenna, therefore, is that it shall have just as many turns as possible, each turn being just as long as possible and just as high as possible and still have no more than the required maximum inductance. The higher the loop is, the greater will be the voltage generated in each side of each turn and the longer it is, the greater will be the difference in time at which these voltages are generated in the two sides of the loop and consequently the greater will be the voltage at the terminals, but it must not have an inductance value greater than that required for tuning

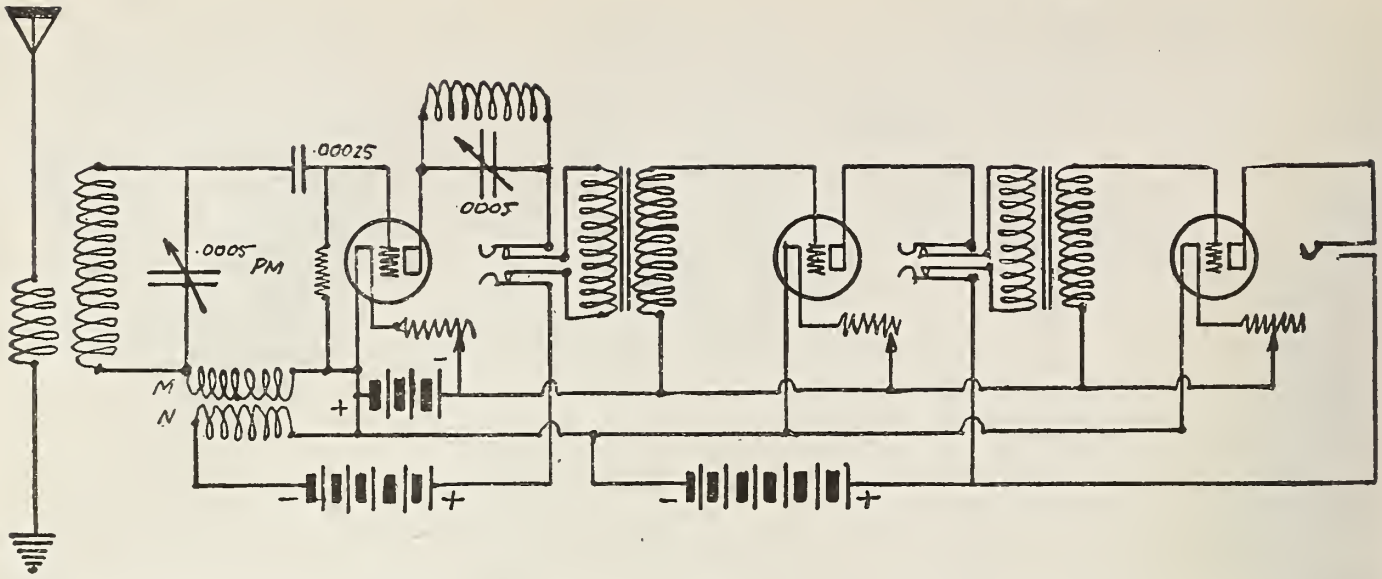

FIGURE 1

A wiring diagram of the Baby Heterodyne, as described in the February, 1924, issue, in connection with a two-stage amplifier. This set requires the use of a separate set of B batteries.

(Continued from page 42)

construction of a pencil mark grid leak appeared in the July, 1923, RADIO AGE, and can be found in the RADIO AGE ANNUAL. The use of WD 11 or 12 tubes in the circuit is also another cause of broadened tuning, and I would suggest that you refrain from using them. Selectivity and long antennas do not go together, and if your antenna is a long one, cut it down. Experiments show that good work has been done with antenna of not over fifty feet in length. I am sure that if you carry out these changes you will find that the set will do everything that is claimed for it.

K. N., Portland. Ore.

Question: I made one of the super-heterodyne receivers described in the March. 1924, issue, but I am not getting results. The signals from local stations come in with good volume, but the turning of the oscillator condenser seems to have no effect at all upon the signal. Is this right? I can turn the dial all the way around without the slightest change in signal strength or pitch. I have checked over the set again and again, and find that the connections are all made as specified. Used good parts, and I know that my tubes are not defective, having tested them out in other sets. What would you suggest?

Answer: The trouble lies in the fact that the wiring diagram of the oscillator is not correct, having no filament return connection. If the remainder of your set has been properly connected, and if you will connect the oscillator as the accompanying diagram (Figure 2) shows, you will have no trouble in getting the proper results. The oscillator dial should be very sharp in its tuning, the signal coming in only on two points on the dial. These points are sometimes so sharp, covering probably only a fraction of a degree, that care must be taken not to pass over them. The tuning on the secondary condenser may seem a little broad on local stations, but the oscillator is always very sharp. If you will make this correction, the set will function properly without questions.

R. P., New York City, N. Y.

Question: In the November, 1923,

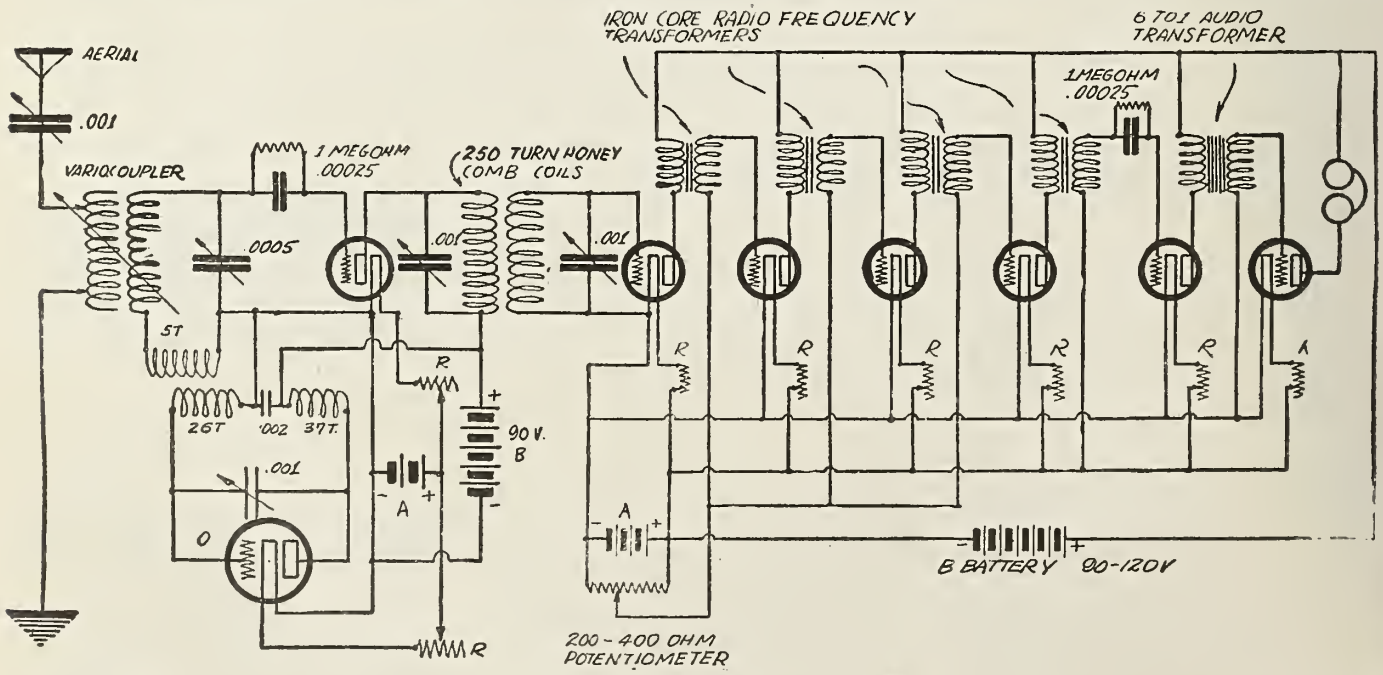

FIGURE 3

A wiring diagram of the super-heterodyne receiver, given in the November, 1923, RADIO AGE, with changes in the oscillator and modulator circuits, which have been found more efficient.

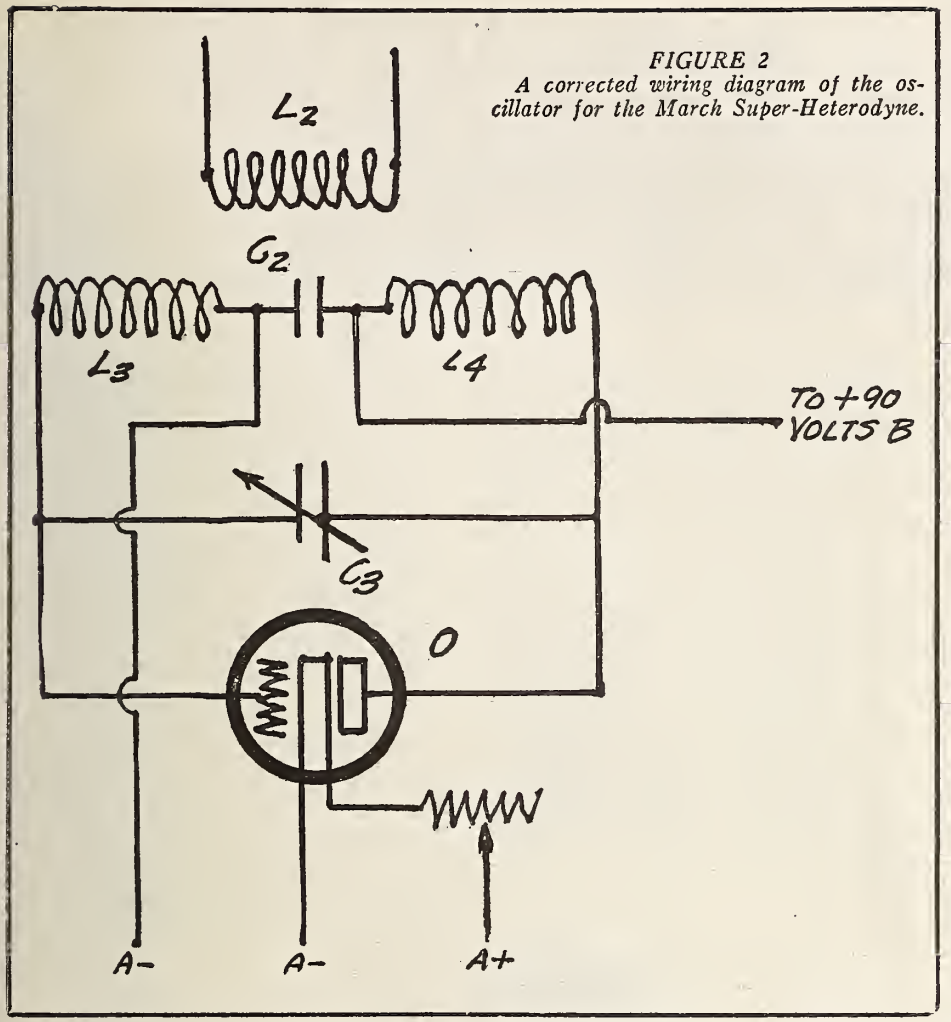

FIGURE 2
A corrected wiring diagram of the oscillator for the March Super-Heterodyne.

issue of RADIO AGE you publish a diagram of the super-heterodyne receiver, I notice that all other tubes but the oscillator and first detector have filament rheostats, and I wonder if this is correct. I have constructed the set, but find that it lacks with respect to control, and I wonder if this is not the defect. Please print a diagram showing how the rheostats should be connected.

Answer: The reason no rheostats were shown is due to the fact that Mr. Pearne suggests the use of WE tubes, which are rated at 6 volts 1.5 ampere, which would not require a rheostat in either case. However, if other tubes are used as oscillator and modulator, the rheostats should be used and the connections should be made as shown in Figure 3. I am also suggesting a few changes in the oscillator which have been found of improvement through further experiments. These changes take place in the number of turns on the oscillator coils. Some kind of hard tube should be used for oscillator in the set, preferably a UV201 (old type), WE or VT1, UV201A or, better still, a UV202 transmitting tube. With these changes, you should be able to get much better results than with the old circuit. I might also say that the primary of the long-wave coils may be tuned with a .0005 MF fixed condenser of the mica type, taking the place of the .001 MF condenser now shown. The secondary should be tuned with the variable condenser, in the following manner: A buzzer and battery of extremely low power should be connected across the terminals of the first condenser (primary long-wave condenser). The secondary should be shunted by a crystal detector and a set of head phones. Setting the buzzer into operation, the secondary condenser is turned until the signal is heard at maximum, indicating that the two coils are in resonance. The long-wave coils are then tuned, and the set is ready for use, after the buzzer and head set, together with the battery and crystal, are removed.

WITH THE MANUFACTURERS

A Folding Loop

Betts & Betts Corporation, 645 West 43rd street, New York, announces the following facts about their Betts-Bonner folding loop:

"For efficient reception with loop aerials, a correct relationship must exist between the length of wire in the coil, the number of turns and the total of the areas enclosed by the several turns. In the Betts-Bonner loop a unique arrangement of wire gives a total enclosed area over 50 per cent greater than that enclosed by the ordinary type of loop of corresponding dimensions and wound with the conventional flat or pancake coil with ¼-inch spacing.

"The two binding posts make it possible to use one of two different numbers of effective turns—giving a wide range of wave lengths and more efficiently adapting itself to the varying antenna requirements of different sets and 'hook-ups'.

"The range of wave lengths, in connection with a receiving set of average efficiency and tuned by a variable condenser of .005 capacity, is from 100 to 610 meters. Higher wave lengths are reached if the tuning condenser has a greater capacity, or if a fixed condenser is added across the loop terminals."

Willard Booklet

"Better Results from Radio" is the title of a booklet issued by the Willard Storage Battery Co., Cleveland, O. The publication is illustrated and takes up various phases of battery care and operation in a way that offers valuable assistance to the radio fan. The booklet describes also the Willard Colloid Rectifier, which keeps "B" storage batteries fully charged. The book is sent free to those writing for it.

Republic Transformer

The Hansen Co., 1772 Wilson ave., Chicago, manufacturers of the Republic Audio Frequency Transformer, gives the following information regarding their product:

"The coils are wound by an entirely automatic process on automatic coil winding machines designed and built by our engineers, using No. 40 magnet wire with the very best insulation, and of exactly the correct number of turns. The metal case is enameled with nickel plated trimmings. The laminated cores of silicon steel are correctly proportioned and shaped for the most effective Electrical field. The primary and secondary posts are clearly marked so that there need be no error in connection."

The list price is $2.50.


The Town Crier

DECEMBER 15, 1923

The Sunset Age

The Christmas Widow

R. C. A.'s Publication


Pierre Boucheron

The Radio Corporation of America has a very pleasant way of greeting its customers and friends. Twice every month it sends out a little publication called The Town Crier. According to the editors, Pierre Boucheron, advertising manager of the R. C. A., and Charles T. Wandres of the Advertising Department, The Town Crier is not primarily a sales promotion paper or a serial catalog. It is intended merely to say hello and to be a friendly little chat such as would take place should one of the executives of the corporation stop in at a dealer's shop.


Charles T. Wandres

A page of editorials, cartoons and the like is followed by a page of descriptions of successful selling methods used by dealers and distributors throughout the country in selling Radiolas and Radiotrons. Photographs are shown wherever possible, giving first hand information on window displays, booths, advertising literature and advertisements that have produced sales. All articles of a similar nature are grouped together under a suitable column head, such as "Window Displays," "Sales Gleams," "Advertising Tie-up," "Behind the Counter," etc.

Page three usually contains a number of articles of general radio interest by leaders in the industry. Some recent articles have been "Paying for Broadcasting," by David Sarnoff; "Radio and the Farmer," by Owen D. Young; "In the Radiola Factory," by H. T. Melhuish, and many more. The fourth and last page contains the technical departments, which give complete descriptions of new items in the R. C. A. line, new developments and circuit improvements for existing models, explanation of operation for sets, Radiotron characteristics and performance, and R. C. A. service notes.

The Town Crier circulates twice a month among the entire list of R. C. A. radio dealers and distributors and their salesmen, and about 2,200 phonograph dealers all over the country. During the first six months of its existence, just completed, The Town Crier has made many friends in the trade who report that they enjoy the periodical and its friendly helpfulness and they always manage to find time to read it.

Three Big Shows

Final arrangements have just been made for the world's first Annual International Radio Show which is to open at Madison Square Garden, New York, on Monday, September 22nd and continue until Sunday night September 28th.

The coming exposition, the largest and most complete show of its kind ever staged anywhere, will be held under the auspices of the newly organized Radio Manufacturers' Show Association, composed of sixty of the most prominent American radio manufacturers. U. J. Herrmann and James F. Kerr, the well-known theatrical managers who have made such a gigantic success of the annual Chicago Radio Show, will be Managing Director and General Manager respectively. There will also be an Advisory Board made up of E. B. Mallory, Chairman of the Radio Division of the Associated Manufacturers of Electrical Supplies, Paul B. Klugh, Executive Secretary of the National Association of Broadcasters and Calvin Harris, the pioneer radio publicity expert.

The Radio Manufacturers' Show Association will hold three great expositions next season which will probably revolutionize the shown end of the business. The first will be in New York, at Madison Square Garden, September 22nd to 28th, the second will be held in Chicago, at the Coliseum November 18th to 23rd and the third will take place on the Pacific Coast early in 1925. The name of the latter city and exact dates will be made known soon.

The Board of Directors of the R. M. S. A., has taken an exclusive ten year lease on Madison Square Garden for its Annual and International Radio Show which will be held there every Fall until 1934. The Association has also taken over the Chicago Coliseum for a like period and another ten year lease is being negotiated on a Western exposition building. The new organization, which is heavily financed, is indeed a permanent institution which promises to be of great benefit to radio in general.

Managers Herrmann and Kerr have incorporated many of their own original ideas into next season's plans which are expected to make the show itself an unusually attractive spectacle and also eliminate nearly all of the unpleasant features of past radio exhibitions, for both exhibitors and patrons.

An outstanding feature next season will be the introduction of foreign exhibits. Several of the leading European manufacturers have applied to Manager Kerr for space and he is now trying to rearrange his plans so as to enable them to have a section of their own.

Manager Kerr has opened headquarters at the Prince George Hotel, 14 East 28th Street, where he will remain with his personal staff until September 15th.

Over seventy per cent of the available space has already been taken and important applications are coming in by every mail. All indications point to a complete sell out of exhibiting space within two or three weeks, in spite of the fact that the opening date is six months off.

New Crystal Detector

The new Freshman double-adjustable crystal detector has several distinctive features. It has a knob which can be brought through to the panel and when turned varies the crystal contact with the loop-whisker, thus permitting the operator to find sensitive spots without disturbing the tension on the whisker spring. It has an insulated housing for the crystal, so that no matter how the crystal is turned there can be no possible short-circuiting with consequent loud scratches and clicks in the head phones.

The lever at the base unit adjusts the contact tension, the whisker being the exclusive Freshman loop design which operates in concentric evolutions about the face of the crystal, thus covering every point on the crystal, as it is adjusted by a little knob on the panel. A special crystal was selected of pure natural ore of a special type which will withstand voltages as high as 130 without burning out. This is highly important in reflex work.

The crystal is glass-enclosed and is supported by insulated ends, giving ample strength and mechanical protection to the unit, at the same time permitting base mounting instead of panel mounting when designed. The panel knob is engraved "Crystal," giving a neat attractive appearance to the panel and requiring little space.

The crystals themselves are replaceable by fresh units which are sold mounted in the non-metallic housing.

Amperite

Amperite, the "self-adjusting" rheostat, is always connected in series with the "A" battery and the vacuum tube filament. It is manufactured by the Radiall Co., 320 West Forty-second street, New York, who write us that it is now being used as standard equipment by more than 50 manufacturers of receiving sets and that among other laboratories which have stamped it with their approval are the Westinghouse, Wireless Specialty and Chicago Radio Laboratory.

Balloon Race Progress to Be Reported by Radio. Amateurs Will Follow All Movements

Eight free balloons, which will take off from Kelly field in this city, April 23, for the National Balloon elimination race, will be followed closely by radio amateurs and the movements reported by radio to the "Balloon Race Executive." Through the co-operation of amateur radio operator spectators, who witness the start of the race, will be able to keep tabs on the progress of contestants and valuable information on air currents may be obtained.

The request for radio assistance was made by Colonel Culver, signal officer of the eighth corps area, and Captain T. E. Boudinot, signal officer at Kelly field. The local arrangements were made through L. D. Wall, district superintendent of the American Radio Relay League. This will be the first time that a great national race of the kind will have been followed by private radio men.

The information desired is:

Location in which the balloon is sighted.

Date and time.

Position, high or low.

Direction it is traveling.

All messages by radio men or other observers should be addressed to "Balloon Race Executive," San Antonio, Texas.

Arrangements are being made by Mr. Wall to have three or four local amateurs keep a twenty-four watch during the race. These will handle incoming messages and promptly transmit them to officials in charge of the race.

Inflating of the balloons will start about 8 A. M. on the 23rd and it is expected they will take off about 5 P. M. It is doubtful if anything will be heard from them before the 24th, as they will not carry any lights and will not be visible at night. With favorable winds some of the balloons are expected to travel as far as Canada and they may be in the air as long as three days.

By The Way

Have you considered renewing your subscription? Think it over—this might be the last number on your subscription. Blank on page 54.

How to Use Various Vacuum Tubes

TO MEET the needs of our readers as evidenced in the many questions about tubes, their adaptation and requirements, this data and the accompanying table is presented. To preserve and file this valuable information for ready reference will greatly lessen the need of covering the points involved in personal inquiries and it will prove a very present help in time of doubt.

A vacuum tube is very similar to an ordinary electric light bulb in the particular that it is a glass bulb from which the air is evacuated. A point of difference is that it contains elements in addition to the filament. These elements are known as the grid and plate, the grid consisting of tiny wires in mesh or lattice work and the plate in a strip of metal, in some cases corrugated.

Why Is Tube Evacuated?

The chief reason for evacuating an audion (vacuum) tube is that the filament can remain heated. If it were rendered incandescent in the open air it would soon oxidize and burn away. This is prevented by keeping it in a vacuum.

When metal is heated it gives off what are known as electrons (negative electricity). When these fly through an evacuated space they create a conductive path for electricity. This path has a very high resistance. We heat the filament of the tube by means of a battery known as the "A" supply. The positive side of a high voltage battery known as the "B" supply, is connected to the plate and phones.

Like electricity repels, unlike electricity attracts. Therefore, when an incoming signal charges the grid of the tube positively a strong flow of electrons (negative) from the filament to the plate takes place, with a corresponding flow of electricity from the plate to the filament and back to the "B" battery through the phones. When the grid becomes negatively charged it deflects the electrons from the plate and a much weaker current flows. The incoming waves charge the grid positively and negatively alternately so that signals are made audible in the phones according to the fluctuations of the current. Thus, the action of an audion tube is analogous to a valve, with the grid as a stopcock.

Kinds of Audion Tubes

We have what are designated as hard and soft tubes. A soft tube is one in which there is not a high degree of vacuum. This type is adapted to function as a detector only. A hard tube is one which has a high degree of vacuum. This type is adapted to function either as detector or amplifier.

Advantages, Limitations

Any ¼ ampere tube can be operated on dry cell batteries, as they are feasible for use in providing current of ¼ ampere or less on any voltage.

This type of tube is convenient for portable sets. They are fair detectors, in consideration of their current consumption, but for audio frequency amplifiers will not afford volume comparable with that realized in employment of a six-volt tube.

They do away with storage battery and charger and bring the first cost of a complete outfit within the reach of every purse.

Now, then, while the "peanut" tube uses less current than a storage battery tube, its amplification constant is much less. Given the identical transformer, it will require three audio frequency stages with these tubes to equal two stages with the six-volt tubes. To this limitation add the distortion resulting from an overloaded third tube and we have food for thought.

These "peanut" tubes can be used in any standard circuit without necessitating any change other than that relating to filament potential ("A" battery). Results will be fair in consideration of the above stated facts.

Dry cell tubes are not to be considered seriously for realization of maximum efficiency in REFLEX CIRCUITS.

How to Make Selection

NOTE.—The filament voltage is less than that of the rated battery voltage. This is explained in that the voltage drop through the resistance offered in wiring and rheostat reduces the potential impressed upon filament at the time it reaches it to meet its rated potential.

Dry Cell Tube Requirements

UV199—C299.

Filament voltage, 3 volts; battery, 4.5 volts; rheostat, 30 ohms; plate voltage as detector, 20 to 35 volts; plate voltage as amplifier, 40 to 80 volts; "C" battery, 1 to 4.5 volts; grid leak, 2 megohms; grid condenser, .00025 mfd; filament current consumption, 0.06 amperes; plate current, ¼ to 4 milliamperes; amplification constant, 6.25.

A fair detector, fair audio frequency amplifier lacking in volume. A good radio frequency amplifier.

UV201A—C301A.

Filament voltage, 5 volts; battery, 6 volts; rheostat, 16 to 30 ohms; plate voltage as detector, 18 to 45 volts; plate voltage as amplifier, 40 to 120 volts; "C" battery, 4½ volts; filament current consumption, ¼ ampere; plate current, 1 to 7.5 milliamperes; amplification constant, 8; grid leak, 2 megohms; grid condenser, .00025 mfd.

Can be operated on dry cells economically if not used more than an hour or two a day. Storage battery preferred. A fair detector, but not sensitive—some think it good. Undoubtedly a good audio frequency amplifier, perhaps the best of the ordinary priced tubes. Very economical. From all standpoints the best audio frequency amplifier, in consideration of first cost, upkeep and effectiveness.

A Two-Element Tube for Dry Cell Operation

The Diode.

It is a small reproduction of the old Fleming valve. It is somewhat better than a crystal detector in range and volume, but does not afford as clear reception. It does not require a "B" battery. Will not amplify. Cannot be used in regenerative circuits.

WD 11-12—

Note — The only difference in these tubes is in their bases. The WD11 has a prong base, while a WD12 has a standard base.

Filament voltage, 1.1 volts; battery, 1.5 volts; rheostat, 6 ohms; plate voltage as detector, 20 to 45 volts; plate voltage as amplifier, 40 to 90 volts; "C" battery, 1.5 to 3 volts; filament current consumption, ¼ ampere; plate current consumption, ¼ to 4 milliampere; amplification constant, 6.5; grid leak, 2 megohms; grid condenser, .00025 mfd.

It is a good detector and fair audio frequency amplifier. A hard tube.

Table for Storage Battery Tube Requirements

VT1—J tube—

Filament voltage, 2-5 volts; battery, 4 to 6 volts; rheostat (vernier), 6 to 15 ohms; plate voltage as detector, 12 to 22½ volts; plate voltage as amplifier, 22½ to 45 volts; "C" battery, about 4.5 volts; filament current consumption, 1.1 amperes; plate current, .5 to 2 milliamperes; grid leak, 2 megohms; grid condenser, .000025 mfd.

UV200—C300—

Filament voltage, 5 volts; battery, 6 volts; rheostat (vernier), 6 ohms; plate voltage (detector only), 15 to 24 volts; filament current consumption, 1 ampere; plate current, ¼ to 1 milliampere; grid leak, ½ to 2.5 megohms; grid condenser, .00025 mfd.

UV201—C301 — Filament voltage, 5 volts; battery, 6 volts; rheostat, 6 ohms.

Plate voltage—As detector, not critical, as amplifier, 45 to 100 volts. "C" battery, 1.5 to 4.5 volts.

Filament current consumption, 1 ampere; grid condenser, .00025 mfd; grid leak, 2 megohms; plate current, 1 to 5 milliamperes; amplification constant, 6.5.

Not a desirable detector usually, but satisfactory where a hard tube is required. Good radio frequency amplifier. Good audio frequency amplifier, but not as economical as the UV201A in current consumption.

VT2E—Filament voltage, 7 volts (will work on 6-volt battery for A F amplification in receiver).

Rheostat, 6 ohms; plate voltage, up to 350 volts; "C" battery, 8 to 20 volts.

Filament current consumption, 1.35 amperes; plate current, 40 milliamperes; amplification constant, 7.

Designed as a 5-watt transmitter, but is one of the best audio frequency amplifiers.

216A—Filament voltage, 6 volts; battery, 6 volts; rheostat, 6 ohms.

Plate voltage, 120 volts; "C" battery, about 9 volts.

Filament current consumption, 1 ampere; plate current, 8 milliamperes; amplification constant, 6.

Designed particularly for audio frequency amplifier.

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers and broadcasters.

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh 326
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio 270
KDPT	Southern Electrical Co.	San Diego, Calif. 244
KDYL	Telegram Publishing Co.	Salt Lake City, Utah 360
KDYM	Savoy Theatre	San Diego, Calif. 244
KDYQ	Oregon Institute of Technology	Portland, Oreg. 360
KDYW	Smith Hughes & Co.	Phoenix, Ariz. 360
KDYX	Star Bulletin	Honolulu, Hawaii 360
KDZB	Frank E. Siefert	Bakersfield, Calif. 240
KDZE	Rhodes Department Store	Scattle, Wash. 270
KDZF	Automobile Club of Southern California	Los Angeles, Calif. 278
KDZI	Electric Supply Co.	Wenatchee, Wash. 360
KDZQ	Nichols Academy of Dancing	Denver, Colo. 360
KDZR	Bellingham Publishing Co.	Bellingham, Wash. 261
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz. 360
KFAE	State College of Washington	Pullman, Wash. 330
KFAF	Western Radio Corp.	Denver, Colo. 360
KFAJ	University of Colorado	Boulder, Colo. 360
KFAN	The Electric Shop	Moscow, Idaho 360
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif. 280
KFAU	Independent School Dist. of Boise City, Boise High School, Boise, Idaho	270
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif. 280
KFAY	W. J. Virgin	Medford, Oreg. 283
KFBB	F. A. Buttrey & Co.	Havre, Mont. 360
KFBC	W. K. Azbill	San Diego, Calif. 278
KFBE	Reuben H. Horn	San Luis Obispo, Calif. 360
KFBG	First Presbyterian Church	Tacoma, Wash. 360
KFBK	Kimball-Upson Co.	Sacramento, Calif. 283
KFBL	Leese Bros.	Everett, Wash. 224
KFBS	Trinidad Gas & Electric Supply Co. and the Chronicle News	Trinidad, Colo. 360
KFBU	The Cathedral (Bishop N. S. Thomas)	Laramie, Wyo. 283
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz. 238
KFCF	Frank A. Moore	Walla Walla, Wash. 360
KFCH	Electric Service Station (Inc.)	Billings, Mont. 360
KFCM	Richmond Radio Shop (Frank T. Doeing)	Richmond, Calif. 360
KFCP	Ralph W. Flygare	Ogden, Utah 360
KFCV	Fred Mahaffey, Jr.	Houston, Texas 360
KFCY	Western Union College	Le Mars, Iowa 252
KFCZ	Omaha Central High School	Omaha, Nebr. 258
KFDA	Adler's Music Store	Baker, Oreg. 360
KFDD	St. Michaels Cathedral	Boise, Idaho 252
KFDH	University of Arizona	Tuscon, Ariz. 360
KFDJ	Oregon Agricultural College	Corvallis, Oreg. 360
KFDO	H. Everett Cutting	Bozeman, Mont. 248
KFDR	Bullocks' Hardware & Sporting Goods (Rob. G. Bullock)	York, Nebr. 360
KFDV	Gilbreth & Stinson	Fayetteville, Ark. 360
KFDX	First Baptist Church	Shreveport, La. 360
KFDY	South Dakota State College of Agriculture and Mechanics Arts	Brookings, S. Dak. 360
KFDZ	Harry O. Iverson	Minneapolis Minn. 231
KFEC	Meier & Frank Co.	Portland, Oreg. 360
KFEJ	Guy Greason	Tacoma, Wash. 360
KFEL	Winner Radio Corp.	Denver, Colo. 360
KFEQ	J. L. Scroggin	Oak, Nebr. 360
KFER	Auto Electric Service Co.	Fort Dodge, Iowa 231
KFEV	Radio Electric Shop	Douglas, Wyo. 263
KFEX	Augsburg Seminary	Minneapolis, Minn. 261
KFEY	Bunker Hill & Sullivan Mining and Concentrating Co.	Kellogg, Idaho 360
KFEZ	Asso. Engr. Societies of St. Louis	St. Louis, Mo. 248
KFFB	Jenkins Furniture Co.	Boise, Idaho 240
KFFE	Eastern Oregon Radio Co.	Pendleton, Oreg. 360
KFFO	Dr. E. H. Smith	Hillsboro, Oreg. 229
KFFP	First Baptist Church	Moberly, Mo. 266
KFFQ	Murksheffel Motor Co.	Colorado Springs, Colo. 360
KFFR	Nevada State Journal (Jim Kirk)	Soarks, Nev. 226
KFFV	Graceland College	Lamoni, Iowa 360
KFFX	McGraw Co.	Omaha, Nebr. 278
KFFY	Pineus & Murphy	Alexandria, La. 275
KFFZ	Al. G. Barnes Amusement Co.	Dallas, Tex. (portable) 226
KFGC	Louisiana State University	Baton Rouge, La. 254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla. 248
KFGH	Leland Stanford University	Stanford University, Calif. 360
KFGL	Arlington Garage	Arlington, Oreg. 234
KFGQ	Crary Hardware Co.	Boone, Iowa 226
KFGV	Heidbreder Radio Supply Co.	Utica, Nebr. 224
KFGX	First Presbyterian Church	Orange, Tex. 250
KFGZ	Emmanuel Missionary College	Berrien Springs, Mich. 268
KFHA	Western State College of Colorado	Gunnison, Colo. 252
KFHB	Rialto Theater (P. L. Beardwell)	Hood River, Oreg. 280
KFHD	Utz Electric Shop Co.	St. Joseph, Mo. 226
KFHF	Central Christian Church	Shreveport, La. 266
KFHH	Ambrose A. McCue	Neah Bay, Wash. 283
KFHJ	Fallon & Co.	Santa Barbara, Calif. 360
KFHR	Star Electric & Radio Co.	Scattle, Wash. 270
KFHS	Clifford J. Dow	Lihue, Hawaii 275
KFHX	Robert W. Nelson	Hutchinson, Kan. 229
KFI	Earle C. Anthony (Inc.)	Los Angeles, Calif. 469
KFID	Ross Arbuckle's Garage	Iola, Kans. 246
KFIF	Benson Polytechnic Institute	Portland, Oregon 360
KFIL	Windisch Electric Farm Equipment Co.	Louisburg, Kans. 234
KFIO	North Central High School	Spokane, Wash. 252
KFIQ	Yakima Valley Radio Broadcasting Association	Yakima, Wash. 224
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska 226
KFIV	V. H. Broyles	Pittsburg, Kans. 240
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo. 240
KFIZ	Daily Commonwealth and Oscar A. Huelsman	Fon Du Lac, Wis. 273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa 248
KFJC	Seattle Post Intelligencer	Seattle, Wash. 233
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla. 252
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg. 252
KFJK	Dclano Radio and Electric Co.	Bristow, Okla. 233
KFJL	Hardsacg Manufacturing Co.	Ottumwa, Iowa 242
KFJM	University of North Dakota	Grand Forks, N. Dak. 229
KFJQ	Valley Radio, Div. of Elec. Constr. Co.	Grand Forks, N. D. 280
KFJR	Ashley C. Dixon & Son	Stevensville, Mont. (near) 258
KFJV	Thomas H. Warren	Dexter, Iowa 224
KFJW	Le Grand Radio Co.	Towanda, Kans. 226
KFJX	Iowa State Teachers' College	Cedar Falls, Iowa 229
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa 248
KFJZ	Texas National Guard, One hundred and twelfth Cavalry	Fort Worth, Texas 254
KFKA	Colorado State Teachers College	Greeley, Colo. 248
KFKB	Brinkley-Jones Hospital Association	Milford, Kans. 286
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark. 224
KFKV	F. F. Gray	Butte, Mont. 283
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr. 341
KFKZ	Nassour Bros. Radio Co.	Colorado Springs, Colo. 234
KFLA	Abner R. Willson	Butte, Mont. 283
KFLB	Signal Electric Manufacturing Co.	Menominee, Mich. 248
KFLD	Paul E. Greenlaw	Franklinton, La. 234
KFLE	National Educational Service	Denver, Colo. 268
KFLH	Erickson Radio Co.	Salt Lake City, Utah 261
KFLP	Evcrette M. Foster	Cedar Rapids, Iowa 240
KFLQ	Bizzell Radio Shop	Little Rock, Ark. 261
KFLR	University of New Mexico	Albuquerque, N. Mex. 254
KFLU	Rio Grande Radio Supply House	San Benito, Texas 236
KFLV	Rev. A. T. Frykman	Rockford, Ill. 229
KFLW	Missoula Electric Supply Co.	Missoula, Mont. 234
KFLX	George Roy Clough	Galveston, Tex. 240
KFLY	Fargo Radio Supply Co.	Fargo, N. Dak. 231
KFLZ	Atlantic Automobile Co.	Atlantic, Ia. 273
KFMQ	University of Arkansas	Fayetteville, Ark. 263
KFMR	Morningside College	Sioux City, Iowa 261
KFMS	Freimuth Dept. Store	Duluth, Minn. 275
KFMT	Dr. George W. Young	Minneapolis, Minn. 231
KFMU	Stevens Bros.	San Marco, Tex. 240
KFMW	M. G. Satercn	Houghton, Mich. 266
KFMX	Carleton College	Northfield, Minn. 283
KFMY	Boy Scouts of America	Long Beach, Calif. 229
KFMZ	Roswell Broadcasting Club	Roswell, N. M. 252
KFNC	Alonzo Monk, Jr.	Corsicana, Texas 234
KFNF	Henry Field Seed Co.	Shcnandoah, Iowa 266
KFNG	Wooten's Radio Shop	Coldwater, Miss. 254
KFNH	State Teachers College	Springfield, Mo. 236
KFNJ	Warrensburg Electric Shop	Warrensburg, Mo. 234
KFNL	Radio Broadcast Ass'n.	Paso Robles, Calif. 240
KFNV	L. A. Drake Battery and Radio Supply Shop	Santa Rosa, Calif. 234
KFNX	Peabody Radio Service	Peabody, Kansas 240
KFNY	Montana Phonograph Co.	Helena, Montana 261
KFNZ	Royal Radio Company	Burlingame, Calif. 231
KFOB	Glenwood Technical Association	Minneapolis, Minn. 224
KFOC	First Christian Church	Whittier, Calif. 236
KFOD	Vern Peters	Wallace, Idaho 224
KFOF	Rohrer Electric Co.	Marshfield, Oregon 240
KFOH	The Radio Bungalow	Portland, Oregon 283
KFOJ	Moberly High School Radio Club	Moberly, Missouri 246
KFOL	Leslie M. Schafbush	Marengo, Iowa 234
KFON	Echophone Radio Shop	Long Beach, Calif. 234
KFOO	Latter Day Saints University	Salt Lake City, Utah 261
KFOP	Wilson Construction Co.	Dallas, Texas 268
KFOQ	Ora William Chancellor	Galveston, Texas 240
KFOR	David City Tire & Electric Co.	David City, Nebraska 226
KFOT	College Hill Radio Club	Wichita, Kansas 231
KFOU	Hommel Mfg. Co.	Richmond, Calif. 254
KFOV	Davis Electrical Corporation	Sioux City, Iowa 234
KFOX	Board of Education, Technical High School	Omaha, Nebraska 248
KFOY	Beacon Radio Service	St. Paul, Minn. 226
KFOZ	Leon Hudson Real Estate Co.	Fort Smith, Ark. 233
KFPB	Edwin J. Brown	Seattle, Wash. 224
KFPG	Garretson and Dennis	Los Angeles, Calif. 238
KFPH	Harold Chas. Mailander	Salt Lake City, Utah 242
KFPL	C. C. Baxter	Dublin, Texas 242
KFPM	The New Furniture Co.	Greenville, Texas 242
KFPN	Missouri National Guard	Jefferson City, Mo. 242
KFPP	G. & G. Radio & Electric Shop	Olympia, Washington 236
KGB	Tacoma Daily Ledger	Tacoma, Wash 252
KGG	Hallock & Watson Radio Service	Portland, Oreg. 360
KGN	Northwestern Radio Mfg. Co.	Portland, Oreg. 360
KGO	General Electric Co.	Oakland, Calif. 312
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach 360
KGW	Portland Morning Oregonian	Portland, Oreg. 492
KGY	St. Martins College (Reb. Sebastian Ruth)	Lacy, Wash. 258
KHJ	Times-Mirror Co.	Los Angeles, Calif. 395
KHQ	Louis Wasmer	Seattle, Wash. 360
KJQ	C. O. Gould	Stockton, Calif. 360
KJR	Northwest Radio Service Co.	Seattle, Wash 270
KJS	Bible Institute of Los Angeles	Los Angeles, Calif. 360
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif. 360
KLX	Tribune Publishing Co.	Oakland, Calif. 509
KLZ	Reynolds Radio Co.	Denver, Colo. 509
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif. 273
KMO	Love Electric Co.	Tacoma, Wash. 360
KNT	Grays Harbor Radio Co. (Walter Hemrich)	Aberdeen, Wash. 263
KNV	Radio Supply Co.	Los Angeles, Calif. 256
KNX	Electric Lighting Supply Co.	Los Angeles, Calif. 360
KOB	New Mexico College of Agriculture & Mechanic Arts	State College, N. Mex. 360
KOP	Detroit Police Department	Detroit, Mich. 286
KPO	Hale Bros.	San Francisco, Calif. 423
KQP	Apple City Radio Club	Hood River, Oreg. 360
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa. 270
KQW	Charles D. Herrold	San Jose, Calif. 360
KRE	V C Battery & Electric Co.	Berkeley, Calif. 278
KSD	Post Dispatch (Pulitzer Pub. Co.)	St. Louis, Mo. 546
KSS	Prest & Dean Radio Co. and Radio Research Society of Long Beach, Calif.	Long Beach, Calif. 360
KTW	First Presbyterian Church	Seattle, Wash. 360
KUO	Examiner Printing Co.	San Francisco, Calif. 360
KUS	City Dye Works and Laundry Co.	Los Angeles, Calif. 360
KUY	Coast Radio Co.	El Monte, Calif. 256
KWG	Portable Wireless Telephone Co.	Stockton, Calif. 360
KWH	Los Angeles Examiner	Los Angeles, Calif. 360
KYQ	Electric Shop	Honolulu, Hawaii 270
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill. 536
KZM	Preston D. Allen	Oakland, Calif. 360
KZN	Cope and Johnson Co.	Salt Lake City, Utah 268
KZV	Wenatchee Battery & Motor Co.	Wenatchee, Wash. 360
WAAB	Valdemar Jensen	New Orleans, La. 268
WAAC	Tulane University	New Orleans, La. 360
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio 360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill. 286
WAAK	Gimbel Brothers	Milwaukee, Wis. 280
WAAM	I. R. Nelson Co.	Newark, N. J. 263
WAAN	University of Missouri	Columbia, Mo. 254
WAAW	Omaha Grain Exchange	Omaha, Nebr. 360
WABA	Lake Forest College	Lake Forest, Ill. 266
WABB	Dr. John B. Lawrence	Harrisburg, Pa. 266
WABD	Parker High School	Dayton, Ohio 283
WABE	Young Men's Christian Association	Washington, D. C. 283
WABG	Arnold Edwards Piano Co.	Jacksonville, Fla. 248
WABH	Lake Shore Tire Co.	Sandusky, Ohio 240
WABI	Bangor Railway & Electric Co.	Bangor, Me. 240

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

WABL	Connecticut Agricultural College	Storrs, Conn.	283
WABM	F. E. Doherty Automotive and Radio Equipment Co.	Saginaw, Mich.	254
WABN	Waldo C. Grover	La Crosse, Wis.	244
WABO	Lake Avenue Baptist Church	Rochester, N. Y.	252
WABP	Robert F. Weinig	Dover, Ohio	266
WABQ	Haverford College, Radio Club	Haverford, Pa.	261
WABR	Scott High School, N. W. B. Foley	Toledo, Ohio	270
WABS	Essex Manufacturing Co.	Newark, N. J.	244
WABT	Holiday-Hall, Radio Engineers	Washington, Pa.	252
WABU	Victor Talking Machine Co.	Camden, N. J.	226
WABV	John H. De Witt, Jr.	Nashville, Tenn.	263
WABW	College of Wooster	Wooster, Ohio	234
WABX	Henry B. Joy	Mt. Clemens, Mich.	270
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	263
WBAA	Purdue University	West Lafayette, Ind.	360
WBAD	Sterling Electric Co.	Minneapolis, Minn.	360
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAN	Wireless Phone Corp.	Paterson, N. J.	244
WBAO	James Millikin University	Decatur, Ill.	360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.	Columbus, Ohio	390
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.	New York, N. Y.	492
WBBA	Newark Radio Laboratories	Newark, Ohio	240
WBBD	Barbey Battery Service	Reading, Pa.	234
WBBE	Alfred R. Marcy	Syracuse, N. Y.	246
WBBF	Georgia School of Technology	Atlanta, Ga.	270
WBBG	Irving Vermilya	Mattapoisett, Mass.	240
WBBH	J. Irving Bell	Port Huron, Mich.	246
WBBI	The Indianapolis Radio Club	Indianapolis, Ind.	234
WBBJ	Neal Electric Co., P. E. Neal	West Palm Beach, Fla.	258
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	283
WBBM	Frank Atlass Produce Co.	Lincoln, Ill.	225
WBBN	Blake, A. B.	Wilmington, N. C.	275
WBBO	Mich. Limestone & Chemical Co.	Rogers, Mich.	250
WBBQ	Frank Crook	Pawtucket, R. I.	252
WBBR	Peoples Pulpit Asso.	Rossville, N. Y.	244
WBBS	First Baptist Church	New Orleans, La.	250
WBBT	Lloyd Brothers	Philadelphia, Pa.	234
WBBU	Jenks Motor Sales Co.	Monmouth, Ill.	224
WBBV	Johnstown Radio Co.	Johnstown, Pa.	248
WBBW	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Infantry, Co. "B" 118th Inf.	Charleston, S. C.	268
WBBZ	Noble B. Watson	Indianapolis, Ind.	227
WBL	T & H Radio Co.	Anthony, Kans.	261
WBR	Pennsylvania State Police	Butler, Pa.	286
WBS	D. W. May, Inc.	Newark, N. J.	360
WBT	Southern Radio Corp.	Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co.	Springfield, Mass.	337
WCAD	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa.	462
WCAG	Clyde R. Randall	New Orleans, La.	268
WCAH	Entrekin Electric Co.	Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	360
WCAK	Alfred P. Daniel	Houston, Texas	263
WCAL	St. Olaf College	Northfield, Minn.	360
WCAM	Villanova College	Villanova, Pa.	360
WCAO	Sanders & Stayman Co.	Baltimore, Md.	360
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C.	469
WCAR	Alamo Radio Electric Co.	San Antonio, Tex.	360
WCAS	William Hood Dunwoody Industrial Institute	Minneapolis, Minn.	246
WCAT	South Dakota State School of Mines	Rapid City, S. Dak.	240
WCAU	Durham & Co.	Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co.	Little Rock, Ark.	360
WCAX	University of Vermont	Burlington, Vt.	360
WCAY	Kesselman O'Driscoll Co.	Milwaukee, Wis.	261
WCAZ	Carthage College	Carthage, Ill.	246
WCBA	Charles W. Heimbach	Allentown, Pa.	280
WCBC	University of Michigan	Ann Arbor, Mich.	280
WCBD	Wilbur G. Voliva	Zion, Ill.	345
WCBE	Uhalt Radio Co.	New Orleans, La.	263
WCBF	Paul J. Miller	Pittsburgh, Pa.	236
WCBG	Howard S. Williams (Portable)	Pascagoula, Miss.	236
WCBI	Nicoll, Duncan & Rush	Bemis, Tennessee	226
WCBJ	J. C. Maus	Jennings, Louisiana	244
WCBK	E. Richard Hall	St. Petersburg, Fla.	266
WCBL	Northern Radio Mfg. Co.	Houlton, Me.	280
WCBM	Charles Swarz	Baltimore, Md.	229
WCBN	James P. Boland	Ft. Benj. Harrison, Ind.	266
WCBO	The Radio Shop, Inc.	Memphis, Tenn.	250
WCBQ	First Baptist Church	Nashville, Tenn.	236
WCBR	University of Mississippi	near Oxford, Miss.	242
WCBR	Charles H. Meester (Portable Station)	Providence, R. I.	246
WCK	Stix, Baer & Fuller Dry Goods Co.	St. Louis, Mo.	360
WCM	University of Texas	Austin, Texas	360
WCX	Detroit Free Press	Detroit, Mich.	517
WDAE	Tampa Daily Times	Tampa, Fla.	360
WDAF	Kansas City Star	Kansas City, Mo.	411
WDAG	J. Laurence Martin	Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South)	El Paso, Tex.	268
WDAK	The Courant	Hartford, Conn.	261
WDAO	Automotive Electric Co.	Dallas, Tex.	360
WDAP	Board of Trade	Chicago, Ill.	360
WDAR	Lit Brothers	Philadelphia, Pa.	395
WDAS	Samuel A. Waite	Worcester, Mass.	360
WDAU	Slocum Killburn	New Bedford, Mass.	360
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	244
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WDBF	Robert G. Phillips	Youngstown, Ohio	246
WDM	Church of the Covenant	Washington, D. C.	234
WDZ	James L. Bush	Tuscola, Ill. Star Store Bldg.	278
WEAA	F. D. Fallain	Flint, Mich.	280
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	492
WEAH	Wichita Board of Trade	Wichita, Kans.	244
WEAI	Cornell University	Ithaca, N. Y.	286
WEAJ	University of South Dakota	Vermillon, S. Dak.	283
WEAM	Borough of North Plainfield (W. Gibson Buttfield)	North Plainfield, N. J.	252
WEAN	Shepard Co.	Providence, R. I.	273
WEAO	Ohio State University	Columbus, Ohio	360
WEAP	Mobile Radio Co.	Mobile, Ala.	360
WEAR	Baltimore American & News Publishing Co.	Baltimore, Md.	360
WEAU	Davidson Bros. Co.	Sioux City, Iowa	360
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Texas	360
WEB	Benwood Co.	St. Louis, Mo.	273
WEV	Hurlburt-Still Electrical Co.	Houston, Texas	360
WEW	St. Louis University	St. Louis, Mo.	261
WFAA	Dallas News & Dallas Journal	Dallas, Texas	476
WFAB	Carl F. Woese	Syracuse, N. Y.	234
WFAF	H. C. Spratley Radio Co.	Poughkeepsie, N. Y.	360
WFAH	Electric Supply Co.	Port Arthur, Texas	236
WFAJ	Hi-Grade Wireless Instrument Co.	Asheville, N. C.	360
WFAM	Times Publishing Co.	St. Cloud, Minn.	360
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn.	360
WFAQ	Missouri Wesleyan College	Cameron, Mo.	360
WFAT	New Columbus College	Sioux Falls, S. Dak.	258
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr.	275
WFI	Strawbridge & Clothier	Philadelphia, Pa.	395
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa.	248
WGAN	Cecil E. Lloyd	Pensacola, Fla.	360
WGAQ	Glenwood Radio Corp. (W. G. Patterson)	Shreveport, La.	252
WGAW	Ernest C. Albright	Altoona, Pa.	261
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGI	American Radio & Research Corp.	Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett	Philadelphia, Pa.	360
WGN	The Chicago Tribune—Edgewater Beach Broadcasting Station,	Chicago, Ill.	370
WGR	Federal Telephone & Telegraph Co.	Buffalo, N. Y.	319
WGV	Interstate Electric Co.	New Orleans, La.	242
WGY	General Electric Co.	Schenectady, N. Y.	380
WHA	University of Wisconsin	Madison, Wis.	360
WHAA	State University of Iowa	Iowa City, Iowa	484
WHAB	Clark W. Thompson	Galveston, Texas	360
WHAD	Marquette University	Milwaukee, Wis.	280
WHAG	University of Cincinnati	Cincinnati, Ohio	222
WHAH	Hafer Supply Co.	Joplin, Mo.	283
WHAK	Roberts Hardware Co.	Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y.	283
WHAP	Otta & Kuhns	Decatur, Ill.	360
WHAR	Paramount Radio & Electric Co. (W. H. A. Pulus)	Atlantic City, N. J.	231
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	380
WHB	Sweeney School Co.	Kansas City, Mo.	411
WHK	Radiovox Co. (Warren R. Cox)	Cleveland, Ohio	360
WHN	George Schubel	New York, N. Y.	360
WIAB	Joslyn Automobile Co.	Rockford, Ill.	252
WIAC	Galveston Tribune	Galveston, Texas	360
WIAD	Howard R. Miller	Ocean City, N. J.	254
WIAF	Gustav A. DeCortin	New Orleans, La.	234
WIAH	Continental Radio & Mfg. Co.	Newton, Iowa	258
WIAI	Heey Stores Co.	Springfield, Mo.	252
WIAJ	Fox River Valley Radio Supply Co. (Quinn Bros.)	Neenah, Wis.	224
WIAK	Journal-Stockman Co.	Omaha, Nebr.	278
WIAO	School of Engineering of Milwaukee	Milwaukee, Wis.	360
WIAQ	Chronicle Publishing Co.	Marion, Ind.	226
WIAS	Home Electric Co.	Burlington, Iowa	360
WIAT	Leon T. Noel	Tarkio, Mo.	360
WIAU	American Trust & Savings Bank	Le Mars, Iowa	360
WIK	K. & L. Electric Co. (Herbert F. Kelso and Hunter J. Lohman)	McKeesport, Pa.	234
WIL	Continental Electric Supply Co.	Washington, D. C.	360
WIP	Gimbel Brothers	Philadelphia, Pa.	509
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	360
WJAF	Press Publishing Co.	Muncie, Ind.	360
WJAG	Norfolk Daily News	Norfolk, Nebr.	283
WJAK	Clifford L. White	Greentown, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAN	Peoria Star	Peoria, Ill.	280
WJAQ	Capper Publications	Topeka, Kans.	360
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	250
WJAT	Kelly-Vawter Jewelry Co.	Marshall, Mo.	360
WJAX	Union Trust Co.	Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	448
WJD	Richard H. Howe	Granville, Ohio	229
WJX	Deforest Radio Telephone & Telegraph Co.	New York, N. Y.	360
WJY	R. C. A.	New York, N. Y.	405
WJZ	R. C. A.	New York, N. Y.	455
WKAA	H. F. Paar	Cedar Rapids, Iowa	268
WKAD	Chas. Looff (Crescent Park)	East Providence, R. I.	240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Texas	360
WKAN	United Battery Service Co.	Montgomery, Ala.	226
WKAP	Dutee W. Flint	Cranston, R. I.	360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	360
WKAR	Michigan Algriculture College	East Lansing, Mich.	280
WKAS	L. E. Lines Music Co.	Springfield, Mo.	360
WKAV	Laconia Radio Club	Laconia, N. H.	254
WKAY	Brenau College	Gainesville, Ga.	280
WKY	WKY Radio Shop	Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn.	417
WLAH	Samuel Woodworth	Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co.	Waco, Texas	360
WLAK	Vermont Farm Machine Corp.	Bellows Falls, Vt.	360
WLAL	Naylor Electrical Co.	Tulsa, Okla.	360
WLAP	W. V. Jordon	Louisville, Ky.	360
WLAQ	Arthur E. Shilling	Kalamazoo, Mich.	283
WLAV	Electric Shop	Pensacola, Fla.	254
WLAW	Police Dept., City of New York	New York, N. Y.	360
WLAX	Putnam Electric Co. (Greencastle Community Broadcasting Station)	Greencastle, Ind.	231
WLB	University of Minnesota	Minneapolis, Minn.	360
WLS	Sears, Roebuck Co.	Chicago, Ill.	345
WLW	Crosley Manufacturing Co.	Cincinnati, Ohio	309
WMAB	Radio Supply Co.	Oklahoma, Okla.	360
WMAC	J. Edw. Page (Olive B. Meredith)	Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	360
WMAH	General Supply Co.	Lincoln, Nehr.	254
WMAJ	Drovers Telegram Co.	Kansas City, Mo.	275
WMAK	Norton Laboratories	Lockport, N. Y.	360
WMAL	Trenton Hardware Co.	Trenton, N. J.	256
WMAN	First Baptist Church	Columbus, Ohio	286
WMAP	Utility Battery Service	Easton, Pa.	246
WMAQ	Chicago Daily News	Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute	Auburn, Ala.	250
WMAW	Wahpeton Electric Co.	Wahpeton, N. D.	254
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	280
WMAZ	Mercer University	Macon, Ga.	268
WMC	"Commercial Appeal" (Commercial Publishing Co.)	Memphis, Tenn.	500
WMH	Precision Equipment Co.	Cincinnati, Ohio	248
WMU	Doubleday-Hill Electric Co.	Washington, D. C.	261
WNAC	Shepard Stores	Boston, Mass.	278
WNAD	University of Oklahoma	Norman, Okla.	360
WNAL	R. J. Rockwell	Omaha, Nebr.	242
WNAM	Ideal Apparatus Co.	Evansville, Ind.	360
WNAN	Syracuse Radio Telephone Co.	Syracuse, N. Y.	286
WNAP	Wittenberg College	Springfield, Ohio	231
WNAQ	Charleston Radio Electric Co.	Charleston, S. C.	360
WNAR	C. C. Rhodes	Butler, Mo.	231
WNAS	Texas Radio Corp. & Austin Statesman	Austin, Texas	360
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa.	360
WNAV	Peoples Telephone & Telegraph Co.	Knoxville, Tenn.	236
WNAW	Peninsular Radio Club (Henry Kunzmann)	Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNJ	Shotton Radio Manufacturing Co.	Albany, N. Y.	360
WOAA	Dr. Walter Hardy	Ardmore, Okla.	360
WOAC	Maus Radio Co.	Lima, Ohio	266
WOAD	Friday Battery & Electric Corp.	Sigourney, Iowa	360
WOAE	Midland College	Fremont, Nebr.	360
WOAF	Tyler Commercial College	Tyler, Texas	360
WOAG	Apollo Theater (Belvedere Amusement Co.)	Belvedere, Ill.	224
WOAH	Palmetto Radio Corp.	Charleston, S. C.	360
WOAI	Southern Equipment Co.	San Antonio, Texas	385
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	360
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	360
WOAP	Kalamazoo College	Kalamazoo, Mich.	240
WOAQ	Portsmouth Kiwanis Club	Portsmouth, Va.	360
WOAR	Henry P. Lundskow	Kenosha, Wis.	229
WOAT	Boyd M. Hamp	Wilmington, Del.	360
WOAV	Pennsylvania National Guard, 2d Battalion, 112th Infantry	Erie, Pa.	242
WOAW	Woodmen of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOI	Iowa State College	Ames, Iowa	360
WOK	Pine Bluff Co.	Pine Bluff, Ark.	360
WOQ	John Wanamaker	Philadelphia, Pa.	509
WOQ	Western Radio Co.	Kansas City, Mo.	360
WOR	L. Bamberger & Co.	Newark, N. J.	405
WOS	Missouri State Marketing Bureau	Jefferson City, Mo.	441
WPAB	Pennsylvania State College	State College, Pa.	283
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	360
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College	Agricultural College, N. Dak.	360
WPAL	Superior Radio & Telephone Equipment Co.	Columbus, Ohio	286

Radio Threatens American Band Concert

Now that half a million people can listen to the programs broadcast from a single station, what will happen to the village bands? Of what use are the uniformed and spangled players that decorate the small town band-stands when the townspeople can just as well sit at home with the phones clamped on their ears? Will the trend be to keep the family at home instead of on the country green or city park?

No longer do we see the old German bands that traveled from place to place and enlivened the atmosphere with their cheerful "toots." The old time fiddlers have vanished into the past and the wailing of their instruments is recalled only in the memory of our grandfathers. Are the deep throated, druming park bands headed in the same way? Can it be that the trombone and the cornet will no more inspire listless citizens to drop comic sheets and orange peels on the green?

What a relief such a change would be to the townspeople of Parkville, Ohio, who for years have undergone the mental suffering of being compelled to listen Friday nights while Tom Green's band got in a couple of hours practice in the vacant room over the local hardware store. Yet again what a tragedy to drift aimlessly about the empty streets on a Saturday night without the familiar martial strain of music.

Surely someone will be quick to declare that something vital and human has gone out of life if radio undertakes to encroach upon the famous institution known as the American band. What excuse, if any, will the farmer have for taking his family to town if he cannot sit back comfortably in his automobile, and when the band has finished playing, reach out and toot his horn for dear life.

The opportunity to meet his neighbors and shake their hand on the strength of a band concert will have been gone and heaven knows a loud speaker is no excuse to break a bottle of lemonade. The disappearance of the band will be a disappointment to the youngsters.

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

WPAM	Auerbach & Guettel	Topeka, Kans.	360
WPAP	Theodore D. Phillips	Winchester, Ky.	360
WPAQ	General Sales & Engineering Co.	Frostburg, Md.	360
WPAR	Ward Battery and Radio Co.	Beloit, Kans.	236
WPAT	St. Patricks Cathedral	El Paso, Texas	360
WPAU	Concordia College	Moorhead, Minn.	360
WPAZ	John R. Koch (Dr.)	Charleston, W. Va.	273
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	360
WQAC	E. B. Gish	Amarillo, Texas	234
WQAD	Whitall Electric Co.	Waterbury, Conn.	242
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275
WQAF	Sandusky Register	Sandusky, Ohio	240
WQAL	Coles County Telephone & Telegraph Co.	Mattoon, Ill.	258
WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	360
WQAQ	Abilene Daily Reporter (West Texas Radio Co.)	Abilene, Texas	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAX	Radio Equipment Co.	Peoria, Ill.	360
WRAA	Rice Insitute	Houston, Texas	369
WRAF	The Radio Club (Inc.)	Laporte, Ind.	224
WRAH	Stanley N. Read	Providence, R. I.	231
WRAL	Northern States Power Co.	St. Croix Falls, Wis.	248
WRAM	Lombard College	Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	236
WRAO	Radio Service Co.	St. Louis Mo.	360
WRAV	Antioch College	Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRAY	Radio Sales Corp.	Scranton, Pa.	280
WRAZ	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	233
WRC	Radio Corporation of America	Washington, D. C.	469
WRK	Doron Bros. Electric Co.	Hamilton, Ohio	360
WRL	Union College	Schenectady, N. Y.	360
WRM	University of Illinois	Urbana, Ill.	360
WRR	City of Dallas (police and fire signal department)	Dallas, Texas	360
WRW	Tarrytown Radio Research Laboratory (Koenig Bros.)	Tarrytown, N. Y.	273
WSAB	Southeast Missouri State Teachers College	Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural College	Clemson College, S. C.	360
WSAD	J. A. Foster Co.	Providence, R. I.	261
WSAG	City of St. Petersburg (Loren V. Davis)	St. Petersburg, Fla.	244
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	309
WSAJ	Grove City College	Grove City, Pa.	360
WSAN	Allentown Radio Club	Allentown, Pa.	228
WSAP	Seventh Day Adventist Church	New York, N. Y.	263
WSAR	Doughty & Welch Electrical Co.	Fall River, Mass.	254
WSAT	Donohoo-Ware Hardware Co.	Plainview, Texas	268
WSAW	John J. Long, Jr.	Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory	Chicago, Ill.	268
WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	233
WSAZ	Chas. Electric Shop	Pomeroy, Ohio	258
WSB	Atlanta Journal	Atlanta, Ga.	429
WSL	J. & M. Electric Co.	Utica, N. Y.	273
WSY	Alabama Power Co.	Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAF	Louis J. Gallo	New Orleans, La.	242
WTAG	Kern Music Co.	Providence, R. I.	258
WTAH	Carmen Ferro	Belvedere, Ill.	236
WTAJ	The Radio Shop	Portland, Me.	230
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gordon & Son	Osseo, Wis.	220
WTAR	Reliance Electric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	275
WTAT	Edison Electric Illuminating Co.	Boston, Mass. (portable)	244
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	360
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	242
WTAW	Agricultural & Mechanical College of Texas	College Station, Tex.	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcasting Station	Oak Park, Ill.	220
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTG	Kansas State Agricultural College	Manhattan, Kans.	485
WWAB	Hoenig, Swern & Co. (John Rasmussen)	Trenton, N. J.	220
WWAC	Sanger Bros.	Waco, Texas	360
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	Alamo Dance Hall, L. J. Crowley	Joliet, Ill.	227
WWAF	Galvin Radio Supply Co.	Camden, N. J.	230
WWAO	Michigan College of Mines	Houghton, Mich.	244
WWI	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	517
WWL	Loyola University	New Orleans, La.	260
WYAM	Electrical Equipment Co.	Miami, Fla.	283
WYAW	Catholic University	Washington, D. C.	236

Canadian Stations

CFAC	Calgary Herald	Calgary, Alberta	430
CFCA	Star Pub. & Prtg. Co.	Toronto, Ontario	400
CFCF	Marconi Wireless Teleg. Co. of Canada	Montreal, Quebec	440
CFCH	Abitibi Power & Paper Co.	Iroquois Falls, Ont.	400
CFCJ	La Cie de L'Evenement	Quebec, Quebec	410
CFCK	Radio Supply Co.	Edmonton, Alberta	410
CFCL	Centennial Methodist Church	Victoria, British Col.	400
CFCN	W. W. Grant Radio (Ltd.)	Calgary, Alberta	440
CFCO	Semmemhaack-Dickson (Ltd.)	Bellevue, Quebec	450
CFCQ	Radio Specialties (Lid.)	Vancouver, B. C.	450
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCW	The Radio Shop	London, Ont.	420
CFDC	Sparks Co.	Nanaimo, B. C.	430
CFQC	The Electric Shop (Ltd.)	Saskatoon, Saskatchewan	400
CFRC	Queens University	Kingston, Ontario	450
CFUC	University of Montreal	Montreal, Quebec	400
CHAC	Radio Engineers	Halifax, Nova Scotia	400
CHBC	Albertan Publishing Co.	Calgary, Alberta	410
CHCD	Canadian Wireless & Elec. Co.	Quebec, Quebec	410
CHCE	Western Canada Radio Sup. (Ltd.)	Victoria, B. C.	400
CHCL	Vancouver Merchants Exchange	Vancouver, B. C.	440
CHYC	Northern Electric Co.	Montreal, Quebec	410
CJCA	Edmonton Journal	Edmonton, Alberta	450
CJGC	London Free Press Prtg. Co.	London, Ont.	430
CJCD	T. Eaton Co.	Toronto, Ont.	410
CJCE	Sprott-Shaw Radio Co.	Vancouver, B. C.	420
CJCI	Maritime Radio Corp.	St. John, New Brunswick	400
CJCN	Simons Agnew & Co.	Toronto, Ont.	410
CJCX	Percival Wesley Shackleton	Olds, Alberta	400
CJSC	Evening Telegram	Toronto, Ont.	430
CKAC	La Presse Pub. Co.	Montreal, Quebec	430
CKCD	Vancouver Daily Province	Vancouver, B. C.	410
CKCE	Canadian Independ. Telephone Co.	Toronto, Ont.	450
CKCH	Canadian National Railways	Ottawa	435
CKCK	Leader Pub. Co.	Regina, Saskatchewan	420
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	410
CKY	Manitoba Telephone System	Winnipeg, Manitoba	450

Cuban Stations

PWX	Cuban Telephone Co.	Habana	400
2DW	Pedro Zayas	Habana	300
2AB	Alberto S. de Bustamante	Habana	240
20K	Mario Garcia Velez	Habana	360
2BY	Frederick W. Borton	Habana	260
2CX	Frederick W. Borton	Habana	320
2EV	Westinghouse Elec. Co.	Habana	220
2TW	Roberto E. Ramires	Habana	230
2HC	Heraldo de Cuba	Habana	275
2LC	Luis Casas	Habana	250
2KD	E. Sanchez de Fuentes	Habana	350
2MN	Fausto Simon	Habana	270
2MG	Manuel G. Salas	Habana	280
2JD	Raul Perez Falcon	Habana	150
2KP	Alvara Daza	Habana	200
2HS	Julio Power	Habana	180
2OL	Oscar Collado	Habana	290
2WW	Amadeo Saenz	Habana	210
5EV	Leopoldo V. Figueroa	Colon	360
6KW	Frank H. Jones	Tuinucu	340
6KJ	Frank H. Jones	Tuinucu	275
6CX	Antonio T. Figueroa	Cienfiegos	170
6DW	Eduardo Terry	Cienfiegos	225
6BY	Jose Ganduxe	Cienfuegos	300
6AZ	Valentin Ullivarri	Cienfuegos	200
6EV	Josefa Alverax	Caibarien	225
8AZ	Alfreda Brocks	Stgo. de Cuba	240
8BY	Alberto Ravelo	Stgo. de Cuba	250
8FU	Andres Vinnet	Stgo. de Cuba	225
8DW	Pedro C. Anduz	Stego. de Cuba	275
8EV	Eduardo Mateos	Stego. de Cuba	180

SOS Signals

Few radio listeners know that behind the scenes in the broadcasting station there is stationed a licensed code operator whose only duty during the period the station is on the air is to listen in for distress signals. While music and addresses are going out from an adjoining room he sits at a receiving set that is tuned to 600 meters, the wave length of ship and coast stations. At the first signal of distress he notifies the engineer in charge and the broadcasting stops at once, the air is left free for the unobstructed transmission of SOS signals.

On Saturday evening, March 22, shortly after 11 o'clock, while WGY, the Schenectady, N. Y., station was in the midst of a dance program from Albany, an SOS was picked up from a ship at sea. Instantly WGY left the "air" and remained out until permission was received to resume. This is the first time, during two years of operation, that WGY has been interrupted by distress signals.

Doubling Condenser's Usefulness

(*Continued from page 20*)

and coil control, whatever be its construction, those stations might all come within the boundaries of the same dial degree and it would be no child's play to set that tuning dial to the exact wave of any one of them.

The Construction

Owners of single circuit receivers who would like to try this arrangement may do so with scarcely any expense and very little trouble. A glance through the following constructional data will tell them what changes must be made in their already built receivers. *Fig. 2* gives a view from the rear, and the parts employed in the set illustrated are as follows:

Panel, 7x10 inches.
Variocoupler.
Vernier condenser (.00025).
.00025 grid condenser.
2 megohm grid leak.
Tube socket.
4 Fahnestock clips.
2 three-inch dials.
Switch lever, 2 switch points, 2 stop points.
4 binding posts.
4 lengths bus bar for connections.
1 rheostat, 16 ohms.

Most any vario-coupler may be employed by connecting one tap at the 40th turn and the other at the 80th, but the type shown was chosen because it is already provided with two binding posts for connection to the middle and end of the outer winding. The variable condenser chosen should have between 11 and 15 plates, and the type illustrated has 14 and a .00025 mfds. capacity. Note the style of vernier in use. Some form of vernier MUST be employed, as it would be physically impossible to set the dial at the exact proper point by use of the large knob alone. The vernier MUST NOT be of the extra plate variety, however, as this makes impossible the accurate notation of dial settings for stations received. A dial setting of the large dial would only hold true provided the vernier plate were at exactly the same position every time. Hence the vernier should, by a gear, a friction contact on the shaft, or friction on the dial, move the entire set of movable plates and not move an extra plate or small extra condenser.

In *Fig. 2* the rear of the set is exhibited. Note the neatness and simplicity of its assembly. The socket is fastened to a long strip of hard rubber which is in turn supported by two brass brackets cut from a piece of brass strip. The brackets are attached to two of the binding posts, and are used as connecting members, too. The four clips on the mounting strip are for connection to the "A" and "B" batteries and their rear placing permits these batteries to be put inside the cabinet if you like. The set might then be self-contained.

Points of Assembly

The grid leak is fastened between two "loops" of bus bar, soldered directly to the winding. If you prefer to use a regular mounting, this should be added to the list of parts. *Fig. 3*, the bottom view, shows the position of the coupling coil, just inside the grid end of the coupler. This is made by winding 15 turns of double covered wire about No. 22 in size on a cylinder slightly less than the diameter of the inside of the coupler tubing. The coil is then slipped off the cylinder and the wires bunched together. They are then slipped inside the coupler and allowed to spring apart until the coil fits the tubing snugly. Remove it then and wrap several strips of bicycle tape around to keep the wires together and replace it inside. Be sure to get the coil at the grid end, for it is that half of the coupler winding which is in circuit regardless of how the switch may be thrown.

Fig. 4 is the circuit diagram and it requires no further explanation. The circuit delivers a good deal of volume from local stations and if you are within 15 miles of some of them you can operate your speaker after a fashion even though you use a dry cell tube. A power tube or 201-A quite satisfactorily works the speaker on your loudest local station. As far as distance is concerned, results are as good with dry cell tubes as with storage battery tubes, and the selection of your "A" battery will have to be made accordingly. Except with a soft tube like the 200, the "B" battery should be a 45-volt unit.

Your aerial, for such a circuit, ought not to have too high a capacity and a single strand of wire 80 to 100 feet long is satisfactory. (I mean one wire, not necessarily single stranded wire, as several strands make for strength and lasting qualities.) Its capacity may be kept low by elevating the wire ten or twelve feet above the roof and keeping the lead-in wire four or five feet out from the building wall on the way down. This is done so that the "natural period" of the aerial system, which includes the coupling coil, may be lower than 200 meters. Otherwise its absorbing effect at its fundamental might interfere with regeneration on that wave length. As it is, the regeneration control, the tickler, is not varied more than five degrees for securing regeneration over the entire wave length scale. This means great ease in securing regeneration and limits the active control to only one—the tuning condenser.

I could, of course, continue describing the tuning possibilities of this slight alteration of the old faithful and reliable single circuit tuner, and I could ask how many of you can tune out WSAI or WLW on 309 meters and hear KGO of Oakland, California, on 312 meters? No, the single circuit won't do that—but I have succeeded in hearing KGO without a peep from WLW several times in New York City with the coupled circuit tuner.

So, if you'd like to pep up your single circuit set and tune out some of the louder stations to hear that far-off broadcaster whose announcements are now killed by blasts of local jazz selections, or if you're thinking about building a simple and effective receiver, try the coupled tuner, for you can't go wrong.

New Aerial Idea

Hartford, Conn.—An Italian radio experimenter, Adriano Ducati, has communicated very successfully with amateurs in this country with a novel antenna arrangement, the use of which is new to radio men in the United States, according to a communication that has just been received by the American Radio Relay League. Mr. Ducati increases the capacity between his antenna and counterpoise with an extra counterpoise erected above the regular antenna system.

He is easily the foremost amateur in Italy inasmuch as he was the first to establish two-way connection with this country. Being unfamiliar with all of the methods employed by American radio men, he did not place any special stress on his novel aerial. The technical department of the A. R. R. L., however, is interested in the use of an additional counterpoise over the antenna and experiments will be made shortly to determine its special advantages.

Hearings on Radio Monopoly

Within about ten days, the Federal Trade Commission will issue a call for hearings on the alleged radio monopoly, and summon witnesses to testify in connection with the answers filed recently.

The answers deny the charges of the commission, claiming that their agreements were not set forth fairly in the complaint.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of Radio Age, published monthly at Chicago, Illinois, for April 1, 1924.

State of Illinois, County of Cook, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Frederick Smith, who, having been duly sworn according to law, deposes and says that he is the Editor of Radio Age and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Radio Age, Inc., Chicago, Ill.; Editor, Frederick Smith, Chicago, Ill.; Managing Editor, Frederick Smith, Chicago, Ill.; Business Manager, M. B. Smith, Chicago, Ill.

2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of each, should be given below; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent or more of the total amount of stock should be given.) Radio Age, Inc., Chicago, Ill.; Frederick Smith, Chicago, Ill.; M. B. Smith, Chicago, Ill.; John H. Lohheck, St. Louis, Mo.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the hooks of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is: (This information is required from daily publications only.)

FREDERICK SMITH,
Editor.

Sworn to and subscribed before me this 5th day of May, 1924.

VIRGINIA Van COURT
(My commission expires Sept. 27, 1927.)

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A three tube set with five tube efficiency—the greatest selectivity with the minimum effort—positive calibration to any wave length between 200 and 600 meters. These are only a few of the many advantages offered in the remarkable new Crosley Trirdyn Radio Receiver.

It was only after a year of constant experimenting that our engineering department perfected this exceptional receiver. Thorough tests proved to us that it would out-perform any receiver ever before produced. But we were not satisfied with our own opinion. So we shipped out 200 of these sets to experts in every part of the United States. Their criticisms are one and the same—"tried out your new Trirdyn Receiver Saturday night and logged 13 stations, among them Cuba, New York and Omaha, between 9 and 10 o'clock. The set was very selective. During the time this test was on, local station KSD was operating and we went through them without any difficulty or interference whatever. The range of the local station was not more than three points variation in the dial setting."

"Tried one of these sets out and obtained wonderful results. Were able to log all stations which we heard very successfully. This set should go over big." "The set has wonderful volume and is selective," etc.

This new Crosley triumph is called the Trirdyn because of its original combination of the three "R's"—Radio frequency amplification, Regeneration and Reflex. The first tube incorporates non-oscillating, non-radiating tuned radio frequency amplification; the second tube, a regenerative detector reflexed back on the first tube for one stage of audio frequency amplification. Then it has a third tube which acts as a straight audio frequency amplifier. It uses the ultra selective, a periodic antenna circuit and external selector coil, which adds to its wonderful selectivity.

The Crosley Trirdyn in range, volume and selectivity is the equal of any five tube receiver on the market. Greater volume will, of course, be obtained through the use of storage battery tubes, but it will function well in any type and can be used with either indoor or outdoor antenna.

The opinions of many experts have convinced us that the Trirdyn is the best receiver ever offered the public regardless of price.

Practically every radio dealer can furnish you Crosley Radio Sets, including not only the Trirdyn, but the Model 51, a two tube set for only $18.50; the Model V, a single tube receiver at $16.00; the Model VI at $24.00; the Super VI at $29.00; the Model X-J at $55.00, and the Super X-J at $65.00.

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Men are needed to build, sell and install radio sets—to design, test, repair as radio engineers and executives—as operators at land stations and on ships traveling the world over—as operators at the hundreds of broadcasting stations. And these are just a few of the wonderful opportunities.

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No matter if you know *nothing* about Radio now, you can quickly become a radio expert, by our marvelous new method of practical instruction—instruction which includes all the material for building the latest up-to-date radio apparatus.

Scores of young men who have taken our course are already earning from $75 to over $200 a week. Merle Wetzel of Chicago Heights, Ill., advanced from lineman to Radio Engineer, increasing his salary 100% even while taking our course! Emmett Welch, right after finishing his training started earning $300 a month and expenses. Another graduate is now an operator of a broadcasting station PWX of Havana, Cuba, and earns $250 a month. Still another graduate, only 16 years old, is averaging $70 a week in a radio store.

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In order to complete your practical instruction at home, learning by actual experience, this splendid regenerative receiving set is now included without the slightest additional cost.

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Hardly a week goes by without our receiving urgent calls for our graduates. "We need the services of a competent Radio Engineer"—"We want men with executive ability in addition to radio knowledge to become our local managers"—"We require the services of several resident demonstrators"—these are just a few small indications of the great variety of opportunities open to our graduates.

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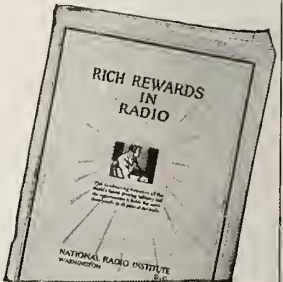

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The Magazine of the Hour

JUNE
1924

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May, 1922
—How to make a simple Crystal Set for $6.

October, 1922
—How to make a Tube Unit for $23 to $37.
—How to make an Audio Frequency Amplifying Transformer.

November, 1922
—Photo-electric Detector Tubes.
—Design of a portable short-wave radio wavemeter.

May, 1923
—How to make the Erla single-tube reflex receiver.
—How to make a portable Reinartz set for summer use.

June, 1923
—How to build the new Kaufman receiver.
—What about your antenna?

July, 1923
—The Grimes inverse duplex system.
—How to read and follow symbols.
—Proper antenna for tuning.

September, 1923
—Simple Radio Frequency Receiver.

December, 1923
—Building the Haynes Receiver.
—Combined Amplifier and Loud Speaker.
—A selective Crystal Receiver.

January, 1924
—Tuning Out Interference—Wave Traps—Eliminators—Filters.
The article which was announced from stations WJAZ, WOC and WOAW.
—A Junior Super-Heterodyne.
—Push-Pull Amplifier.
—Rosenbloom Circuit.

February, 1924
—How to make a battery charger.
—Improved Reinartz Circuit.
—Interference rejectors.
—Single Tube Heterodyne.
—How antenna functions.
—Adding two audio stages to selective receiver which began as a crystal set.
—Superdyne receiver.

March, 1924
—An Eight-Tube Super-Heterodyne.
—A simple, low loss tuner.
—Junior Heterodyne Transformers.
—A Tuned Radio Frequency Amplifier.
—How to make the Kopprasch Receiver.
—Adding Radio Frequency to the Variometer Set.
—Simple Reflex Set.

April, 1924
—An Efficient Super-Heterodyne (fully illustrated).
—Selecting the Right Receiver.
—A Ten-Dollar Receiver.
—Anti-Body Capacity Hook-ups.
—Radio Frequency Amplification.
—Reflexing the Three-Circuit Tuner.
—Index and first two instalments of Radio Age Data Sheets.

May, 1924
—Construction of a Simple Portable Set.
—An Ideal Set for the Summer Camper.
—A Traveling Man's Receiver.
—Radio Panels.
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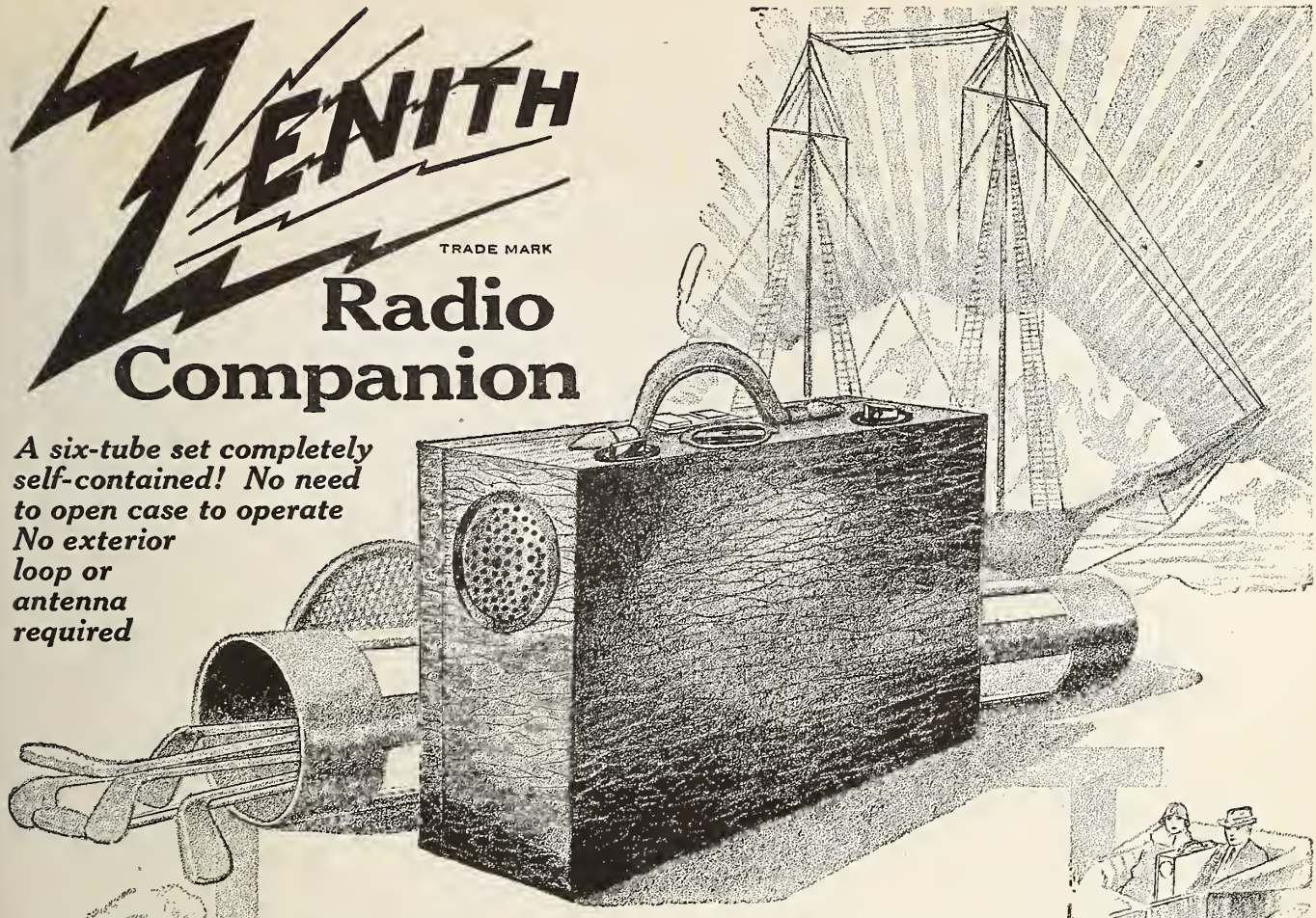

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Again, think how such a set would while away a lonesome evening in that dreary out-of-town hotel—what a god-send it would be to that invalid mother—to that dear relative or friend who must spend weeks and months in the hospital!

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RADIO AGE

The Magazine of the Hour

Established March, 1922

Volume 3 *JUNE, 1924* *Number 6*

CONTENTS

Radio Age is published monthly by
RADIO AGE, Inc.

Advertising, Editorial and Publication Offices,
500 N. Dearborn St., Chicago

Louis L. Levy, *Circulation Manager*
Frederick Smith, *Editor*
Frank D. Pearne, *Technical Editor*
M. B. Smith, *Business Manager*

Eastern Representatives
DAVIDSON & HEVEY
17 West 42nd Street, New York City
Telephone, Longacre 1698

Advertising forms close on the 15th of the month
preceding date of issue
Applicants for membership in A. B. C.

Issued monthly. Vol. 3, No. 6. Subscription price, $2.50 a year.

Entered as second-class matter April 4, 1924, at the post office at Chicago, Illinois, under the act of March 3, 1879.

A Chat With the Editor

WHILE there may be a slacking up of construction work during the hotter weeks of Summer, it is already quite evident as we go to press that the radio public is not losing its interest in reading about radio. It does not seem to require much training before the fan is able to get amusement and real instruction out of the mere studying of wiring diagrams. While the practice of one's knowledge of hook-ups may be temporarily suspended, there is still a deal of enjoyment in contemplating the theories.

That is why we are again offering, in this June number, a variety of technical articles with the usual helpful illustrations.

It is apparent that much of the public interest is centered on the super-heterodyne. This outfit, heretofore avoided by many because of the expense involved in purchasing a sufficient number of tubes and other accessories, is being simplified with a view to reducing the number of tubes needed. It is only a question of time when the super-heterodyne will be within the reach of the average fan, both as to cost and to construction and operation.

Meanwhile the regenerative, the Reinartz and several others of the standard circuits, such as the reflex, claim the attention of a vast number of home experimenters.

The old fable that something may be invented tomorrow that will make the receiver of today look like a wheelbarrow in an automobile show, is still popping up occasionally. Let us make the prediction that for a long time to come new developments in radio will find their birth in patient, deliberate experimentation. Radio is still an infant art, but Rome was not built in a day. We ask that you follow our writers in their discussions in future issues of the improvements and discoveries as they are made.

Frederick Smith

—Editor, RADIO AGE

"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"

No. 766 "B" Battery, 22½ volts

More Power for Summer Radio

When you take radio away with you—take Eveready Radio "A" and "B" Batteries, the batteries whose great power lasts longer. Remember, summer's the time when radio signals are weaker.

Batteries do get used up in time. The ones you've been using, though partly exhausted, may be satisfactory for the strong winter signals, but are probably inadequate for the weaker summer signals.

For instance, use the familiar standard 22½-volt Eveready "B" Battery No. 766. It has variable taps for "soft" detector tubes. Put two, three or four in series to provide sufficient power for amplifiers.

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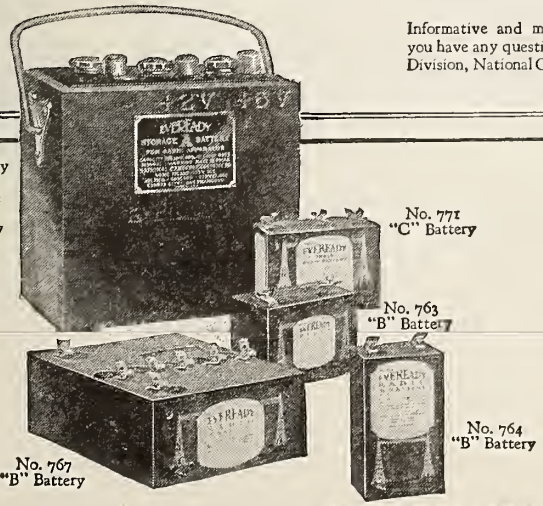


EVEREADY
Radio Batteries
—they last longer

Kadel & Herbert Photo.

FIRST AID TO THE SHIPWRECKED

The S. S. "Columbus" is the first ocean liner to carry lifeboats fully equipped with radio receiving and transmitting equipment. The set shown above, a powerful one capable of receiving stations several thousand miles away, is placed under the prow. Officers are rigging and hauling up the antenna on one of two motor lifeboats equipped with radio.

RADIO AGE
The Magazine of the Hour
M. B. Smith
Business Manager
A Monthly Publication
Devoted to Practical
Radio
Frederick A. Smith
Editor

Important Factors in the Construction of the Super-Heterodyne

By FRANK D. PEARNE

ALTHOUGH many new receiving sets have appeared during the last year and a half, some of which are claimed to pick up any station within a radius of three thousand miles, it is doubtful whether or not any of them can even begin to compare with the Super-Heterodyne. Ask any radio man of experience what he would suggest as the best possible set and invariably the answer will be, the super-heterodyne. It was this type of receiver that first made it possible to reach across the ocean and when properly constructed and operated, its performance has never been equalled, this fact having won for it the title of "king of them all."

Just why should this arrangement be so far ahead of everything else of its kind? It is not new, but it is only within the last year that its real value has been appreciated, but one reason for its sudden popularity is the fact that its construction is based upon good sound logic, but while it has never met its peer, it must be remembered that in order that it may produce the remarkable results which are claimed for it, the greatest of care must be exercised in its construction and even when this is done one must not expect to learn to handle it as easily as he can operate other receivers.

The operation of this receiver is an art and will require considerable patience on the part of the operator before he will be able to tune it quickly and sharply to any desired wave. When playing with the dials, even the most unsophisticated amateur cannot help but realize that he has before him something very unusual, for he will hear every thing known to broadcast programs as the dials are moved slowly around, but to select and bring in any particular one of them is a different story. They are all there and with them is a strange collection of sounds and noises such as he never heard before, and it will take time and patience to learn just how to bring them in loud and clear and to lose the weird sounds that seem to accompany the programs. When by constant practice and study, he gets so far advanced that he can bring in just what he wants, and that only, he stops experimenting on receivers, for he has reached the top of radio reception.

Because of the apparent expense involved in the construction of the super-heterodyne many of the old timers have hesitated about building it, but when the whole thing is boiled down to just what is actually needed in the way of apparatus, much of it can be made at home with ordinary tools and in many cases this home made apparatus will give better results than factory made parts. The object of this article is not, however, to describe the construction of the set, but rather to explain the action of some of the most important parts, so that the builder may know exactly what he is doing. Numerous complaints have been received from our readers who have purchased parts for the building of a super-heterodyne set, claiming that they would not work, but whether this is caused by the assembly of parts which are not well suited for each other, or whether some of the manufacturers are not careful enough in the selection of these parts, is a question and it is in the hope of clearing up some of this trouble that the following specifications are given.

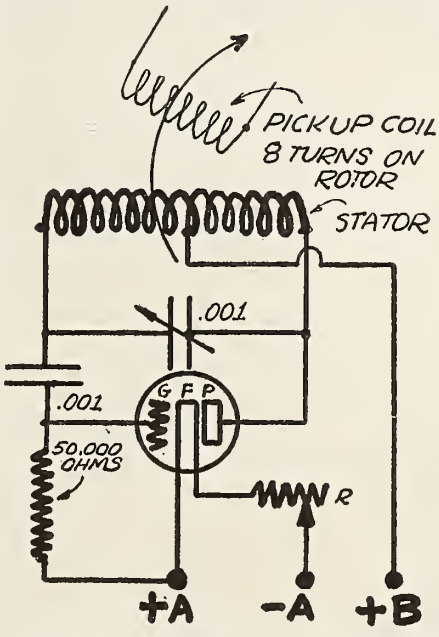


Figure 2. A diagram of the Hartley Oscillator.

How the Super-Heterodyne Works

Distant reception is best accomplished by the use of radio frequency amplification, used before the signal is detected. By using several stages of this type of amplification ahead of the detector, it is possible, according to theory, to pick up very weak signals from great distances and so amplify them before detection that they can be heard as well as local stations. This theory would work out very nicely if all the broadcast waves had the same frequency, but unfortunately this would make it impossible to tune in any particular one, and as any radio frequency transformer, such as is used in this type of amplification, will have one particular frequency at which it will operate at its greatest efficiency, then it may be readily seen that one certain station sending out waves at just the particular frequency best suited to the type of radio frequency used would be heard with remarkable clearness and volume and all the rest of the stations using waves of different frequencies would come in poorly.

Now the super-heterodyne, as will be explained later, consists of a method of changing the frequency of any incoming wave to that best suited to the radio frequency transformers used. That is, the signals, no matter at what frequency they come in, are changed in any case to one common frequency, so that any of them selected will always pass through the radio frequency transformers at the same frequency, which is that at which they function at their greatest efficiency. This is called the intermediate frequency. It has been found that these intermediate frequencies should be those of much greater wave length than those for which

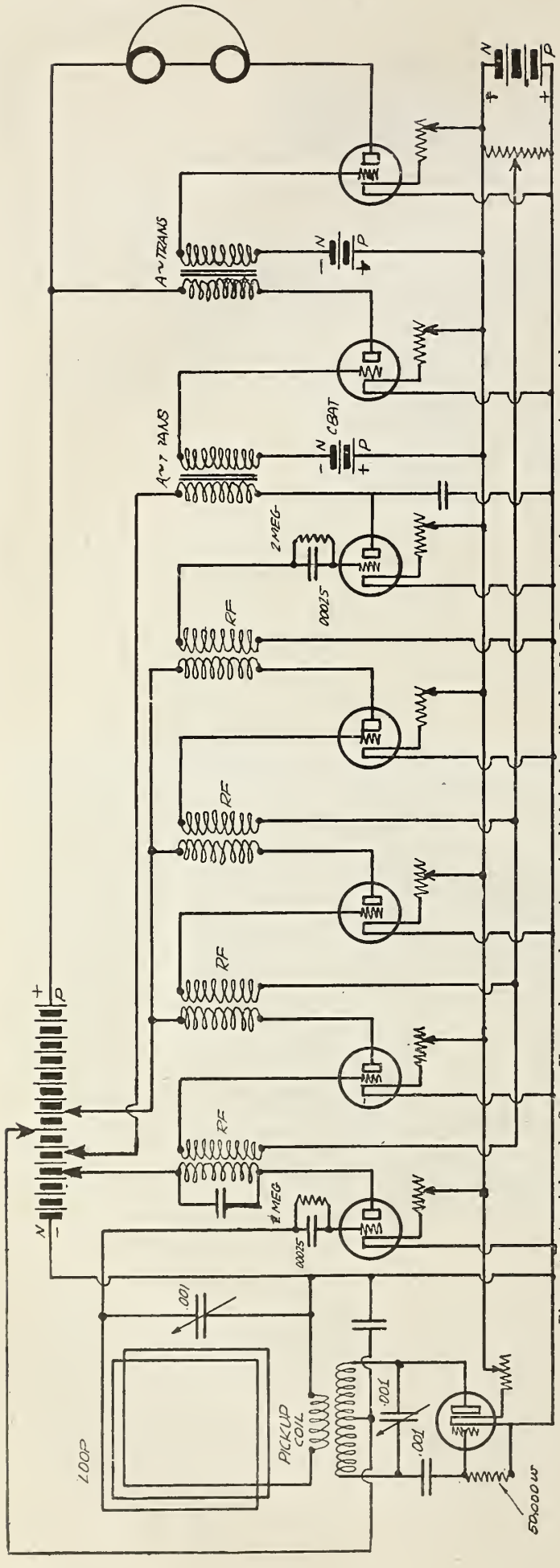


Figure 1. An eight tube Super-Heterodyne, the action of which is described by Mr. Pearne in the accompanying article. The action and rules governing the operation and design of super-hterodyne receivers are taken one by one and discussed frankly and clearly by our technical editor.

The circuit shown is not printed for the purposes of actual construction, but is shown to illustrate in the clearest possible manner the theory of a set of this kind. Note the use of the Hartley oscillator, much used because of its stable action over a wide band of frequencies. In the text Mr. Pearne gives various dimensions for oscillators which can be used.

A potentiometer is used to bias the intermediate amplifiers, and to prevent distortion of signals by suppressing the self oscillation of the radio frequency tubes. This method is sometimes called the "bias" method of stabilization, and means that control of the valves is effected by impressing either negative or positive potential on the grids of the tubes, control of which is effected by the potentiometer.

the ordinary radio frequency transformer is constructed, consequently those used in the super-heterodyne must be of special design.

Experiment has proven that these intermediate frequencies should be of wave lengths of from 3,000 to 10,000 meters, it of course being understood that whatever wave length selected from this range is to be the fundamental wave length of the transformers used, and does not mean that the transformers will operate on any wave length from 3,000 to 10,000 meters. If the transformers to be used are of the iron core type, then because of their greater re-actance at the higher frequencies, those frequencies having from 3,000 to 6,000 meter wave lengths are usually chosen, but if the transformers are of the air core type they can be designed for the higher wave lengths. In purchasing or building these long wave transformers these facts should be remembered: if iron core type are selected then some wave length between 3,000 and 6,000 should be decided upon and those transformers having that particular fundamental wave length should be selected. If, on the other hand, air core type is to be used, then those having any fundamental wave length between 3,000 and 10,000 meters should be selected, but whatever wave length is chosen, all of the transformers used must be the same.

The Function of the Oscillator

The next thing to be considered is just how the different incoming waves are changed to meet the requirements of the radio frequency transformers used. This is accomplished by the heterodyne method, which consists of leading the incoming wave through what is known as the pickup coil, which is inductively connected to a coil in the circuit of the local oscillator. Now then, we have the incoming wave passing through the pickup coil, let us say for example that it is a 360 meter wave. Dividing 300,000,000 (the speed at which electricity travels) by 360 we obtain the frequency of this wave. This gives us then a frequency of 833,000 cycles passing through the pickup coil (see *Figure 1*). Now if we start the oscillator, the coil of which is inductively connected to the pickup coil, we will find that another oscillating current is induced in the pickup coil, and this current will of course have whatever frequency the oscillator is adjusted for. Thus we find the pickup coil receiving waves of two frequencies, one of which is the 833,000 cycles from the broadcast station and the other is of some other frequency supplied by the oscillator.

These two frequencies, acting upon the pickup coil, will combine, producing a frequency which is equal to the difference between the two. If then we adjust the condensers of the oscillator circuit so that it will have a frequency of 883,000 cycles (340 meters) then the difference between this frequency and that of the incoming wave (833,000 cycles, or 360 meters) will be 50,000 cycles, or a wave length of 6,000 meters, which will be exactly right for radio frequency transformers having a wave length of 6,000 meters.

The same result will occur if the oscillator is adjusted to produce 783,000

cycles, or 383 meters, as the difference between the two will still be 50,000 cycles, or 6,000 meters.

From this process it will be seen that no matter what the fundamental wave length of the radio frequency transformers may be, or what the length of the incoming wave may be, it is possible, by the adjustment of the frequency of the local oscillator, to form a combination frequency which will be suitable for the particular radio frequency transformers used. In this way then it is possible to use radio frequency transformers which respond perfectly to only one particular frequency, and by means of the oscillator to change any incoming wave to this frequency. Thus it is possible to get the maximum efficiency from these transformers, no matter what may be the length of the incoming wave.

There are several different methods of constructing an oscillator and there are also many different ways of connecting the pickup coil, but as that shown in Figure 1 is found to be very effective, I am using it to show how the oscillator and the radio frequency transformers are connected.

Construction of the Oscillator

One of the greatest difficulties encountered in the construction of the superheterodyne receiver is to get an oscillator which will oscillate freely over a wide band of wave lengths, and much of the trouble experienced in the construction of a set of this kind is caused by a poor oscillator. In cases where the intermediate frequency (that of the radio frequency transformers) is set at 3,000 meters, the oscillator should be designed to cover a range of from 214 to 750 meters.

This will require a variable condenser having a capacity of .00083 to .001 M.F. connected across an inductance of 155 microhenries. For intermediate wave length of 6,000 meters, the oscillator will have to cover a range of from 207 to 666 meters, which will require a variable condenser ranging from .00097 to .001 M.F. in combination with an inductance of 124 microhenries.

Where intermediate wave length of 10,000 meters is to be used, the variable condenser should have a range of from .0001 to .001 M.F. and the inductance should be 110 microhenries. Most any of the capacities mentioned may be obtained with a good 43 plate variable vernier condenser and means for obtaining the proper inductance will be explained later.

These values are found mathematically. For example, the 3,000 intermediate frequency requires wave lengths ranging from 214 to 750 meters. The 214 meter wave has a frequency of 1,400,000 cycles and the 3,000 meter wave (the intermediate) has a frequency of 100,000 cycles. Subtracting this 100,000 from 1,500,000, which is the frequency of a 200 meter wave and is the lowest used, we get 1,400,000 cycles, which is a wave length of 214 meters, which is found by dividing 300,000,000 (the speed of electricity) by 1,400,000. The high wave length range

(Continued on page 36)

Kadel & Herbert Photo.

ENTERTAINMENT WHILE YOU WORK

That's the idea of "Blind George" Wittenberg, newsdealer at Forty-second Street and Sixtieth Avenue, New York City. He combines his business with pleasure by listening to serious discourses while he waits upon his customers. And although George is blind he can still see the advantages of having RADIO AGE within easy reach on his stand.

De Forest Wins Radio Fight

Dr. Lee De Forest, eminent scientist and "daddy of the radio," was declared to be the originator and sole inventor of the "feed back" and regenerative circuits in a ruling handed down recently by the United States Court of Appeals in the District of Columbia.

The decision, rendered by Chief Justice Smyth, with the associate justices concurring, ends litigation and innumerable suits which have dragged through the courts for more than seven years. Because of their importance the suits have attracted world-wide attention.

Four Claimed Invention

Four men, each claiming the invention, were directly interested and entangled in the suits. They are Doctor De Forest, inventor of the audion; Dr. Irving Langmuir, of the General Electric Company; Dr. A. Meissner, German radio expert, and Maj. Edwin H. Armstrong. Five separate actions with each of these men either as defendants or plaintiffs were directly disposed of by the decision.

The case which brought the final decision was brought by Doctors De Forest, Langmuir and Meissner from the decision of the Commissioner of Patents, who had awarded priority to the invention to Armstrong.

"The whole case," says the decision, "turns upon the question of priority to be determined solely as a question of fact. The Commissioner of Patents, affirming a decision by the Board of Examiners-in-Chief, awarded priority to Armstrong.

"We have no doubt but what Armstrong produced the invention at the time alleged. But his earliest claim to a conception of his invention in October, 1912, followed by a witnessed sketch on January 31, 1913. This date antedates any time claimed by or available to either Meissner or Langmuir and therefore eliminates them from further consideration.

Notes Reveal Discovery

"It is clearly shown that De Forest was developing the idea involved in this invention in the early part of 1912. It appears from his book-notes that the first discovery of the feed-back circuit occurred in connection with his work on the amplifier.

"There is some testimony prior to August, 1912, that the oscillating properties of the audion were discovered by De Forest. The decisions of the Commissioner are reversed and a priority awarded to De Forest."

Automatic Filament Control

By ROSCOE BUNDY

CONTROL of the filament current and electron emission by means of a manually operated rheostat is as old as the vacuum tube, and with the exception of a few minor refinements in the general design of the rheostat there has been but little attempt at improvement in this part of the circuit. This lack of interest in what is really one of the most important functions of the radio receiver seems strange when one considers the close attention that has been paid to the development of the other apparatus used.

The electron stream issuing from the heated filament surface is the carrier of the radio impulses passing through the tube, and represents the relaying energy supplied by the local battery. For this reason the amplification of the tube is in rough proportion to the quantity of electrons emitted by the filament, and as the emission is roughly proportional to the filament temperature it is evident that the filament current control is of vital importance. Every tube develops its maximum economical electron emission at a given voltage across the filament circuit. If this voltage is much exceeded, then the filament current will cause some additional amplification but at the cost of a marked reduction in the useful life of the tube. With a voltage lower than normal, the emission will be reduced and the amplification will suffer to a corresponding degree.

Unless a voltmeter is attached to each receiving set, as is very frequently done with the large and expensive Super-Heterodynes, it is almost certain that voltage control will be uncertain and that either the life of the tubes or the amplification will be reduced below the normal mark set by the maker of the tubes. Unguided hand control is both wasteful and annoying in the operation of amplifier tubes. The ideal condition for the operation of amplifier tubes is met with in an automatic device which will maintain the constant rated voltage across the filament regardless of fluctuations in the battery voltage, all without the attention of the operator.

With the large multi-tube receiving sets of the present day, such as the neutrodyne and Super-Heterodyne, the control of from four to six amplifying tubes is quite a problem. All of the tubes connected in one series must give equal electron emission for maximum amplification and this is hardly possible when the tubes are controlled separately by manually operated rheostats or even when the bank of tubes is operated from a single rheostat. Individual regulation depending upon the judgment of the operator is the height of uncertainty. With the tubes operated from a common rheostat, there will be a difference in potential across the filament of each tube due to the voltage drop in the line, the voltage being lower at the tube farthest from the rheostat than at the tube next to the variable resistance. Individual control of the tubes is desirable only if the control is automatic.

Still another item in the economical operation of the tubes is that of carelessness in handling a manually controlled rheostat, or the use of a battery switch if one is installed. On multi-tube sets it is the common practice to leave the rheostats of the amplifying stages in their normal "on" position after pulling the battery switch, and this means that the filaments will be subjected to an excessive current flow for several seconds after the battery switch is again snapped on, for the cold rheostat will not present its full resistance until it has been warmed up by several seconds of current flow. During this time, the filaments receive abuse which in the course of time will make a marked reduction in their life. Again, we frequently find that the rheostats have been unintentionally turned full on by inquisitive persons monkeying with the sets, and again the tubes receive a jolt when the switch is snapped on.

Probably the most noteworthy attempt at automatic filament control for amplifier tubes is met with in the "Amperites" manufactured by the Radiall Company. These are small cartridge like resistance units which remind one of the usual tubular grid leak and are mounted on small springclip bases much like the tubular leak type. One of the Amperites is placed in series with each of the tube filament lines, just as with the ordinary rheostats, and by the properties of the resistance unit the filament current flow is held at a constant value regardless of the voltage fluctuations of the battery. Fully charged or discharged, the battery voltage makes no difference in the potential across the filaments until the battery voltage is finally allowed to drop below the normal voltage rating of the tube.

Practical tests with these little automatic rheostats showed that the tubes were held at the proper voltage through a wide range of battery charge conditions, and that all of the tubes in the bank were delivering their maximum output. As an additional advantage, there were no amplifier rheostat knobs on the panel and the wiring was very much simplified. Instead of fussing around with the rheostat knobs and lifting the cover of the cabinet to watch the filaments, one can confine their attention to the tuning controls.

OFTEN HEARD BUT SELDOM SEEN

These are the "faces that go with the voices" from Station WGY, the Schenectady station of the General Electric Company. These popular announcers are, from left to right, front row: Robert Weidaw, Kolin Hager, chief announcer; Carl Jester; back row, William Fay, Asa O. Coggeshall and Edward H. Smith.

A Universal Amplifier

By FELIX ANDERSON

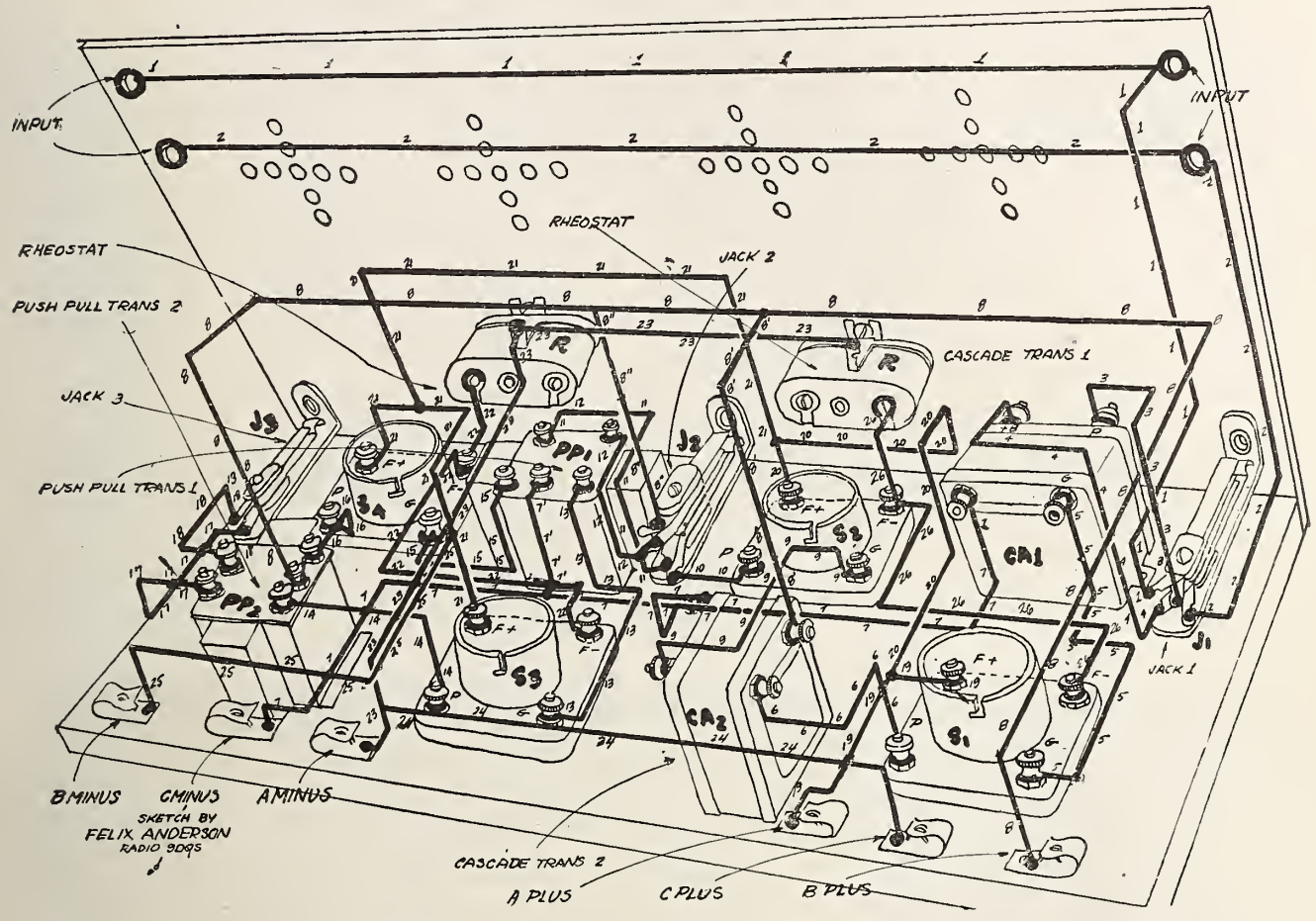


Figure 3. An isometric sketch of the improved amplifier with wires numbered to correspond with the circuit diagram of Figure 4.

RECENTLY the writer has noted a tremendous demand for receivers of the improved type. Readers have repeatedly sent in requests asking how their one-tube receivers may be improved. In their questions they request us to specify whether radio frequency or audio frequency shall be used, and in some cases both are advised; some only audio or radio, and some neither. This depends entirely upon the type of circuit used.

With the idea in mind of designing a unit that could be used effectively on any type of receiver, the writer decided that the majority of the simple circuits would not profit by a radio frequency amplifying unit, and therefore devoted his attention toward designing a unit that would be compact, inexpensive, efficient, and which could be used to advantage with practically any type of receiver.

Portables for Vacations

With the advent of Summer, one also has to consider that there will be many portable sets constructed which will be taken on vacation journeys and jaunts. On returning to the summer cottages or homes these small compact portable receivers will lose their usefulness inasmuch as their signals are not loud enough to be used to entertain a large gathering.

The writer decided, therefore, that it would be a good idea to show readers how to construct a unit that could be connected to either a portable or a home receiver, and which would produce signals of sufficient intensity to be used on the same basis as the phonograph; for dancing and general entertainment.

Returning to our original subject, the demand for improvements on receivers has been very great and we therefore recommend that experimenters who care to improve their present sets consider the construction of a unit of this type.

The improved Cockaday is probably the most convincing argument in this behalf.

The Unit

The unit which I am about to describe consists of two stages of cascade audio frequency amplification which uses the tubes in the ordinary manner of connecting up the two-stage amplifier. The remaining tubes are used as a third stage of amplification employing the balanced amplifying circuit more commonly known as push-pull amplification.

The merits of using the balanced amplifier for a third stage were discussed in detail in the January, 1924, number, where the separate unit of this type was described. Briefly, its advantage lies in the fact that the two tubes are practically used to do the work of one, which results in more efficient action on the part of the valves and transformers and produces a signal of great audibility without the customary squeals, distortions and noises which accompany amplifiers in the third stage when connected in cascade.

The expense involved in such a unit is not very great when one considers the quality, amount, and nature of the signals produced.

Construction

First of all, the parts required for the unit are as follows:

1 panel, 7x14 inches.
1 cabinet, 7x14 inches.
1 mounting board.

(Continued on page 16.)

(Diagrams on next page.)

Amplifying Unit for Any Type of Receiver

(Continued from preceding page.)

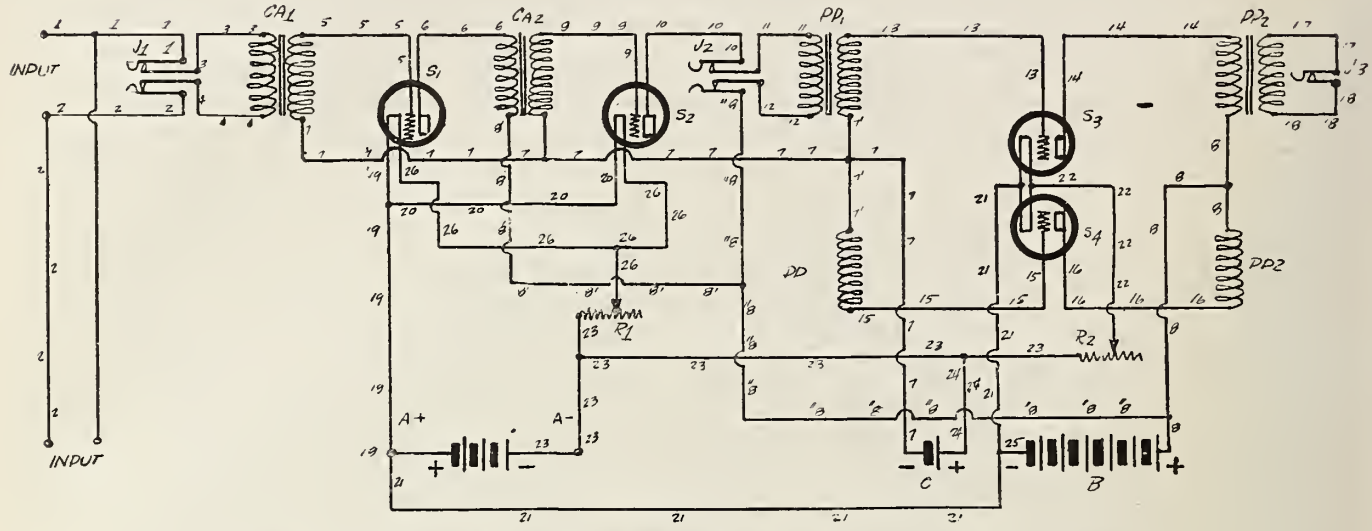


Figure 4. Connections on the above cut correspond with the numbering on Figure 3.

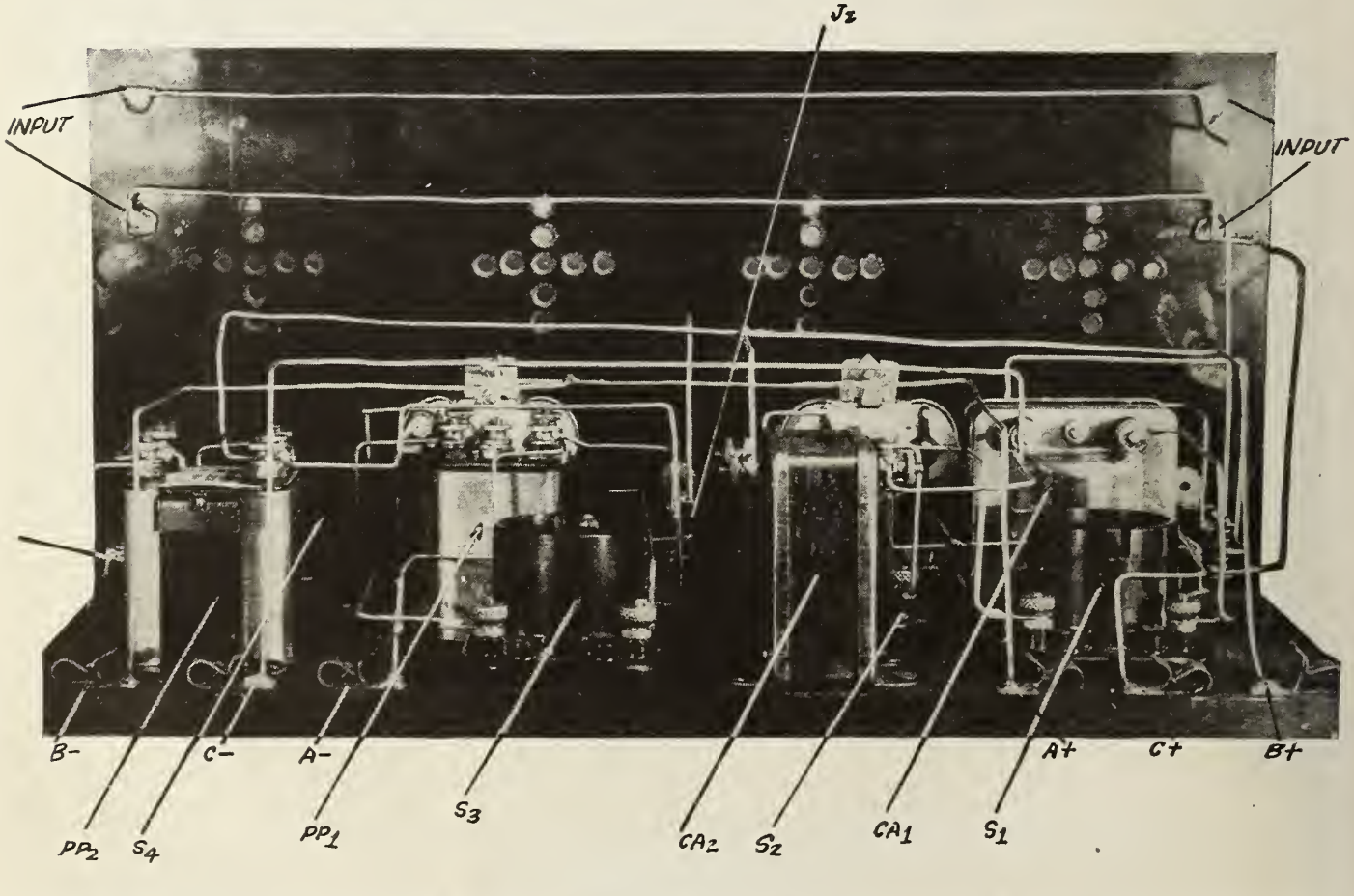


Figure 5. A back view of the amplifier described in the text on pages 9, 10 and 16. The lettering refers to the following parts: PP1 and PP2 the push-pull transformers, S 1, 2, 3 and 4 the tube sockets, J 2 the jack for the cascade amplifiers, CA 1 and 2 the cascade transformers, and the binding posts which are marked according to their respective polarities. This unit can be used effectively with any type of receiver, and will deliver signals of great intensity when properly constructed and operated. Two sets of input binding posts are used, making it possible to use the unit with either right or left handed receivers.

(This article continued on page 16.)

All Together for a Radio Summer

1924 to Be Most Popular Season

THE Summer of 1924 is destined to be the greatest "radio Summer" since broadcasting was begun, as a result of extensive plans and programs just completed by leading broadcasting stations throughout the country, as well as manufacturers of radio apparatus.

A nation-wide survey has disclosed that at no previous time has the radio industry been so geared to give a higher standard of service to the radio public. Reports from manufacturers, distributors, amateurs' organizations and other factors in the industry indicate a general movement to bring radio out into the sunshine during the Summer months.

Conventions "On Air"

Probably the great Summer-time event on the season's schedule is the Democratic national convention in New York City this month and the Republican national convention in Cleveland. These great gatherings will put the "fan" in the thick of the pre-election campaign and for the first time in history millions of people will be able to "attend" the national conventions.

The listeners-in will be able to follow each political issue as it is fought out on the convention floor; they will hear the nomination speeches of "favorite sons"; the thunder of applause for popular candidates—the music, the clamor and the excitement of the impromptu parades which will spring up from time to time on the convention floors. Elaborate arrangements are being made so that the largest possible radio audience may be able to listen in on these conventions.

Immediately after the conventions will come the Presidential election campaigns, in which radio again will play an epochal part, for nearly every candidate intends to broadcast his appeal to the electorate through the air.

Increase In "B" Stations

Because there are more Class B high-powered broadcasting stations in operation this year than during 1923, reception during the hottest Summer months will be vastly better than ever before. The new allocation of wave lengths, especially among the higher powered stations, is expected to eliminate much of the interference resulting from conflicting wave lengths.

Most of the great sporting classics and outdoor events scheduled for 1924 will be held during day-time, thus assuring clarity of reception. Also, such events offer another reason for the anticipated increase in popularity radio will enjoy this Summer.

Manufacturers of radio products point out that because of the vast improvement in radio apparatus during the past year, the varied programs from many broadcasting centers will be received with great satisfaction by millions of radio "fans" throughout the country.

With 591 broadcasting stations to select from this Summer, no town or hamlet in the country will be without a suitable program during the sultry days. Changes in antenna and aerial systems have increased the radiation efficiency of many stations.

Broadcasters to Join

The broadcasters especially are doing their "bit" to make 1924 a successful radio Summer. Inter-connecting systems of radio broadcasting, whereby important stations will join for the simultaneous broadcasting of outstanding events, will insure the clear and adequate reception of the many messages of national importance now being planned.

The uses of radio during Summer-time are unlimited. Besides being a fascinating pastime during the long Winter months, radio reception will be a boon to those

Kadel & Herbert Photo.

NOW A FLAT TIRE IS A PLEASURE

For while she's waiting for someone to come along and change the tire, our lady vacationist can tune in on her faithful set and be entertained from distant cities. Radio has become so popular that vacationists and tourists this year are planning to take their sets along to help idle away the Summer hours. The scene above was snapped in the vicinity of Washington, D. C., and shows a radio enthusiast experimenting with a super-heterodyne with which no aerial or ground is needed.

who have vacation thoughts for Summer.

Radio can be quickly made a permanent part of every seashore home; the mountain home or lodge; the camp; the automobile on tour; the farm catering to Summer boarders and the motor boat or canoe with facilities for a portable receiving set.

Any of these places can easily be equipped with a radio set, for they are never so far away from the nearest broadcasting station that good results cannot be obtained. Portable sets, which can be transported from place to place and set up in a few moments, are expected to be extraordinarily popular this Summer.

Radio Everywhere

Summer resorts already are advertising radio as one of their special advantages for the vacation months. All this forecast of expected conditions indicates that no matter where a "fan" travels this year, he can always have his faithful friend, radio, within easy reach.

The baseball fan will be able to follow his favorite team no matter where he goes. Every station of importance is arranging to broadcast the baseball scores in all the leagues. Several boxing events, ending with a championship bout between Jack Dempsey and Harry Wills in the late Summer, will be carried through the ether to millions of eager listeners.

A comprehensive list of suggestions for the summer-time radio fan, with latest pictures and diagrams, will be published in the RADIO AGE for July. Watch for it.

Radio Conference Planned

Secretary of Commerce Hoover will call a general radio conference in Washington soon after the adjournment of Congress in an effort to secure co-operation of all radio interests in clearing up the ether and solving the problem of distributing wave lengths. A conference will be called whether or not new legislation is enacted.

The conference will be similar to those in the Springs of 1922 and 1923, at which representatives of the manufacturers, broadcasters, engineers, amateurs, commercial operators, and broadcast listeners aided in drawing up voluntary regulations under which radio has been supervised ever since. It was in this manner that the distribution of wave lengths for broadcasters and other interests was developed.

Present indications are that broadcasting stations will continue to increase, although wave lengths available for this use are practically exhausted and stations are doubling up. Even time allotments in congested sections are becoming difficult to make.

Secretary Hoover believes congested conditions and interference are not improving.

If the White bill is enacted, Secretary Hoover pointed out, new regulations and probably re-allocations of wave lengths will have to be made, and if no legislation is passed this will still be the case; otherwise a condition such as prevailed two years ago would confront the radio public.

Thousands in "Radio Church"

The voices of clergymen in Schenectady, N. Y., which for years have been limited to the confines of their churches, are now carried to all parts of the North American continent by radio.

Every Sunday the services of the many churches in Schenectady are attended by two congregations; one visible to the pastor and the other that unseen but appreciative audience of radio devotees.

Sermons Go Everywhere

Religious services have been a regular part of WGY's programs for several months, in co-operation with the Schenectady Ministerial Association. The messages of the clergy have reached especially to the thinly populated districts of Northern New York, New Hampshire, Vermont and Canada.

All of the ministers report the daily receipt of letters of appreciation from the listeners. Frequently they contain sums of money, which in many cases are set aside as mission funds. The most enthusiastic praise has been received from woodsmen, farmers, forest rangers, keepers of light ships and others in isolated regions.

Kadel & Herbert Photo.

BROADCASTING FROM THE CLOUDS

The newest feature of broadcasting has been adopted by army fliers. Under the direction of Major George Vaughn, 27th Air Service of the New York National Guard, former aces are now piloting airplanes and broadcasting interesting talks on army life while their machines speed through the sky. Each radio plane covers a specified territory and is equipped with a five-tube army transmitting set, which makes the new innovation possible. The picture shows Captain Brower, former war ace, piloting a Curtis plane while a radio engineer is talking into the transmitter.

A Sure Fire Reflex Set

By R. J. ROBBINS

IT HAS been my sad experience that there are many so-called reflex hook-ups printed for which great claims were made. The ones which intrigued my interest mostly, however, were the one-tube sets which were widely advertised to work a loud speaker, but which I, frankly, have not been able to duplicate in practice. At the beginning of this description of my latest pet circuit I will be pardoned if I remark that this set will *not* work a loud speaker in my town on *anything* except the *local* broadcaster. Nevertheless, it will satisfy the most hardened BCL for tone quality, distance and volume. The circuit used is an old standby that is known to every BCL or Ham and was selected from several as the most promising of all. The general layout and method of tuning may be of interest, and it is hoped that a few of the DT's will try it out. I can promise entire satisfaction if all instructions are faithfully carried out.

Materials Needed

1 panel condensite celoron or radion, 10x10x3/16 inches.
1 panel for shelf celoron or radion, 8x5½x3/16 inches.
1 potentiometer, 400 ohms.
1 rheostat, 30 ohms.
1 good socket (do not substitute).
1 neutroformer.
1 4-inch dial.
1 piece angle brass, ½x½x7 inches.
1 jack (double circuit if audio amplifier to be used.
1 crystal detector.
1 audio transformer.
1 Acme R-2 R. F. transformer.
4 binding posts.
3 mica fixed condensers, .002, .006, .001 M. F.

Layout of the Panel and Shelf

The dimensions given for the panel and shelf are not in conformity with the standard sizes now furnished by most manufacturers, although the writer knows of at least one who carried the 10x10-inch size fairly recently. The layout for the panel with all necessary dimensions and indications of operations to be performed is shown in *Fig. 3,* while *Figs. 1 and 2* represent the front and rear views, respectively, of the assembled set.

The various holes are first laid out carefully. The only part of the work which should present any difficulty will be the sight holes for the bulb and the mounting screws for the neutroformer. The centers for all of these holes should all be located carefully by means of the compasses and all intersections of lines at correct points should then be deeply punched to center the drill.

All holes should be started with a small size drill to insure accuracy. These are then "chased" with increasingly larger sizes until all are of the sizes specified in plan.

The same procedure is carried out in regard to the shelf, which is shown in *Fig. 4.* If other parts than those specified are to be substituted some of these figures will probably have to be altered, but this is left to the individual who builds the set. In the case of the Acme R. F. transformer substitution is not advised, as a great deal of the success of the set will depend on this feature alone.

Assembly of the Set

The use of the neutroformer provides a novel tuner which has thus far proved very satisfactory. The aperiodic primary winding eliminates the necessity for switches and taps in the antenna circuit, thereby boiling down the total adjustments of the set to four—if the crystal detector may be classed thus.

The shelf is first mounted in place by means of the 7-inch length of angle brass drilled off as shown in *Fig. 5* and held to the front panel and shelf by means of flathead brass 8-32 machine screws and nuts.

The neutroformer comes next, being mounted by means of long 8-32 flathead brass machine screws and check nuts in such manner that it is spaced back from the panel about ½ inch. If this combination is used a very efficient tuning unit is assured and the front appearance will be found to be quite effective. It will be noted that the edge of dial comes directly in line with one of the mounting screws which support the shelf. This was intentional design and offers a very handy index for the dial if the slot in the screw is left in a vertical position to line up properly with the dial divisions.

The rheostat, potentiometer, jack, antenna and ground binding posts are now put in place, particular care being taken in the case of the first two named that binding posts face upward. The potentiometer should be on the side facing the ground lead, thus insuring short connections. The crystal detector occupies the space to the right of the dial in the two holes provided for it. This completes the assembly of the panel.

The balance of the work is soon accomplished. The socket is mounted in the

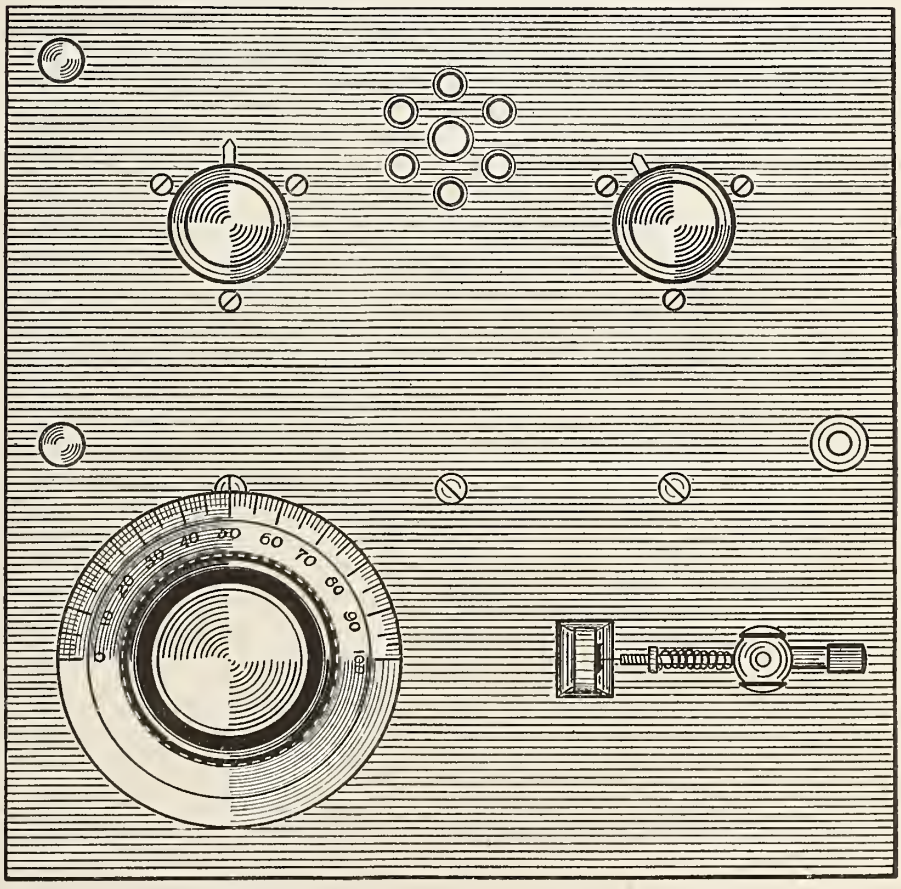


Figure 1. A front panel elevation of the Simple Sure Fire Reflex Receiver. There are only three major controls, two of which require but little attention while tuning. The dial in the upper left-hand corner is the potentiometer, immediately to the right are the peep holes for the tube, and next is the rheostat. Directly below the potentiometer is the tuning condenser and to the right is the crystal detector. A phone jack is shown directly to the right and above the crystal detector.

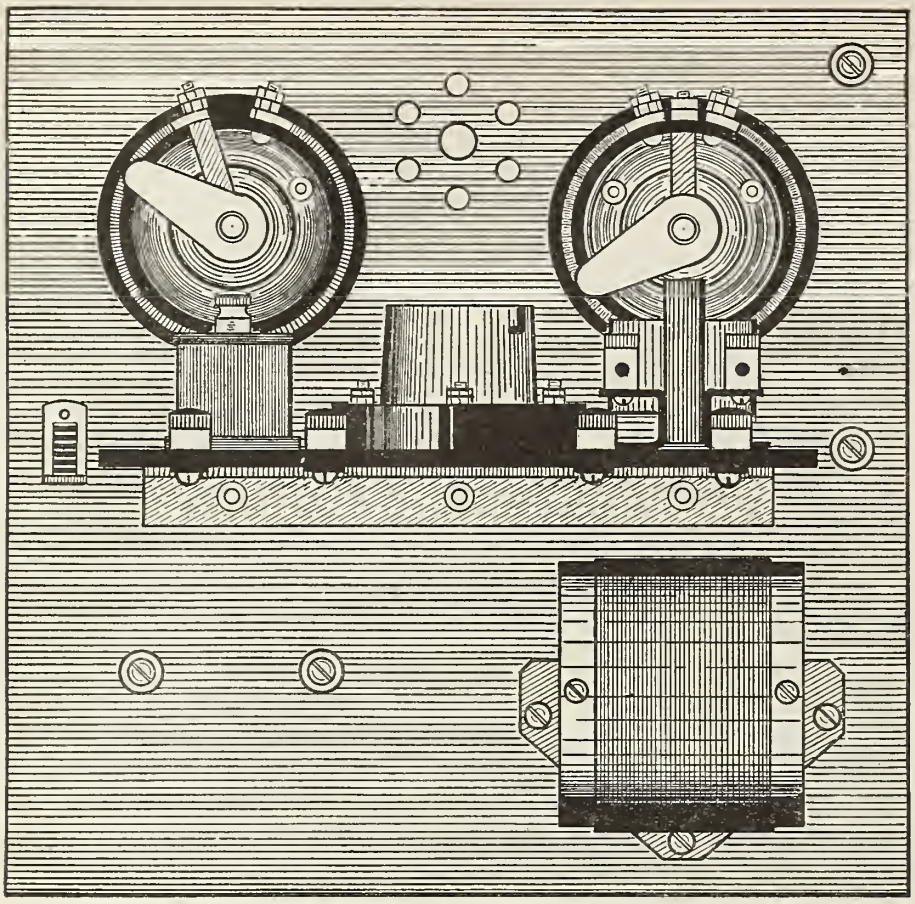


Figure 2. The back panel layout of the simple Sure Fire Reflex Receiver.

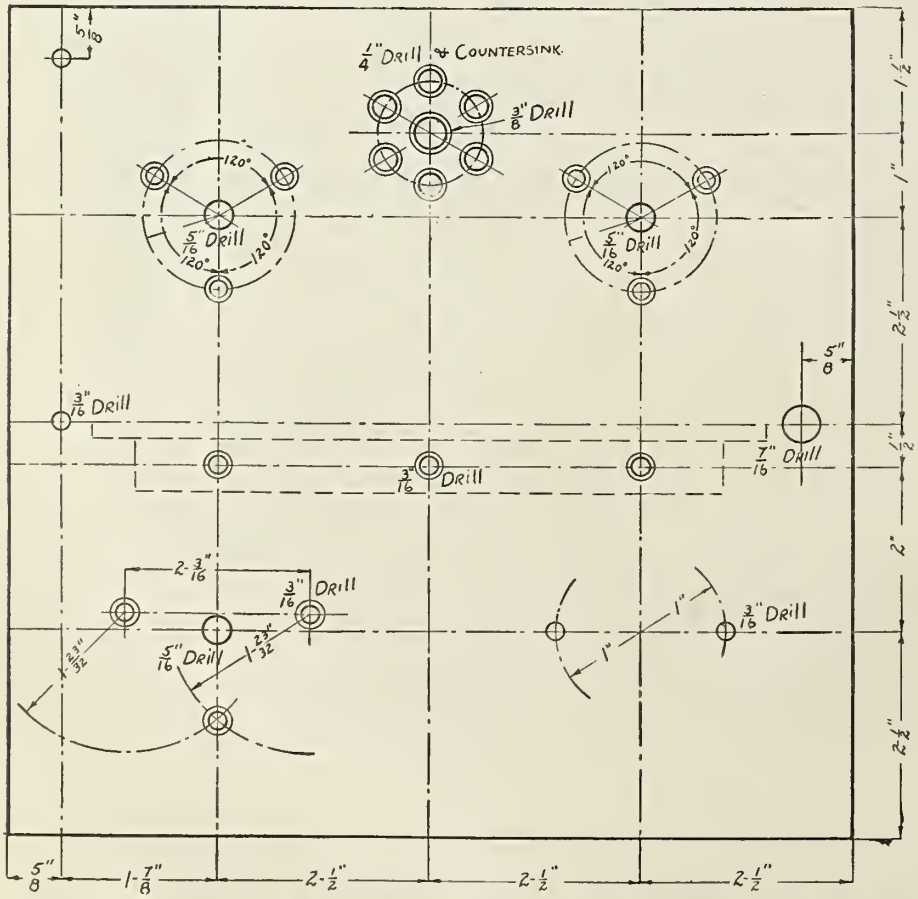


Figure 3. Template, drilling and layout instructions for the simple reflex described in the accompanying article.

center of the shelf in the position shown. Care should be taken that the posts marked G and P be left facing the rear, which will make for the shortest possible leads. The R. F. transformer is then put in place to the left of the socket and the audio transformer to the right. This places it close to the grid, which is desirable, while the plate leads are equally short to the R. F. transformer and B battery posts. The binding posts are the last to be put in place.

This completes the assembly work on the set, and we are ready to commence the last stage of the work, namely, the wiring. To some this work is the bugaboo of making a set, but there are comparatively few wires in this set, and this should present little difficulty even to an inexperienced worker.

Wiring of the Reflex

The writer may horrify certain of the radio fraternity who have fixed ideas as regards methods of wiring and soldering connections. The first blow will be dealt to those who use rosin. Many use this stuff and apparently get away with it, but here is one experienced radio man who says that the stuff is better to oil up fiddle bows with. The tinsmith doubtless will find it very serviceable in his profession, but it is not good for this work. I just had the pleasure of tearing down a perfectly nice job which had been done on a five-tube Neutrodyne which refused to utter a whimper. The root of the trouble proved to be the *non-corrosive* rosin which occupied every bit of space it could find in the interstices between the soldering lugs and binding posts. This formed a nicely *insulated* joint which would not pass storage battery current in some cases. In passing may I mention that I do not use an excessive amount of flux or solder on any joint, yet the above trouble developed after considerable precaution had been exercised. The cure was found in the use of muriatic acid cut with zinc and used very sparingly with plenty of heat to each joint. Do not be content until the solder runs bright and flows evenly over the wire.

In the case of binding posts it will be found more effective not to use soldering lugs at all, but make connections direct with the wire itself by making neat bends in it with the pliers and gripping with the posts. Do not solder to a post, as this procedure is unnecessary and makes dissembling of the set more difficult if this should prove necessary.

Keep all wiring widely spaced and run plate and grid wires at right angles if any come near each other. Try to figure the shortest possible route for each wire to run and keep all lines parallel by making neat bends of 90 degrees whenever a wire has to change direction. After wire is all in place connect in the three fixed condensers at points indicated and set is ready to try out. At this time it would be well to provide a suitable cabinet. This may be of oak, mahogany, birch or any wood preferred by the builder and should be given a good finish, as the set will present a fine appearance if properly enclosed.

Some Hints for Operating

This set will be found to give best results with UV201A tubes, although the UV199's may be used if the proper socket is used originally. Do not use adapters, as too much energy is lost in these makeshift arrangements. Short, direct leads and good connections go far to insure success with a reflex set. Insulation is of paramount importance and the writer advises against anything but a solid rubber socket or one made entirely of bakelite or similar material. This feature alone has spelled doom to success for many. Those with metal ferrules especialiy are to be avoided, as undesirable capacity effects are too often introduced in such sockets. Quite often we hear of some person who has a set employing one or two stages of R. F. amplification bulb detector and additional tubes for audio. He employs sockets such as were mentioned above and very often finds that his bulb detector will rectify perfectly without grid condenser or leak. As a matter of fact, the poor insulation between terminals is responsible for these results in a great many cases and his tube is no different from scores of others which ordinarily perform in normal style. For a set of this kind the oft despised porcelain sockets which have been placed on the market by several courageous manufacturers should yield very good results and may be classed favorably with the all-rubber or all-bakelite sockets mentioned before.

When all is ready connect the A and B batteries to the proper binding posts and light the bulb by turning up the rheostat. A pronounced click in the phones should be heard when the plug is pushed into the jack, indicating that the plate circuit has been connected up correctly. If there is no stray leakage at any point no music, signals or noises of any kind should be audible until the catwhisker is placed upon a sensitive point on the crystal. It will be found very simple to locate a good spot, as the crystal is very easy to operate when strong R. F. voltages are applied to it. Any good crystal rectifier such as galena, radiocite, silicon or carborundum will be satisfactory. Their grade of sensitiveness will be about in the order named.

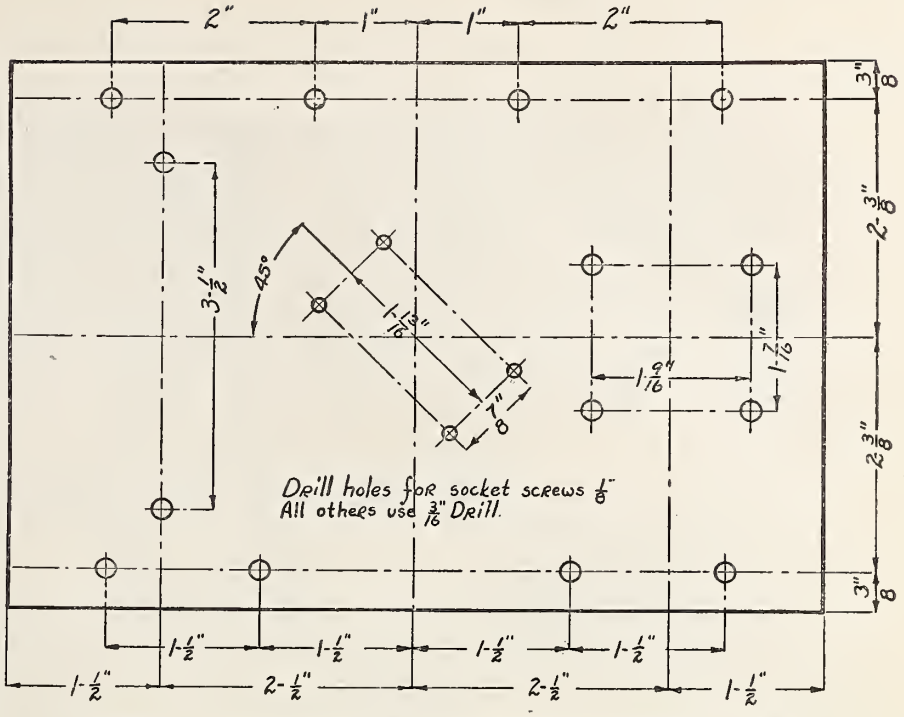


Figure 4. How to drill the holes on the tube and transformer shelf.

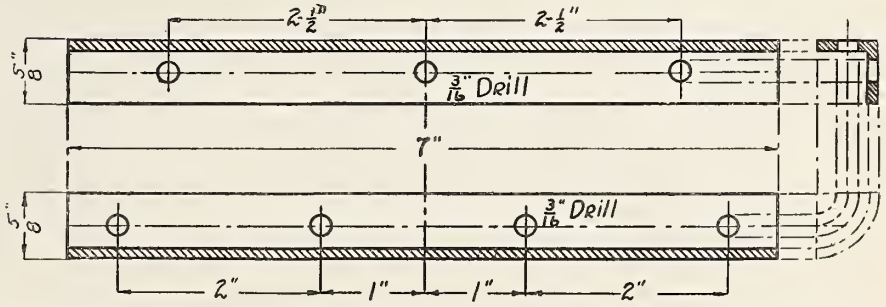


Figure 5. The bracket supporting the shelf is drilled in the manner shown herewith for the best mounting arrangement.

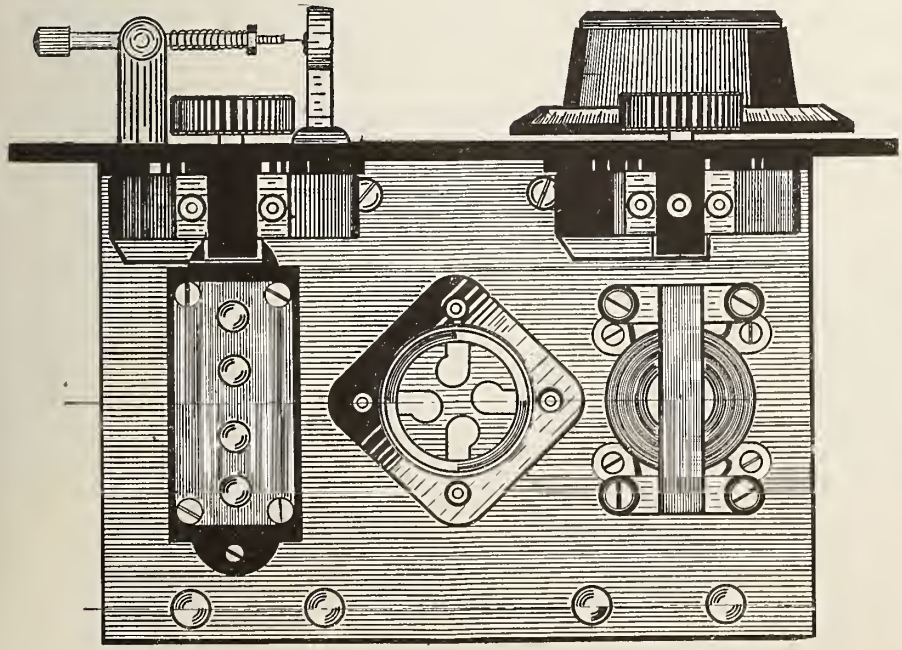


Figure 6. A top elevation of the Sure Fire Reflex.

When a broadcasting station is tuned in on the dial the potentiometer and rheostat are given further adjustments until the signal is at maximum intensity. It may be well to try for a better point on the crystal also as this will make a marked difference on the strength of the received music. Several bulbs should be tried out until a good one is found, as all 201A's will not reflex equally well. In the writer's experiments a 5-watt power tube gave surprising results on a 6-volt A battery and 90-volts plate which is far below the rated plate voltage for these tubes.

It is suggested that this set by a little alteration in design may be adapted to a portable form including batteries and all by use of the UV199 tubes. In such case the panel may be made a little smaller. The rheostat and potentiometer would

(Continued on page 26.)

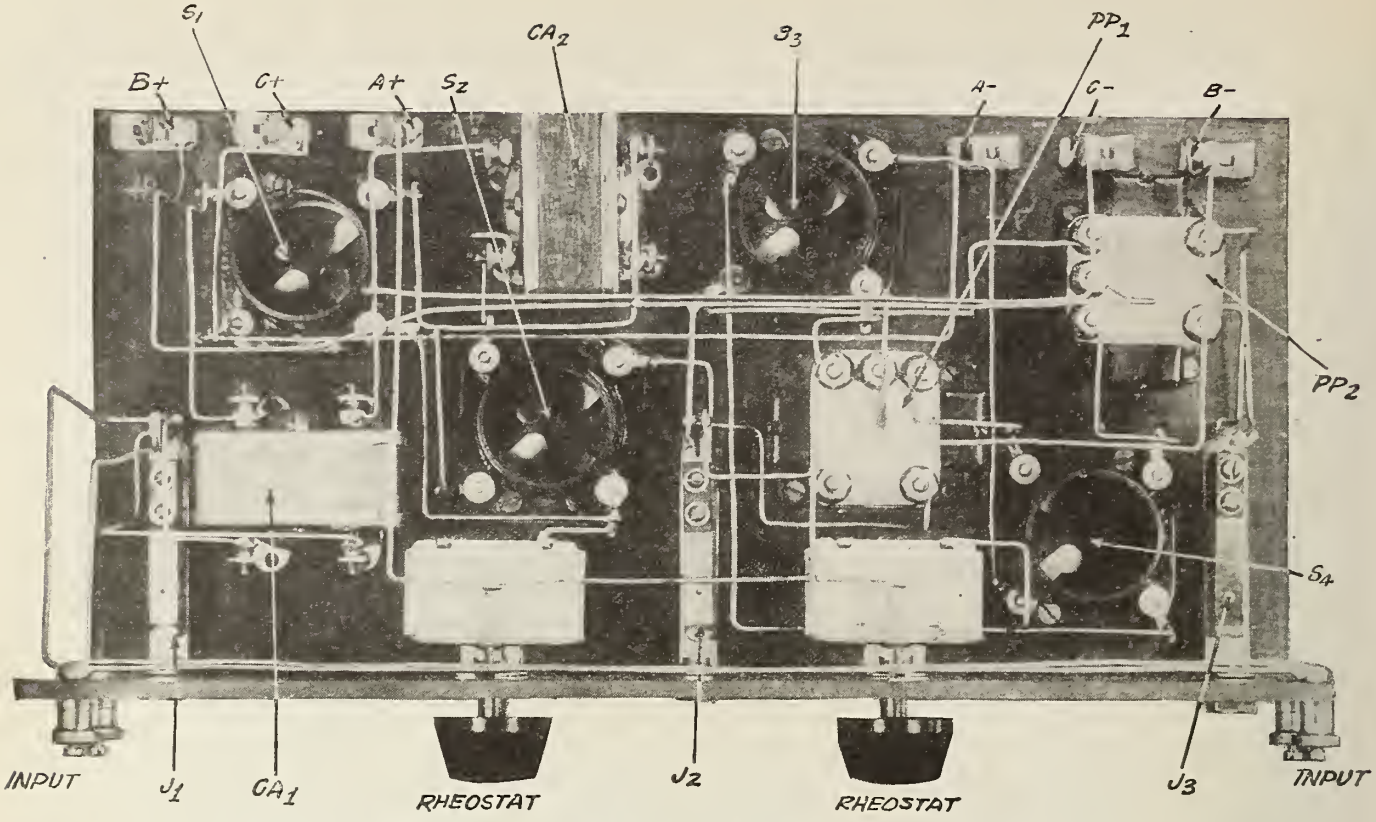


Figure 2. A top view showing the layout of apparatus and their respective mounting on the panel. Binding posts make connections with the wires going to the batteries through holes drilled in the back of the panel. The cabinet should be one with a hinged top.

A Universal Amplifier

(Continued from page 10.)

2 rheostats, 6:10 ohms.
1 5-to-1 amplifying transformer.
1 3-to-1 amplifying transformer.
1 pair push-pull transformers.
4 tube sockets.
2 four-spring jacks.
1 2-spring jack.
6 Fahnestock binding posts.
4 panel mounting binding posts.
7 small wood screws.
20 feet tinned copper busbar.
4 UV 201-A tubes.
1 nine-volt C battery.
2 forty-five-volt block batteries.

The panel should be drilled in accordance with *Figure 5*, which shows the back view of the unit. It is quite necessary to adhere to this method of drilling if the layout of apparatus shown in *Figure 2* is to be used.

Two Rheostats Used

The apparatus should be placed as shown in *Figure 2*. It will be noted that this affords short connections; it places all transformers with cores at right angles, thereby reducing chance of interstage coupling, and yet preserves the symmetry of the unit so that the tube sockets will come directly behind the peep holes drilled in the panel.

Only two rheostats are used, one controlling the cascade amplifiers, and the remaining one controlling the balanced amplifier. Rheostats should be from 6 to 10 ohms if UV 201-A tubes are used, and they should provide sufficient resistance for the two tubes when used in parallel. If the type of rheostats shown are used, the connections should be made in accordance with instructions accompanying them. The jack, J1, connects to the plate circuit and B battery of the detector, and provides a means of using the detector alone if so desired.

When the plug is inserted in J2 and the first rheostat is turned on, the cascade amplifiers are in use. When the second rheostat is turned on and the phones plugged into J3, the balanced amplifier is automatically connected into the circuit and the entire component is used.

The writer is aware of the fact that there are many receivers built with both right and left hand outputs, and has therefore incorporated the idea of two input sets of binding posts on the front of the panel. This is a matter left to the judgment of the builder, who can decide which is the most efficient from the construction of his present set.

Figures 3 and 4 are the working sketch and wiring diagrams respectively. The wires are numbered to correspond to reduce the possibility of incorrect connections.

Figure 5 is another view of the unit, showing how the arrangement looks from a rear elevation.

Getting Rid of Noise

In all cases the lettering refers to the following parts. CA1 is the first cascade transformer; CA2 the second; PP1 and PP2 are the push-pull transformers; S1, 2, 3, and 4, the tubes and sockets; J1, 2, and 3, double and single circuit jacks respectively, binding posts being lettered in accordance with their respective values.

It is a wise plan if the set is found to be noisy to place a .00025 MF fixed mica condenser across the secondary (G and F posts) on the cascade transformers and across this condenser connect a grid leak of the pencil mark type. This invariably reduces noises and clears up reception.

The signals can be adjusted further by placing the low ratio transformer in the first cascade amplifier circuit, and by shunting a .001 MF fixed condenser across the input posts on the panel.

The RADIO AGE data sheets printed on pages 37 and 39 should be carefully filed away as described in the preceding issue.

In a comparatively short time these sheets will represent a world of valuable information and reference.

Don't fail to save them.

Broadcaster Wins Copyright Suit

ONE of the most important court decisions in the history of radio was handed down in the United States District Court at Cincinnati, when Judge Smith Hickenlooper ruled that radio is not a public performance for profit and the broadcasting of copyrighted music does not constitute a violation of the copyright laws.

Accordingly Judge Hickenlooper dismissed a suit filed by Jerome H. Remick & Company, Inc., New York music publishers, against the Crosley Radio Corporation, in which the plaintiffs attempted to compel the Crosley Corporation to pay a special tax for permission to broadcast copyrighted music.

Not For Profit

The rendition of a copyright musical composition is not a "public performance" within the meaning of the music copyright law, the judge explained, because in making the copyright statutes Congress intended that there must be an assemblage of persons congregated at the place of amusement for the purpose of hearing the music.

The Remick petition was dismissed on the grounds that the facts stated did not establish just cause for action.

The decision will have an important bearing on the radio industry and the development of broadcasting, as it literally makes the air free for radio. It gives broadcasters the right to play all music, whether copyrighted or not, without their being compelled to pay a special tax to the American Society of Composers, Authors and Publishers, of which the Remick Company is a member.

The Crosley company's attorneys' sole contention was that the broadcasting of a song is not a public performance for profit.

History of Campaign

The campaign against broadcasting stations was started by certain members of the American Society of Song Writers, Authors and Publishers, about two years ago. They began by notifying the studio directors that they could not play certain music unless they announced before each selection that it was being played by permission of the society.

There was no objection to this on the part of the broadcasters, and the wishes of the society were complied with. Some time later the society notified all broadcasting stations that they must pay a special tax to the society before they could play copyrighted music. There were a number of station owners who agreed to the request of the society and paid this tax, but there were others, including the Crosley Radio Corporation, who contended the imposition of this tax was unconstitutional and refused to pay it. A large amount of music was being published by independent music houses, and distributed among the radio stations by the National Association of Broadcasters, and from this the radio stations selected their songs.

The task of eliminating all copyrighted music, however, was a fairly large one, and due to an error a copyrighted selection was played from W L W. This happened to be a song published by the Remick Company, and so that organization filed the suit.

The latest decision regarding broadcasting of copyrighted music will be appealed and probably will go to the United States Supreme Court, unless the National Association of Broadcasters succeeds in having the Copyright Act amended.

The Association of Broadcasters, however, has warned its members against using American Society music, on the basis of the decision, because broadcasters must remember that this is a decision merely by a single judge, and that judge himself is of the view that his decision is contrary to that of another Federal judge. If the highest court reverses this decision, then various penalties for infringement would be enforced. Broadcasters are therefore advised to avoid using any music except that which is released and approved by the National Association of Broadcasters.

Photo Topics, Inc.

THE LINE FORMS ON THE RIGHT

When the New York Police Department placed a ban on loud speakers in front of stores, the Chamberlain Electric Company showed a bit of enterprise to gain the attention of passers-by. They hitched up a few sets of earphones to a set displayed in the window, and offered them to pedestrians who cared to listen in. The number of persons who stand in front of the window was limited, but the "fans" waited in line to get a few bits of a popular concert.

Amendment In Senate

Whether copyright laws will apply to compositions broadcast in the ether, requiring payments of royalties to the authors, composers and publishers by the broadcasting stations, is now up to the Senate Patent Committee. Considering the mass of testimony, pro and con, given in two days of hearing on the amendment to the Copyright Laws proposed by Senator C. C. Dill, which would eliminate broadcasters from paying fees to copyright holders, it may be some time before the committee can digest the matter and make a report.

"Like free speech, religion and the freedom of the press, he wants radio un-handicapped and un-controlled," Senator Dill said. "If moving pictures and automobiles took their people out of their homes, radio has a tendency to bring them back. The listener-in should not be taxed, and he is confident that through radio a universal language will develop which will better unite people of all nations, and may prevent future wars."

Opposition to his measure, The Dill Bill, S2600, is strong, however, and Senator Dill's plans may be defeated in committee or later on the floor.

Leading musicians, authors, composers and publishers appeared before the Senate Committee, in opposition to the Dill Bill. In general they were members of the American Society of Composers, Authors and Publishers, but some independents also testified.

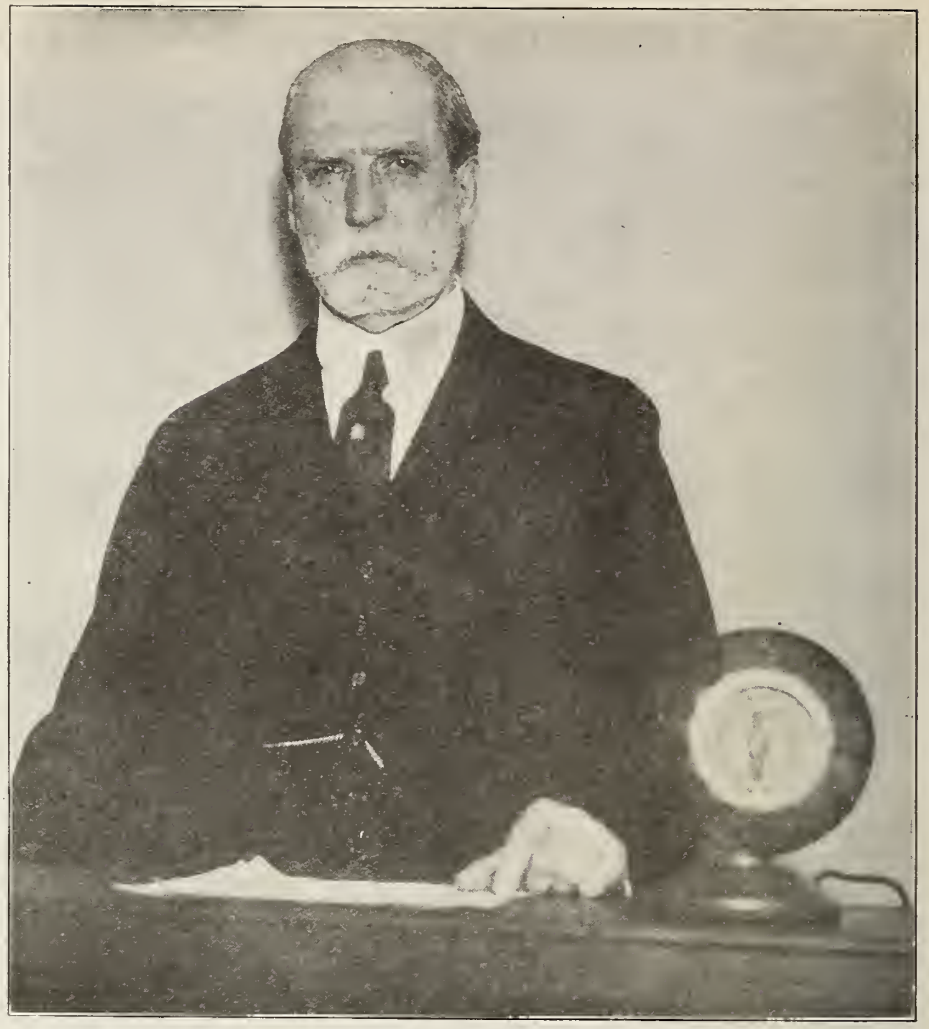
Those present included Gene Buck, president of the society; Victor Herbert, vice-president; E. C. Mills, chairman of the administrative committee; Ellis Barker Butler, president of the Authors' League; John Philip Sousa, Augustus Thomas, and Nathan Burkam, attorney for the Composers' Society.

Mr. Buck said he was appearing in opposition to the Dill Bill "for the life of song writing," and flatly denied that the Publishers' Association was a monopoly or trust of any kind. Questioned, Mr. Buck answered that the association, in asking broadcasters to pay for using songs, does not differentiate between a station operated by a radio manufacturer or one operated by a newspaper. He contended that when people hear a song over the radio they do not care to buy it and said that the continual use of a song in the air made the people "sick of it."

Herbert and Sousa Oppose

Victor Herbert and John Philip Sousa also opposed the bill, contending that the present copyright law should not be changed.

Charles H. Tuttle, of the National Association of Broadcasters, stated that radio was the greatest blessing that science ever had given to man. He accused the composers of "passing the buck" to the listener-in and claimed that the composers wanted the broadcasters to join with them in an agreement to charge the public, in which case it would be one of the greatest monopolies ever realized. He denied that radio was emptying the moving picture houses. The Composers' Association was said to be trying to tax the radio broadcasters and not the individual songs which they send out. He believes that the music publisher is opposing the bill and not the writers and authors.



Kadel & Herbert Photo.

SECRETARY HUGHES OPENS CONVENTION

Charles Evans Hughes, secretary of state, made an impressive keynote speech before the Republican State Convention in New York recently; doubly impressive because his message was broadcast to eager partisans who could not attend the convention. Here he is before the microphone, addressing the convention and his ethereal audience.

Drake Takes Over WDAP

Arrangements were completed last week whereby The Drake Hotel, Chicago, is to assume permanent control of Station WDAP, formerly owned by The Chicago Board of Trade. While the broadcasting of market reports is expected to be continued, the new owners have announced they will reorganize the operation of the station and possibly apply for a new wave length. The call letters also may be changed. Jack Nelson, who has been director of the station for several months, will continue in that capacity. An extensive series of interesting programs is being arranged for June, it was said.

Radio Helps Solve Mirage

When approaching Sydney, Nova Scotia, recently, Captain Bauge of the Hospital Ship St. Joan of Arc, was confronted by a mirage which distorted the shore lines so they could not be recognized. Calling his radio compass into service, he took radio bearings from North Sydney, Magdalen Island, and Canso, with the result that he succeeded in locating his position.

Endeavoring to find the proper point at which to land in a fog, Captain Bauge and a native fisherman who was on board were greatly confused by a mirage which changed the appearance of the coast. They knew they were not in front of Scarati, for a steep cliff could be seen behind the lighthouse, obviously not the gentle sloping hill of the Nova Scotia shore, five miles distant from the lighthouse.

Standing by temporarily until the sun came out, the skipper took an altitude, which plotted with his radio bearings, intersected in a triangle of error of less than three miles on a side. He was east-northeast of Scarati. Soon the lighthouse appeared in its natural place. The radio compass proved correct, he states, despite the "evidence" of their eyes.

The Why of the Heterodyne

By JOHN B. RATHBUN

UP TO the present time, nearly every article published on the subject of the super-heterodyne has started out in the same way, and after reading our first article on the subject we can generally omit the first page and a half of each succeeding article with perfect safety. Possibly this is perfectly correct for articles dealing with so novel a principle, but at times it is rather a bore to read the constant reiteration on the theory of beat reception or how two superimposed waves of different frequencies lead to a resultant wave of a different frequency or wave length. In view of all this repetition on the development of the long wave or beat note, it seems exceedingly strange that all of the writers gracefully side step the true purpose of all this elaborate preparation and entirely fail in telling us why amplification at radio frequencies is more efficient on long wave lengths than at broadcasting frequencies.

In this little sketch I am going to depart somewhat from the conventional and attempt to short description of what takes place in the intermediate stages after the broadcasting waves have passed through the frequency changing stage of the circuit. We will therefore assume that the long wave resultant has already been created in the oscillator-tuner stage by some means or other, and that the low frequency wave has just entered the first stage of the radio frequency amplification system, where it is to be amplified before entering the second detector tube for reduction to audio frequency. Whether this long wave has been created by the superimposed oscillations of a tube or by those of a motor-generator is no concern of ours at the present.

Amplification Wavelength Differs

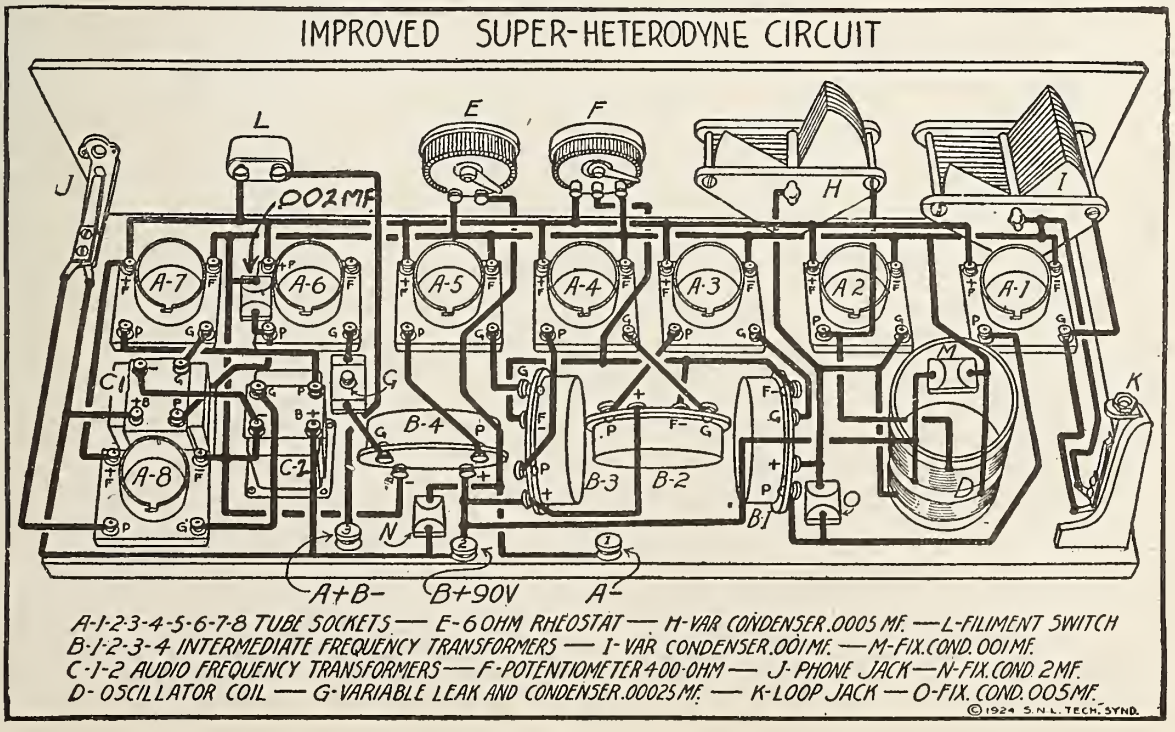
To begin with we must understand that the super-heterodyne is essentially a radio frequency amplification circuit, and in many ways comparable with the standard R. F. circuits or the well-known neutrodyne. The incoming waves are first amplified before the final detection and reduction to audible waves which affect the diaphragms of the phones or loud speaker. The outstanding difference lies in the fact that the radio frequency waves in the heterodyne are amplified at a constant frequency under all conditions and not at any old wave length that the set may happen to be tuned in on. Both the standard radio frequency sets and the neutrodyne carry on amplification at the broadcasting wave lengths of the various stations, but the super-heterodyne amplifies at one constant wave length regardless of the station wave length.

Advantages

It has been intimated in the 101 articles on the subject already printed that amplification at a constant long wave length greatly increases the effectiveness of the radio frequency amplifying stages. It permits of a degree of amplification not approached by the standard radio frequency circuits or by even the neutrodyne. The whole circuit, transformers, tubes and all, can be adjusted to their most advantageous frequency and then afterwards operated indefinitely at this optimum wave length. By this means we can more nearly approach the full output capacity of the tubes than by any other method yet proposed, and as we all know, the capacity of the tubes is the limiting factor in the amplification of the waves. With circuits amplifying at varying broadcasting frequencies, it is not likely that we much exceed 60 per cent of the full amplification capacity of the tubes because of certain reactions that take place in both the tubes and the transformers.

As with all radio frequency circuits we have the regeneration or feed-back to contend with that is due to the capacitance or condenser effect between the grid and plate of the tube. The grid and the plate (in effect) form the two plates of an electrical condenser and through the capacitance of this small condenser, energy is fed back into the grid circuit from the plate circuit, thus introducing oscillations and other reactions which interfere seriously with amplification of the radio frequency circuit. An interchange of electrical charges also takes place in the reverse direction, from the grid to plate, so that a certain percentage of the grid charges are dissipated to the plate and hence the control of the grid over the electron stream is reduced. The net result of the grid-plate capacity is reduced amplification and range.

In the neutrodyne circuit, the capacitance or condenser effect between the grid and plate of the tube is "neutralized" by the introduction of small condensers known as "neutrodons" so that there is little feed-back or regeneration between the radio stages. The reactance of the neutrodons opposes the reactance of the grid-plate condenser, and hence is a decided step in advance of the standard radio frequency circuit. However, perfect neutralizing adjustment is seldom attained under practical working conditions, and many of the evils attending amplification



at high broadcasting frequencies still persist. For the complete elimination of the grid-plate condenser effect we must take up still another method of reducing the reaction, and this is to reduce the capacitance by a reduction in the frequency of the input current.

With any condenser the capacity varies with the area of the two metal plates, the distance between them, the nature of the insulation between the plates, and the frequency of the alternating or oscillating current supplied to the condenser. It is, of course, impossible to change the capacity of the tube grid-plate condenser by varying the area or spacing of these elements since they are sealed within the tube, and for the same reason it is impossible to make changes in the nature of the matter between the elements. However, it is possible to reduce the capacity of the grid and plate by reducing the frequency or wave length of the current in the plate and grid, and this is exactly what is done in the super-heterodyne circuit.

At wave lengths of 3,000 to 10,000 meters the capacity of the grid-plate condenser is very much lower than at the ordinary broadcasting range of 300 to 600 meters, and hence there is much less tendency to feed back or oscillate on the long wave lengths. Instead of receiving the high frequency station currents directly in the amplifying tubes, the frequency is first reduced by the oscillator circuit to that frequency which gives the least tube condenser effect. Theoretically this minimum capacity would be had at wave lengths just above audible frequency, but practically it is not desirable to use such long waves because of other effects which develop in the circuit. A wave length of 10,000 meters is probably the longest wave in common use, and this is far above audible frequency. With wave lengths above 5,000 meters the circuit is likely to suffer from interference due to long wave length stations, and it is much more likely to pick up noises caused by atmospheric disturbances or waves emanating from the electrical circuits of industrial plants and electric railway systems.

Danger from plate-grid feed back and regeneration ceases at about 1,500 meters wave length with ordinary commercial tubes having the usual internal capacities. At 2,000 meters there is very little chance for free oscillation to develop and there is a much less tendency toward picking up interference than at the higher wave lengths. The best wave length for the radio stages from a practical standpoint is still a matter of much discussion, but it would seem that there is a decided limit beyond which it is not practical to go. There are circuits which operate very satisfactorily at from 1,750 to 3,000 meters wave length and as a rule these circuits are not so noisy as those operating on 5,000 to 10,000 meters. An added advantage attending the use of the shorter wave lengths lies in the fact that the radio frequency transformers are simpler.

With wave lengths approximating 2,000 meters we can construct very cheap, simple transformers of the air core neutrodyne type which need only have from 250 to 350 turns of wire in the secondary coil. On 10,000 meters we may require a thousand or two thousand turns on the secondary, thus both increasing the size and the cost of construction. Transformers of the 5,000 to 10,000 meter class are not easily built at home.

Heterodyne Transformers

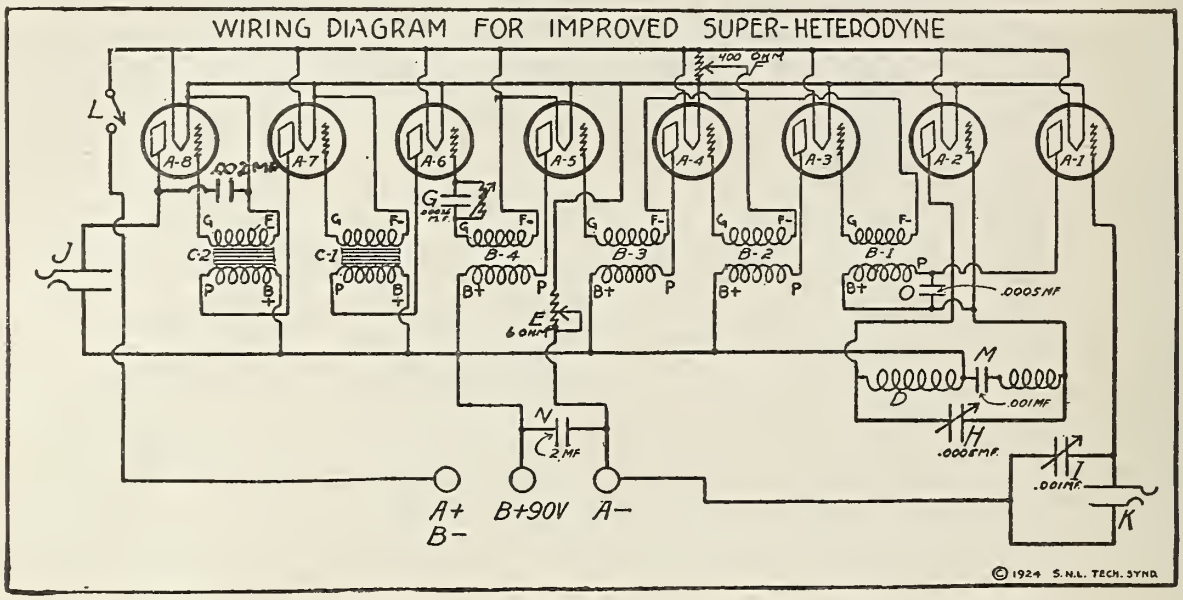
A second point in the consideration of the superior efficiency of the heterodyne radio frequency circuit is the great amplification peak possible with the transformers when they are operated at a constant frequency or wave length. As they work at a single constant wave length they can be carefully tuned to this point when they are built, thus obtaining a maximum ratio without the necessity of repeated retunings every time that the wave of the station is changed. The ordinary type of short wave untuned transformers designed to operate on a wide range btween 200 and 600 meters give a very low amplification except at one or two points in this range. It is very possible that the great superiority of the average home-built neutrodyne depends more on the fact that the transformers are tuned to meet each separate incoming signal than upon the principle of neutralization itself. This, however, requires several variable condensers and as many controls as there are stages of amplification which adds to the difficulty of tuning.

With the heterodyne we gain all of the advantages of the neutrodyne in having closely tuned transformers, and at the same time avoid the many controls since our transformers are tuned once and for all time by means of a fixed condenser set for the constant wave length. In the heterodyne we have only two controls, the wave length (tuning) condenser, and the oscillator condenser, while in other radio frequency systems using tuned transformers we have as many condenser controls as there are radio frequency stages (plus one).

Operating an ordinary radio frequency set with untuned condensers is much like trying to operate an ordinary receiving set without tuning controls. At all wave lengths, except one, the reception will be very weak and the selectivity is greatly reduced. You can hardly imagine a receiving set built without a coupler or without a tuning condenser, but this is practically equivalent to what takes place when untuned radio frequency transformers are used. If you do not believe this, just connect an ordinary short wave untuned radio transformer in place of your variocoupler and see what happens.

There is one advantage in the heterodyne circuit which seems to have escaped the notice of the transformer manufacturer, and that is the possibility of using high transformer ratios. With the plate-grid capacity effect reduced to a minimum it would seem that higher ratios would be possible than are ordinarily used without danger of the tubes breaking down into free oscillations. In the majority of cases the present transformer ratios are in the nature of two to one, with four to one as a maximum. When ratios of five to one, and even eleven to one, are used in

(Continued on page 56.)



Adding Radio and Audio to Baby Heterodyne

By JOHN B. RATHBUN

IN RESPONSE to the many inquiries for the addition of radio and audio frequency stages to the baby heterodyne, the following circuit has been devised which gives two stages of radio frequency amplification, detector, and two stages of audio frequency amplification. This five tube set requires the usual precautions against setting up free oscillations in the tubes and feed-backs that must be taken with all radio frequency sets, but when everything is adjusted it will pull in distance with probably twice the range of the detector alone. The audio stages of course permit of loud speaker operation upon fairly distant stations.

The basis of this circuit is the single tube heterodyne which occupies the position in the circuit marked "detector," and this will be quickly recognized by those who have read or used the article in the February issue of Radio Age. The two coilers marked (M-N) correspond to the coils (M-N) in the February issue and are almost historic by this time. It should be particularly noted that the detector circuit is supplied with plate current by a separate "B" battery (-B2, * B2) which is necessary for proper operation. The first "B" battery supplies both the radio and audio frequency circuits in the usual manner.

The first change necessary is the removal of the old fixed coupler from the simple detector circuit. This is removed and used as the first tuning inductance at (FC) at the extreme left where the primary and secondary coils are marked (P) and (S) respectively. In the detector circuit, the tuning unit is replaced by the ordinary neutrodyne transformer (RFT-2) or by another radio frequency transformer as will be described later.

As shown in the diagram, two air core transformers of the neutrodyne type are shown at (RFT-1) and (RFT-2), the secondaries (K) of these transformers being tuned by the 17 plate (0.00035 mf) condensers marked (C2) and (C3). The secondary coils (K) are wound with 66 turns of No. 24 D.C.C. wire, while the primary coils (J) have only eight turns of the same wire, this giving a transformer ratio of over eight to one. These can be made at home, winding the coils on 3-inch paper or bakelite tubes, but it is easier and cheaper to buy standard neutrodyne coils for this purpose. If the coils are wound at home, care must be taken to wind the small coil (J) at one end of the tube so that it is separated by a short distance from the coil (K).

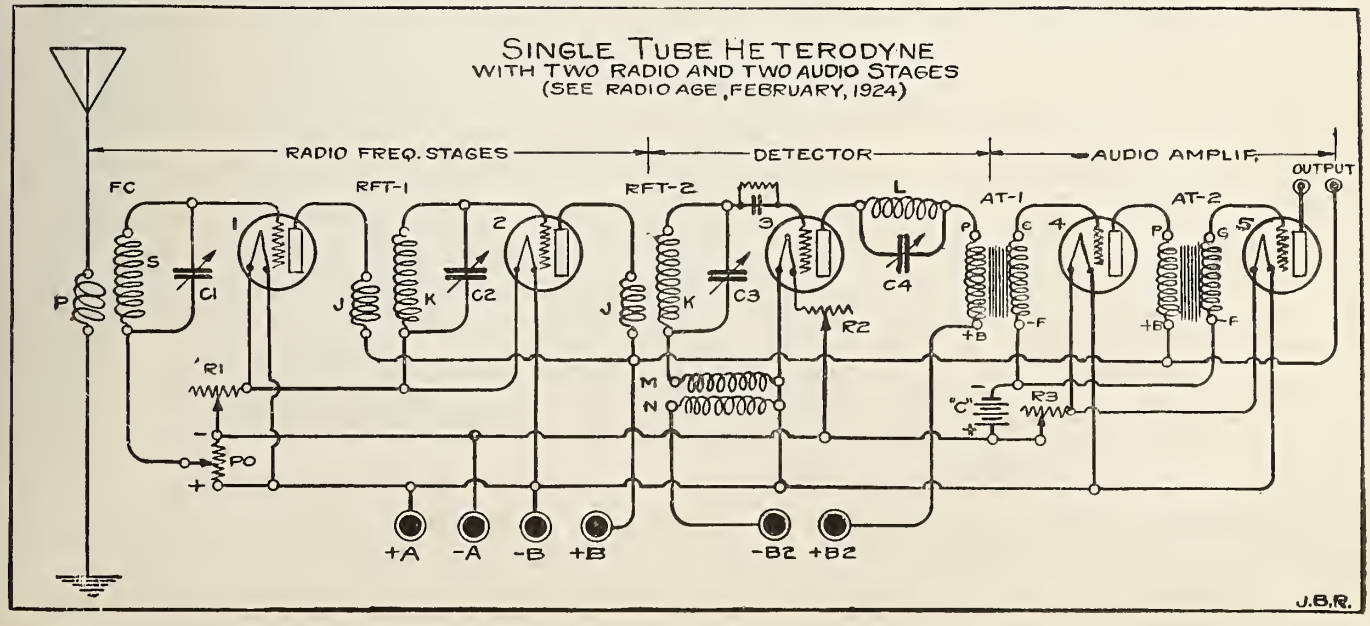
The use of the above transformers, while giving the maximum results, gives us a great many controls to handle, or in fact we have four tuning controls which are quite critical. While this gives almost 100 percent selectivity, yet it is tedious and decidedly bothersome for the beginner. The use of ordinary untuned radio frequency transformers at these points, such as the Erla, Acme, Rasla, and others, does away with the necessity of the condensers (C2) and (C3), and thus reduces the controls to two units. The volume and distance will suffer accordingly but this sacrifice is sometimes advisable in view of the difficulties just mentioned.

The two radio frequency tubes (1) and (2) are controlled by a single rheostat (R1), and the grid potential is regulated by the 200 ohm potentiometer (PO). The latter is necessary to prevent oscillations in these tubes but is not critical. The detector tube (3) is contained in the circuit already familiar to our readers and is controlled by the rheostat (R2). This should preferably be a vernier rheostat. As before, (L) is a 50 turn honeycomb coil and (C4) is the condenser controlling regeneration and frequency.

This brings us to the audio frequency tubes (4) and (5) which are controlled by the single rheostat (R3). The iron core radio frequency transformers (AT-1) and (AT-2) can be any good make, preferably with a ratio of five to one, although other ratios can also be used. For maximum amplification (AT-1) can have a ten to one ratio, but for clear undistorted speech a five to one ratio is best. You will note that the four terminals of these transformers are marked (P), (G), (*B) and (-F) as usually found on the posts of such devices.

For maximum amplification, reduced distortion, and minimum "B" battery current, a small biasing battery marked "C" is used with its negative pole connected to the (-F) posts of both audio transformers as shown. This is simply a small three cell flashlight battery giving a potential of about 4.5 volts, and is connected directly into the circuit as there is no flow of current when the set is idle. The output of the set is at the extreme right, and no jacks are provided since in a circuit of this sort it is not advisable to introduce any more capacity than is absolutely necessary.

For the radio and audio stages, as well as for the detector circuit itself, about 67 volts of "B" battery will give the best results. For economy, we can use 45 volts at (B2), but a higher voltage will give better results. It goes without saying that all of the tubes, detector tube (3) included, must be hard amplifying tubes, such as the UV-201A, C-301A and UV-199 or C-299. A soft tube like the UV-200 will not work at the high plate voltages



given. Please, please, please do not use either the WD-11 or WD-12 tubes in a circuit like this, and then write in and ask why you are not getting results. If I had my way about it I would pass a law against the use of WD-11's in everything except Ultra-Audions and similar single circuit sets.

Now returning to the front end of the dingus at the left, we see our old friend the fixed coupler (FC), alias the "Wizard" coil, alias several other names. This contains 28 turns in the primary (P) and 60 turns in the secondary (S), all wound on a three inch tube with No. 24 D.C.C. or No. 26 D.C.C. wire. Full details were given for the construction of this coil. Yes, you can also use a four inch tube or a five inch tube, providing that you reduce the number of turns in proportion. The tuner coil (FC) has its secondary coil tuned by the same old 23 plate (0.0005) condenser that we used in the old detector circuit, and is indicated by (C1).

This will require a 7x26-inch or a 7x28-inch panel, the latter preferred if neutrodyne type coils are used for radio frequency transformers. With these transformers, do not have the coils closer than 5.5-inch centers, and turn them at an angle of 45 degrees so that the bores of the tubes will not be in line. If each transformer (RFT-1, RFT-2) is turned at an angle of 45 degrees with the horizontal and vertical, then there will be no "feedback" nor regeneration between the radio frequency stages, but if all the transformers are in line, then you will get no results whatever for the energy will be short circuited between the transformers and the radio tubes will not amplify.

Latest Radio Frequency Transmissions

The Bureau of Standards is transmitting special signals of standard frequency about twice a month. The next schedule is announced below. The signals can be heard and utilized in general east of the Mississippi River.

These special signals of standard frequency are of use to testing laboratories, transmitting stations, operators, and others in standardizing wave meters and adjusting transmitting and receiving apparatus. The transmissions on June 5 will be of special interest to ship operators, those on July 7 to amateurs, and those on June 20 to broadcasting station operators. The accuracy of these signals is better than three-tenths of one per cent. Information on how to use them was given in the February, 1923, issue of the Radio Service Bulletin. More detailed information is given in Bureau of Standards Letter Circular No. 92, which may be obtained, on application from the Bureau of Standards, Washington, D. C.

All transmissions are by unmodulated continuous-wave telegraphy. A complete frequency transmission includes a "general call," a "standard frequency signal," and "announcements." The "general call" is given at the beginning of the eight-minute period and continues for about two minutes. This includes a statement of the frequency. The "standard frequency signal" is a series of very long dashes with the call letters WWV intervening.

This signal continues for about four minutes. The "announcements" are on the same frequency as the "standard frequency signal" just transmitted, and contain a statement of the measured frequency. An announcement of the next frequency to be transmitted is then given. There is then a four-minute interval while the transmitting set is adjusted for the next frequency.

The schedule of standard frequency signals from the Bureau of Standards is as follows:

Eastern Standard Time	June 5	June 20	July 7
11:00 to 11:08 P. M	300	550	1363
	(1000)	(545)	(220)
11:12 to 11:20 P. M.....	315	650	1430
	(952)	(461)	(210)
11:24 to 11:32 P. M.....	345	750	1500
	(869)	(400)	(200)
11:36 to 11:44 P. M.....	375	833	1600
	(800)	(360)	(187)
11:48 to 11:56 P. M.....	425	940	1700
	(705)	(316)	(176)
12:00 to 12:08 A. M.....	500	1050	1800
	(600)	(285)	(167)
12:12 to 12:20 A M.....	600	1150	1900
	(500)	(261)	(158)
12:24 to 12:32 A. M.....	667	1250	2000
	(450)	(240)	(150)

Kadel & Herbert Photo.

AND THE AIR WAS FILLED WITH ELOQUENCE

Leave that to William Jennings Bryan. For the first time the famous publicist delivered an address recently on "The Election of 1924." Here he is shown before the microphone of WJZ at the Hotel Commodore, New York City. By means of radio millions were able to hear Mr. Bryan's fiery address for the first time in their lives.

What the Broadcasters are Doing

Schenectady Announcers

Radio, the newest industry and science, now claims the labor of 250,000 people and the leisure and rest of countless more. In the broadcasting branch of the science a new vocation has developed, that of the radio announcer.

To be a successful announcer something more than a pleasing voice and clear enunciation are required. The ideal announcer is a musician with a knowledge of composers and their work; he should be a linguist familiar with French, Italian and German; he should be able in an emergency to make an announcement in English without confusion and free from grammatical errors. He must be tactful in receiving artists and instructing them in proper position before the microphone.

Singers and speakers accustomed to public appearance very often develop microphone fright, not because the studio surroundings are overpowering but because they miss the stimulating presence of an audience; it is difficult to visualize the vast radio audience, headphones on head or grouped about loud speakers.

The announcer's duties are not limited to his appearance before the microphone At WGY, the popular station of the General Electric Company at Schenectady, rehearsals are conducted by one of the group of six announcers at WGY. By means of the try-out poor singers are saved the embarrassment of failure before the microphone. The rehearsal also serves to demonstrate that certain voices have not the quality for radio transmission. Sometimes the finished and successful singer is found to have a voice unsuited for radio transmission and on the other hand a singer whose voice is too weak for public hall or theatre, sometimes possesses quality and tone which win instantaneous popularity with the radio audience.

Four of the six announcers at WGY are vocal soloists and may, in the event of an emergency, such as the failure of scheduled artists to arrive, step before the microphone and give a creditable performance. Kolin Hager, the chief announcer, has been associated with WGY since the station opened. He is a trained musician, linguist and public speaker. When a boy he was soprano soloist in an Albany Cathedral and is now baritone soloist in a Schenectady church. Carl Jester is a tenor with a thorough musical education, and for the past year he has directed the WGY Light Opera Company in its various appearances.

Asa O. Coggeshall, also a tenor, a third announcer, is director of a boy choir in an Amsterdam, N. Y., church. William Fay, the last to join the announcer force at WGY, is a baritone, and his voice has brought him many fan letters.

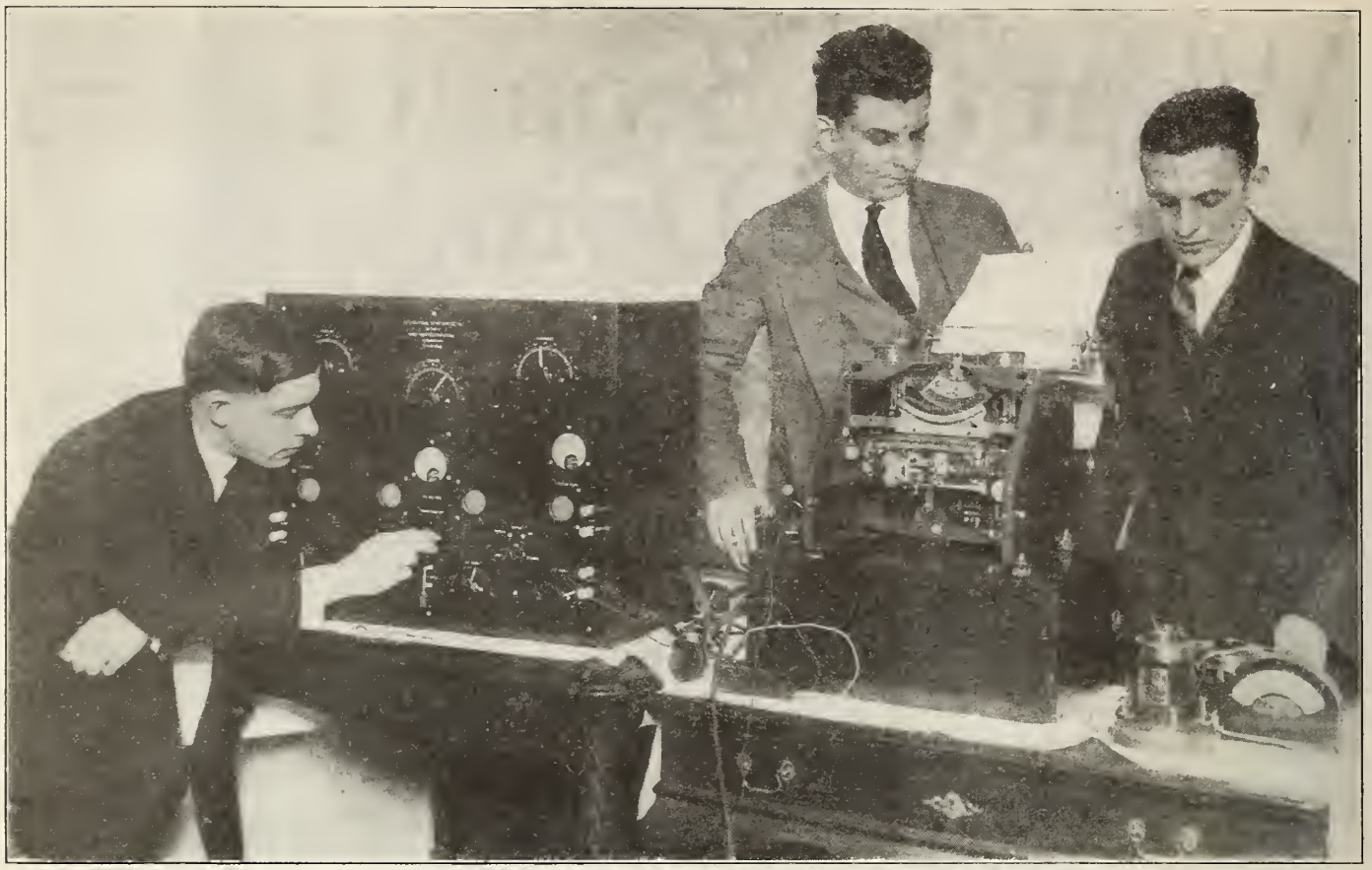
The other announcers at Schenectady station are Robert Weidaw, who gives much of his time to the executive work of the studio, and Edward H. Smith, who is director and leading man of the players, and assists in planning feature programs such as Uncle Josh's golden wedding, and minstrel shows. An entire evening's program may be put on by the announcers without the aid of outside talent.

Kadel & Herbert Photo

THE THREE MUSKETEERS OF WLS

These jolly chaps keep their ethereal customers smiling from WLS, the Sears-Roebuck Agricultural Foundation Station at Chicago. From left to right they are George D. Hay, the "solemn owl of Memphis," and chief announcer of WLS; Ford Rush, director of music and Robert Northrup, assistant announcer and entertainer. Mr. Hay is shown with the locomotive whistle that made him famous among the fans down in Dixie.

WANTED: Contributions to the Pick-ups Page. Lists of stations heard; see February 1924 issue of RADIO AGE for particulars. Short stories under 250 words in length; jokes and anecdotes; brief sketches of humorous incidents in radio building; summaries of experiments with receiving sets; listening experiences; photographs, wiring diagrams; also any other interesting items. Address: RADIO AGE, Box PP, 500 N. Dearborn St., Chicago, Ill.



Kadel & Herbert Photo.

A NEW ERA IN NEWSPAPER PUBLISHING

A group of astonished newspaper editors, electrical and radio engineers at the American Newspaper Publishers' Convention in New York watched a radio typewriter being operated by a person who was sitting in an experimental laboratory more than two miles away. The "copy" was received and typed at a rate of sixty-five words a minute and with an accuracy of 99½ per cent. The machine operates on a short wave tuner ranging from 60 to 150 meters, with detector and amplifier. The new device is expected to revolutionize transmission of newspaper messages.

First to Hear McMillan Gets $100

The first amateur who succeeds in picking up the Donald B. McMillan station, WNP, on the Schooner Bowdoin, now frozen in within eleven degrees of the North Pole, will be awarded $100.00 in gold by U. J. Herrman, managing director of the Radio Manufacturers' Show Association, which will hold radio shows in New York and Chicago this Autumn.

To the next amateur who reports a confirmed reception of the McMillan expedition's transmission, E. F. McDonald Jr., president of the Zenith Radio Corporation, will award a Zenith receiving set—an exact duplicate of the one in use on the Bowdoin.

The offers are made to stimulate watchfulness on the part of amateurs who can receive code messages from WNP. Nothing has been heard from the McMillan party since May 10. Amateurs who pick up messages sent from WNP are asked to telegraph to Mr. Herrman, at 127 North Dearborn Street, Chicago, or to Mr. McDonald at 332 South Michigan Avenue, Chicago, care the Zenith Radio Corporation.

To the sender of the first telegram containing a message from the McMillan party, which it is possible to confirm, $100.00 in gold will be awarded.

Phonograph Broadcast Succeeds

Successful broadcasting and re-recording of phonograph records have been accomplished by experimenters at WGN, the Chicago Tribune-Zenith station at Chicago.

When WGN went on the air with its inaugural program Saturday, March 29, Frank Hoyt, inventor of a new method of recording broadcast reception, tuned in at his laboratories in New York City and recorded his reception of the program on aluminum disks.

He succeeded in recording virtually all of the program, which continued from 6 p. m. Saturday to 6 a. m. Sunday. Some of the records were brought to Chicago and under Mr. Hoyt's supervision they were broadcast as a part of WGN's regular program for Donald B. McMillan, whose ship is frozen in eleven degrees from the North Pole.

This broadcast of a previous recording was received in Chicago and New York, and the broadcasts were received with sufficient clarity and volume to be recorded again. This is said to be the first time such an experiment has successfully been carried out on a large scale, according to Ben Garetson, director of WGN.

WTAM "Takes the Cake"

George A. Rudd, a Cleveland confectionery manufacturer, enjoyed the special Easter concert from WTAM so well that he bought a gaily decorated cake and sent it to the radio artists as an appreciation. The cake measured eighteen inches in diameter and was six inches high. The decorations were in all colors of the rainbow. The pastry donation was heartily received by the radio artists, and Art Herske, the announcer, became so enthused over it that he forgot to sign off.

Girl Wins Radio Drama Prize

"A Million Casks of Pronto," a comedy drama of business life, won first prize in the radio drama competition conducted by WGY, the General Electric station at Schenectady. Miss Agnes Miller, of 150 East Seventy-second Street, New York, wrote the play, which will bring her a cash prize of $500.00. The object of the competition was to develop a type of play especially adapted to radio presentation, and which tells its story through an appeal to the ear and imagination instead of to the eye. The winning play will be presented by the WGY Players soon.

RADIOTORIALS

THE NEXT member of Congress who tries to put an obstacle in the way of radio's progress will know he has a fight ahead of him. The recent victory of radio's friends in the United States Senate and the defeat of the proposal to inflict a tax of 10 per cent on all radio products proves that.

For some reason a Senate committee had figured it would be a smart bit of legislation to place a burden on the infant industry. There were senators who insisted they saw nothing illogical in forcing a fee from the schoolboy who undertook to build a receiving set—after being taught how to build it in a public school. Let the taxpayers finance the technical education of a radio-loving boy in a public school and then let the government impose a tax on what the boy makes.

That is not an exaggerated statement of the attitude of the pro-tax senators. Abandon this tax plan and give radio a full and free chance to show that it is a necessity, rather than a luxury? No, S-I-R! The senators wanted $10,000,000 and they were going to raise it in radio levies.

But they did not. Radio interests combined to make the voice of radio heard down in Washington. It was a giant voice when it spoke. Manufacturers of radio sets and equipment used the newspapers, the direct mail campaigns and the broadcasting stations to inform the radio public of what was going forward. The users and prospective users of radio equipment were assured that they would ultimately pay the tax.

The country was astonished when the word was passed on to the big cities and the cross-road hamlets. Tax radio? Put a brake on an art in which the United States had just fairly shown that this country led the world in development of that art? Burden a science that was just beginning to show its tremendous value in the dissemination of information and entertainment? Interfere with the development of a science that had become an indispensable aid to the mariner and to commerce and world communication? Put a brake on a device that was knitting the peoples of all sections into a closer relationship and bringing the university course and the musical college to humble homes of millions? Put a tax on time signals, weather reports, United States agricultural reports, news bulletins, market quotations? Tax a science that is and will be a vital part of the army and navy in peace and war?

Well, the plan was fortunate in enjoying a painless death. The radio public was asked to tell Congress what it thought. The result was a protest that left nothing to be desired in the way of volume. Letters and telegrams swept in upon Washington. Politicians suddenly found themselves blinking into a calcium light. They discovered that this is a radio republic. The tax amendment came up in a session of the Senate and was voted down and out. It was beaten at a moment when the fans thought they were making only the preliminary moves to defeat it.

We would suggest that the next senator who wants to ease the burden on some private interest by tightening up on radio should go about it only after taking an aeroplane voyage over our little old country and counting the radio aerials on American roofs.

AN AGITATOR has appeared in the East who contends that the government should force broadcasting stations to give both sides of every political question an equal opportunity to use their microphones for the purpose of haranguing the public. With equal justice the government could force the newspapers to publish two editorial pages—one Republican and the other Democratic.

SECRETARY HOOVER, of the Department of Commerce, is to call another national conference for the discussion of radio problems. He says the most serious menace to the proper enjoyment of radio broadcasting at this time is interference. Wave lengths of stations in the same community are within too narrow a band. More power to the Hoover elbow!

WHEN the S.S. "Columbus," a new ocean greyhound, arrived in New York recently, there was considerable interest in two lifeboats carried by the liner. These had been equipped with both transmitting and receiving apparatus. Once launched they readily could be transformed into sending or receiving stations. The vast possibilities of this development of radio are apparent at a glance. Engineers have devised methods of using radio to locate without loss of time miners who may be imprisoned by explosions or other accidents under ground. One railroad has its own broadcasting station with a system of minor transmitting and receiving stations. Chicago has a broadcasting station specially devoted to the interests of the farmer. Radio gives ships their bearings on storm-swept coasts. Radio has taken the place of the time regulator in the watchmaker's shop window; America is setting its clock by the signal from the broadcasting station. Radio is finding lost persons and lost property. Radio is helping to run down fugitive criminals. Radio is the livest thing in the United States. It is the only buoyantly alive industry in the country at this time. And yet the things that radio has accomplished and is accomplishing are only a beginning. The new season is to see radio step forth as a real giant, sure of its strength at last.

A GOVERNMENT radio expert predicts that before 1924 is over the ether will be entirely free of all interference. If we ever reach such a stage of radio bliss, tuning in on your favorite station will be just like turning on a phonograph. Please, Mr. Expert, leave us a little interference just for fun.

Radio Does Not Electrocute

WASHINGTON, D. C.—Radio, unfortunately and unjustly, frequently gets a "black eye" through improper headlines and sometimes badly written stories in the daily press. The headline, "Electrocuted by Radio," which recently appeared in a local paper, was not only misleading, but wrong according to the brief story itself. In the first place, radio itself cannot electrocute anyone, except in case of transmitting stations where high-power supply is used. At the radio receiving end, radio is not dangerous.

It is even doubtful if the high-frequency power put into transmitting antenna at big commercial stations could kill, although it is admittedly dangerous to touch bare wire, the motor-generator, bus-bars, or the transmitting circuits, as a shock or burn might result. Only at high-powered, low frequency stations could serious results occur. Receiving sets are not dangerous, according to all well-informed experts, unless of course they are charged by outside electric power.

Referring again to the headline and the story of the unfortunate lad, who, it developed, let his antenna come into contact with an electric wire charged with 2,300 volts, it is readily seen that he was not electrocuted by radio but by an electric power line. It would have been the same had he been stringing a wire clothesline, although his death would not have been charged to a clothes-line. An autoist who stalls his machine on a railway track and is killed by an express train is not said to have been killed by an automobile.

Antennas Necessary

Some sort of an aerial is necessary to every receiving set, and it is well known that an outside aerial is better than an inside one or a loop, except in specially constructed high power tube receivers.

According to Dr. J. H. Dellenger, chief of the Radio Laboratory of the Bureau of Standards, a fairly long and high antenna is the cheapest way to get loud signals with the simplest receiving sets. "To get the best results, an outdoor antenna, used for great distances or for crystal sets, one should use a single, continuous copper wire, 50 to 150 feet long, direct from the set to the highest point available at the far end, supported by good insulators, such as porcelain or glass, and kept well away from trees and buildings. "Keep the antenna away from possible accidental contact with electric wires," he admonishes.

Are Antennas Dangerous?

Replying to the query: "Are antennas dangerous?" Doctor Dellenger said:

"The lightning hazard is practically nil. Only for outside antennas need lightning protection be considered at all, it is very simple. A small and cheap device called a lightning arrester should be connected between the antenna and the ground wire on receiving sets. An antenna is no more likely to bring lightning into a house or apartment than are overhead telephones or electric light wires. The principal hazard from antennas is from stringing outdoor antennas over or near electric light wires. A number of persons have met death by electrocution from this cause." A special committee on the National Electrical Safety Code is now drawing up regulations and precautions for the erection and use of aerials, and will report soon.

Concerning antennas in general, Doctor Dellenger pointed out that there is nothing about them to justify the large amount of worry and uncertainty they seem to give many uninitiated fans. An antenna, he explained, is the "harness" that converts the radio wave motions into currents which operate the receiving set. Almost any sort will work for a broadcast receiving set, he said, adding that fans do not need to imitate the amateur transmitters and erect elaborate antennas of several wires.

Single Wire Best

A general antenna for reception should be a single wire running from the set, direct if possible to a conveniently high point at the far end. It does not have to be horizontal, a slight angle is sometimes advantageous, and it does not matter in what direction the antenna points. Little directional difference is noted in reception, except in special and long antennas.

"Antenna length," he sums up, "is a compromise between loudness of signals and freedom from interference."

The public trend is no longer for distance, but quality of reception, he believes. If, however, one wants to astonish his friends with a long distance record, he explains, let him erect a "whale of a long antenna," or, use a very sensitive, many-tube receiving set, or both, and pile up a record. Receiving sets using electron tubes work well with indoor antennas or loops, the latter aiding in directional effects, but these antennas are relatively weak and therefore the signals must be amplified, he explained.

A Sure-Fire Reflex

(Continued from page 15.)

then be replaced by smaller sized instruments. The neutroformer would be dissembled and the condenser mounted in the same place. The transformer coils, however, would be mounted in the space directly back of the crystal detector to conserve space. This would make room for the A and B batteries in the bottom of the cabinet. The A battery in such case would, of course, be made up of flashlight batteries.

Such a set may be taken to the summer camp and will provide plenty of entertainment on the hike or at the fireside. A portable wire wound on a good sized spool with a couple insulators will be about all that is necessary for an antenna.

The writer would be pleased to hear personally from anyone who builds this set and offers to answer any questions relative to troubles encountered in getting it into operation.

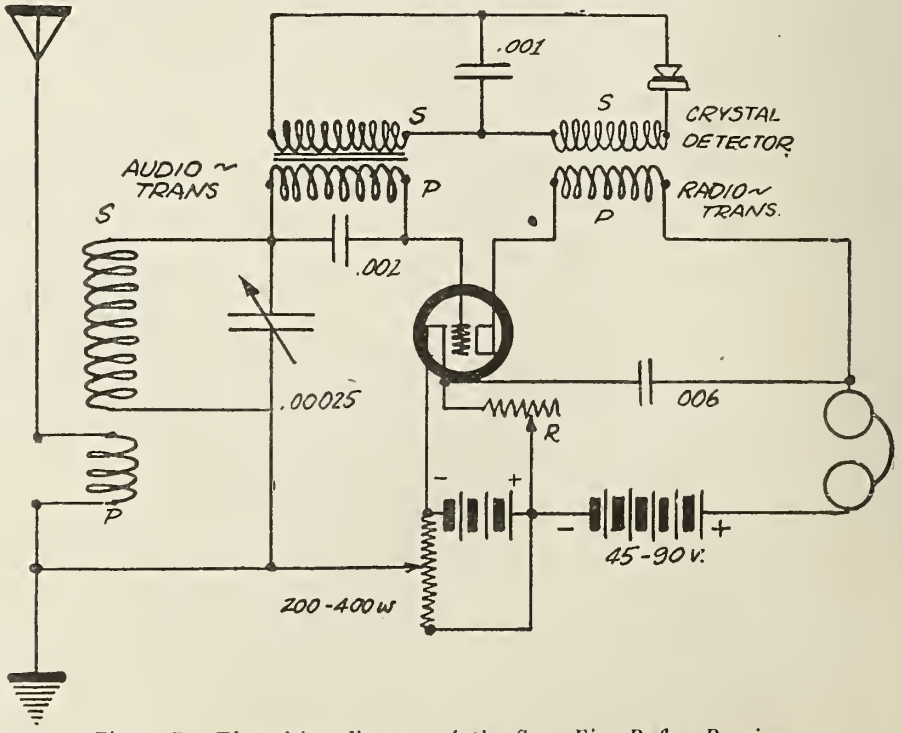
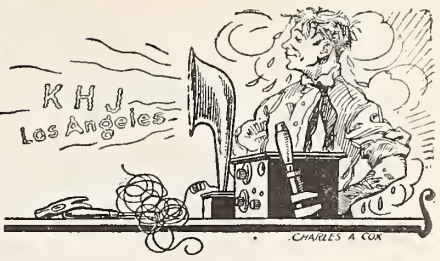


Figure 7. The wiring diagram of the Sure Fire Reflex Receiver.

Pick-ups and Hook-ups by our Readers



THE business of choosing the letters to be used for publication in the Pickups Pages is getting to be quite a problem. It is a wonderful sight to see all the letters sent in by fellow fans offering suggestions and contributing hints, lists, stories and other matter, nearly all of which say in the last line of their letters, I hope I may be able to see in print in your next issue.

As much as we'd like to, we can't print all of them. Sometimes it is hard to have to turn down a nicely arranged list, or a little suggestion that, while it may be trivial in nature, carries with it a good idea.

So if you meet a fellow wearing a little button about 3/16 of an inch wide, with the following appearance:

This is the emblem which says that a fellow has contributed something to the common good of the Dial Twisters. Do you want one? Does your record entitle you to one?

you will know that he has contributed a list of stations that was meritorious; that he submitted a good suggestion that we have on file to refer to some fan that needs it, or that he has done other good work for his brother Dial Twisters.

As a matter of form, the fellows who get their names and contributions in print will be given a button as well, they having contributed something of value.

We sent out a few dozen of these little buttons as an experiment to various "fans" who sent in lists and got some of the following replies:

> Received your emblem this morning and I felt prouder than the town constable when the office force asked me what I got it for.
>
> Everybody wants to know how to get one.
>
> . . . the suggestion which I sent you some time ago with reference to the mounting of homemade spider-web coils, which was acknowledged with your little button, certainly makes me very happy. I showed the idea to several of my radio friends, who scoffed and laughed until you told me that the idea was a good one and gave me the button to show your appreciation.

CONTRIBUTORS

C. A. Williams J. J. Drey C. R. Williams

DIAL TWISTERS

Name	Address	Circuit
S. J. Craig	1390 12th Ave., New Westminster, B. C., Can	Honeycomb
H. K. Hathaway	441 Brunswick St., Halifax, N. S., Can	Honeycomb
John Sabiston	Bay Shore, L. I., New York	Atwater Kent
George A. Holly	10214 Adams Ave., Cleveland, O	Erla Triplex
Mr. A. C Hart	2336 Lawrence Ave., Chicago, Ill	First Tube
T. W. Robinson	Britton, Okla	Three Circuit
C. W. Nestler	Flaxton, N. Dak	Single Circuit
J. P. Cooper	c/o Southland Cotton Co., Memphis, Tenn	Cockaday
Ray Ellis	Durant, Ia. (Cedar County)	Reinartz
John Escher	Spring Lane, Englewood, N. J	Single Circuit
A. P. Smith	RFD No. 8, Bangor, Me	Ultra Audion
Richard H. Starkie	950 St. Marks Ave., Brooklyn, N. Y	Reflex 1 Tube
C. B. Gannon	1731 Ensor St., Baltimore, Md	Reinartz Regenerator
Kenneth B. Glass	144 S. Mt. Vernon Ave., Uniontown, Pa	Reinartz Regenerator
E. Brand Boylan	1106 West 8th St., Wilmington, Del	Single Circuit
Clarence Easton	35 S. Raymond, Rm. 320, Bradley Bldg., Pasadena, Calif.	Rosenbloem
B. Drum	99 S. Main St., Asbury Pk, N. J	Three Circiut
E. L. Blass	716 Oakluna Blvd., Fort Smith, Ark	Neutrodyne
M. S. Miller	1506 Jones St., Souix City, Ia	Single Circuit
Eden W. Hollon	3096 Coplin Ave., Detroit, Mich	Neutrodyne
Francis E. Chrestien	416 W. Embargo St., Rome, N. Y	Single Circuit
W. Eichler	4438 N. Artesian Ave., Chicago, Ill	Single Circuit
August Strom	Miller, Ind	Single Circuit
E. L. Ludell	Shelbyville, Ill	Long 45
Edward Sagle	2609 N. Bouvier St., Philadelphia, Pa	Three Circuit
Joseph Ross	1056 Greene Ave., Brooklyn, N. Y	Honeycomb
Robert E. Boyle	133 West Div. St., Fond du Lac, Wis	Westinghouse DA
A. M. Boyenga	Greene, Ia	Single Circuit

While they're laughing up their sleeves, I laugh up my vest—and last laughs best because they all respect my ideas as to radio construction, and I am very sure that one of them is secretly developing some idea of his in an effort to be recognized as I am.

Incidentally, the department editor wants to say that the response to the request for information on the part of readers who have Super-Heterodyne receivers (the request was published in the March issue) has been very small indeed. We got an offer from one fellow who has a super constructed after the November issue, which was never fulfilled. Where have the rest of you been since 1898? Let's have some response!

Before you start reading the rest of the department matter, don't forget to look over that Static Puncturing Contest. We hope to get some nice lists.

THE PICKUPS EDITOR.

"Let our hookups be your guide" is the motto of Mr. J. J. Drey, who contributes the following letter, which we think is very interesting and highly instructive:

> RADIO AGE,
> Gentlemen:
>
> In the April issue of your valuable magazine you published the exceptional good results I am experiencing with the Reinartz hookup, in which through experiments I discovered a few valuable leads, to which I attribute the remarkable results that this fateful Reinartz accomplishes.
>
> Since your publication I am flooded with inquiries as to my hookup. My business duties throughout the day occupy the greater portion of my time, leaving me very little time for private correspondence. I greatly appreciate the enthusiasm displayed by so many of my brother fans. For their convenience I am submitting a diagram of my hookup, as I have found it through various experiments and finally discovered that the hookup in this form is terrifically loud and clear in volume and exceptionally sensitive to distance. I have received stations everywhere in the U. S. and many portions of Canada, all on loud speaker. I do not use ear phones at all.
>
> In this diagram you will note the specifications for the winding of the coil, which I have found in this form covers broadcasting stations with wave lengths from 150 to 600 meters. I have also discovered that the single cotton-covered wire gives louder and clearer signals. The coil can be wound on any ordinary spider frame that can be purchased at any radio shop. It is also important that the plate coil and the grid coil should both be wound in the same direction, clockwise. It is necessary for clear, sharp tuning that the filament lead on the secondary radio frequency transformer should lead to the sliding or

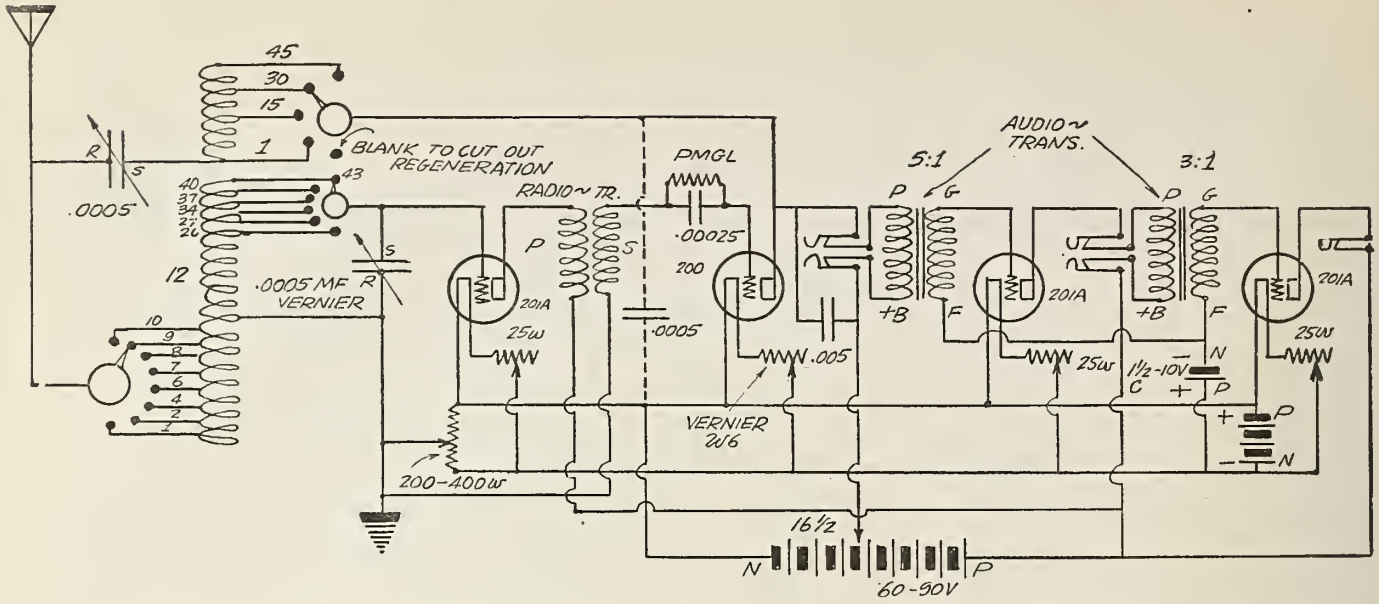


Figure 3. A diagram of the receiver described by Mr. J. J. Drey. Note especially the winding of the coils.

third arm of the potentiometer. I have also discovered that by putting a micafix condenser from the plate of the detector tube to the negative B battery lead will prevent radiation and the stations just simply walk in. Tuning must be done slowly.

In using the 6-volt storage battery, wherein the UV200 tube for the detector and UV201A's for amplifiers are used, the C battery is not necessary because of the placing of the micafix condenser across the primary of the first audio frequency transformer. The condenser from the plate of the detector tube connected to the negative B battery makes the grid circuit very quiet and clear. But where the dry cell tubes are used, it is advisable to insert a C battery of approximately 1½ to 4½ volts. This depends according to the wiring. It is also important that a vernier or carbon rheostat be used with the detector tube, because this circuit tunes exceptionally sharp and is very selective. I also recommended the shielding of the panel with a sheet of aluminum or thin copper sheet, covering the portions of the two condensers. Also, the plate should be attached to the ground connection, to prevent body capacity. In fact, my machine is so well balanced that body capacity is not known. When the condensers are attached to the panel it is important that a thin sheet of medium weight oiled paper be inserted between the shielding plate and the end of the condenser so that stator screws of the condenser will not come in metallic contact to the shielding plate.

I have found through various experiments that the proper ratio audio transformers to be used in the first stage should be either a 5 to 1 or 6 to 1; not higher. The second audio transformer should be a 3 or 3½ to 1. The grid leak should be variable from 1 to 5 megs. This I have found to assist greatly in receiving stations on long distances, when climatic conditions change daily. Varying the grid clears the distant stations up remarkably. I have found it very important and I fully realize that every radio fan wants to reach distance. As I have stated before, I have heard practically every leading broadcasting station in the U. S., and this I know every fan desires.

I am at present experimenting with numerous new hookups, as experimenting seems to be my favorite pastime. But the fateful Reinartz is not touched. It brings in the stations clear and loud every night.

In conclusion I can say that any of my radio fan brothers who want a clear, loud, far-reaching set should follow these instructions and he will write RADIO AGE a long letter of thanks, because I have discovered that the hookups in RADIO AGE are something to be proud of.

I remain,

Yours sincerely,

J. J. DREY.

Iron River, Mich.

The Reinartz bugs will no doubt oscillate and radiate nothing but pure delight and gratitude for this generous letter of Mr. Drey's, and the department editor wants to say that we hope Mr. Drey will let us have the benefit of his later ideas and experiments.

We present herewith some data which should be of interest to those experimenting with the Superdyne receiver. Mr. M. C. Williams is connected with the Air Service Technical School at Rantoul, Ill., and has submitted some most interesting and enlightening data on the construction and choice of apparatus for this receiver.

RADIO AGE,

Gentlemen:

Attached herewith find print and "writeup" on the Superdyne, which I am submitting to your magazine, in which I am intensely interested, and of which I never fail to get a copy.

This set has been constructed as indicated and works wonderfully in my home.

Very truly yours,

M. C. WILLIAMS.

Box 353, Rantoul, Ill.

COIL DATA: Secondary or stator should be 4 inches in diameter, similar in design to coils sold in Kresge's stores. Wound with 25 turns of No. 22 D. S. C. wire, commencing about ½ inch (one-half inch) from rotor shaft and top edge of tube.

ROTOR OR TICKLER: Similar in design to those sold in Kresge's stores. Wound with 18 turns of No. 22 D. S. C. wire, commencing at outer edges and winding towards center, leaving a space in center.

PLATE REACTANCE COIL: Similar in design and size as the above rotor. Wound with 30 turns of D. S. C. wire, commencing about ½ inch from top and rotor shaft hole.

GRID AND PLATE CONDENSERS: .00055.

LOOP: Very good results should be obtained by connecting the loop to the aerial and ground binding posts through a small fixed condenser. Better results, however, may be obtained by grounding the negative side of the filament and connecting a small aerial strung across the room to the stationary plates of the first variable condenser.

TUBE ARRANGEMENT: Tubes may be arranged in any manner to suit the fancy of the builder, but remember that the leads which carry radio frequency current must be very short and direct.

WIRING: The wiring of the filament and other parts at more or less ground potential should run near the front of the panel and the rotary plates of the variable condensers should be as near to ground potential as possible to reduce stray capacity from the hands of the operator. All wires from the grid and plate circuits

should be far back from the panel and separated from themselves and everything else as far as possible.

RADIO FREQUENCY STAGE: A great deal depends on the construction of this stage whether it really beats a regenerative detector and two-stage audio or not. The main thing to remember is to hold the radio frequency tube from oscillating when both tuned circuits are brought to absolute resonance. With the tickler winding on the rotor described above both halves are connected in series so that the windings are in the same direction on the halves. It does not really matter which direction the rotor or stator is wound as they can be shifted by turning rotor over. By reversing the coil in the plate circuit will change audibility of signals sometimes.

OPERATION: The operation is apt to be a bit puzzling at first. With the aerial connected, also ground, etc., set the resonator dial (condenser) to the left and the wave length dial to the right, say at about 20, and advance the stabilizer from the "zero" or full reversed position until a click is heard in the phones or loud speaker; this denotes oscillation. Work slowly on the edge of this point, coming forward with the resonator and wave length dials until the old familiar squeal of a station is heard. Tune this in at the loudest and then reduce the stabilizer little by little and follow up with the resonator keeping the squeal at a low tone until finally the squeal is entirely lost and speech comes in clear. Then try the wave length dial for micrometer adjustment to refine the music or speech. Experience alone is the best teacher with this sensitive receiver.

PARTS USED: 1 special coupler, stator and rotor; 1 plate inductance; 5 rheostats; 5 freshman condensers; inch; 1 panel, 7-inch by 26-inch; 2 6 sockets; 1 cabinet, 7-inch by 26- variable condensers, .00055; 2 transformers, first and second stage; 3 3-inch white dials; 7 binding posts; 1 input push and pull modern transformer; 1 output push and pull modern transformer; necessary bus-bar and spaghetti. Total cost, about $60.00.

RANGE: Unlimited. Easy to tune western stations as Los Angeles, etc. (Chicago with loud speaker without resorting to the usual head phones first); volume from KFI resembles a phonograph. Most sensitive set known for the number of tubes used, outside of the super-heterodyne.

GRID LEAK: Some tubes have a tendency to block or choke when resonance is passed. This condition may be removed by touching the moistened finger tip to the grid terminal on the socket of the detector tube. However, if this becomes annoying it may be further remedied by using a better grid condenser or using a grid leak. One very important thing to remember is never connect a grid leak across the grid

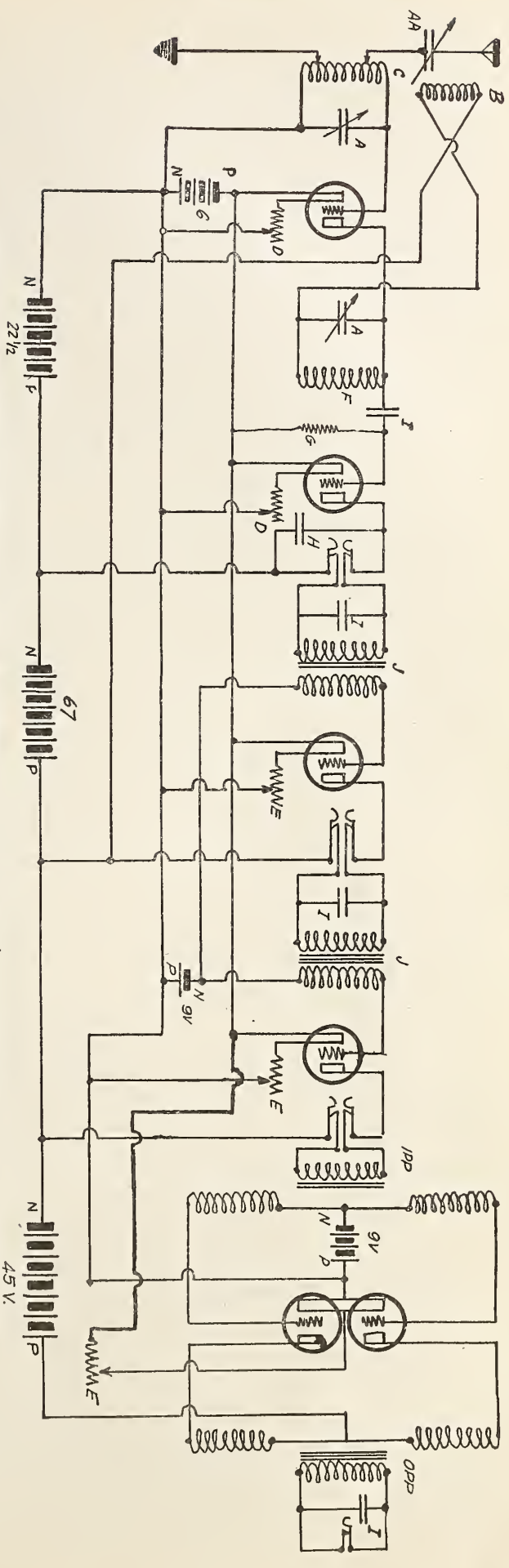


Figure 1a. The Superdyne received described by Mr. Williams. The lettering on the circuit diagram bears the following meanings: AA antenna tuning condenser preferably 23 plates; B rotor tickler for negative feedback; C the stator. The coils B and C may be a rewound variocoupler, the coils being wound as specified in the accompanying text. A is the tuning condenser 23 plates 0.0005 microfarads; A in plate circuit of radio frequency tube is the reactance condenser 0.0005 mfds. maximum; F is the reactance coil. The reactance condenser and coil can sometimes be substituted for by a good variometer with equal results. I grid condenser .00025 MFD for 200 tubes and WD's and should be .0005 for UV199; G grid leak, preferably of the pencil mark type; D the rheostat; J amplifying transformers; 1PP and OPP the input and output push-pull transformers; and the remaining by-pass condensers I, which should be .100 microfarads fixed mica type.

A set of this type gives complete control of oscillations, increases range, reduces radiation and tunes sharply. In recent tests, the set in actual working comparison showed an audibility ratio of 10,000 in some cases over a standard regeneratives audibility of 85, on the same signals.

insulating condenser. If a grid leak is needed it should be connected from the grid terminal of the detector socket to the positive terminal of the same socket. From two to three megohms are used with hard tubes while it is not necessary with soft tubes. The grid condenser should be about .00025 and well insulated.

LEGEND OF FIGURE 1

AA—Antenna wave length condenser for balancing. After once adjusted for the particular type of antenna need not be touched again. Many use the small fixed condensers after the one best suited has been tried out.

B—Special coupler, stator has 25 turns No. 22 D. S. C. wire, ½ inch from top edge and rotor shaft. Tube 4 inches in diameter.

A—Variable condenser .00055 for wave length of station to be tuned in.

C—Rotor, feed-back stabilizer, 18 turns on each side No. 22 D. S. C. wire, connected on inside in series, leaving space on outside between windings.

F—Plate inductance, 4-inch tube, wound with 30 turns No. 22 D. S. C. wire, ½ inch from top edge and rotor holes, if an old variocoupler stator is used.

E—Rheostats.

D—Rheostats.

G—Variable grid leak.

H—Fixed condenser, .00025.

I—Fixed condensers, .002.

J—Sheltran transformers, same ratio, 9 to 1.

K—Modern push and pull transformers.

LEGEND OF FIGURE 2

Resonator—Condenser .00055.

Stabilizer—Special coupler with stabilizing rotor.

Wave Length—Condenser .00055.

Rheostats — For amplifier and detector tubes. 3 and 4 rheostats for two audio tubes. 5 for the two P. and P. tubes.

LEGEND OF FIGURE 3

1—Resonator condenser.

2—Special coupler and stabilizer.

3—Wave length condenser.

4—Plate resonance coil.

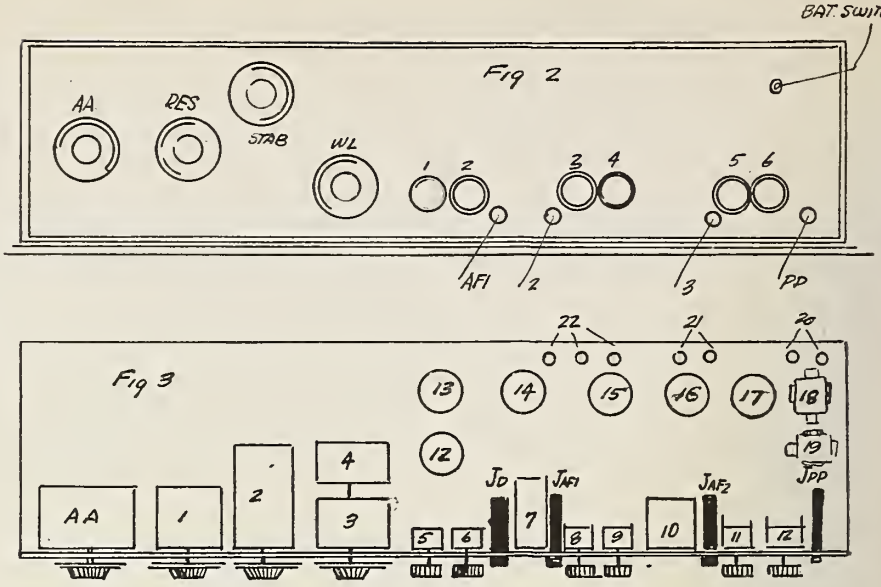


Figure 1b. The layout of the Superdyne receiver.

5—Bradleystat for amplifier tube.

6—Bradleystat for detector tube.

7—First audio transformer.

8—Rheostat, first audio tube.

9—Rheostat, second audio tube.

10—Second audio transformer.

11—Rheostat for two push and pull tubes.

12—Radio amplifier tube.

13—Detector tube.

14—First audio tube.

15—Second audio tube.

16 and 17—Push and pull tubes.

18 and 19—Push and pull transformers.

20—"C" battery binding posts.

21—"A" battery binding posts.

22—"B" battery binding posts.

23—Jack for first audio stage.

24—Loud speaker jack.

NOTES

With the old-fashioned VT1 tubes as detector and all stages of amplification this is the most sensitive set obtainable which will work under the existing circumstances.

Twenty feet of wire strung around the room under molding or around picture, or straight run through attic, makes a very good aerial. But the best aerial is a single wire about seventy feet in length.

Do not touch the wave length condenser after it has once been tuned or balanced with the aerial, for this will throw the entire set out of tune.

Stations one thousand miles can be heard at any time through any interference and loud enough to be heard on a Brandes Table Talker one city block.

Very much care, indeed, must be taken in the wiring and in the selection of instruments. It is always better to select the very best instruments and save the later purchase, for eventually better grades must be installed.

If we were to judge from the correspondence of the technical department with reference to the Superdyne circuit, we would like to say that Mr. Williams' data is most welcome. Many fans have been asking for more detail with regard to amplification and panel layout, together with a complete list of parts—and here it is. Mr. Williams enclosed a well designed blueprint of the circuit (Figure 3), with instructions as to the layout of the receiver, and we are sure that he will be amply rewarded for his troubles in the grateful thanks of many DT'S.

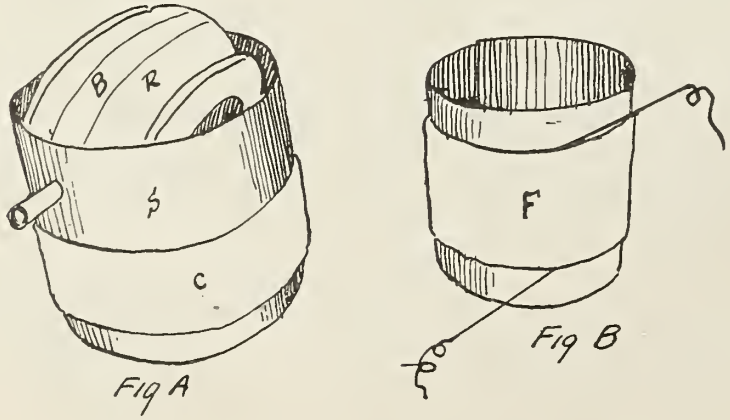


Figure 1c. Arrangement of the coupler and plate coils.

RADIO AGE,
Gentlemen:

Since publication of my letter in the April issue I have received a number of letters from fans asking for the circuit diagram, etc.

I am therefore sending it to you herewith.

Sincerely,
CLARENCE R. WILLIAMS.
7 East St. S., Janesville, Wis.

Mr. Williams' contribution incorporates some very good ideas on a simple, efficient receiver, and the Technical Editor thinks very highly of his letter. We hope the fans will appreciate his efforts in their behalf.

RADIO AGE,
Gentlemen:

Your issue of April, 1924, contains picture of Thomas J. Kennedy's set of three-circuit, honey-comb coils.

I use the same circuit and apparatus as Mr. Kennedy (detector and two stages) constructed along similar lines, but not the honey-comb coils. I find that ordinary coils absorb a great deal of moisture from the air. I would like to suggest that I prove this by saying that probably the most effective test is to place them in an oven for about 15 minutes, letting them dry thoroughly, and then notice the greater pep they give.

Winding three on wooden forms 2½ inches in diameter and with 35 pegs evenly spaced for primary 38 turns 22; secondary 50 turns, and tickler 75 turns evenly spaced, winding in one direction every two pegs, and hooking them up the same as honey-combs, has the honey-combs cheated a thousand different ways, and costs only 35 cents to construct.

Mr. Kennedy no doubt has some remarkable record, but just look at a few of my long-distance ones on my 35 center situated amongst a bunch of sparks, CW squeaks, howls and street cars. And I find no difficulty in bringing them in.

KGO, KGW, KPO, KZN, KFI, KHJ, are the distant ones. My list is too long if I were to put down the nearer distances, and it gets worse and worse with respect to length when I start to consider local DX. (Local DX is reception of about 200 miles or less.—Dept. Ed.)

However, here are some of the stations I get with great volume regularly: WGR, KDKA, CFCA, CFCF, WLW, WEAF, WHB, WDAP, PWX.

I sincerely hope that my list and suggestions will be of value.

Yours very truly,
S. J. CRAIG.

1390 Twelfth Ave.,
New Westminster, B. C.,
Canada.

RADIO AGE,
Gentlemen:

As an American radio fan, living way down east, I like your wonderful magazine; and as I like your book and your drawings of circuits, which are so simple and plain to everyone, accept if you please my sincere compliments. If everyone goes by your motto, they won't go wrong. Your book has been a wonderful help to me.

I am using the three honey-comb coil set using two peanut tubes. My set is on the same pattern of Thomas J. Kennedy's in your April book, and this circuit is surely a DX getter. This is my list and hope it will make me a Dial Twister—one from "Way Down East," if you please:

KDKA, KGO, WGY, WOO, WOR, WIP, WMAF, WBZ, WNAC, WFI, WTAM, WGI, WEAF, WABL, WMAK, WGN, WHAZ, WDAR, WCAP, CHYC, CKAC, CFCF, WHN, WLAW, WDAP, WMAH, PWX, WHAM, WJZ, WLAG, WMAQ. These stations come in real good. I have heard four amateur stations this week from the states who use microphones.

We had a big storm here a week ago, and my aerial wire broke into two pieces. I tuned in and heard the following stations with the antenna down: WBZ, WGY, KDKA, WJAR, WHN, which came in with good volume. Freak, wasn't it?

I am on my set nearly every night till late, as we are one or two hours ahead of you fellows.

I must say I got my best results out of your wonderful book, which usually is a little late, but always is appreciated.

I hope Mr. Kennedy can log the only two Halifax stations, CHAR and CHAC. The old DX getter and the RADIO AGE are my standbys. Wishing your magazine every success, I remain,

Yours very truly,
H. K. HATHAWAY.

441 Brunswic St.,
Halifax. N. S.

By the way, it might be of interest to you fans to know that a diagram of the receiver as used by Mr. Kennedy is printed in the troubleshooter section. Nuff sed!

RADIO AGE,
Gentlemen:

A few months ago I sent you a list of stations I had received up to December 31. Now I will give you a real list that I have received since January 1, 1924. The last four months has been unusually good for me, as I have received about one hundred more stations since I last wrote you. This list may put me on the familiar list known as the Dial Twisters. There certainly are some great records on your lists. I have been trying to beat two great rivals of mine, and I am getting closer to them all the time, but they are still far away. I am not discouraged yet and expect to beat them if it takes me a year to do it. They are Kenneth Fisher and Curtis Springer of Indianapolis. I imagine you know them well, as I saw their wonderful list in one of your issues. My last issue expired with the April number, but I am renewing my subscription at the same time I am sending you this. RADIO AGE certainly is a wonderful magazine. I like it better than any of them.

You will notice that I received 2KW, England; this being on the night of Sunday, March 16, from 12:30 p. m. to 12:50. I received England weak, but I couldn't get the name of the station calling them. All I got was "The Voice of CAPE COD." What station is that; could you tell me? They played the "Parade of the Wooden Soldiers" and a number of others. I heard the announcement and it sounded to me something like 1XAL. I will give you my list and show some of these Reinartz and single circuit fans a real list to think about. My set is an Atwater-Kent detector and two step. My aerial is one hundred feet long with a fifty-foot lead-in.

I have proof of every station in case there is any doubt about them.

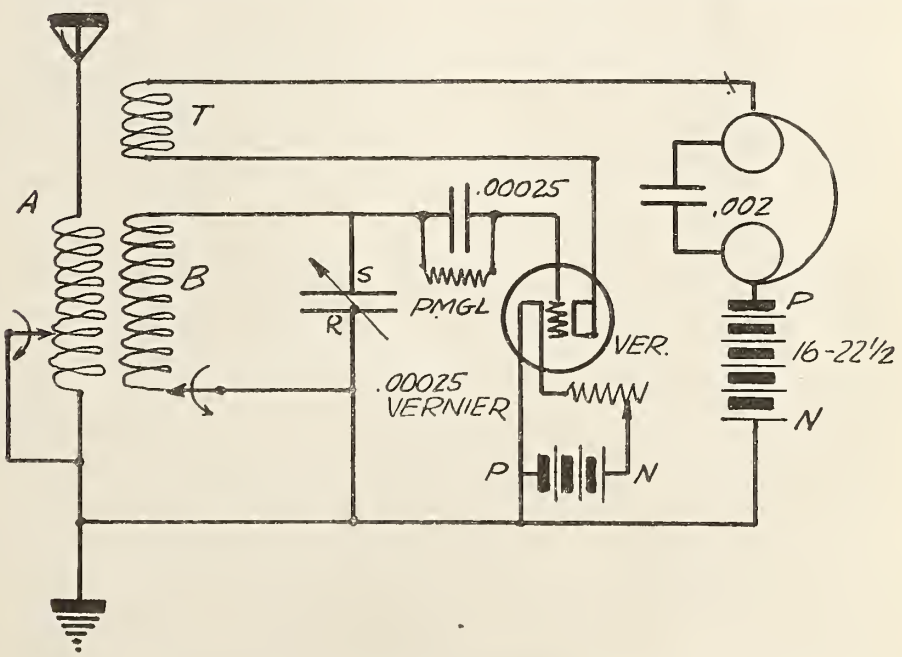


Figure 2. A diagram of Mr. Williams' receiver. The primary has 77 turns of No. 24 DCC on a 4-inch tube, the secondary 70 turns of the same size wire on the same tube wound in the same direction with 1-inch coupling; the winding being split in the center to allow for the tickler shaft. The tickler has 50 turns of No. 24 DCC wire, 25 turns on each side. The secondary should be tapped at the 22nd and 44th turn.

Half of them I received on a loud speaker.

Sincerely yours,
JOHN SABISTON, JR.

Bay Shore, Long Island, N. Y.
Here's the list:

KDKA, KFKX, KOB, KOP, KSD, KYW, PWX, WAAF, WAAW, WBAH, WBS, WBAV, WBZ, WCAE, WCAD, WCAP, WCBD, WCX, WDAF, WDAP, WDAR, WDAY, WDT, WEAF, WEAN, WFAA, WFAY, WFI, WGI, WGR, WGY, WHAM, WHAS, WHAZ, WHB, WHN, WIP, WJAR, WJAX, WJZ, WJY, WKAQ, WLAG, WLW, WMAF, WMAQ, WNAC, WOS, WOAW, WOC, WOO, WOR, WPAB, WPAH, WPAD, WRC, WSAD, WSB, WTAS, WTAM, WSAI, WWJ, WQAM, WMAK, WCAL, WSY, WIAD, WFAB, WPAB, WCE, WHAA, WTAY, WABT, WBBR, WOAI, WEAY, WGAY, WJAN, WRAX, WMC, WRM, WQAN, WMAY, WQAE, KMO, WDAH, WRAY, WWAD, WBBG, KZN, KFAF, WRR, KFEX, WGAG, WDBC, WBL, KFCH, WTAW, WRK, WDK, KFKB, KFI, WCAH, WSAR, WSAG, IXAL, 2BXL, 9XAT, 5ST, 9ESI, 6KW, 8XS, IXAE, 2NZ, 9BM, NRE, NRG, 2KW, KQV, KFGZ, KGW, 9CY, WGN, WBAK, WRW, WGAZ, WJAS, WRAX, WTAN, WMAV, WOQ, WCBR, WFAT, WABL, WSAC, WCAG, WIAO, WGAW, CHXC, CFAC, CKY, CKCK, CKCH, CJCN, CFCF, CHYC, CHCB, CKAC, CFCA.

One hundred and fifty exactly. Not so bad for four months. What say?

RADIO AGE,
Gentlemen:

Your seven pages of "pickups" in the March issue of RADIO AGE have sure made me a Dial Twister fan. I have heretofore skipped this section, thinking it to be of no interest to a dried up old man nearing the halfway post, but, oh, boy! it's the meat of the publication; that is, after one has grown weary of trying to build every new circuit that comes out and settles down to really enjoy radio reception as brought in by a real outfit that stands well up toward the top of the list of consistent receivers. I refer to the Erla three-tube reflex circuit.

Reading the letter from G. S. Baird, Suffern, New York, and your comments on same have prompted me to write to you and give you a log of what I have gotten out of my set. Before reading Baird's letter I had not thought very much about the performance of my set. I was perfectly satisfied with what it was doing and getting a lot of enjoyment out of it. After looking over my log I felt like writing to John Sabiston and asking for that extra bakelite crepe. I mean the one he could not use last month. I think I could present it to my friend Baird. A copy of my log is attached; it shows 94 stations. Each one has been heard at least two times. I have 20 more that have been heard only once, so they are not entitled to a place on my honor list. Stations up to 100 miles distant can be brought in almost at will, provided they are on the air and no other station is working on the exact wave. I have a verification of reception from nearly every station listed.

In building my set I used the parts recommended by the Erla people and followed their blue prints to a hair. If this is done I cannot see why anyone had trouble with this circuit, but I know a great many have.

Antenna consists of 30 feet of solid No. 12 wire hung in the attic with lead-in taken out of attic window and dropped down to window in living room (17 feet) ground of No. 12 wire 18 feet long to a water pipe.

One hundred and twenty volts on the plates supplied by a homemade Edison element B battery.

I am an Erla fan and have built every circuit they have ever devised and have had wonderful results from all of them.

I would be glad to pass on to faltering fans what little I know about these Erla circuits.

I do not expect you to give space in your publication for this long, rambling letter, but if you can spare the time would like to hear from you as to what you think of the work the Erla Triplex is doing for me.

Thanking you for the mighty interesting department in RADIO AGE, I am,

Respectfully,
GEORGE A. HOLLY.
10214 Adams Ave.,
Cleveland, Ohio.

Mr. Holly's list:

WCX, KOP, WSAJ, WJAS, KDKA, WCAE, WEAO, WBAV, WKAR, WSAZ, WGR, WPAB, WMAK, WSAI, WLW, CFCA, WHAM, WABC, WBAK, WKC, WIAD, WFI, WDAR, WIP, WOO, WRAX, WDAP, WJAZ, WMAQ, WCAP, WRC, KYW, WTAY, WCBD, WHAS, WTAS, WOR, WRM, WGY, WEAM, WAAM, WHA, WHN, WJY, WJZ, WEAF, WHAZ, WPAH, WBT, WOC, WCAZ, WBZ, WHAA, WCK, KSD, CFUC, CHYC, CKAC, CFCF, WOAN, WEAN, WJAR, WBBF, WSB, WHAT, WNAC, WOS, WSY, WMC, WCAL, WOI, WLAG, WDAF, WHB, KFLZ, WAAW, WOAW, KFKB, WPAK, CKCR, WFAV, KFKX, WKY, WFAA, WBAP, WWAC, PWX, KDYL, CHBC, CJCA, KHJ, KFI, CKCD, WWJ, 8BZS, 8BRK, BJY, 8BMK.

RADIO AGE,
Gentlemen:

The more I read of your magazine, the more convinced I become that you have selected the correct slogan, "Let Our Hookups Be Your Guide."

From your October issue I built "Your First Tube Set" and was very much pleased with the results obtained with it. Everything went along nicely until WJAZ broadcasting on 448 was changed to WGN, broadcasting on 370. Then my troubles began. It cut me out of WDAP, and there are parts of their programs which I enjoy very much.

I began at once to look through your magazine for help and found your eliminator in the January number. I constructed this experimentally, mounting it on a pine board, and while I know this is not what would be termed proper construction, yet I am able to cut WGN entirely out and listen to WDAP without interference. Last night when KYW, WGN, and WDAP were going full blast, I eliminated WGN entirely and brought in WDKA without any interference.

I sincerely appreciate the helps which your magazine rendered.

Yours very truly,
A. C. HART.
2336 Lawrence Ave.,
Chicago, Illinois.

RADIO AGE,
Gentlemen:

In your November issue you gave instructions for the building of the old standby, the three-circuit regenerative receiver. I just happened to get a copy of that issue.

I knew absolutely nothing about radio—had hardly seen a set in my life, and had never tuned one. So I hesitated considerably before I decided to build a set. However, the bug had me—so I followed your instructions and built the three-circuit.

It was by this time nearly Christmas, and it took me some little time to get the set to operate properly—so that I have not actually been using it very long. Nevertheless, I have now heard 139 broadcast stations, and am adding new ones regularly.

THE IHC RADIO CLUB

IS COMPOSED OF EMPLOYEES OF THE INTERNATIONAL HARVESTER COMPANY OF AMERICA AT OKLAHOMA CITY, WHO OWN AND OPERATE RECEIVING SETS THESE BROADCAST LISTENERS WANT TO EXPRESS THEIR APPRECIATION OF WORTHWHILE PROGRAMS THESE CARDS WILL BE SENT ONLY TO STATIONS BROADCASTING OUR CONCEPTIONS OF HIGH CLASS PROGRAMS SUCH AS WE WISH TO ENCOURAGE. THE FACT THAT YOU HAVE RECEIVED THIS CARD INDICATES OUR APPROVAL AND APPRECIATION OF YOUR PROGRAM

IHC
RADIO CLUB
APPLAUSE CARD
OKLAHOMA CITY, OKLA.

STATION RADIO AGE APR 2 1924
YOUR PROGRAM OF EVERY MONTH
RECEIVED AND APPRECIATED BY ME
TYPE OF RECEIVING SET YOUR 3 CIRCUIT
RECEPTION WAS ENTHUSIASTIC
PLEASE THANK THE ARTISTS CONTRIBUTING
REMARKS YOUR DIAGRAMS AND HOOKUPS ARE THE BEST EVER
SIGNED P. A. Robinson
ADDRESS BRITTON, OKLA.

Look what RADIO AGE got! In a little while we'll be considered a regular broadcaster—applause cards 'n everything!

These 139 stations are located in 34 different states, the District of Columbia, Mexico, Cuba, and four provinces in Canada. To go into a little more detail, they are located as follows: 1 in Alabama, 3 in Arkansas, California 6, also 6 in Colorado, 1 in Arizona, 1 in Florida, 1 in Georgia, a dozen in Illinois, 1 in Indiana, 7 in Iowa, 6 in Kansas, 1 in Kentucky, 4 in Louisiana, 10 in Missouri, 6 in Minnesota, 1 in Maryland, 5 in Michigan, 1 in Massachusetts, 1 in Mississippi (the only one in this state), 8 in Nebraska, 4 in New York, 2 in North Dakota, 2 in New Mexico, 1 in North Carolina, 1 in New Jersey, 6 in my home state of Oklahoma, the same number in Ohio, 1 in Oregon, 4 in Pennsylvania, 1 in South Dakota, Texas holding the record with 14, 3 in Tennessee, 2 in Wisconsin, and 1 in Wyoming. This is all—in the U. S., except 1 in Washington, D. C. Then my records show 1 in Havana, Cuba, 2 in Mexico City, 2 in Calgary, 1 in Winnipeg, 1 in Regina, and 1 in Toronto, these last five being Canadian stations.

How's that for a log over the time I have been using my set? Oh, by the way, I forgot to tell you that I am a traveling man, and am away from home about half the time.

I don't claim to be an expert as yet in the operation of a set, but I'll undertake to tune in any one of forty or fifty of the principal stations in the country as quickly as anyone. My record for one evening is forty stations, 29 of them less than a thousand miles distant—and these over a thousand miles away: WGY, Schenectady, 1,375 miles; PWX, Havana, 1,225 miles; KDKA, Pittsburgh (not re-broadcast from Hastings), 1,050 miles; KFI, Los Angeles, 1,200 miles; KHJ, Los Angeles, 1,200 miles; KPO, San Francisco, 1,410 miles; KGO, Oakland, 1,410 miles; KLX, Oakland, 1,410 miles; CFCN, Calgary, 1,375 miles; WCAE, Pittsburg, 1,050 miles, and KGW, Portland, 1,510 miles. Portland is generally regarded as a "dead spot" here, very few ever hearing them. I forgot to try, or I could have added KFSG at Los Angeles to the above list.

Does this let me in to the "Dial Twisters"—or do you want more? I can very easily better this night's performance.

Sincerely,
T. W. ROBINSON.
Britton, Ok'a.

RADIO AGE,
Gentlemen:

I am an ardent reader of your good magazine and am very desirous of becoming a Dial Twister. I onticed that you have published several records of some fans who operate three-tube, three-circuit sets and who I think ought to be eliminated entirely because anyone with such a set ought to consider the records that they send in very poor. I am an ardent backer of the single circuit set. Please consider the much-sought-for record of one who operates an old moth-eaten homemade single circuit. Although I have four tubes, I used but the detector tube when I got the following:

WLAG, WCBD, WDAY, WJAZ, WOC, WHB, WCAL, WTAS, KDKA, KFI, WDAP, KDZR, KFJR, WWAE, CFCN, WFAA, KHJ, KPO, CJCA, KLZ, KJO, CHCE, WBAP.

I used but four and a half hours and quit at 11:30. The total mileage was between nineteen and twenty thousand miles. How's that for an old detector tube under the ideal conditions of a noisy generator of the local power plant and several other single circuit users?

Don't fail to make your queries and letters conform with the rules published in the May, 1924, Troubleshooter section. There is no excuse for not complying with rules such as were found necessary to assure all our readers an equal chance of this service.

We have a number of questions on hand at present that have not been answered because their writers did not observe the rules as they were specified. Due to the great number of questions we receive, this has been found necessary, in order that justice may be done to all of them.

If you don't know what we are referring to, read the notice published on page 42, Troubleshooter section of the May, 1924, issue.

Technical Editor.

This all happened on the night of January 20, a Sunday night at that.

Very truly yours,
CARLOS W. NESTLER.
Flaxton, N. D.

Mr. James P. Cooper of Memphis, Tenn., care of Southland Cotton Company, writes of his experiences with a Cockaday set, and tells how he learned to operate the set so as to get a list as long as a music roll. He also says he picked up 13 stations in 39 minutes, or a station every three minutes. Some speed!

Ray Ellis of Durand, Ia., Cedar County, writes of his success with the Reinartz, and states: "The Reinartz hookup means to the broadcast listener more volume, greater distance, and wonderful selectivity."

John Escher of Spring Lane, Englewood, N. J., says: "I am sending you a log of stations heard on a set (single circuit) which was made by myself and a friend. I am 12 and he is 14.

"Johnny operates under restrictions. All stations were received before 9:30 P. M., as I am not allowed to stay up later."

What surprises the gentle reader is that Johnny has a list of 73 stations, including reception from United States, Canada and Cuba. Great!

A. P. Smith of R. F. D. No. 8, Bangor, Me., sends us a letter enclosing a long list of calls heard and wants to be a Dial Twister. Surenuff.

Mr. Richard H. Starkie sends in a long list of stations heard on the loud speaker with a single tube reflex circuit. His list totals 50 stations form every part of the country.

Clarence B. Gannon of 1731 Ensor Street, Baltimore, Md., and Kenneth Glass of 144 South Mount Vernon Avenue, Uniontown, Pa., both send in a list of suggestions on the Reinartz Audio Regenerator, which we will present in next month's Pickup pages. They certainly are appreciate, but due to the fact that they came in just as we are about to go to press with this issue, we could not print them.

E. Brandt Boylan of 1106 West Eighth Street, Wilmington, Del., "The First City of the First State," sends in a list of great length compiled from receptions on a Bachman single circuit receiver. He has several 2,000-mile receptions to his credit. FB OM!

To conclude this month's Pickup Section, we print this letter from a California fan who must be living near some movie lot where they make comedies.

RADIO AGE,
Gentlemen:

First of all I want to tell you that most radio magazines are NG. Savvy? For instance—a hookup form (name of magazine upon request) knocked my tube colder than King Tut's grand-dad, and also gave my ears a vacation. Another hookup from the same magazine made me think my antenna had fallen on a trolley wire; in fact, my phones were doing a 1921 shimmy, and danced around like Indian clubs.

Yes, ma'am—they sure did have chills. Just as I was about to take the axe and make my radio set look like the ZR-2 wreck, with the exception of the Japanese earthquake, a thought came to me, saying: *"Stay at it until you do get a good set."*

All right, I says to myself, I'll do it! So I grabbed my hat, and started for a magazine and book store, hitting on all two; got there in ten minutes, just before closing time, 6 o'clock, and purchased a magazine I had never heard of before—RADIO AGE!

I rushed back home, as I knew it was silent night for Los Angeles, hooked up your Roses-in-bloom circuit, only to find that my A battery

(Continued on page 53.)

PMGL

By THE TECHNICAL ASSISTANT

REGULAR readers of this magazine, when referring to circuit diagrams, no doubt have noticed the letters PMGL next to the zig-zag line denoting the grid leak, and without question they wonder what this means. It has probably been given different names to suit the lettering, but the matter stands that it is very important.

There are, perhaps no other units in the receiver that make more trouble, noises and are given less attention than the grid leak and condenser. Just because an experimenter can wander into most any radio store and purchase something that masquerades under the title of grid leak, it does not mean that this little unit is not important. The sooner the DX "fan" finds out that the grid leak is one of the factors in the success or failure of his receiver to be sensitive, the more distance his set will cover.

A good grid leak must have the right resistance for the type of tube used, must not assume different values with different weather conditions, and must make good contact. So simple that it is considered unimportant.

Pmgl

The pencil mark grid leak is probably the most simple and effective type on the market—*if it is properly constructed.* A leak of this type is illustrated in *Figure 1,* and consists of nothing more than a strip of insulating material with a pencil mark drawn between two good contacts—hence the name "Pencil Mark Grid Leak."

When making a leak of this kind, do not use a fiber, paper or cardboard strip. These things are useless, because they soak up moisture in wet weather, and every time it gets damp the leak absorbs moisture and you have two grid leaks instead of one. The moisture furnishes one resistance, and the pencil mark another, with the result that the set is unstable, finicky, and hard to tune, often fails to stop oscillating, and many other disagreeable experiences are encountered.

Procure a piece of hard rubber or a strip of bakelite-dilecto about 1¾ or 2 inches long and ½ to ¾ of an inch wide and sandpaper the surface you are going to use. Do it in the same manner as you would grain a panel except that you refrain from using the oil to wipe the excess dust off.

Good Contacts Essential

Drill two holes to fit the type of machine screws you intend to use; the size is not important. After this has been done, take a good soft pencil, a No. 2 or B is satisfactory, and make a good heavy smudge of pencil lead around the hole made for the machine screw, enough to allow a good margin around a tinfoil washer. Rub the lead good and hard, and let it be big enough to come out around the washer a considerable distance—⅛ inch is not too much. Do this for each side as illustrated. Now place a soldering lug and a tinfoil washer on the machine screw, and insert the screw into the hole. Tighten down the hole unit good, making sure that good contact is made.

Connect the wires by soldering them to the lugs as furnished. Be careful not to let the flux, rosin or whatever agent you are using for soldering run on to the grained strip. Turn on the tubes and plug the phones on the detector stage. The set will very likely be cranky and unstable, will howl and squawk at the least touch, and will give weak and wheezy signals. This is, of course, only when the grid wires are so arranged that they do not touch the panel or mounting board or any part of the cabinet.

One can classify this matter as a sort of unintentional grid leak, and the symptoms are that the leak, when connected and adjusted, has no effect upon the action of the tube. This means that the tube socket is poor, the grid wire is touching something that is causing the trouble, the panel is bad or that the grid condenser is faulty. Be cautious about buying moulded mud grid leak mountings, as they often are grid leaks in themselves and defeat the purpose of the one you are seeking to adjust.

Adjusting

Adjusting the grid leak of the pencil mark type is very simple. The leak is connected in the regular manner across the grid condenser or from the G post to the positive filament, and if the set is OK and the tube is normal, the set will be cranky as mentioned before. Now take the pencil and draw a firm line between the two edges of pencil mark sticking outside of the tinfoil washer. The action of the set will be very much different.

Experiment by making the mark a little heavier, and you will soon find the point where the tube settles down to business and operates at maximum effectiveness. Too much leak will cause the set to oscillate too readily, giving the operator the impression that it is very sensitive, when it is really dead. In either case, the leak is adjusted by lowering the resistance or raising it until best action is obtained. Incidentally, some of the C300 or UV200 tubes often function without a leak at all. The other high vacuum valves invariably require leaks.

Adjustable Leaks

Adjustable leaks are very handy and convenient if they are so constructed that they hold their values. If this is not so, the leak will have to be tinkered with constantly. Some of these leaks fit the usual clips, and others are so designed to mount on a panel. Personally, the writer finds that the panel mounting types nearly always cause trouble in the hands of beginners, because they mount them too close to other units, binding posts and parts. Also, it is not good design to run wires of the grid circuit near to the panel, as hand capacity and critical tuning is nearly always the result. The grid leak in connection with the grid condenser should be mounted directly on the G post of the tube socket, which should be of good hard rubber, porcelain, pyrex or other insulator of high dielectric strength. Mount them as close as you can mechanically. The reward comes later in the form of steady signals.

Noises

Noises in sets can often be traced to poor contact in grid leaks and grid condensers. If this happens to a sealed-in glass tube leak—throw it away, and use a new one. However, before you discard the unit make positive that the trouble comes from the inside and not from the clips.

(Continued on page 36)

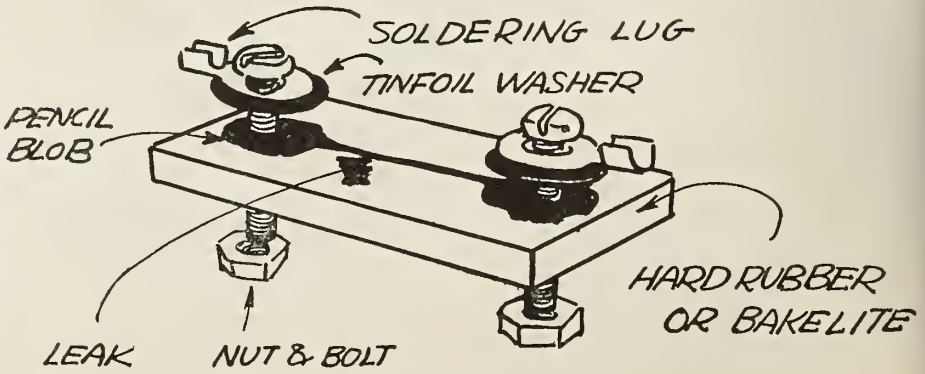
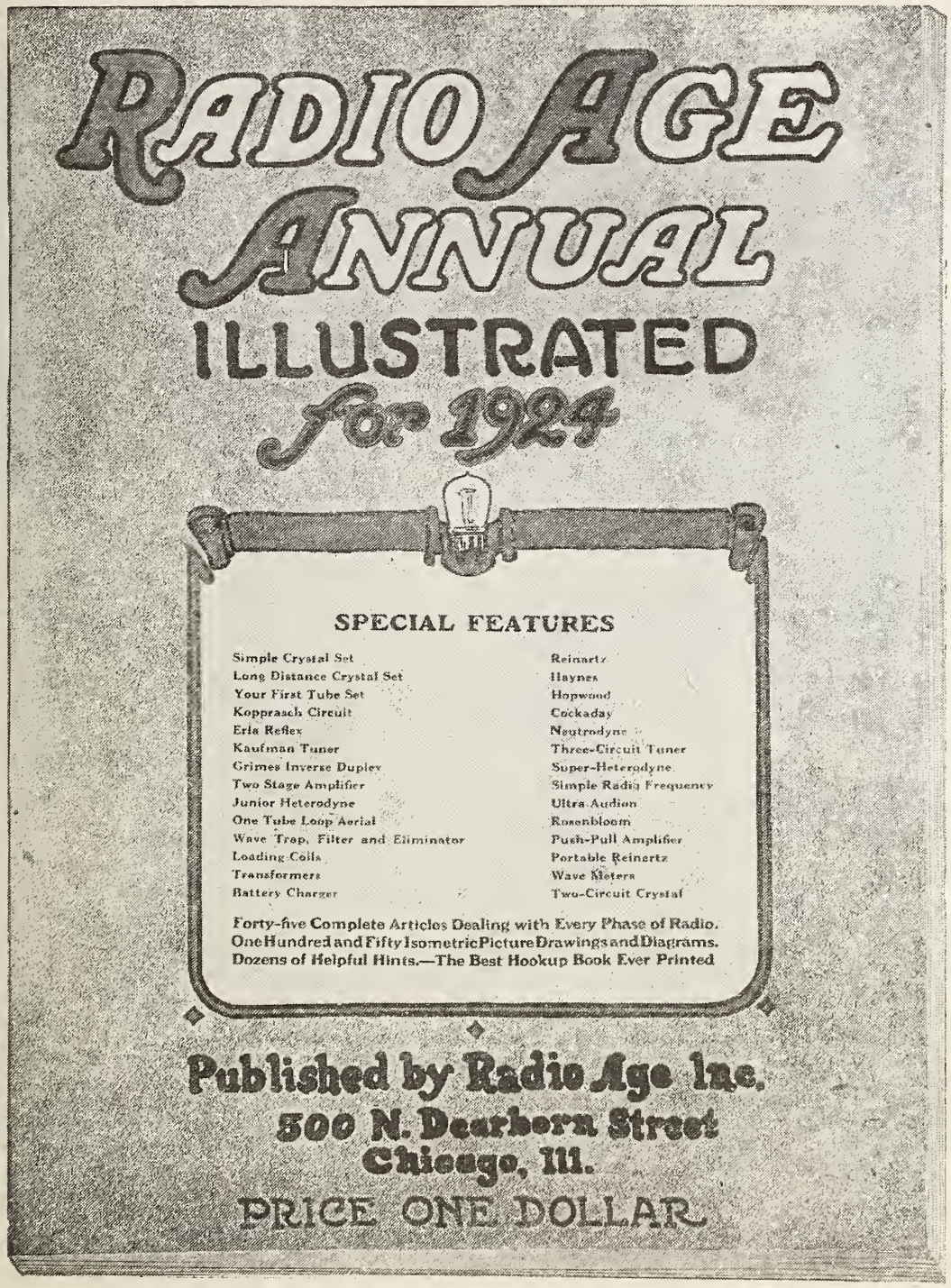


Figure 1. An easily constructed variable grid leak that gives good results. The leak is adjusted by making a mark between two contacts, the size of the mark and the heaviness determining the resistance. If the value is too low, more pencil should be applied; if it is too high, it can be lowered by erasing it lightly with a pencil eraser.

Here's the Best Hookup Book Ever Printed!



Detach this Coupon, fill in, pin a Dollar Bill to it and mail TODAY!

If Paying by Check Add 5 Cents for Exchange.

RADIO AGE, Inc., 500 N. Dearborn St., Chicago, Ill.

Gentlemen: Attached find One Dollar ($1) for which kindly forward me by return mail one copy of RADIO AGE ANNUAL FOR 1924. If not satisfied with it I will return it to you within three days and you will refund my money.

Name.....

Address.....

City.....State.....

Kadel & Herbert Foto

RADIO REPLACES SCHOOL TEACHERS

The experiment of teaching school children by means of lectures broadcast has been inaugurated by the London County Council and a loud speaker installed in many schools in London. The first lecture was broadcast by Sir Walford Davies on "Musical Appreciation." Photo shows pupils at the Hugh Wyddleton School listening to the lecture.

Just because you have a good grid leak, don't think you can use any makeshift for a grid condenser—and yet expect the set to work decently. It won't do. Use a good sealed-in mica condenser, tested to the capacity you want, and avoid the use of paper or other contrivance that radio engineers classify as "Gyp" stuff.

General Suggestions

Don't expect your set to work decently with a thin layer of soldering flux all over the parts. They are grid leaks and cut down your efficiency. Inspect the leak and condenser often, because even the best parts go wrong occasionally. Avoid the use of carbon paper grid leaks. If you use the cartridge types, get a whole set of them from .5 megohm all the way up to 10 megohms. Try them all out on the tube until you find the best one. Some leaks have a metal seal end, with metal dust flashed on the inside, and then sealed. Such leaks are almost always good. The glass sealed type with the carbon paper leak are more apt to be defective, as only too often they are carelessly assembled and absolutely "NG" for radio work.

Last but not least, after you've found the right resistance, *leave it alone*. Don't be nervous and continually "hike" the leak. You will always end up where you started, and often a good adjustment is lost by not refraining from tinkering.

Audio Amplification

Three stages of resistance-coupled amplification should give slightly greater amplification than a two-stage transformer-coupled amplifier. The quality, of course, will be much better. The B battery voltages, except on the detector, should be from 90 to 180 volts.

Important Super-Heterodyne Factors

(Continued from page 7.)

is found in the same way. The highest of the normal broadcast waves will not be over 600 meters. This will have a frequency of 500,000 cycles. There is a difference between this and the 100,000 cycles of the intermediate frequency amounting to 400,000 cycles, which is equal to a 750 meter wave. By this method, the range required for the oscillator is obtained, and in a like manner the range of the oscillator required for other intermediate frequencies is obtained.

The most simple oscillator for the novice to make is that designed by Hartley, the circuit of which is shown in *Figure 2*. It can be made by taking an ordinary vario-coupler and stripping it of all the windings. The size of the tube will, however, have much to do with the winding required, so that several specifications will have to be given in order that one may adapt a coupler of any size to the purpose. The rotor is to be used for the pickup coil, but in any case the winding will be the same. Eight turns of No. 18 double silk insulated wire should be used.

For the 3,000 meter intermediate wave, the windings should be as follows: If the tube is 3 inches in diameter, with plenty of winding space, it may be wound with 49 turns of No. 18 double silk insulated wire. This will require approximately 2 3/16 inches of winding space and the tap is taken out at the 25th turn. It may also be wound with 48 turns of No. 20 wire, in which case the winding space will have to be 1¾ inches. It may also be wound with 42 turns of No. 22 wire, if the winding space is short. In any case the tap is taken from the center of the coil.

If the tube happens to be 4 inches in diameter, then it may be wound with 36 turns of No. 18, 33 turns of No. 20, or with 30 turns of No. 22. As mentioned before, the rotor has only 8 turns of No. 18 regardless of the size of the tube.

To wind the tube for a 6,000 meter intermediate wave use 42 turns of No. 18 if it is a 3-inch tube, or 39 turns of No. 20, or 33 turns of No. 22. If a 4-inch tube is used, either 29 turns of No. 18, 26 turns of No. 20, or 23 turns of No. 22. For use with a 10,000 meter intermediate wave, wind the 3-inch tube with 36 turns of No. 18, 34 turns of No. 20, or 30 turns of No. 22. If the tube has a diameter of 4 inches, it may be wound with 28 turns of No. 18, 23 turns of No. 20, or 21 turns of No. 22. These specifications will give a fairly wide range of variation to suit the particular size of coupler used.

From the pickup coil, the combination wave is passed on to the grid of the first detector tube. This, however, should not confuse the reader, who will probably wonder why it is necessary to use two detector tubes in the super-heterodyne circuit, but the reason for this is that the first detector is used in the transformation of the frequency while it is still above audibility, and a second detector is necessary to bring it down to audibility.

CONSTRUCTION NOTES (S-30-10)
WIRING AND CONNECTIONS

"A" BATTERY LINES. The following notes apply to connections made in the filament circuit such as connections to filament rheostats, to the "A" battery, sockets, etc. In making these connections care should be observed in having the correct polarity at all points.

(1) Rheostat should be in negative line (−A) or (−F) for both detector and amplifier tubes.

(2) While the polarity of the two posts marked (+F) and (−F) on the sockets is not of actual importance, yet the connections should be made to the posts with the proper polarity in order to have a systematic arrangement if nothing else.

(3) Be sure that the rheostat has the proper resistance for the tube used. If the resistance is too high or too low, then the proper filament control will not be had.

(4) At points where the (−A) and (−B) connections come on one post or on two directly connected binding posts, place the battery cutout switch in the (−A−B) lead rather than in the positive "A" (+A) line. If this is done, then both the "A" battery and "B" battery will be cut out when the switch is opened and the leakage of "B" battery current will thus be avoided when the line is idle.

(5) Be sure that the rheostat binding posts are tight and are making good contact with the coil before making connections to the rheostats. Also make sure that the binding posts on the socket are tight and that the spring clips in the socket are not loose.

(6) Adjust contact fingers of rheostats and potentiometers to the proper tension before wiring, and see that the contact finger makes proper contact with the coil in all positions. Adjustment of this part is difficult after the set is wired up.

(7) As the rheostats and "A" battery lines are generally inaccessible on most sets after wiring, these parts should be mounted on the panel and completely wired before the other parts are installed.

(8) Tube sockets should be mounted on rubber or felt cushions before wiring so that vibration will not cause the ringing bell like noises known as "microphonic noises." Particular care should be taken with dry cell tubes as these are generally strongly microphonic.

(9) Use only heavy bus wire for the filament or "A" battery wiring since these lines carry comparatively heavy currents. No. 14 bare tinned copper bus wire is the smallest that should be used.

(10) Wherever possible use solder lugs at the points of connection and solder the wires firmly to the lugs. Wires fastened only under binding screws are likely to loosen or corrode.

(11) Wires should be well supported so that they cannot sag and come into contact with one another, thus forming short circuits.

(12) Use spaghetti on the "A" battery wiring where considered necessary as a protection against short circuits, but leave it off on the lines which carry radio frequency currents as the spaghetti increases the distributed capacity.

COMPILED BY
J. B. RATHBUN

INDUCTANCES (F-2-1)
INDUCTANCE AND FREQUENCY

WAVE LENGTH AND FREQUENCY. A radio wave travels forward at a velocity of 300,000,000 meters per second, or approximately 186,000 miles per second. This velocity of translation is approximately the same as for light waves. At the same time, the wave is subjected to a series of vibration so that the intensity of the wave is continually varying during this time. The rate of vibration or oscillation is determined by the characteristics of the circuit constants of the transmitting station and may range from 100 to 2,000,000 complete cycles per second in ordinary circuits. The rate of vibration or oscillation is known as the "frequency" of the wave.

In one second the wave travels a distance of 300,000,000 meters, and if the complete number of out and back oscillations (cycles) during this time are 300,000, then the distance between the centers of the peaks of the waves will be equal to the total distance divided by the number of double vibrations. This center to center distance between waves of like direction is called the "Wavelength" of the system and is totally dependent upon the frequency. Thus,

$$\text{WAVE LENGTH IN METERS} = \frac{300{,}000{,}000}{300{,}000} = 1{,}000 \text{ meters.}$$

In the form of a general rule for any frequency, this can be stated as follows:

$$\text{WAVE LENGTH IN METERS} = \frac{300{,}000{,}000}{\text{Cycles per Sec.}}$$

Or in the reverse sense we can obtain the frequency from the wave length by:

$$\text{CYCLES PER SECOND} = \frac{300{,}000{,}000}{\text{Wave Lgth.}}$$

It is profitable to note that the product of the wave length in meters by the frequency in cycles per second is always equal to 300,000,000. This fact gives us a check on our calculations.

KILOCYCLES. As the usual broadcasting wave lengths are in the nature of 500,000 to 1,000,000 cycles per second, the term "cycle" is too small to be handled conveniently, hence we frequently see the term "Kilocycle" used. A kilocycle = 1,000 cycles per second, hence the term 600 kilocycles means the same thing as 600,000 cycles per second.

WAVE LENGTH AND INDUCTANCE. The use of inductances, or combinations of inductances and condensers, gives us a means of bringing our receiving sets into resonance or into step with a transmitting station, or a means of rejecting certain stations which we do not care to hear. At the transmitting station, the use of inductances and condensers allows the station to send out waves of a given frequency.

Each inductance has a natural wave length or natural period of oscillation which may be increased or decreased by adding or subtracting turns of wire or by the use of condensers applied in parallel or in series with the inductances. The maximum flow of current through an inductance takes place when the inductance is so adjusted that it is in resonance or in step with the incoming radio impulses. This adjustment is commonly known as "tuning" and affords a means of receiving or rejecting stations operating at various wave lengths or frequencies.

In the calculation of inductances which are to cover a certain band of wave lengths, it is more convenient to use the frequency in terms of cycles per second than to use the wave length in meters. For this reason, when the frequency is given in meters of wave length, we must convert the wave length into terms of cycles per second by the above formula before proceeding with the calculation of the inductance.

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J. B. RATHBUN

Radio Will Not Be Taxed

Storm of Protest Defeats Senate Radio Tax

RADIO is tax-free! The first attempt to place a federal tax on radio, which originated in the United States Senate with the proposal that a 10 per cent excise tax be levied on radio sets, parts and accessories, has been defeated after the greatest storm of public protest America has ever known.

The amateur radio "fan" was sponsored by virtually every force in the radio industry in his fight to make radio goods free from taxation of any kind. The United States Senate was literally flooded with literature and delegations protesting against the suggested "harnessing of American inventive genius."

Starts In Senate

The proposed tax on radio was not contained in the revenue bill as it came from the House of Representatives, but was inserted by the Senate committee on finance. The principal clause was Section 700 of "Excise Taxes," which read:

> SEC. 700. On and after the expiration of thirty days after enactment of this Act there shall be levied, assessed, collected and paid upon the following articles sold or leased by the manufacturer, producer or importer, a tax equivalent to the following percentage of the price for which so sold or leased.
>
> 10. Radio receiving sets, 10 per cent.
>
> 11. Parts and accessories for radio receiving sets, sold or leased to any person other than a manufacturer or producer of such sets, 10 per cent.

As soon as the proposal was made public, public sentiment rose immediately and set out to kill the radio clause in the revenue bill. Senator C. C. Dill championed the fans' cause in the Senate and arranged for the various petitioners to appear before the upper house of Congress to present their arguments.

The press, radio publications as well as newspapers, combined with the broadcasters and manufacturers to fight the radio tax. Members of the House of Representatives asserted they would do all in their power to kill the proposal in the event it was passed by the Senate.

Public Sentiment Wins

Public opinion was so strong, however, that the radio excise tax died in the Senate itself, thus assuring radio from federal levy for at least two years.

The entire radio field stood solidly behind the amateur radio owner in his fight against the tax. At a meeting of metropolitan jobbers of radio products, held in New York, more than thirty jobbers pledged their support to the campaign.

A fund to help fight the tax was subscribed to liberally by the radio jobbers. The Radio Deals Inc., an organization with more than 100 members among the trade, went on record as opposed to the tax. The Radio Trade Association, the Radio Chamber of Commerce, the Radio Manufacturers of New Jersey, the Cleveland Radio Dealers' Association, the Pacific Radio Trade Association, the Atlanta Radio Trade Association and the Kentucky Radio Trade Association are but a few of the jobbers' and manufacturers' organizations who made their influence felt in Washington.

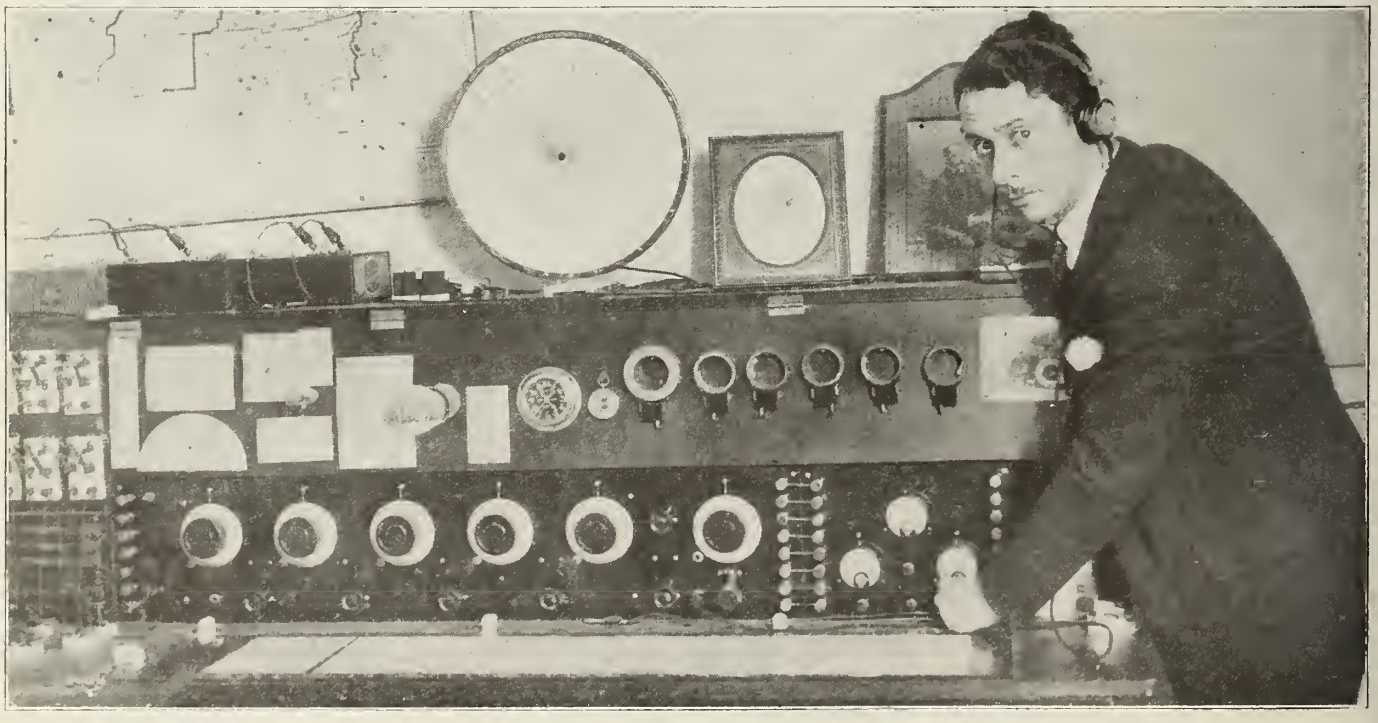
More than 50,000 circulars were distributed to dealers and jobbers by the Radio Trade Association of New York. A steady stream of telegrams from fans throughout the country pledged support to the campaign.

The Talking Machine and Radio Men, Inc., an organization of music producers and manufacturers, went on record against the tax. The National Association of Broadcasters helped to furnish the public and the newspapers with the fans' and broadcasters' reasons for opposing the tax.

Dill Boosts Cause

Senator Dill, after furnishing the Senate finance committee with the public's petitions, introduced an amendment to the

(Continued on page 40)



THE "LEVIATHAN OF RADIO"

Charles Caesar Ritz, of Forest Hills, Long Island, receives San Francisco and other California stations on the loud speaker of his four stage tuned radio frequency set with amazing clearness. Mr. Ritz, who is the son of Caesar Ritz, founder of the chain of Ritz-Carlton Hotels, builds all of his own equipment. The set shown in the photo is radically different in design and can be operated entirely as a four stage neutrodyne set or four staged tuned radio frequency set. This is quite an achievement, as it is considered virtually impossible to use more than two stages in a neutrodyne type receiver. Mr. Ritz has found that when he uses the set as straight tuned radio tuned frequency it is more selective and sensitive than when it is used as a neutrodyne. Eight tubes in all are used; four for radio frequency, one for detector and three for push-pull power amplifier.

VACUUM TUBES (JJ-9-27)
OPERATING CHARACTERISTICS

AUDIO BIASING VOLTAGES. In the following table are shown the proper negative biasing voltages for audio amplification for a given plate or "B" battery voltage. The biasing voltage is the voltage of the "C" battery in the grid circuit, and the values shown produce maximum amplification with a minimum of distortion for the various classes of tubes listed.

BIASING VOLTAGES FOR AUDIO AMPLIFICATION

TYPE OF TUBE	PLATE VOLTS	BIAS OR "C" VOLTS	NO. OF DRY CELLS
UV-201A, C-301A	40	0.5-0.75	1
" "	45	0.7-0.9	1
" "	50	1.0-1.5	1
" "	60	1.5-2.0	1
" "	67.5	2.0-3.0	1 to 2
" "	75	3.0-4.0	2 to 3
" "	80	4.0-4.5	3
" "	90	4.5-5.0	3 to 4
" "	100	5.0-6.0	3 to 4
" "	112.5	6.0-7.5	4 to 5
" "	120	6.0-9.0	4 to 6
UV-199, C-299	40	0.5-0.75	1
" "	45	0.7-0.9	1
" "	50	1.0-1.5	1
" "	60	1.5-2.0	1
" "	67.5	2.0-3.0	2
" "	75	3.0-4.0	2 to 3
" "	80	4.0-4.5	3
" "	90	4.5-5.0	3 to 4
" "	100	5.0-6.0	4
WD-11, WD-12, C-11, C-12	45	0.0-0.0	None
" " " "	50	0.5-0.8	1
" " " "	60	1.0-1.5	1
" " " "	67.5	1.5-2.0	1 to 2
" " " "	80	2.0-3.0	2
" " " "	90	3.0	2
WE 216-A	45	1.0-1.5	1
" "	67.5	3.0-3.5	2 to 3
" "	90	4.5-6.0	3 to 4
" "	112.5	6.0-7.5	4 to 5
" "	150	12.0	8
WE-VT-2	90	4.5-6.0	3 to 4
" "	150	12.0	8
" "	200	22.5	15
" "	350	40.0	28

COMPILED BY
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VACUUM TUBES (JJ-9-30)
OPERATING CHARACTERISTICS

BIASING AND PLATE CURRENT. The plate current taken by the various tubes depends upon the plate voltage and the degree of bias placed on the grids, and whether this bias is of a positive or negative potential. A positive (+) bias is ordinarily necessary with a detector tube and causes a considerable current to flow, but in audio amplification circuits, super-regenerative circuits and a few other types, the use of a negative bias will greatly reduce the flow of plate current and will therefore greatly increase the life of the "B" battery.

In the following table, we have figures that apply to tubes operating under different degrees of bias. The flow of plate current is given in terms of "milliamperes" or thousandths of an ampere.

DETECTOR TUBE PLATE CURRENT

TUBE NAME	"B" VOLTS (PLATE)	"C" VOLTS (BIAS)	PLATE CURRENT MILLIAMPERES	FILAMENT CURRENT (AMPERES)
UV-199	22.5	+1	0.60	0.06
C-299	45	+1	1.65	0.06
UV-200	22.5	+1	0.75	1.00
C-300	22.5	+1	0.75	1.00
UV-201	22.5	+1	0.60	1.00
C-301	45	+1	1.80	1.00
UV-201A	22.5	+1	0.50	0.25
C-301A	45	+1	2.00	0.25
WD-11	22.5	+1	0.70	0.25
WD-12	45	+1	1.75	0.25

AUDIO AMPLIFIER PLATE CURRENT

UV-199	45.0	0	1.40
C-299	67.5	0	2.40
"	67.5	−3	1.80
"	90.0	0	4.00
"	90.0	−4.5	2.25
UV-201	45.0	0.0	1.50
C-301	67.5	0.0	2.50
"	67.5	−3.0	1.90
"	90.0	0.0	3.90
"	90.0	−4.5	2.10
UV-201A	45.0	0.0	1.50
C-301A	45.0	−1.5	1.10
"	67.5	0.0	3.50
"	67.5	−3.0	1.90
"	90.0	0.0	6.00
"	90.0	−4.5	2.00
WD-11	45.0	0.0	1.50
WD-12	45.0	−1.5	1.10
"	67.5	0.0	2.50
"	67.5	−3.0	1.60
"	90.0	0.0	4.50
"	90.0	−4.5	2.50
216-A	120.0	0.0	13.80
"	120.0	−9.0	7.50

The effect of a negative bias on the UV-201A or C-301A is very pronounced, as with a bias of −4.5 volts, the tube only takes one-third the plate current taken with zero bias.

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(Continued from page 38)

revenue bill cancelling the 10 per cent tax.

This amendment prevented a summary approval by the Senate and caused the radio provision to be subjected to open debate.

A nation-wide appeal to amateurs interested in radio to join the fight on the tax was sent out by the American Radio Relay League through Hiram Percy Maxim, president of the organization.

The American Radio Relay League has a membership of 16,000 amateurs throughout the country. These amateurs own low power transmission and receiving sets which they use to pick up and relay non-commercial messages.

"A proposal to tax radio is an effort to levy a financial burden on the amateur inventive genius of this country," Mr. Maxim asserted. "Radio owes much of its development to the research work that has been done by the young men of the nation. Radio has probably done more than any other agency for keeping boys at home. It has stimulated imagination, thought and scientific effort.

A Needless Tax

"Why should we needlessly cripple it? The Radio Relay League does not believe that any such service should be taxed without need. The educational opportunities of radio should be stimulated instead of handicapped. We don't tax schools and colleges in this fashion, so why should we tax this newest and greatest of educational agencies?"

William P. Davis, chairman of the Emergency Radio Tax Committee of New York, reported that "immediate, spontaneous hostility to the public has been expressed by letters, telegrams and editorials throughout the country. There has been no favorable expression of opinion regarding the radio tax. The only argument advanced for the tax is that the money must be raised somehow.

"Against this, criticism is expressed everywhere against imposing this tax on an industry just struggling to its feet, with an enormous amount of development and standardization confronting it and no solution yet offered for the great problem of broadcasting.

Tax Would Raise Prices

"Such a tax would have an adverse effect on the tendency to improve product and reduce prices; a most deplorable condition, especially because the manufacturers could not absorb the taxes, which would then have to be passed on to the consumer with all the intermediate increases inevitable in such a process.

"There is also a general impression that by resisting this new nuisance tax the people will hasten the final elimination of existing nuisance taxes. Radio has been developed and perfected largely by the inventions of amateurs.

"By placing burdens on these amateurs, the government will actually be taxing American inventive genius."

Senator William S. McKinley from Illinois opposed the tax in a statement to the Radio Trade Association:

"I am opposed to the taxation of the radio business," he said. I consider radio the greatest discovery of the age and one which is bringing pleasure to untold millions of people."

World Metric Standards

Adoption of metric units of weights and measures in merchandising will be a timely topic of discussion before the great convention of the Chamber of Commerce of the United States, to be held at Cleveland in May. On May 5th the metric issue will be prominent, the national council being called upon to advise whether the pending Metric Referendum shall be submitted to nationwide vote of American business organizations.

A year of study and conference was devoted to world standardization by the Metric Committee of the Chamber of Commerce of the United States, and the report of this group will be the basis of the vote. Already the national council is on record in favor of sympathetic consideration of the metric advance, and it is believed that the Referendum will be called forthwith.

Wendell Hall on Mardi Gras From WLS

Wendell Hall, the traveling radio troubadour, and the Cambridge Sisters, the divine trio of harmony, featured the Herald and Examiner's Midnight Mardi Gras from WLS recently. Hall, the famous "red-headed musicmaker," sang, among others, his own "Dear Heart of Mine," "Shattered Dreams" and "If I Only Knew."

A Chat With the Big Family

RADIO AGE has undergone a process of enlargement and extensive changes have been made in all departments. The magazine has moved into more roomy offices, the second move which has been forced by increasing business within the year.

The radio public has been kind enough to put its stamp of approval on our periodical and as a result the task of making good our slogan "Service to Readers First" has become more complicated and difficult. Correspondence is enormous and this chat with readers is for the purpose of suggesting ways and means of more effective cooperation between reader and publisher.

We want to discuss details which, when taken individually, are trifles, but which become vastly important in the mainte nance of a smoothly functioning, exten sive service system. RADIO AGE has a technical service department, the value of which is known only to those who use it. In order to make that department more useful we are asking readers to keep in mind the following details:

Remittances

Occasionally, one of our readers will find it necessary to place an order for a back number; a copy of the Reinartz Book; or perhaps desires a copy of the new book just off the press, the *RADIO AGE ANNUAL*. This involves the handling of money, stamps or currency or other form of exchange, as the case may be.

In remitting by check, stamps or currency, you run little or no risk in sending the order by first class mail—but don't you think that it would be more sure if you took the time to register your letter? In event that we fail to receive your letter, the matter could so much more easily be cleared up if the letter were properly safeguarded.

Copies of the *RADIO AGE ANNUAL* are sent to purchasers by parcel post. To assure our patrons of the promptest delivery, and to further insure their safe delivery, they are listed at the Post Office. In event that any of our patrons fail to receive their orders, we suggest that they inform us promptly, in order that investigation may be made, and the trouble located without undue delay.

Subscribers

Occasionally we are informed by our subscribers that they fail to receive their magazines, and we would like to advise that they notify the Subscription Service Department immediately, in order that the trouble may be located, and the correction be made. Should subscribers change address or move, we earnestly request that they inform us. Failure to do so leaves a magazine without a recipient.

Incidentally, we wish to tell our readers that we cannot assume the responsibility for the loss of money in the mails or in transit, nor can we assume the loss of any orders shipped, when our records show that the order has been filled and sent out. We would advise our subscribers to be careful about permitting their mail to lie in hallways or on porches, as it has often come to our notice that magazines have been appropriated by people other than to whom they are directed, after delivery by the mail carriers.

Another thing which saves time and gets your order out is to list all your orders and subscriptions on a separate sheet other than that of your pickups, records or questions.

Technical Questions

Whenever your letter contains a request for technical information, it is a good and effective plan to list your questions on a separate sheet, which can be easily turned over to the service department for attention without first waiting for your order to be listed, the subscription entered and your instructions noted.

Subscribers are requested to enclose a stamped, addressed envelope if they desire an answer. No answers will be mailed unless this detail is observed.

Address your questions with regard to technical difficulties to RADIO AGE, Inc., Technical Office, 500 North Dearborn Street, Chicago, Illinois, if you desire the promptest of service.

In closing this little get-to-together talk, we wish to advise the usual, old, and stereotyped phrase, "Put the return address on all your correspondence." Write legibly, and don't take chances in sending coins in plain envelopes.

To Avoid Radiation

The fact that many receiving sets are so constructed that they radiate an oscillating wave from the aerial has been a source of constant interference which is growing daily. As a result of an article on this subject published a short time ago, many letters have been received asking how this may be prevented, which shows conclusively that some of the fans, at least, take this matter seriously and want to do their part in the elimination of this nuisance.

In the case of a regenerative set one can do much in the way of clearing up the air by learning to tune properly. Any set in which the plate is connected to the aerial will be one of the worst offenders. In the operation of this kind of a set some other method besides careful tuning will be necessary. The radiating effect may be partially reduced by connecting a potentiometer in the aerial circuit. This is done by connecting the middle arm, or lever, of the potentiometer to the aerial binding post on the set, and either one of the other terminals to the aerial.

This may sound peculiar, as it increases the resistance of the aerial circuit, but, curiously enough, it does not seem to interfere with the reception.

M. O. B., San Francisco, Cal.

Question: I have had quite an argument with my landlord with respect to the danger of lightning striking an antenna, and I would like to have your opinion on the subject. He says that it is very dangerous, that it attracts bolts toward the aerial wire, and consequently exposes one to the dangers of an electrical discharge of this nature. What is your opinion on the subject?

Answer: Funny as it may seem, some people persist in believing that radio antennas "draw" lightning during an electrical storm, and I want to say right now that this opinion is all wrong and should be discouraged. In the first place, a bolt has about as much chance of attacking your antenna system, as it has of striking your wife's clothes line.

Tell your friend that if your antenna is properly protected by an approved lightning arrester, which is properly grounded, the system becomes a protector of property instead of a hazard. However, a well constructed non-grounded antenna has the properties of accumulating a strong charge of electricity during a storm of any great electrical violence, and if the antenna is not grounded properly, this charge can jump a good distance from the lead-in end of the system into various grounded objects. If the object happens to be inflammable, it can cause a fire, but this is about the only danger which exists.

Some time ago, I carried on a test to see how much of this theory was true, and leaving my experimental antenna, which happens to be very well insulated and ungrounded, I inserted a small air gap, one side of which was connected to a good ground.

The gap between the electrodes was about one-half inch, and during the storm, heavy sparks jumped the gap, surprising everyone who saw the display. Another time, using an antenna during dry weather when a lot of static was in the air, I found that my antenna accumulated strong enough charges to jump the plates of a variable condenser which I had connected in the antenna lead of the receiver. It is herein that the danger lies, and not in the actual striking of the bolt.

Don't fail to make your queries and letters conform with the rules published in the May, 1924, Troubleshooter section. There is no excuse for not complying with rules such as were found necessary to assure all our readers an equal chance of this service.

We have a number of questions on hand at present that have not been answered because their writers did not observe the rules as they were specified. Due to the great number of questions we receive, this has been found necessary, in order that justice may be done to all of them.

If you don't know what we are referring to, read the notice published on page 42, Troubleshooter section of the May, 1924, issue.

Technical Editor.

R. N., New York City

Question: Kindly give a diagram of the Low Loss Receiver described in your March number in connection with a two-stage amplifier. I have constructed this set, and find it does everything you say it does. Tuning is very sharp, and stations come in with great intensity. The set is a very convincing argument for good condensers, and has taught me a good lesson about choice of apparatus.

Answer: We are printing in *Figure 1* a diagram of the circuit you desire. Reports on this receiver indicate that it is a very popular one among broadcast listeners, due to the fact that it is easy to construct, easy to operate, and tunes very sharply. C batteries should be inserted in the leads marked X if a high plate voltage is used. This will conserve your B battery by keeping the drain on that part of the set as low as possible.

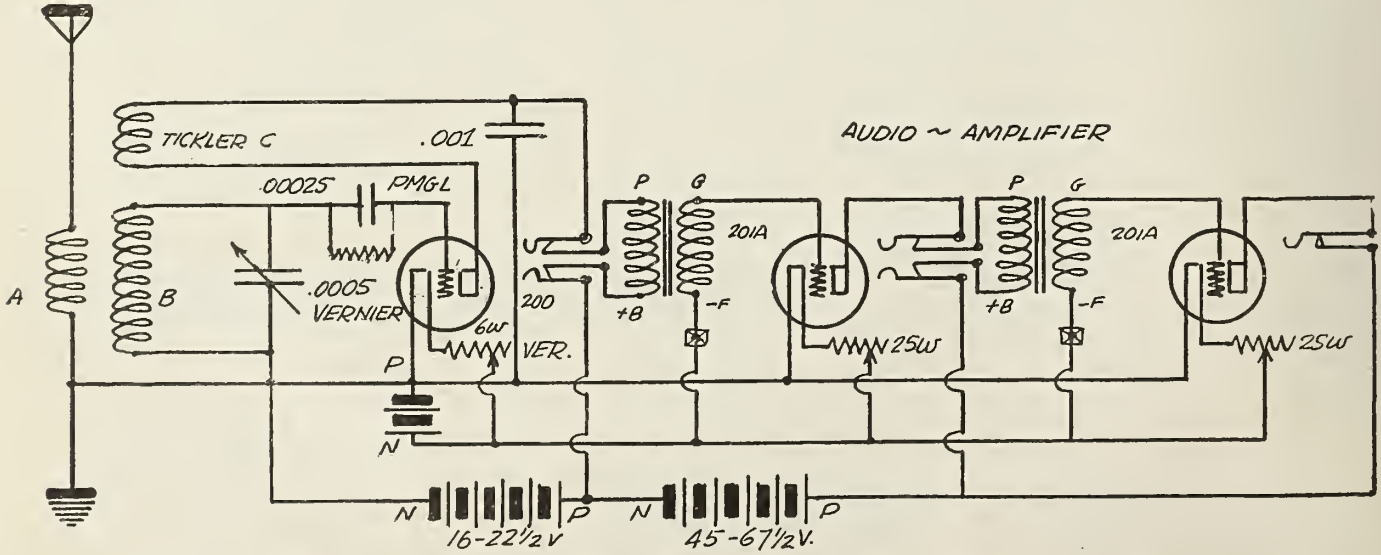


Figure 1. A diagram of the Low Loss receiver showing the addition of two stages of audio frequency amplification. C batteries can be added at the points marked X.

CLASSIFIED ADVERTISEMENTS

Six cents per word per insertion, in advance. Name and address must be counted. Each initial counts as one word. Copy must be received by the 15th of month for succeeding month's issue.

RADIO CIRCUITS

If your Neutrodyne won't "Neut" o. k., send 10c for Details of Kladag Coast to Coast circuit, bill of materials, etc., to change over your Neut into a set that will bring them all in from Mexico City to Tunucu, Cuba, on a loud speaker. Or send $5.00 for all extra parts, blue print, etc., you need to do this. Stamps accepted. Radio list for stamp. Super Heterodyne specifications, 10c. Kladag Radio Laboratories, Kent, Ohio.

RADIO EQUIPMENT.

Harkness circuit two tubes take place of four or five; Detector 2 R. F., 2 A. F. Complete, genuine parts including set of Flex-o-formers, Rbeinhold detector and 201-A type tubes, $23.50. Range, 1,000 to 1,500 miles on loud speaker. New Catalog 64 on request. Royal Manufacturing Co., 206 Broadway, Dept. 19. New York.

TRANSMITTING SET

15-20% DISCOUNT ON ALL STANDARD RECEIVERS. Fried-Eisemann Neutrodyne, $125.00: New Radiolas, etc. Thomas Radio Co., 111 Dex St., Muncfe, Ind.

RADIO BATTERIES

Super Radio A and B Circuit Batteries, which brfng in long distance reception. Sold for cash or on payment plan. Write for prices and details. Radio Battery Corporation, 501-B Industrial Bank Bldg., Flint, Mich.

MISCELLANEOUS

158 GENUINE Foreign Stamps. Mexico War Issues. Venezuela, Salvador and India Service. Guatemala, China, etc., only 5c. Finest approval sheets 50 to 60%. Agents Wanted. Big 72-p. Lists Free. We Buy Stamps. Established 20 Years. Hussman Stamp Co., Dept. 152, St. Louis, Mo.

R. T. C., Chicago, Ill.

Question: I have a single circuit receiver, which I am told oscillates and sends out carrier waves into the air which spoil my neighbors' reception. I am told that it does this only when the set is in the oscillating stage, and when it is doing so, I am not getting maximum efficiency out of it. Is there any instrument that I could put in the circuit that would tell me when the set is transmitting energy? How can I stop it?

Answer: It is pretty hard for the average fan to tell when his set is in the oscillating condition except by noting the noises which the set emits while tuning. When you tune across the wave of a broadcasting station, and the set gives a whistle which varies as you move any of the knobs, it is an infallible sign that the set is oscillating and transmitting energy.

Another test possible is to touch the set in any part in the grid circuit or antenna circuit. If you have taps in the antenna circuit, you can try lifting the switch lever. If the set is oscillating, a pronounced "thud" or "thuop" will be heard in the phones. If not, a light click or scratch will be heard.

Another sign of an oscillating receiver is a slight whistle or whine with the signal when reception is carried on. You can put a milliameter of about 0 to 25 milliamps maximum in the plate or tickler circuit and watch the meter pointer as it travels across the face of the scale. As the set bursts into oscillation, the meter usually gives a decided swing toward maximum, indicating resonance. This is nearly always a sign that the set is oscillating.

The best results are obtained when one tunes just below the regenerating point, as the signal will then come in without the customary squeals and whistles. To accomplish this, reduce the filament current, and the tickler coupling, and if it is still difficult to control, adjust your grid leak until it does so. It is often necessary to use a smaller grid condenser to accomplish this purpose.

However, under no circumstances should you let your set radiate strongly, as the use of aperiodic coupling will reduce this nuisance to a minimum.

A. M. B., Des Moines, Iowa

Question: I have read with considerable interest the comment on honeycomb receivers, and would like very much to have you print a diagram of a receiver using this circuit. I note in your magazine of a month or so ago that you mention the results obtained by T. J. Kennedy, and would like very much to have a diagram of a receiver of the type used by him.

Answer: I am printing in *Figure 2* a copy of the diagram used by Mr. Kennedy in his record-breaking receptions. The antenna series condenser (which by the way can be placed in either antenna or ground leads) should be a good 23-plate vernier type and is not very critical in tuning. The other secondary condenser across the honeycomb is the tuning unit

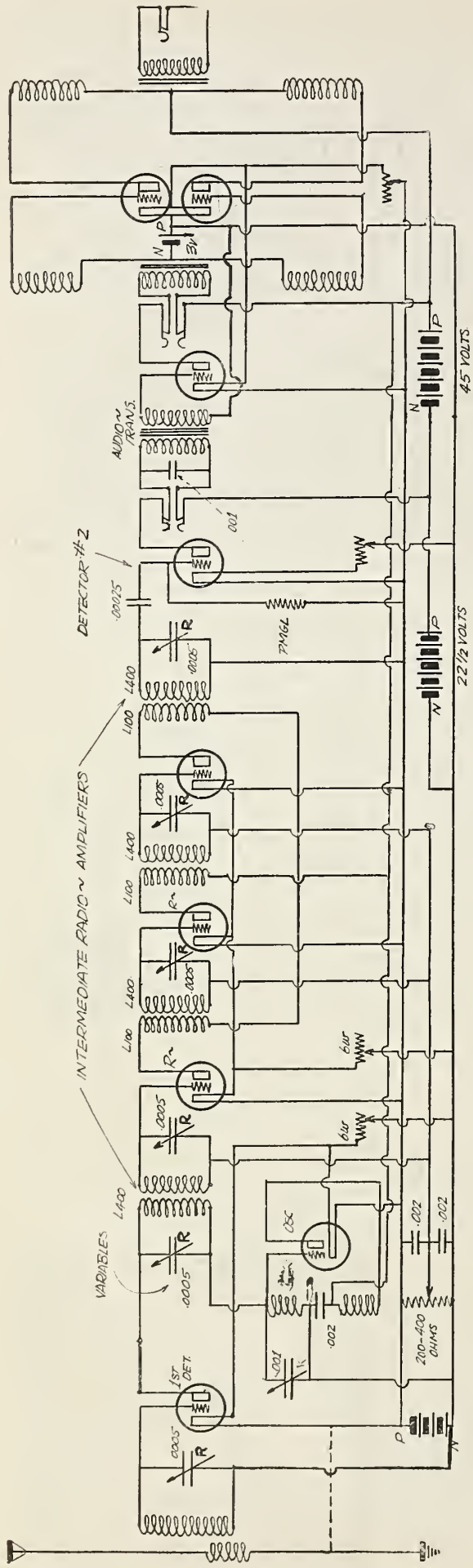


Figure 3. Another diagram of the McCullah Super-Heterodyne receiver showing several improvements. While only nine tubes are shown, another stage of radio can be added in the usual manner.

The improvements made incorporate a variable condenser across the primary of the longwave coils so that any intermediate wave length can be used on the radio frequency stages as are within the range of the coils. The oscillator condenser is connected across the grid coil of 27 turns instead of across both plate and grid inductances. The first detector is also changed, as it has no plate battery potential. The rotary plates of the variable condensers should be connected to the filament circuit as indicated to offset any hand capacity which may develop. Four rheostats are used, the first controlling the frequency changer and oscillator; the second, the intermediate stages; the third, the detector and the last the audio frequency unit.

The circuit is often improved when the positive filament is grounded as indicated by the dotted line. A pencil mark grid leak, as described in this issue, is used on the second detector, as shown next to the legend PMGL.

and should be of the very highest grade for maximum results.

The detector rheostat should be of the vernier type to permit close adjustment of the filament current; a factor of great importance in any receiver. Mr. Kennedy uses fixed condensers of .00025 MF capacity with a grid leak shunted across the G and F posts of the audio transformers to help eliminate noises in the set, an idea which is very practical. No jacks are used in the detector or first stage circuits, due to the fact that they contribute to noises in the receiver.

M. T. P., Birmingham, Ala.

Question: I have a three circuit receiver, and would appreciate a few instructions as to the method of tuning a receiver of this kind. I find that it tunes very closely, but I have much trouble in deciding which control I should manipulate to get the best results. Could you give me a few pointers?

Answer: The matter of tuning any receiver, as I have said before, is a matter of practice, and the familiarization of one's ears to the various noises of the set. However, I will outline briefly the procedure that is usually followed with a standard three circuit tuner using two variometers and a coupler. Set the grid and plate variometers at zero. Vary the secondary (rotor) of the variocoupler until a signal is heard. This signal should be tuned in to maximum intensity.

Next, vary the grid variometer until the signal is further increased in strength. The plate variometer is then varied until a point is reached where the familiar "thud" or "thump" accompanying regeneration is heard. The filament can then be turned back until the signal comes in clearest, or the plate variometer can be brought back (or both) until a point just below oscillation is reached, where the signal will be loudest. It is customary to set the secondary of the coupler first, and then vary the grid and plate variometers together until the best effect is reached. If difficulty is had in finding this point, the rheostat is resorted to, and the filament should be decreased or increased until the proper value is found. I am assuming, of course, that the grid leak and other values such as the plate battery are at maximum effectiveness. If interference is encountered, the secondary of the coupler should be turned to decrease the coupling between that coil and the primary.

A. S. M., Toronto, Ont., Canada

Question: I have constructed one of your super-heterodyne receivers as was described by your Mr. McCullah in the April, 1924, issue. While the set functions, I find that its range is rather limited, and I would like very much to know if you could suggest anything to improve the range.

Answer: In *Figure 3*, I am printing a diagram of the super-heterodyne receiver of the type designed by Mr. McCullah with several changes thereon.

The fixed condenser across the primary of the LWC (long wave coils) is sub-

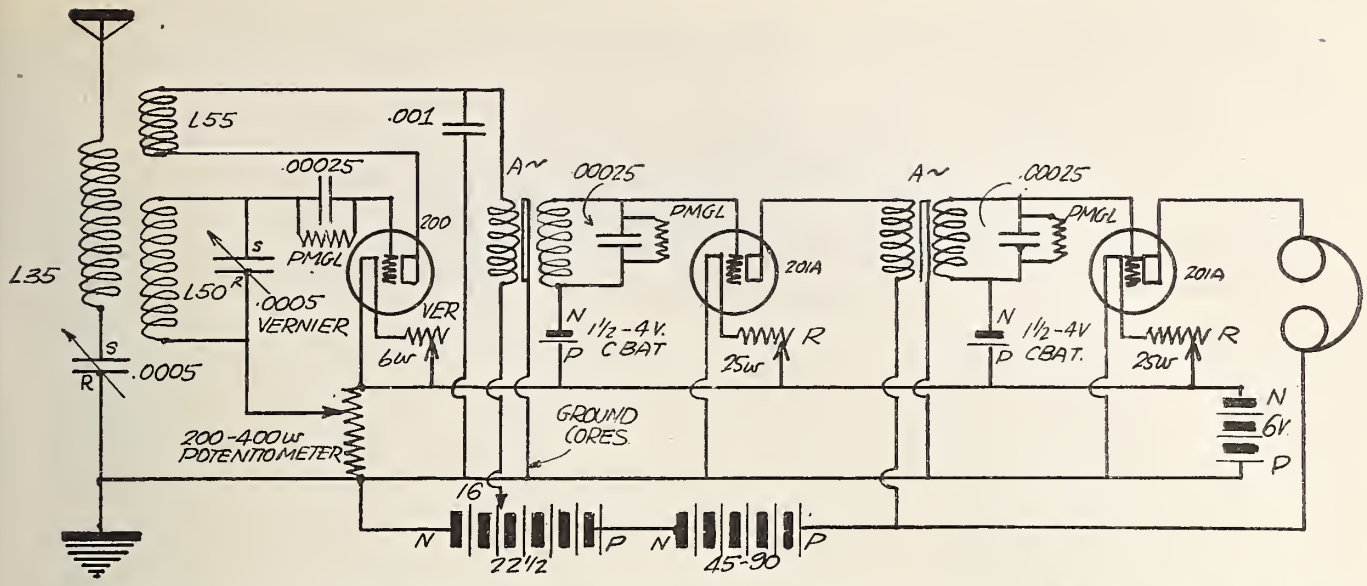


Figure 2. A diagram of the receiver used by T. J. Kennedy in his record breaking receptions. The secondaries of the audio transformers are shunted by a .00025 MF condenser and a variable pencil mark grid leak.

stituted with a .0005 MF variable, which permits the use of different intermediate waves for amplification. With some minor changes in the plate circuit of the first detector and grid circuit of the oscillator, the circuit is practically the same. For lack of space only 9 tubes are shown, the original circuit using 10. The omitted tube is the radio frequency amplifier which is added in the ordinary manner.

Scotch Loop Gets WGY

James Mackintosh of Inverness, Scotland, found WGY signals coming in so strong that he decided to try a frame aerial consisting of four turns of bell wire wound on a square frame with four feet sides. "Surprising were the results," reports Mr. Mackintosh, "the music from WGY was distinctly audible and the speech just defined enough to enable the call sign to be obtained."

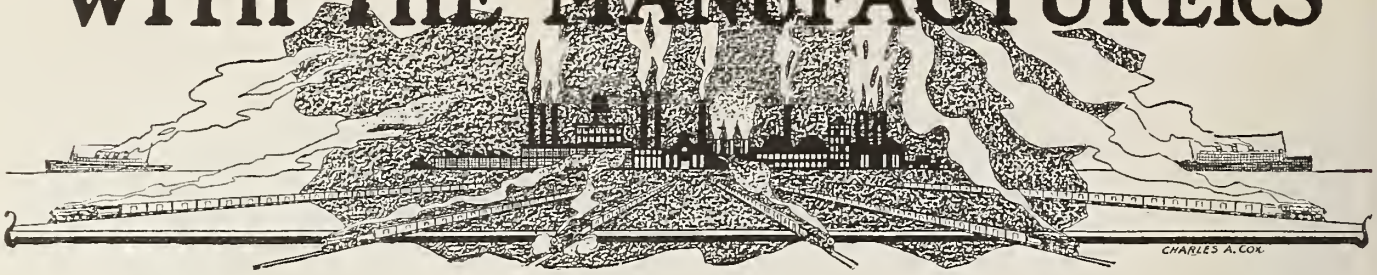
American Sets Wanted

It is only natural that for American broadcast reception American-made apparatus is sought abroad, and nearly every week requests for radio apparatus, data and catalogues are received by the Department of Commerce. Many overseas seek to become agents of American manufacturing firms and the Department is forced to keep a list of such requests for reference. Just now Italy is seeking receiving sets suitable for reception on wave lengths from 400 to 600 and 400 to 4,000 meters, and ranges from 10 to 2,000 miles. Calls have also been received recently from Brazil, Portugal, Sweden, New Zealand and Australia for apparatus and batteries. Some countries are already jealous of American sets and have prohibited its importation or imposed high tariffs to protect home-made sets.

Radio to Prevent Forest Fires

Messages by Secretary of Agriculture Wallace and Governor Gifford Pinchot of Pennsylvania were broadcast from thirty radio stations during Forest Protection Week, April 21-27, as a means to spread the doctrine of forest fire prevention. Several of the messages were broadcast personally by Governor Pinchot and Secretary Wallace from stations in Harrisburg, Pa., and Washington, D. C. In addition to their messages, talks on forest fires were made over radio by forestry officials of many states and by members of the Forest Service. Early reports indicate that the radio appeal for forest protection was so effective it will probably be made a regular government policy.

WITH THE MANUFACTURERS



New Loud Speaker

Radio listeners who now demand not only volume and quality of tone, but pleasing appearance, will find in the new Western Electric No. 14-A Loud Speaking Telephone Outfit an efficient cabinet type of instrument that makes use of the latest developments in the electrical communication art. It is a combined loud speaking telephone and audio-frequency amplifier. This outfit, including the horn, is built into a mahogany cabinet of attractive design, which may be placed on a table.

The novel feature of this outfit is the horn, which, folded into a relatively small compass, has yet the properties of a straight horn almost twice as long as the cabinet is deep. Despite its small size, it is more effective even than the horn supplied with the 10-A and 10-D loud speaking telephone outfits. Connected to the horn is a loud speaking telephone similar to that used on many occasions to project the voices of speakers, notably at the inauguration of the late President Harding.

Two stages of audio-frequency amplification are provided, the last stage using two tubes connected in "push-pull." This arrangement gives the maximum output with practically no distortion of the quality of the transmission. Volume control is effected by turning a knob on the front of the cabinet; this varies the audio voltage applied to the grid of the first tube. A snap-switch, also controlled from the front, turns on and off the filament current.

The outfit has been designed to operate with No. 216-A tubes, which are designed to work on a 6-volt storage battery. Plate current supply may be secured from any battery which will give 22 milliamperes at 120 to 135 volts. Six large size 22½-volt "B" batteries may be used, or a Western Electric No. 2-A Current Supply Set will furnish both filament and plate current.

Since this outfit can do no more than give an amplified reproduction of the output of a radio receiver, it is important that the latter be capable of giving an output of good quality and of sufficient volume to be satisfactory to a listener using a telephone head set. It should be remembered that this outfit is in no sense a radio receiver or tuning device.

British Interest Grows

Enthusiasm for radio telephony continues to grow throughout Great Britain, according to Acting Commercial Attache Hugh A. Butler. Up to March 1, 1924, over 600,000 licenses for receiving sets had been issued.

Electrad Variohm On Market

Considerable popularity for Electrad's new "Variohm" has been reported by dealers throughout the country. It is said to be the newest thing in variable grid leaks, being unusually compact and taking up little room on either panel or inside the set.

A complete range of resistances in one unit is afforded, ranging from one-fourth to ten megohms. The Variohm is non-microphonic, moisture proof, saves B batteries and does away with circuit noises, according to a circular sent to dealers by Electrad, Inc., of New York City. Another advantage is the elimination of local stations and the opportunity to receive distant stations without interference.

On Freed-Eisemann Force

EDGAR K. JAMES

Amateurs all over the United States know Edgar K. James, who conducted the first radio show for amateurs, and assisted in the latest show held in the Pennsylvania Hotel, New York. He has always been active in amateur radio and is a member of the Second District Executive Radio Council. During the war he was instructor at McCook's field in Dayton, Ohio, and in 1919 he started the radio department for Stanley & Paterson, radio jobbers. He was with the De Forest Company two years, and two years with the A. H. Grebe Company in Richmond Hill, L. I. Now the Freed-Eisemann Radio Corporation have him, and he is out doing a big job in the Eastern territory.

Four Brazilian Stations

Permission to establish four radio broadcasting stations has been granted by the Ministry of Public Works of Brazil to the Brazilian Radio Telegraph Company for the purpose of broadcasting information, lectures, concerts, etc. The four stations are to be located at Sao Paulo, Bello Horizonte, Bahia, and Pernambuco.

The Inside of a Radio Factory

By E. J. Craine

The inside of a radio factory is like nothing else in the world but a gigantic bee-hive, and one of its chief points of similarity is the promptness with which drones must be eliminated.

The same curiosity that makes a small boy want to see the inside of a watch urges the average "fan" to see the inside of a radio factory. The results, however, are not so disastrous in a radio plant, although a feeling of awe casts its spell throughout.

Visits Freed-Eisemann

It was to Joseph D. R. Freed that I confided my longing to visit the Freed-Eisemann organization in Brooklyn.

The first room I entered was filled with a huge pile of panels, several feet deep and still enclosed in their white wrappings. Nearby, workmen were drilling four panels simultaneously and with the greatest care, with machines that are set with mathematical accuracy.

Once drilled, the edges of the panels are smoothed, and then, with a battery of ten huge machines that look like overgrown drawing toys, the name, "Freed-Eisemann" is engraved, as well as the various names which indicate dial numbers, etc.

Rows and rows of benches where expert workmen were winding coils were found in an adjoining room. Other workmen varnish the coils with a secret preparation, after which they were left to dry. Coils and condensers are then attached to the panel, which soon begins to be recognizable, with its three coils, four posts, and tube shelf.

Soldered parts are given the closest scrutiny and wiring is tested by experts. Every speck of dust is blown out with a strong compressed air blower. Not the smallest detail is left to chance, and each step in the work of construction is tested. If any part falls under perfection, it is sent back and often broken up.

When a set is still in embryo state it is given a long tag and in the course of completion each man who contributes to its construction signs his name to the tag; so, when the set finally stands forth, every worker's signature is there. These tags are filed in order that inferior workmanship can be traced.

Tested for Flaws

In the engineer's department the receiver is neutralized and tested again for any possible flaw. When the apparatus is finally enclosed in its cabinet it is sent to a "laboratory" where it must run the gauntlet of examination and test. After

passing through the hands of many skilled workmen it is enclosed in a carton.

Air chambers protect the set perfectly in the carton, keeping it absolutely safe until it arrives at its destination.

The Freed-Eisemann plant occupies about 25,000 square feet. More than 400 workmen are employed in the factory.

Phonograph Dealers Interested

Phonograph dealers recently have shown considerable interest in radio. The increased publicity being devoted to radio is expected to result in more sales for phonograph concerns as well as all classes of stores who sell radio.

To "tie in" with this activity, the Manhattan Electrical Supply Company is offering for sale a new phonograph attachment under their trade mark, "Red Seal." It consists of a special Red Seal receiver attached to a heavy non-resonant metal base with air chamber and diaphragm especially designed to operate the large air column of a reproducing horn.

Attachment is made to the tone arm of the phonograph by means of a soft rubber tube. This new attachment is very sensible to faint signals and re-creates musical programs faithfully.

New Managers for Goldschmidt

John B. Price and Harry Kamen have been appointed to district managerships by the Goldschmidt Corporation. Mr. Price has been chosen New York district manager and will have charge of the supervision of sales of N & K Imported Phones, loud speakers and other products which the Goldschmidt Corporation plans to put on the market soon in Northern New Jersey, greater New York, New York State and Long Island.

Mr. Kamen will have charge of the New England district and will handle the same products as Mr. Price. Mr. Kamen has been connected for twelve years with the A. C. Gilbert Company of New Haven, Conn., in the electrical specialty business.

Cruver Has New Condenser

The Cruver Manufacturing Company, Chicago, has just put out a new condenser, invented and designed by G. M. Proudfoot, their engineer. The condenser cuts down the inefficient capacities by means of mounting the stator plates on two rods instead of three, thereby reducing losses to a negligible quantity.

The 23-plate condenser showed the same reading at maximum capacity and 290 meters as the standard used, which is said to have a loss of only seven one-thousandths of one per cent at a capacity of .001 M. F. The model was used in the Trans-Atlantic test in the "low loss" tuner designed and operated by F. J. Marco of Experimental Station 9XBA, Chicago.

When the group plates are set for the coarse adjustment, the reading shows on the large scale. The knob is then turned in the opposite direction and the fine adjustment is read on the inner scale, thus enabling an accurate log to be obtained.

Chicago Radio Makers Unite

The Associated Radio Manufacturers, an organization of manufacturers who will produce $150,000,000 worth of radio sets during 1924, has been organized in Chicago as a means of maintaining radio trade relations and increasing the efficiency of radio products.

Many of the big radio manufacturers in the Chicago district are represented in the new organization. They place their 1924 production estimate at a minimum of $150,000,000. More than 2,000,000 transformers alone are expected to be turned out. In the manufacture of radio sets the Zenith Radio Corporation has fixed its minimum at $3,500,000 worth of sets.

With the industry traveling along at such a lively clip, the manufacturers decided to get together and enlist their cooperation in a drive to eliminate the evils of radio reception as well as the evils offered by those who attempt to foist inferior apparatus on the radio public.

Herbert H. Frost, A. J. Carter, Frank Reichman, A. A. Howard and E. N. Rauland were elected as a temporary board of directors.

At the first general organization meeting the following firms were enrolled:

Rauland Manufacturing Company, Howard Radio Company, Carter Radio Company, Herbert H. Frost, Inc., Belden Manufacturing Company, Premier Electric Company, Bremer-Tully Manufacturing Company, Dudlo Manufacturing Company, Trimm Radio Manufacturing Company, Runzel-Lenz Electrical Manufacturing Company, Multiple Electric Products Company, American Art Mache Company, Seaman Paper Company, Electrical Research Laboratories, Walbert Manufacturing Company, Winkler-Reichman Company, Buell Manufacturing Company, French Battery Company, Zenith Radio Corporation.

G. A. Sawin Elected

G. A. Sawin, assistant to manager, Supply Sales Department, Westinghouse Electric and Manufacturing Company, has been elected chairman of a new section of the Electric Power Club. The section, including instruments and instrument transformers, was recently organized.

Mr. Sawin, who is chairman of the Instruments and Measurements Committee of the American Institute of Electrical Engineers, has also been appointed chairman of the Institute's section for revising the Institute's standardization rules pertaining to instrument transformers.

His wide experience with instruments and transformers will be of great aid to Mr. Sawin in the new duties assigned him.

Jacquet With National Carbon

Lloyd Jacquet, formerly with the Westinghouse Electric, has recently been placed in charge of the publicity section of the National Carbon Company's radio division. Previous to his connection with Westinghouse, Mr. Jacquet was radio editor of the New York Evening Mail.

AUTHENTIC—ACCURATE
RADIO AGE
MONTHLY DATA SHEETS
Pages 37 and 39, This Issue

Evils of Home Broadcasting

By L. O. MARSTELLER

THE trouble caused by an amateur's innocently operating his receiving set as a miniature broadcasting station is a radio bug-bear that can easily be overcome with a little thought and study on the subject of radio interference.

Nearly all the sensitive receiving sets in use are capable of broadcasting speech and music. This can readily be done by the use of a microphone properly connected to a receiving set.

A microphone is a simple little device, one form of which we use every day; namely, the part of the telephone into which we talk. Talking into a very sensitive microphone causes the voice to affect the powerful radio waves sent out by the transmitter, which is fundamentally a large sensitive receiving set having a microphone connected to it. The tickler on the transmitter is necessarily adjusted so as to make the circuit oscillate and consequently transmit radio waves just as your receiving set will do with a similar tickler adjustment.

If I thought that you would use the microphone only to reprimand your neighbor, who is causing his receiving set to transmit whistles and squeals, then I certainly would explain how to connect the device to your set. However, there is always the possibility of the ladies broadcasting tea party gossip or the uncanny East or West wind from a Mah Jong party, so I shall leave the home broadcasting idea for you to think about.

The purpose of mentioning the possibility of using the receiving set as a broadcasting station is to call your attention to the power you control with the knobs and dials on your set.

If you do not have a microphone connected to your receiving set, you can still transmit, but it will be whistles and squeals which are a source of interference to your neighbors.

Whence That Squeal?

Many times during the reception of an interesting program, one will hear a whistle or squeal caused by a neighbor who improperly manipulates the controls of his set. The fact that he can very easily prevent such interference is an excellent reason for paying him a visit and explaining the situation. Before paying your neighbor this instructive visit, however, it would be well to learn the cause, effect and remedy for such interference.

There are several types of receiving sets which can be made to act as a transmitter. The first of these is the favorite set, a single circuit receiver. There are two controls on a single circuit receiver. One of these controls is known as a tuner handle or knob. This control makes it possible to tune in one station and eliminate another. The other control is a tickler or intensifier. Its purpose is to increase the signal strength. Both tuner and tickler should be operated simultaneously. Now let us consider the proper operation of this set.

With the tickler set near zero, bring the tuner control to approximately the setting where you would expect to find the desired signal, and, with the other hand, bring the tickler control up to the point where a slight hiss or rustle is heard and keep the tickler so adjusted as you more accurately tune in the signal.

If a slight change of the tuner adjustment causes a squeal or whistle to be heard, you should immediately remedy matters by decreasing the tickler until the whistle disappears. If you do not decrease the tickler setting, your set will continue to act as a transmitter and radiate an interfering wave. This will cause your neighbors to receive a whistle like noise mixed in with the concert music from the broadcasting station. Many times music of excellent quality is condemned because of the interference caused by the wave sent out from a neighbor's receiving set.

With a very little practice the single circuit receiving set can be operated night after night without causing any interference.

The Three Control Type

Another type of receiver which often finds a place in the amateur's home and sometimes is used for broadcast reception, has one more control than the single circuit set, making a total of three controls.

One control tunes the primary or antenna circuit and the other tunes the secondary or tube circuit. The third control is marked tickler or intensifier. This receiver is very selective, but requires considerable skill and patience in order to tune in weak signals. As this type of receiver has three controls, it is rather difficult to keep the tickler properly adjusted as the primary and secondary controls are operated. The general tendency is to set the tickler to maximum and then tune the primary and secondary until the whistle like note of a broadcasting station is heard.

For people who only have two hands, there is only one way to operate such a set and not cause interference; that is, to calibrate the secondary circuit by marking the proper setting down on a chart. Then to tune in a station it is only necessary to set the secondary control to the proper point as determined from the calibration chart and adjust the tickler to the point where a slight hiss or rustle is heard as the primary circuit is tuned to the desired signal.

There is one other receiver which is commonly used. This receiver causes a great amount of interference, as it has three tuned circuits. Two of the controls are marked primary and secondary and are manipulated to tune in a signal. The third control acts as a tickler and has a definite adjustment for each adjustment of the secondary circuit. With this type of receiver, it is almost impossible to tune in a station without radiating an interfering wave. Every time that the third control is tuned to the secondary circuit, an interfering wave will be radiated.

Can Be Heard Six Blocks

How far will any one or all of these three types of receivers transmit? Anyone will cause interference over a distance of four city blocks and can under most favorable conditions be heard six blocks away.

Possibly the evil has been recognized in the cities where so many receiving sets must be used within a small area, and, that greater co-operation between neighbors has necessarily been obtained.

Sophs' Radio Party Spoiled

Troy, N. Y.—When the Class of 1926 of the Rensselaer Polytechnic Institute staged its big social event, the Sophomore Soiree, the students wanted the whole world to know they were having a good time.

And the world would have known it if the envious freshmen hadn't known something about radio.

The sophomores had persuaded Station WHAZ to hook up with the 105th Regiment Armory, where the event was being held, and put the syncopated music of Ben Selvin and his Moulin Rouge Orchestra on the air.

Wires, microphone pickups and electrifiers were placed in their proper places, and on tests held early in the evening everything worked perfectly. After local broadcasting stations closed for the night the announcement was sent out that WHAZ would broadcast the student affair. Radio listeners settled back to hear the jazz music and gay laughter.

But something went wrong. There came occasional strains of music, interrupted by long periods of silence. The radio men were stumped; they inspected the apparatus, changed the microphone and tested the wires—but still no music came forth, although the orchestra was playing for all it was worth.

It was the first time in two years that the station's program had been spoiled. After several hours' investigation the "experts" discovered that in an obscure place back of the Sage dining hall the transmission wires had been tapped in two places with leads to the ground.

After a little sleuthing, the investigators forced a group of freshmen to confess they had tapped the wires and inserted a microphone intended to broadcast remarks harmful to their hated rivals—the sophomores. Fortunately the second microphone did not work, but the frosh took solace in the fact the sophomores' program was not broadcast to a wondering world.

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers and broadcasters.

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh	326
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270
KDPT	Southern Electrical Co.	San Diego, Calif.	244
KDYL	Telegram Publishing Co.	Salt Lake City, Utah	360
KDYM	Savoy Theatre	San Diego, Calif.	244
KDYQ	Oregon Institute of Technology	Portland, Oreg.	360
KDYX	Star Bulletin	Honolulu, Hawaii	360
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZE	Rhodes Department Store	Seattle, Wash.	270
KDZI	Electric Supply Co.	Wenatchee, Wash.	360
KDZQ	Nichols Academy of Dancing	Denver, Colo.	360
KDZR	Bellingham Publishing Co.	Bellingham, Wash.	261
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	360
KFAE	State College of Washington	Pullman, Wash.	330
KFAF	Western Radio Corp.	Denver, Colo.	360
KFAJ	University of Colorado	Boulder, Colo.	360
KFAN	The Electric Shop	Moscow, Idaho	360
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif.	280
KFAU	Independent School Dist. of Boise City, Boise High School, Boise, Idaho		270
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280
KFAY	W. J. Virgin	Medford, Oreg.	283
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Azbill	San Diego, Calif.	278
KFBE	Reuben H. Horn	San Luis Obispo, Calif.	242
KFBG	First Presbyterian Church	Tacoma, Wash.	360
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and the Chronicle News	Trinidad, Colo.	360
KFBU	The Cathedral (Bishop N. S. Thomas)	Laramie, Wyo.	283
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFCF	Frank A. Moore	Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)	Billings, Mont.	360
KFCP	Ralph W. Flygare	Ogden, Utah	360
KFCV	Fred Mahaffey, Jr.	Houston, Texas	360
KFCY	Western Union College	Le Mars, Iowa	252
KFCZ	Omaha Central High School	Omaha, Nebr.	258
KFDA	Adler's Music Store	Baker, Oreg.	360
KFDD	St. Michaels Cathedral	Boise, Idaho	252
KFDH	University of Arizona	Tuscon, Ariz.	368
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	360
KFDO	H. Everett Cutting	Bozeman, Mont.	248
KFDR	Bullocks' Hardware & Sporting Goods (Rob. G. Bullock)	York, Nebr.	360
KFDV	Gilbrech & Stinson	Fayetteville, Ark.	360
KFDX	First Baptist Church	Shreveport, La.	360
KFDY	South Dakota State College of Agriculture and Mechanics Arts	Brookings, S. Dak.	360
KFDZ	Harry O. Iverson	Minneapolis Minn.	231
KFEC	Meier & Frank Co.	Portland, Oreg.	360
KFEL	Winner Radio Corp.	Denver, Colo.	360
KFEQ	J. L. Scroggin	Oak, Nebr.	360
KFER	Auto Electric Service Co.	Fort Dodge, Iowa	231
KFEV	Radio Electric Shop	Douglas, Wyo.	263
KFEX	Augsburg Seminary	Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining and Concentrating Co.	Kellogg, Idaho	360
KFEZ	Asso. Engr. Societies of St. Louis	St. Louis, Mo.	248
KFFB	Jenkins Furniture Co.	Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.	Pendleton, Oreg.	360
KFFO	Dr. E. H. Smith	Hillsboro, Oreg.	229
KFFP	First Baptist Church	Moberly, Mo.	266
KFFQ	Marksheffel Motor Co.	Colorado Springs, Colo.	360
KFFR	Nevada State Journal (Jim Kirk)	Sparks, Nev.	226
KFFV	Graceland College	Lamoni, Iowa	360
KFFX	McGraw Co.	Omaha, Nebr.	278
KFFY	Pincus & Murphy	Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.	Dallas, Tex. (portable)	226
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	273
KFGL	Arlington Garage	Arlington, Oreg.	234
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFGV	Heidbreder Radio Supply Co.	Utica, Nebr.	224
KFGX	First Presbyterian Church	Orange, Tex.	250
KFGZ	Emmanuel Missionary College	Berrien Springs, Mich.	268
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHB	Rialto Theater (P. L. Beardwell)	Hood River, Oreg.	280
KFHD	Utz Electric Shop Co.	St. Joseph, Mo.	226
KFHF	Central Christian Church	Shreveport, La.	266
KFHH	Ambrose A. McCue	Neah Bay, Wash.	283
KFHJ	Fallon & Co.	Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.	Seattle, Wash.	270
KFHX	Robert W. Nelson	Hutchinson, Kan.	229
KFI	Earle C. Anthony (Inc.)	Los Angeles, Calif.	469
KFID	Ross Arbuckle's Garage	Iola, Kans.	246
KFIF	Benson Polytechnic Institute	Portland, Oregon	360
KFIL	Windisch Electric Farm Equipment Co.	Louisburg, Kans.	234
KFIO	North Central High School	Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association	Yakima, Wash.	224
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIV	V. H. Broyles	Pittsburg, Kans.	240
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huelsman	Fon Du Lac, Wis.	273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	Seattle Post Intelligencer	Seattle, Wash.	233
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	252
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg.	252
KFJK	Delano Radio and Electric Co.	Bristow, Okla.	233
KFJL	Hardsacg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	229
KFJQ	Valley Radio, Div. of Elec. Constr. Co.	Grand Forks, N. D.	280
KFJR	Ashley C. Dixon & Son	Stevensville, Mont. (near)	258
KFIV	Thomas H. Warren	Dexter, Iowa	224
KFJX	Iowa State Teachers' College	Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	248
KFJZ	Texas National Guard, One hundred and twelfth Cavalry	Fort Worth, Texas	254
KFKA	Colorado State Teachers College	Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association	Milford, Kans.	286
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark.	224
KFKV	F. F. Gray	Butte, Mont.	283
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	341
KFKZ	Nassour Bros. Radio Co.	Colorado Springs, Colo.	234
KFLA	Abner R. Willson	Butte, Mont.	283
KFLB	Signal Electric Manufacturing Co.	Menominee, Mich.	248
KFLD	Paul E. Greenlaw	Franklinton, La.	234
KFLE	National Educational Service	Denver, Colo.	268
KFLH	Erickson Radio Co.	Salt Lake City, Utah	261
KFLP	Everette M. Foster	Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop	Little Rock, Ark.	261
KFLR	University of New Mexico	Albuquerque, N. Mex.	254
KFLU	Rio Grande Radio Supply House	San Benito, Texas	236
KFLV	Rev. A. T. Frykman	Rockford, Ill.	229
KFLW	Missoula Electric Supply Co.	Missoula, Mont.	234
KFLX	George Roy Clough	Galveston, Tex.	240
KFLY	Fargo Radio Supply Co.	Fargo, N. Dak.	231
KFLZ	Atlantic Automobile Co.	Atlantic, Ia.	273
KFMQ	University of Arkansas	Fayetteville, Ark.	263
KFMR	Morningside College	Sioux City, Iowa	261
KFMS	Freimuth Dept. Store	Duluth, Minn.	275
KFMT	Dr. George W. Young	Minneapolis, Minn.	231
KFMU	Stevens Bros.	San Marco, Tex.	240
KFMW	M. G. Sateren	Houghton, Mich.	266
KFMX	Carleton College	Northfield, Minn.	283
KFMY	Boy Scouts of America	Long Beach, Calif.	229
KFMZ	Roswell Broadcasting Club	Roswell, N. M.	252
KFNC	Alonzo Monk, Jr.	Corsicana, Texas	234
KFNF	Henry Field Seed Co.	Shenandoah, Iowa	266
KFNG	Wooten's Radio Shop	Coldwater, Miss.	254
KFNH	State Teachers College	Springfield, Mo.	236
KFNJ	Warrensburg Electric Shop	Warrensburg, Mo.	234
KFNL	Radio Broadcast Ass'n.	Paso Robles, Calif.	240
KFNV	L. A. Drake Battery and Radio Supply Shop	Santa Rosa, Calif.	234
KFNX	Peabody Radio Service	Peahody, Kansas	240
KFNY	Montana Phonograph Co.	Helena, Montana	261
KFNZ	Royal Radio Company	Burlingame, Calif.	231
KFOC	First Christian Church	Whittier, Calif.	236
KFOD	Vern Peters	Wallace, Idaho	224
KFOF	Rohrer Electric Co.	Marshfield, Oregon	240
KFOH	The Radio Bungalow	Portland, Oregon	283
KFOJ	Moberly High School Radio Club	Moberly, Missouri	246
KFOL	Leslie M. Schafbush	Marengo, Iowa	234
KFON	Echophone Radio Shop	Long Beach, Calif.	234
KFOO	Latter Day Saints University	Salt Lake City, Utah	261
KFOP	Willson Construction Co.	Dallas, Texas	268
KFOQ	Ora William Chancellor	Galveston, Texas	240
KFOR	David City Tire & Electric Co.	David City, Nebraska	226
KFOT	College Hill Radio Club	Wichita, Kansas	231
KFOU	Hommel Mfg. Co.	Richmond, Calif.	254
KFOV	Davis Electrical Corporation	Sioux City, Iowa	234
KFOX	Board of Education, Technical High School	Omaha, Nebraska	248
KFOY	Beacon Radio Service	St. Paul, Minn.	226
KFOZ	Leon Hudson Real Estate Co.	Fort Smith, Ark.	233
KFPB	Edwin J. Brown	Seattle, Wash.	224
KFPG	Garretson and Dennis	Los Angeles, Calif.	238
KFPH	Harold Chas. Mailander	Salt Lake City, Utah	242
KFPL	C. C. Baxter	Dublin, Texas	242
KFPM	The New Furniture Co.	Greenville, Texas	242
KFPN	Missouri National Guard	Jefferson City, Mo.	242
KFPP	G. & G. Radio & Electric Shop	Olympia, Washington	236
KFPQ	Clifford M. Ecler	Denison, Texas	231
KFPR	Los Angeles Co. Forestry Dept.	Los Angeles, Calif.	231
KFPS	Carter A. Ross Motor Service Co.	Casper, Wyo.	242
KFPV	Heintz & Kohlmoos, Inc.	San Francisco, Calif.	236
KFPW	St. Johns M. E. Church, S.	Carterville, Mo.	268
KFPY	Symons Investment Co.	Spokane, Wash.	283
KFPX	First Presbyterian Church	Pine Bluff, Ark.	242
KFSG	Angelus Temple	Los Angeles, Calif.	278
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service	Portland, Oreg.	360
KGN	Northwestern Radio Mfg. Co.	Portland, Oreg.	360
KGO	General Electric Co.	Oakland, Calif.	312
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach	360
KGW	Portland Morning Oregonian	Portland, Oreg.	492
KGY	St. Martins College (Reb. Sebastian Ruth)	Lacy, Wash.	258
KHJ	Times-Mirror Co.	Los Angeles, Calif.	395
KHQ	Louis Wasmer	Seattle, Wash.	360
KJQ	C. O. Gould	Stockton, Calif.	360
KJR	Northwest Radio Service Co.	Seattle, Wash.	270
KJS	Bible Institute of Los Angeles	Los Angeles, Calif.	360
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	360
KLX	Tribune Publishing Co.	Oakland, Calif.	509
KLZ	Reynolds Radio Co.	Denver, Colo.	509
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif.	273
KMO	Love Electric Co.	Tacoma, Wash.	360
KNT	Grays Harbor Radio Co. (Walter Hemrich)	Aberdeen, Wash.	263
KNX	Electric Lighting Supply Co.	Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture & Mechanic Arts	State College, N. Mex.	360
KOP	Detroit Police Department	Detroit, Mich.	286
KPO	Hale Bros.	San Francisco, Calif.	423
KQP	Apple City Radio Club	Hood River, Oreg.	360
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa	270
KQW	Charles D. Herrold	San Jose, Calif.	360
KRE	V C Battery & Electric Co.	Berkeley, Calif.	278
KSD	Post Dispatch (Pulitzer Pub. Co.)	St. Louis, Mo.	546
KTW	First Presbyterian Church	Seattle, Wash.	360
KUO	Examiner Printing Co.	San Francisco, Calif.	360
KUY	Coast Radio Co.	El Monte, Calif.	256
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	360
KWH	Los Angeles Examiner	Los Angeles, Calif.	360
KYQ	Electric Shop	Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	536
KZM	Preston D. Allen	Oakland, Calif.	360
KZN	Cope and Johnson Co.	Salt Lake City, Utah	268
KZV	Wenatchee Battery & Motor Co.	Wenatchee, Wash.	360
WAAB	Valdemar Jensen	New Orleans, La.	268
WAAC	Tulane University	New Orleans, La.	360
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	286
WAAK	Gimbel Brothers	Milwaukee, Wis.	280
WAAM	I. R. Nelson Co.	Newark, N. J.	263
WAAN	University of Missouri	Columbia, Mo.	254
WAAW	Omaha Grain Exchange	Omaha, Nebr.	360
WABA	Lake Forest College	Lake Forest, Ill.	266
WABB	Harrisburg Sporting Goods Co.	Harrisburg, Pa.	266
WAED	Parker High School	Dayton, Ohio	283
WABE	Young Men's Christian Association	Washington, D. C.	283
WABG	Arnold Edwards Piano Co.	Jacksonville, Fla.	248
WABH	Lake Shore Tire Co.	Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co.	Bangor, Me.	240
WABL	Connecticut Agricultural College	Storrs, Conn.	283
WABM	F. E. Doherty Automotive and Radio Equipment Co.	Saginaw, Mich.	254
WABN	Waldo C. Grover	La Crosse, Wis.	244

Evolution of a Condenser

Originally all condensers were of the fixed type, and alternate sheets of glass and tin foil had to be built up to secure the capacities required or to tune in the wave length desired, according to a circular issued by the Charles Freshman Company, Inc.

Then came sliding plates of metal which intermeshed with opposing plates, thus giving an adjustable capacity. From the simple sliding plate type, the next step was to mount one set on a rotating shaft and by simply turning the shaft, variation in capacity was secured.

The "Freshman Selective" type has been put on the market as the latest in variable condensers. Using walls of mercury separated by a sturdy sheet of mica, the Freshman condenser secures capacity ranges by varying the area of the mercury walls. The operation is simple, the dial setting corresponding to capacity variation or wave lengths the same as any other condenser.

A. M. Joralemon Joins Crosley

The appointment of A. M. Joralemon as general sales manager of The Crosley Radio Corporation, Cincinnati, brings another executive to the organization which has grown so rapidly in the past three years under the guidance of Powel Crosley, Jr., its president. The new executive, who joined the organization April first, needs no introduction to the radio industry, for he has been with the National Carbon Company, in managerial capacity, for the past fourteen years. His most recent endeavors were as sales manager of the radio division of that company.

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

WABO	Lake Avenue Baptist Church	Rochester, N. Y.	252
WABP	Robert F. Weinig	Dover, Ohio	266
WABQ	Haverford College, Radio Club	Haverford, Pa.	261
WABR	Scott High School, N. W. B. Foley	Toledo, Ohio	270
WABS	Essex Manufacturing Co.	Newark, N. J.	244
WABT	Holiday-Hall, Radio Engineers	Washington, Pa.	252
WABU	Victor Talking Machine Co.	Camden, N. J.	226
WABV	John H. De Witt, Jr.	Nashville, Tenn.	263
WABW	College of Wooster	Wooster, Ohio	234
WABX	Henry B. Joy	Mt. Clemens, Mich.	270
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	263
WBAA	Purdue University	West Lafayette, Ind.	360
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAN	Wireless Phone Corp.	Paterson, N. J.	244
WBAO	James Millikin University	Decatur, Ill.	360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.	Columbus, Ohio	390
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.	New York, N. Y.	492
WBBA	Newark Radio Laboratories	Newark, Ohio	240
WBBD	Barbey Battery Service	Reading, Pa.	234
WBBE	Alfred R. Marcy	Syracuse, N. Y.	246
WBBF	Georgia School of Technology	Atlanta, Ga.	270
WBBG	Irving Vermilya	Mattapoisett, Mass.	240
WBBH	J. Irving Bell	Port Huron, Mich.	246
WBBJ	Neal Electric Co., P. E. Neal	West Palm Beach, Fla.	258
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	283
WBBM	Frank Atlass Produce Co.	Lincoln, Ill.	225
WBBN	Blake, A. B.	Wilmington, N. C.	275
WBBO	Mich. Limestone & Chemical Co.	Rogers, Mich.	250
WBBQ	Frank Crook	Pawtucket, R. I.	252
WBBR	Peoples Pulpit Asso.	Rossville, N. Y.	244
WBBS	First Baptist Church	New Orleans, La.	250
WBBT	Lloyd Brothers	Philadelphia, Pa.	234
WBBU	Jenks Motor Sales Co.	Monmouth, Ill.	224
WBBV	Johnstown Radio Co.	Johnstown, Pa.	248
WBBW	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Infantry, Co. "B" 118th Inf.	Charleston, S. C.	268
WBBZ	Noble B. Watson	Indianapolis, Ind.	227
WBL	T & H Radio Co.	Anthony, Kans.	261
WBR	Pennsylvania State Police	Butler, Pa.	286
WBS	D. W. May, Inc.	Newark, N. J.	360
WBT	Southern Radio Corp.	Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co.	Springfield, Mass.	337
WCAD	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa.	462
WCAG	Clyde R. Randall	New Orleans, La.	268
WCAH	Entrekin Electric Co.	Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	360
WCAK	Alfred P. Daniel	Houston, Texas	263
WCAL	St. Olaf College	Northfield, Minn.	360
WCAM	Villanova College	Villanova, Pa.	360
WCAO	Sanders & Stayman Co.	Baltimore, Md.	360
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C.	469
WCAR	Alamo Radio Electric Co.	San Antonio, Tex.	360
WCAS	William Hood Dunwoody Industrial Institute	Minneapolis, Minn.	246
WCAT	South Dakota State School of Mines	Rapid City, S. Dak.	240
WCAU	Durham & Co.	Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co.	Little Rock, Ark.	360
WCAX	University of Vermont	Burlington, Vt.	360
WCAZ	Carthage College	Carthage, Ill.	246
WCBA	Charles W. Heimbach	Allentown, Pa.	280
WCBC	University of Michigan	Ann Arbor, Mich.	280
WCBD	Wilbur G. Voliva	Zion, Ill.	345
WCBE	Uhalt Radio Co.	New Orleans, La.	263
WCBF	Paul J. Miller	Pittsburgh, Pa.	236
WCBG	Howard S. Williams (Portable)	Pascagoula, Miss.	236
WCBI	Nicol, Duncan & Rush	Bemis, Tennessee	226
WCBJ	J. C. Maus	Jennings, Louisiana	244
WCBK	E. Richard Hall	St. Petersburg, Fla.	266
WCBL	Northern Radio Mfg. Co.	Houlton, Me.	280
WCBM	Charles Swarz	Baltimore, Md.	229
WCBN	James P. Boland	Ft. Benj. Harrison, Ind.	266
WCBO	The Radio Shop, Inc.	Memphis, Tenn.	250
WCBQ	First Baptist Church	Nashville, Tenn.	236
WCBR	University of Mississipi	near Oxford, Miss.	242
WCBR	Charles H. Meester (Portable Station)	Providence, R. I.	246
WCBT	Clark University, Collegiate Dept.	Worcester, Mass.	238
WCBU	Arnold Wireless Supply Co.	Arnold, Pa.	254
WCBV	Tullahoma Radio Club	Tullahoma, Tenn.	252
WCBW	George P. Rankin, Jr., and Maitland Soloman	Macon, Ga.	226
WCBY	The Forks Electrical Shop	Buck Hill Falls, Pa.	268
WCBZ	Coppotelli Bros. Music House	Chicago Heights, Ill.	248
WCK	Stix, Baer & Fuller Dry Goods Co.	St. Louis, Mo.	360
WCM	University of Texas	Austin, Texas	360
WCX	Detroit Free Press	Detroit, Mich.	517
WDAE	Tampa Daily Times	Tampa, Fla.	360
WDAF	Kansas City Star	Kansas City, Mo.	411
WDAG	J. Laurence Martin	Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South)	El Paso, Tex.	268
WDAK	The Courant	Hartford, Conn.	261
WDAO	Automotive Electric Co.	Dallas, Tex.	360
WDAP	Board of Trade	Chicago, Ill.	360
WDAR	Lit Brothers	Philadelphia, Pa.	395
WDAS	Samuel A. Waite	Worcester, Mass.	360
WDAU	Slocum Kilburn	New Bedford, Mass.	360
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	244
WDBA	Fred Ray	Columbus, Ga.	236
WDBB	A. H. White & Co., Inc.	Taunton, Mass.	229
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WDBD	Herman Edwin Burns	Martinsburg, W. Va.	268
WDBE	Gilham-Schoen Electric Co.	Atlanta, Ga.	252
WDBF	Robert G. Phillips	Youngstown, Ohio.	246
WDBH	C. T. Scherer Co.	Worcester, Mass.	268
WDBI	E. Budd Peddicord	New Orleans, La.	242
WDBJ	Richardson Wayland Electric Corp.	Roanoke, Va.	229
WDBL	Wisc. Dept. of Markets	Stevens Point, Wisc.	278
WDBN	Electric Light & Power Co.	Bangor, Me.	252
WDM	Church of the Covenant	Washington, D. C.	234
WDZ	James L. Bush	Tuscola, Ill. Star Store Bldg.	278
WEAA	F. D. Fallain	Flint, Mich.	280
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	492
WEAH	Wichita Board of Trade	Wichita, Kans.	244
WEAI	Cornell University	Ithaca, N. Y.	286
WEAJ	University of South Dakota	Vermillon, S. Dak.	283
WEAM	Borough of North Plainfield (W. Gibson Buttfield)	North Plainfield, N. J.	252
WEAN	Shepard Co.	Providence, R. I.	273
WEAO	Ohio State University	Columbus, Ohio	360
WEAP	Mobile Radio Co.	Mobile, Ala.	360
WEAR	The Evening News Publishing Co	Baltimore, Md.	261
WEAU	Davidson Bros. Co.	Sioux City, Iowa	360
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Texas	360
WEB	Benwood Co.	St. Louis, Mo.	273
WEV	Hurlburt-Still Electrical Co.	Houston, Texas	360
WEW	St. Louis University	St. Louis, Mo.	261
WFAA	Dallas News & Dallas Journal	Dallas, Texas	476
WFAB	Carl F. Woese	Syracuse, N. Y.	234
WFAF	H. C. Spratley Radio Co.	Poughkeepsie, N. Y.	360
WFAH	Electric Supply Co.	Port Arthur, Texas	236
WFAJ	Hi-Grade Wireless Instrument Co.	Asheville, N. C.	360
WFAM	Times Publishing Co.	St. Cloud, Minn.	360
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn.	360
WFAQ	Missouri Wesleyan College	Cameron, Mo.	360
WFAT	New Columbus College	Sioux Falls, S. Dak.	258
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr.	275
WFI	Strawbridge & Clothier	Philadelphia, Pa.	395
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa.	248
WGAN	Cecil E. Lloyd	Pensacola, Fla.	360
WGAQ	Glenwood Radio Corp. (W. G. Patterson)	Shreveport, La.	252
WGAW	Ernest C. Albright	Altoona, Pa.	261
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGI	American Radio & Research Corp.	Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett	Philadelphia, Pa.	360
WGN	The Chicago Tribune—Edgewater Beach Broadcasting Station,	Chicago, Ill.	370
WGR	Federal Telephone & Telegraph Co.	Buffalo, N. Y.	319
WGV	Interstate Electric Co.	New Orleans, La.	242
WGY	General Electric Co.	Schenectady, N. Y.	380
WHA	University of Wisconsin	Madison, Wis.	360
WHAA	State University of Iowa	Iowa City, Iowa	484
WHAB	Clark W. Thompson	Galveston, Texas	360
WHAD	Marquette University	Milwaukee, Wis.	280
WHAG	University of Cincinnati	Cincinnati, Ohio	222
WHAH	Hafer Supply Co.	Joplin, Mo.	283
WHAK	Roberts Hardware Co.	Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y.	283
WHAP	Otta & Kuhns	Decatur, Ill.	360
WHAR	Paramount Radio & Electric Co. (W. H. A. Pulus)	Atlantic City, N. J.	231
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	380
WHB	Sweeney School Co.	Kansas City, Mo.	411
WHK	Radiovox Co. (Warren R. Cox)	Cleveland, Ohio	360
WHN	George Schubel	New York, N. Y.	360
WHO	Bankers Life Company	Des Moines, Iowa	526
WIAB	Joslyn Automobile Co.	Rockford, Ill.	252
WIAC	Galveston Tribune	Galveston, Texas	360
WIAD	Howard R. Miller	Ocean City, N. J.	254
WIAF	Gustav A. DeCortin	New Orleans, La.	234
WIAH	Continental Radio & Mfg. Co.	Newton, Iowa	258
WIAI	Heey Stores Co.	Springfield, Mo.	252
WIAJ	Fox River Valley Radio Supply Co. (Quinn Bros.)	Neenah, Wis.	224
WIAK	Journal-Stockman Co.	Omaha, Nebr.	278
WIAO	School of Engineering of Milwaukee	Milwaukee, Wis.	360
WIAQ	Chronicle Publishing Co.	Marion, Ind.	226
WIAS	Home Electric Co.	Burlington, Iowa	283
WIAT	Leon T. Noel	Tarkio, Mo.	360
WIAU	American Trust & Savings Bank	Le Mars, Iowa	360
WIAY	Woodward & Lothrop	Washington, D. C.	273
WIK	K. & L. Electric Co. (Herbert F. Kelso and Hunter J. Lohman)	McKeesport, Pa.	234
WIL	Continental Electric Supply Co.	Washington, D. C.	360
WIP	Gimbel Brothers	Philadelphia, Pa.	509
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	360
WJAG	Norfolk Daily News	Norfolk, Nebr.	283
WJAK	Clifford L. White	Greentown, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAN	Peoria Star	Peoria, Ill.	280
WJAQ	Capper Publications	Topeka, Kans.	360
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	250
WJAT	Kelly-Vawter Jewelry Co.	Marshall, Mo.	360
WJAX	Union Trust Co.	Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	448
WJD	Richard H. Howe	Granville, Ohio	229
WJX	Deforest Radio Telephone & Telegraph Co.	New York, N. Y.	360
WJY	R. C. A.	New York, N. Y.	405
WJZ	R. C. A.	New York, N. Y.	455
WKAA	H. F. Paar	Cedar Rapids, Iowa	268
WKAD	Chas. Looff (Crescent Park)	East Providence, R. I.	240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Texas	360
WKAN	United Battery Service Co.	Montgomery, Ala.	226
WKAP	Dutee W. Flint	Cranston, R. I.	360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	360
WKAR	Michigan Agriculture College	East Lansing, Mich.	280
WKAS	L. E. Lines Music Co.	Springfield, Mo.	360
WKAV	Laconia Radio Club	Laconia, N. H.	254
WKAY	Brenau College	Gainesville, Ga.	280
WKY	WKY Radio Shop	Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn.	417
WLAH	Samuel Woodworth	Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co.	Waco, Texas	360
WLAK	Vermont Farm Machine Corp.	Bellows Falls, Vt.	360
WLAL	Naylor Electrical Co.	Tulsa, Okla.	360
WLAP	W. V. Jordon	Louisville, Ky.	360
WLAQ	Arthur E. Shilling	Kalamazoo, Mich.	283
WLAV	Electric Shop	Pensacola, Fla.	254
WLAW	Police Dept., City of New York	New York, N. Y.	360
WLAX	Putnam Electric Co. (Greencastle Community Broadcasting Station)	Greencastle, Ind.	231
WLB	University of Minnesota	Minneapolis, Minn.	360
WLS	Sears, Roebuck Co.	Chicago, Ill.	345
WLW	Crosley Manufacturing Co.	Cincinnati, Ohio	309
WMAB	Radio Supply Co.	Oklahoma, Okla.	360
WMAC	J. Edw. Page (Olive B. Meredith)	Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	360
WMAH	General Supply Co.	Lincoln, Nebr.	254
WMAJ	Doerers Telegram Co.	Kansas City, Mo.	275
WMAK	Norton Laboratories	Lockport, N. Y.	360
WMAL	Trenton Hardware Co.	Trenton, N. J.	256
WMAN	First Baptist Church	Columbus, Ohio	286
WMAP	Utility Battery Service	Easton, Pa.	246
WMAQ	Chicago Daily News	Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute	Auburn, Ala.	250
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	280
WMC	"Commercial Appeal" (Commercial Publishing Co.)	Memphis, Tenn.	500
WMH	Precision Equipment Co.	Cincinnati, Ohio	248
WMU	Doubleday-Hill Electric Co.	Washington, D. C.	261
WNAC	Shepard Stores	Boston, Mass.	278
WNAD	University of Oklahoma	Norman, Okla.	360
WNAL	R. J. Rockwell	Omaha, Nebr.	242
WNAM	Ideal Apparatus Co.	Evansville, Ind.	360
WNAN	Syracuse Radio Telephone Co.	Syracuse, N. Y.	286
WNAP	Wittenberg College	Springfield, Ohio	231
WNAQ	Charleston Radio Electric Co.	Charleston, S. C.	360
WNAR	C. C. Rhodes	Butler, Mo.	231
WNAS	Texas Radio Corp. & Austin Statesman	Austin, Texas	360
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa.	360
WNAV	Peoples Telephone & Telegraph Co.	Knoxville, Tenn.	236
WNAW	Peninsular Radio Club (Henry Kunzmann)	Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNJ	Shotton Radio Manufacturing Co.	Albany, N. Y.	360
WOAA	Dr. Walter Hardy	Ardmore, Okla.	360
WOAC	Maus Radio Co.	Lima, Ohio	266
WOAD	Friday Battery & Electric Corp.	Sigourney, Iowa	360
WOAE	Midland College	Fremont, Nebr.	360
WOAF	Tyler Commercial College	Tyler, Texas	360
WOAG	Apollo Theater (Belvedere Amusement Co.)	Belvedere, Ill.	224
WOAH	Palmetto Radio Corp.	Charleston, S. C.	360
WOAI	Southern Equipment Co.	San Antonio, Texas	385
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	360
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	360
WOAP	Kalamazoo College	Kalamazoo, Mich.	240
WOAQ	Portsmouth Kiwanis Club	Portsmouth, Va.	360
WOAR	Henry P. Lundskow	Kenosha, Wis.	229
WOAT	Boyd M. Hamp	Wilmington, Del.	360
WOAV	Pennsylvania National Guard, 2d Battalion, 112th Infantry	Erie, Pa.	242
WOAW	Woodmen of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOI	Iowa State College	Ames, Iowa	360
WOK	Pine Bluff Co.	Pine Bluff, Ark.	360
WOO	John Wanamaker	Philadelphia, Pa.	509

Pickups & Hookups

(Continued from page 33.)

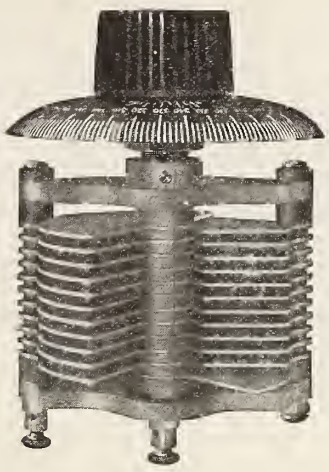
was so low that I couldn't get any point of regeneration because the last hookup I tried from still another magazine shorted my A battery. I had it charged, and was all ready to try to set Wednesday evening following, and *the first station I received was KFKX of Hastings, Neb.* Here are the following stations I received from 8:30 P. M. to 1:30 P. M. of the same evening. Some of these stataions were testing, and it is also known that Pasadena is very hard on radio reception due to the mountains—but just take a slant at this:

KFKX, KDYL, KGG, CYB, CKCB, CFCN, KFCB, KFAW, KPO, KFNV, KLX, KGO, KFKB, and all local stations on loud speaker! Stationary variocouplers and adjustable bakelite—WOW!! I'll tell the world RADIO AGE is no joke. I'd like to make a six-stage amplifier and yell into the mouthpiece "Three cheers for RADIO AGE!"—because I don't think the yell I can emit is loud enough for a book like that!

Yours very truly,
CLARENCE EASTON.
35 South Raymond, Room 320,
Bradley Bldg., Pasadena, Calif.

And while you are still laughing at that one, we'll get next month's issue ready. S'long.

A Condenser That Cuts Losses



G. M. Proudfoot, engineer for the Cruver Manufacturing Company, has designed a new condenser for the purpose of reducing losses and inefficient capacities.

The new condenser, shown above, achieves its aim by means of stator plates mounted on two rods, instead of the traditional three.

This model was used recently in a trans-Atlantic test of a "low-loss" tuner designed by F. J. Marco, of station 9XBA, Chicago. The condenser loss was only 7-1,000 of one per cent.

See Page 36 for Special June Offer for Reinartz Fans!
A Real Radio Bargain!

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

WOQ	Western Radio Co.	Kansas City, Mo.	360
WOR	L. Bamberger & Co.	Newark, N. J.	405
WOS	Missouri State Marketing Bureau.	Jefferson City, Mo.	441
WPAB	Pennsylvania State College.	State College, Pa.	283
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	360
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College.	Agricultural College, N. Dak.	360
WPAL	Superior Radio & Telephone Equipment Co.	Columbus, Ohio	286
WPAM	Auerbach & Guettel.	Topeka, Kans.	360
WPAP	Theodore D. Phillips.	Winchester, Ky.	360
WPAR	Ward Battery and Radio Co.	Beloit, Kans.	236
WPAT	St. Patricks Cathedral.	El Paso, Texas	360
WPAU	Concordia College.	Moorhead, Minn.	360
WPAZ	John R. Koch (Dr.).	Charleston, W. Va.	273
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	360
WQAC	E. B. Gish.	Amarillo, Texas	234
WQAD	Whitall Electric Co.	Waterbury, Conn.	242
WQAE	Moore Radio News Station (Edmund B. Moore).	Springfield, Vt.	275
WQAF	Sandusky Register.	Sandusky, Ohio	240
WQAL	Coles County Telephone & Telegraph Co.	Mattoon, Ill.	258
WQAN	Scranton Times.	Scranton, Pa.	280
WQAO	Calvary Baptist Church.	New York, N. Y.	360
WQAQ	Abilene Daily Reporter (West Texas Radio Co.).	Abilene, Texas	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAX	Radio Equipment Co.	Peoria, Ill.	360
WRAA	Rice Insitute.	Houston, Texas	369
WRAF	The Radio Club (Inc.).	Laporte, Ind.	224
WRAH	Stanley N. Read.	Providence, R. I.	231
WRAL	Northern States Power Co.	St. Croix Falls, Wis.	248
WRAM	Lombard College.	Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	236
WRAO	Radio Service Co.	St. Louis Mo.	360
WRAV	Antioch College.	Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop (Horace D. Good).	Reading, Pa.	238
WRAX	Flaxon's Garage.	Gloucester City, N. J.	268
WRAY	Radio Sales Corp.	Scranton, Pa.	280
WRAZ	Radio Shop of Newark (Herman Lubinsky).	Newark, N. J.	233
WRBC	Imanuel Lutheran Church.	Valparaiso, Ind.	278
WRC	Radio Corporation of America.	Washington, D. C.	469
WRK	Doron Bros. Electric Co.	Hamilton, Ohio	360
WRL	Union College.	Schenectady, N. Y.	360
WRM	University of Illinois.	Urbana, Ill.	360
WRR	City of Dallas (police and fire signal department).	Dallas, Texas	360
WRW	Tarrytown Radio Research Laboratory (Koenig Bros.).	Tarrytown, N.Y.	273
WSAB	Southeast Missouri State Teachers College.	Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural College.	Clemson College, S. C.	360
WSAD	J. A. Foster Co.	Providence, R. I.	261
WSAG	City of St. Petersburg (Loren V. Davis).	St. Petersburg, Fla.	244
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	309
WSAJ	Grove City College.	Grove City, Pa.	360
WSAN	Allentown Radio Club.	Allentown, Pa.	229
WSAP	Seventh Day Adventist Church	New York, N. Y.	263
WSAR	Doughty & Welch Electrical Co.	Fall River, Mass.	254
WSAT	Donohoo-Ware Hardware Co.	Plainview, Texas	268
WSAW	John J. Long, Jr.	Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory	Chicago, Ill.	268
WSAY	Irving Austin (Port Chester Chamber of Commerce).	Port Chester, N. Y.	233
WSAZ	Chas. Electric Shop.	Pomeroy, Ohio	258
WSB	Atlanta Journal.	Atlanta, Ga.	429
WSL	J. & M. Electric Co.	Utica, N. Y.	273
WSY	Alabama Power Co.	Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAF	Louis J. Gallo.	New Orleans, La.	242
WTAG	Kern Music Co.	Providence, R. I.	258
WTAH	Carmen Ferro.	Belvedere, Ill.	236
WTAJ	The Radio Shop.	Portland, Me.	230
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gordon & Son.	Osseo, Wis.	220
WTAR	Reliance Electric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	275
WTAT	Edison Electric Illuminating Co.	Boston, Mass. (portable)	244
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	360
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	242
WTAW	Agricultural & Mechanical College of Texas.	College Station, Tex.	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcasting Station	Oak Park, Ill.	220
WTAZ	Thomas J. McGuire.	Lambertville, N. J.	283
WTG	Kansas State Agricultural College.	Manhattan, Kans.	273
WWAB	Hoenig, Swern & Co. (John Rasmussen).	Trenton, N. J.	220
WWAC	Sanger Bros.	Waco, Texas	360
WWAD	Wright & Wright (Inc.).	Philadelphia, Pa.	360
WWAE	Alamo Dance Hall, L. J. Crowley.	Joliet, Ill.	227
WWAF	Galvin Radio Supply Co.	Camden, N. J.	230
WWAO	Michigan College of Mines.	Houghton, Mich.	244
WWI	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News (Evening News Assn.).	Detroit, Mich.	517
WWL	Loyola University.	New Orleans, La.	260
WYAM	Electrical Equipment Co.	Miami, Fla.	283
WYAW	Catholic University.	Washington, D. C.	236

Canadian Stations

CFAC	Calgary Herald.	Calgary, Alberta	430
CFCA	Star Pub. & Prtg. Co.	Toronto, Ontario	400
CFCF	Marconi Wireless Teleg. Co. of Canada.	Montreal, Quebec	440
CFCH	Abitibi Power & Paper Co.	Iroquois Falls, Ont.	400
CFCJ	La Cie de L'Evenement.	Quebec, Quebec	410
CFCK	Radio Supply Co.	Edmonton, Alberta	410
CFCL	Centennial Methodist Church.	Victoria, British Col.	400
CFCN	W. W. Grant Radio (Ltd.).	Calgary, Alberta	440
CFCO	Semmemhaack-Dickson (Ltd.).	Bellevue, Quebec	450
CFCQ	Radio Specialties (Ltd.).	Vancouver, B. C.	450
CFCR	Laurentide Air Service.	Sudbury, Ont.	410
CFCW	The Radio Shop.	London, Ont	420
CFDC	Sparks Co.	Nanaimo, B. C.	430
CFQC	The Electric Shop (Ltd.).	Saskatoon, Saskatchewan	400
CFRC	Queens University.	Kingston, Ontario	450
CFUC	University of Montreal.	Montreal, Quebec	400
CHAC	Radio Engineers.	Halifax, Nova Scotia	400
CHBC	Albertan Publishing Co.	Calgary, Alberta	410
CHCD	Canadian Wireless & Elec. Co.	Quebec, Quebec	410
CHCE	Western Canada Radio Sup. (Ltd.).	Victoria, B. C.	400
CHCL	Vancouver Merchants Exchange	Vancouver, B. C.	440
CHYC	Northern Electric Co.	Montreal, Quebec	410
CJCA	Edmonton Journal.	Edmonton, Alberta	450
CJGC	London Free Press Prtg. Co.	London, Ont.	430
CJCD	T. Eaton Co.	Toronto, Ont.	410
CJCE	Sprott-Shaw Radio Co.	Vancouver, B. C.	420
CJCI	Maritime Radio Corp.	St. John, New Brunswick	400
CJCN	Simons Agnew & Co.	Toronto, Ont.	410
CJCX	Percival Wesley Shackleton	Olds, Alberta	400
CJSC	Evening Telegram.	Toronto, Ont.	430
CKAC	La Presse Puh. Co.	Montreal, Quebec	430
CKCD	Vancouver Daily Province	Vancouver, B. C.	410
CKCE	Canadian Independ. Telephone Co.	Toronto, Ont.	450
CKCH	Canadian National Railways.	Ottawa	435
CKCK	Leader Pub. Co.	Regina, Saskatchewan	420
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	410
CKY	Manitoba Telephone System	Winnipeg, Manitoba	450

Cuban Stations

PWX	Cuban Telephone Co.	Habana	400
2DW	Pedro Zayas.	Habana	300
2AB	Alberto S. de Bustamante.	Habana	240
20K	Mario Garcia Velez.	Habana	360
2BY	Frederick W. Borton.	Habana	260
2CX	Frederick W. Borton.	Habana	320
2EV	Westinghouse Elec. Co.	Habana	220
2TW	Roberto E. Ramires.	Habana	230
2HC	Heraldo de Cuba.	Habana	275
2LC	Luis Casas.	Habana	250
2KD	E. Sanchez de Tuentes.	Habana	350
2MN	Fausto Simon.	Habana	270
2MG	Manuel G. Salas.	Habana	280
2JD	Raul Perez Falcon.	Habana	150
2KP	Alvara Daza.	Habana	200
2HS	Julio Power.	Habana	180
2OL	Oscar Collado.	Habana	290
2WW	Amadeo Saenz.	Habana	210
5EV	Leopoldo V. Figueroa.	Colon	360
6KW	Frank H. Jones.	Tuinucu	340
6KJ	Frank H. Jones.	Tuinucu	275
6CX	Antonio T. Figueroa.	Cienfiegos	170
6DW	Eduardo Terry.	Cienfiegos	225
6BY	Jose Ganduxe.	Cienfuegos	300
6AZ	Valentin Ulliarri.	Cienfuegos	200
6EV	Josefa Alverax.	Caibarien	225
8AZ	Alfreda Brocks	Stgo de Cuba	240
8BY	Alberto Ravelo.	Stgo. de Cuba	250
8FU	Andres Vinnet.	Stgo. de Cuba	225
8DW	Pedro C. Anduz.	Stego. de Cuba	275
8EV	Eduardo Mateos.	Stego. de Cuba	180

Big Test Station Planned

A new experimental radio station for a more complete investigation of radio phenomena and broadcasting will be opened within the next few months by the General Electric Company, at an estimated cost of $150,000.

The station will be built on land recently acquired by the company in Schenectady, N. Y. A power house capable of delivering high power at various frequencies will be erected. The antenna structures will allow a wide range of wave lengths, so that systematic investigation can be made of the advantages of various wave lengths in solving the various problems discovered daily in the radio field.

The General Electric Company decided to erect an experimental station because the space available in the power house and operating section of WGY, the big broadcasting station, is not sufficient to permit test work without interfering with the regular programs.

The Why of the Super-Heterodyne

(Continued from page 20.)

the neutrodyne it seems logical that similar increases in the ratios of heterodyne transformers would be attended with equally improved results. With higher ratios we would have greater grid potentials per stage and greater amplification for a given number of stages. Whether this would work out as well in practice as on paper remains to be seen.

Regeneration

As ordinarily built in this country, the tuning circuit and first detector are of the simple non-regenerative type and therefore contribute little or nothing to the amplification. In the European versions, however, regeneration is generally used in the circuit of the first detector tube to gain increased range and amplification. This may be of the simple feed-back type with an adjustable tickler coil placed in inductive relation to the tuning inductance, or it may be of the "tuned plate" order in which a variometer is placed in the plate circuit of the first detector tube. The latter is the simplest and the more common method.

While the addition of regeneration by tickler or variometer does add considerably to the performance of the set, yet it has the objection of adding a third control. As the controls are fairly simple in the usual circuit (non-regenerative) this additional control is not a great objection when one becomes experienced in tuning the heterodyne, but still it is one more control just the same. Instead of having two controls we now have three, which in any event is no worse than with the neutrodyne.

It is likely that a simple regenerative circuit for the first tube (without regenerative controls) would be satisfactory, such as the common Colpitts type of "Ultra-Audion" or the "Wizard" described in the April issue of RADIO AGE. In such circuits, regeneration in the detector circuit is controlled largely by the rheostat adjustment and in a sense adds little to the complexity of tuning.

Regeneration in the first detector circuit must not be confused with the undesirable regeneration that we have taken so much pains to avoid in the radio frequency stages. It is desirable in the detector circuit, but must be avoided at all costs in the radio frequency circuit. Regeneration in the first detector circuit increases the output of the first detector tube and increases its sensitivity, thus giving the succeeding radio frequency amplifying stages stronger signals to work on. In the case of DX work this is a decided advantage. The great disadvantage is the fact that regeneration in the first detector circuit may cause re-radiation from the aerial and "pronounced squealing" when the tubes are allowed to oscillate, just as with an ordinary straight regenerative set.

It would seem that the signal strength could be still further increased by causing regeneration to take place in the circuit of the second detector tube, but to date the writer has not seen any attempt at this method. This arrangement, of course, would not increase the range, but would only strengthen the signals of the waves passing through the radio frequency stages, and would probably act as an additional stage of audio amplification.

Super-Regeneration

There have been a number of attempts at combining the super-regenerative circuit and the heterodyne, but so far not much real progress has been made. Instead of using the conventional non-regenerative circuit for the first detector tube, a super-regenerative circuit has been substituted, thus greatly increasing the sensitivity and signal strength of the conventional heterodyne. With a circuit of this type properly worked out we would have the maximum possible in radio reception, but this would be at the expense of control complication and tuning difficulties. The super-regenerative circuit is complicated and critical alone, but when operated in connection with a heterodyne the difficulties of tuning would make the circuit fit only for the expert operator.

Audio Amplification

The heterodyne circuit proper ends at the second detector tube, where the amplified radio frequency waves are converted into audible sound frequency waves. If increased volume is then required for the operation of a loud speaker, we must add the usual audio amplification circuit on one or more stages. There is no marked difference in the audio amplification system from that ordinarily used with the simpler receivers, except that it is highly desirable to use an independent "B" battery for the audio stages, and when dry cell tubes are used in the set, even a separate "A" filament battery is highly desirable.

With a common "B" battery for both the radio and audio amplification stages there is likely to be much noise and distortion due to the harmonics and minor oscillations taking place in the first part of the circuit. These undesirable pulsations and "bumps" are carried directly into the audio frequency tubes through the common "B" battery wires unless a special filter circuit is interposed. With a separate "B" battery for the audio tubes, the bumps can only be carried in by induction and hence are not so noticeable. Direct wire connections of any sort between the heterodyne and audio stages should be eliminated whenever possible.

Filter Circuits

In the most highly developed heterodyne circuits it is common practice to place a "filter" circuit between the second detector and the audio stages. This consists of a combination of high resistance units with condensers or choke coils which damp down undesirable pulsations that originate in the first stages before they pass to the audio stages. Such filters are highly desirable and are comparatively simple and inexpensive accessories to the heterodyne circuit.

Every noise developed in the detectors and radio stages is, of course, amplified with the voice and music by the audio stages, and with two or more audio stages the foreign pulsations become almost unbearable unless they are removed or reduced by the filter system. The greater the audio amplification, the greater will be the necessity for an effective filter.

Antenna Insulation

Good insulation is necessary and it recommends that the wire be swung over a clear space if possible, with at least five feet clearance over all objects crossed. Number 14 solid, bare, copper wire, or larger sizes, are recommended, since it has low resistance and results in loud signals. Stranded wire, though stronger, is not considered quite as good as solid wire. Insulated wire, he explained, is not especially detrimental, but costs more than bare wire. From 50 to 150 feet is the usual length recommended for broadcast reception; longer aerials bring in stronger signals, and are more certain to bring in distant stations. But they also bring in more interference, including static.

For Women Buyers

The feminine influence is commencing to make itself felt in radio. One large manufacturer of loud speaker horns has received orders for thorite horns to be made in nine different pastel shades to harmonize with the color schemes of boudoirs and the complexions of their owners. Dealers report that where a man will insist on purity of tone and volume from a loud speaker, the women buyers will devote just as much attention to the coloring and design of the outfit. Incidentally, the loud speaker industry is assuming tremendous proportions, 600,000 horns and 90,000 complete thorophone loud speakers being fixed as the 1924 production from one Chicago factory.

Navy's Radio Progress

The navy recognized the value of radio in 1899, when Marconi came to New York with three radio sets to aid in reporting the yacht races between the Shamrock and the Columbia. Four naval officers observed the operation of the sets, and a short time later the Battleship Massachusetts, the Cruiser New York, and the Torpedo Boat Porter were placed at the disposal of Mr. Marconi and an experimental shore station was established at Highland Lights.

Today the navy's communication system represents an investment of $15,000,000 and includes nine high-powered, long range stations, together with 71 medium and low powered stations, and 45 compass stations, operated by 70 officers and 1,167 men.

CROSLEY

Better-Cost Less Radio Products

WORLD LEADERS

IN EVERY field of endeavor there is always a champion—a man, a product or a thing that takes the leadership, not by accident, but because of actual merit. In the new industry of radio, a leader has already arisen—Crosley Radio Receivers.

There is nothing miraculous about the tremendous popularity of Crosley Instruments. They have taken their place at the top through proven performance, continually giving perfect satisfaction where, perhaps, radio disappointment had been purchased at a much higher price.

In new inventions, new simplified devices and new ways and means of giving greater radio value at a lower price, Crosley has constantly led. As a result, the purchaser of a Crosley Radio Receiver, knows that he is getting the last word in radio perfection.

This is evidenced by the fact that Crosley is building more radio receivers than any other manufacturer in the world.

Above are illustrated two good reasons for Crosley supremacy—the Crosley Trirdyn 3R3 and Crosley Trirdyn 3R3 Special.

These instruments are the latest radio engineering triumphs—three tube sets giving five tube efficiency.

They contain the following attractive features: Tuned Radio Frequency Amplification, Regenerative Detector reflexed back on the first tube, and an additional stage of Audio Frequency Amplification.

They are non-radiating, thus entirely eliminating neighborhood interference. For ease of picking up new and distant stations, perfect calibration and extreme selectivity, the Trirdyn is unexcelled.

The only difference between the two models is in the size and style of the Cabinets. The Trirdyn 3R3 Special is completely self-containing, having places for the necessary dry batteries, head phones and other accessories.

Over 200 experts have thoroughly tested the Crosley Trirdyn. Their opinions are one and the same. "There is no receiver to compare with it at any price."

Licensed under Armstrong Regenerative Patent No. 1,113,149.

Before you buy see the Crosley line. **For sale by good dealers everywhere.**

THE CROSLEY RADIO CORPORATION

Powel Crosley, Jr., President

Formerly The Precision Equipment Company *and* Crosley Manufacturing Company

663 ALFRED STREET CINCINNATI, OHIO

Crosley owns and operates Broadcasting Station WLW.

I Can Qualify You as a Radio Expert in a Few Months!

E. R. HAAS
Director, National Radio Institute.

Learn at Home

Earn $2500 to $10,000 a Year

Merle Wetzel, one of my students, reports that he is now making *three times* what he did before becoming a radio expert. Emmett Welch writes that after finishing my training, he made $300 a month and all expenses. George Jones says: "To your course I credit my present position as manager of this Radio Department." Another graduate is now an operator of a broadcasting station, PWX of Havana, Cuba, and earns $250 a month. Still another graduate, only 16 years old, is averaging $70 a week in a radio store. Hundreds of other former students enthusiastically tell of their successes as radio experts! The field of Radio today is a real treasure house of wonderful opportunities. It offers rewards beyond your fondest dreams! Mail coupon today for my Free Book just out—which explains in detail the amazing opportunities in this World's Fastest-Growing Industry.

Hundreds of Big Paying Positions Waiting

Do you want to earn far more money than you ever dreamed possible? Do you want to be your own boss?—to have a profitable business of your own? Do you want to travel the whole world over—and make big money while doing so?

Radio offers you all of these opportunities—and more! Radio, the new infant industry; Radio, growing with leaps and bounds; Radio, the field of endeavor with the most promising future of all!

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JULY 1924

RADIO AGE

The Magazine of the Hour

WITH WHICH IS COMBINED

Radio Topics

In This Issue

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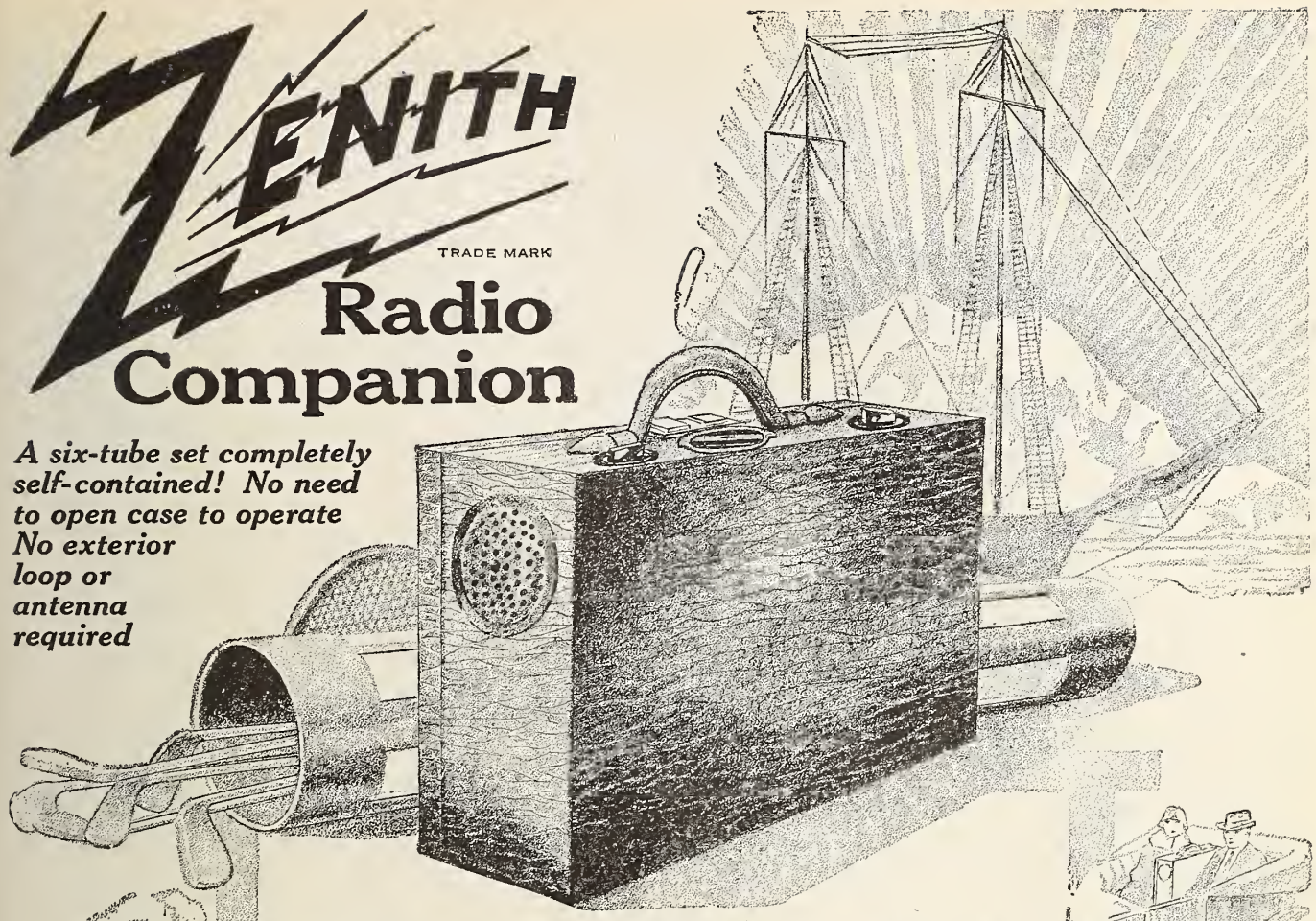

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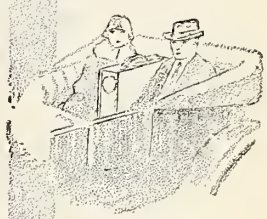

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RADIO AGE

The Magazine of the Hour
Established March, 1922

WITH WHICH IS COMBINED

Radio Topics

Volume 3 *JULY, 1924* *Number 7*

CONTENTS

Radio Age is published monthly by
RADIO AGE, Inc.

Advertising, Editorial and Publication Offices,
500 N. Dearborn St., Chicago

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Advertising forms close on the 10th of the month preceding date of issue
Applicants for membership in A. B. C.

Issued monthly. Vol. 3, No. 7 Subscription price, $2.50 a year.

Entered as second-class matter April 4, 1924, at the post office at Chicago, Illinois, under the act of March 3, 1879.

A Chat With the Editor

THE EDITOR takes this opportunity to welcome into the big RADIO AGE family the many other thousands of readers who are with us this month because of our purchase of the magazine, RADIO TOPICS.

We wish to assure our new readers that the same editorial policies which have made RADIO AGE one of the most popular of practical radio periodicals will be followed carefully. We believe that our method of printing only the best of constructional data and plenty of it will result in continued prosperity and growth.

Our magazine has again occupied larger quarters and has increased its organization in both the business and editorial departments. Russell H. Hopkins, an efficient and experienced magazine man, becomes Associate Editor, and Harry A. Ackerburg is advertising manager.

For both of them we bespeak your good will with the assurance that they will extend to you the most willing co-operation.

Radio as an industry is to step forth into a new era during the coming ninety days. Improvements in apparatus and more stable conditions of manufacture and sale will place the business on a higher plane.

Immense numbers of new enthusiasts are getting into radio daily. To all these recruits and to our loyal followers of the last two years we suggest that you do not fail to read each issue. New features for RADIO AGE are in process of development, to the end that the magazine shall live up to its sub-title, "The Magazine of the Hour."

The next few issues especially should be watched closely, for when plans now under way are fully developed, RADIO AGE will be bigger, better and more of a necessity to the conscientious radio fan than ever before.

Frederick Smith

—Editor, RADIO AGE

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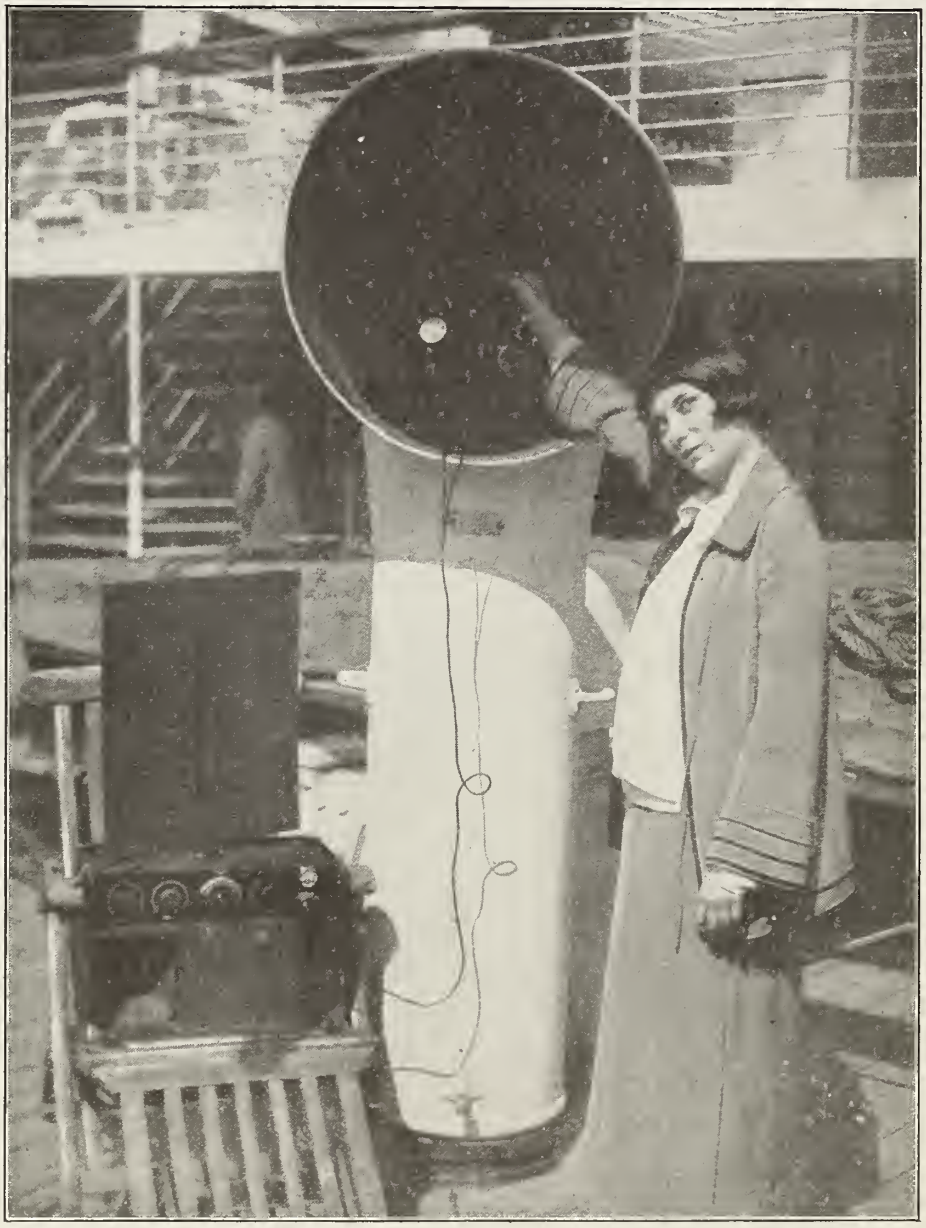

From Foto Topics.

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And a permanent one, too! Ethel Hirsch, a traveler on board the S. S. California, enjoyed a concert on her portable so well that she wanted her fellow voyagers to share it. So she dropped the ear phones into a giant ventilator on the ship. Immediately passengers on the entire deck could hear the concert in clear, forceful tones. Try it the next time you travel o'er the brine.

RADIO AGE
The Magazine of the Hour

M. B. Smith
Business Manager

A Monthly Publication Devoted to Practical Radio

Frederick A. Smith
Editor

A Portable Tuned Impedance Reflex

By JOHN B. BATHBUN

LAST Summer, when the portability craze was at its height, the writer did a considerable amount of experimenting with circuits which were primarily designed for compactness, and among these circuits were several reflex types. At first the reflex principle made an appeal to me because of the dual role played by the tube, but after playing with these circuits for some time I learned that the conventional form of reflex seldom lived up to expectations because of certain losses which took place in the radio frequency phase. Beautiful in theory but particularly "punk" in practice, was the conclusion arrived at after Experiment No. 5 had been filed away in the archives.

In the first place, I never succeeded in attaining any great degree of radio frequency amplification when the conventional untuned short wave transformers were used, and as regeneration in the true sense was impossible with these circuits, there was much left to be desired in the way of distance reception. Again, the tubes which gave excellent results in amplifying radio frequency currents gave but poor amplification in the audio phase, and so on through all of the usual troubles met with when radio frequency is used.

Only One Peak

Theoretically, a single tube reflex with a crystal detector gives one stage of radio amplification, one stage of audio amplification, and rectification or detection. Practically, the full benefit of this dual action is never realized when an untuned radio transformer is used as a coupling for the reason that there is only one single wave length on which the transformer gives peak amplification, and this peak is not so very high at that. The circuit is never perfectly tuned in and this results in much less volume and range than we would expect at first glance. It is imperative that we have perfect tuning both in the tube and detector circuits if we are to obtain maximum results in regard to distance, volume and selectivity.

With an untuned detector circuit we must depend entirely upon the condenser and tuning inductance in the first stage for selectivity, and when we are in the vicinity of a powerful broadcasting station this single control alone is not sufficient.

With this idea in view, I next tried a reflex circuit in which tuned air core transformers of the neutrodyne type were used, the secondary of the transformer being tuned in the usual way with a 23 plate condenser. This was a very decided improvement and the volume and selectivity became at least 50 per cent better than before as the entire circuit was now tuned to the incoming frequency with a sharp amplification peak at the transformer output. However, there was still one fault remaining and this was the regeneration and partial rectification that still took

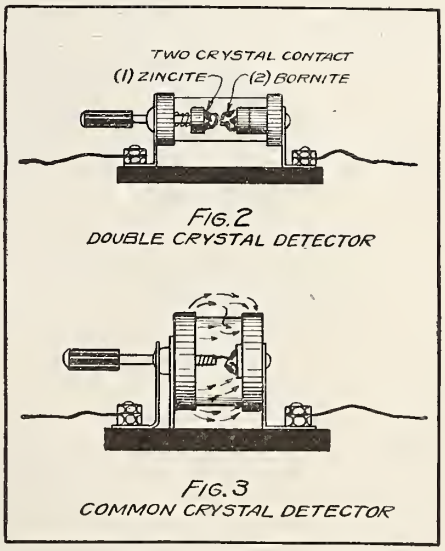


FIG. 2
DOUBLE CRYSTAL DETECTOR

FIG. 3
COMMON CRYSTAL DETECTOR

place through the grid-plate capacity of the tube. The inductance of the transformer primary in the plate circuit was sufficient to cause oscillations in the circuit even when the primary coil was reduced to as low as 12 turns. That the tube acted to a limited degree as a detector could be easily proved by lifting the cat's whisker off the crystal and at which time signals could still be heard with fair volume.

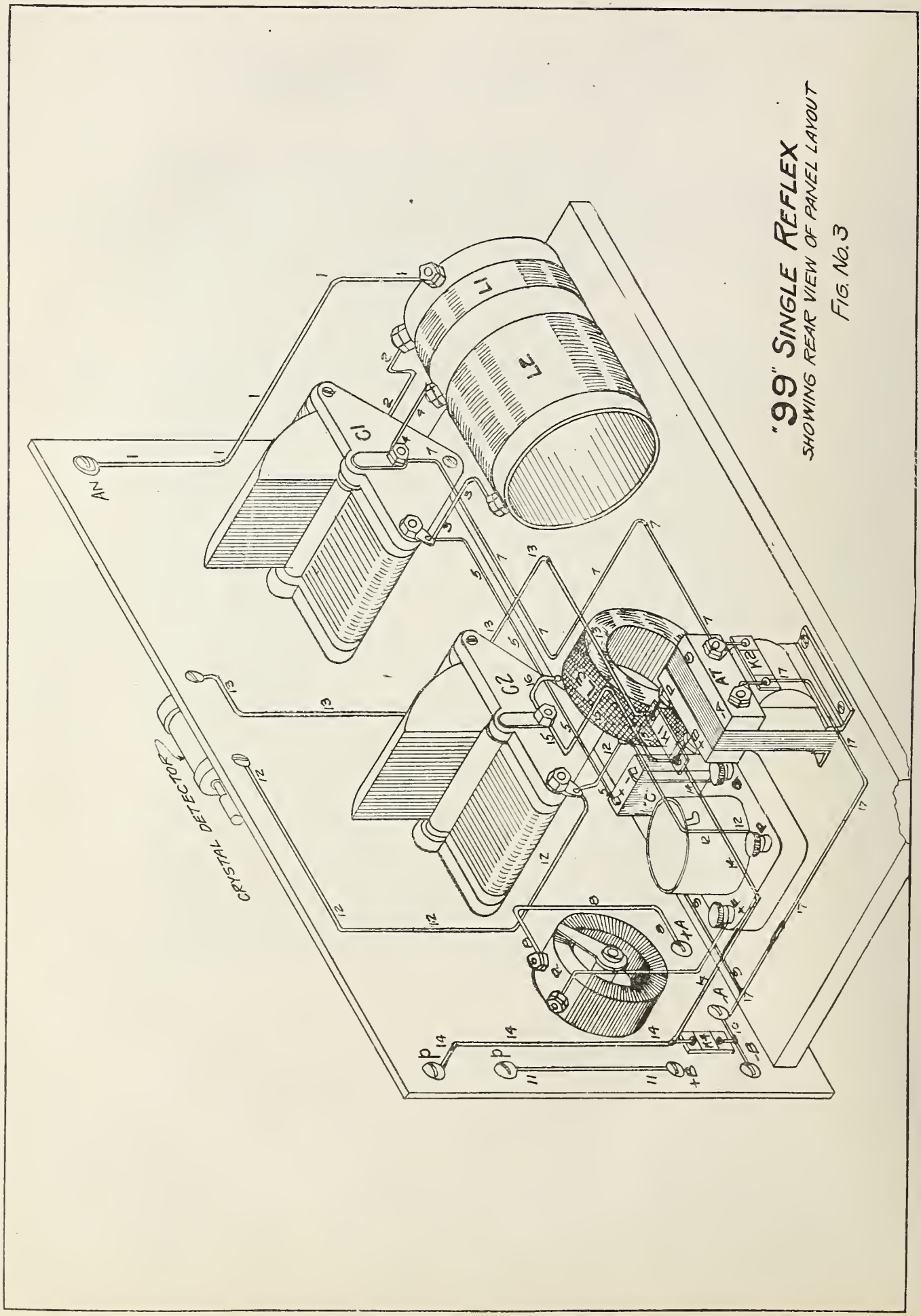
It now occurred to me that these oscillations could be suppressed and at the same time that the audio amplification could be increased by giving a negative bias to the grid of the tube by means of a small flashlight battery placed in the grid circuit. Trial immediately proved the worth of this theory and from this time on there was no further difficulty with free oscillations and the audio amplification was tremendously increased. In fact, the latter was great enough to operate a loud speaker with enough volume to hear it in every room of a large five-room apartment. A 1000-watt station, two blocks away, could be tuned out "cold" with very little loss in volume. The transformer used was a typical neutrodyne transformer with 15 turns on the primary and 65 turns on the secondary.

Transformer Takes Space

Still there was much to be desired in the set even though the tuned transformer gave far better results than the usual untuned type. The neutrodyne transformer took up a great deal of valuable space and at times there was a considerable display of body capacity which most certainly was not desirable. At one time it seemed that I had reached the end of the line and that my carefully developed reflex circuits were only partial successes at the best. At no time was the volume of the tube doubled as it should have been, according to the principles of the circuit, and the distance received was only comparable to a rather indifferent regenerative circuit.

About this time I had an opportunity to use a well-known factory-made radio frequency set that employed tuned impedance coupling instead of transformers, and the excellent performance of this little set at once opened the question as to whether tuned impedance could not also be employed with profit on a reflex set. This was tried some days after with most gratifying results and the circuit is shown in diagrammatic form by *Fig. 1*. The radio frequency transformer is eliminated but the audio transformer (AT) is still used as before.

Starting at the left of *Fig. 1* we have the familiar fixed coupler (FC) which was used in both the "Baby Heterodyne" and the "Wizard" circuit described in past issue of RADIO AGE. The primary coil (L1) has 28 turns of No. 24 wire while the secondary coil contains 60 turns of the same size wire. Both coils are wound on a three inch tube according to the details given in the March issue of this magazine. For very long aerials it is likely that better results will be had on low wave lengths if a few turns are removed from the secondary coil (L2), while with short aerials



"99" SINGLE REFLEX
SHOWING REAR VIEW OF PANEL LAYOUT
FIG. No. 3

it may be necessary to add a few turns to (L2) in order to get the higher wave lengths. This sort of coupler, when once properly adjusted, eliminates the taps and many controls necessary with the ordinary variocoupler and as a rule gives sharper tuning with less loss. The secondary coil is tuned to wave length by the (0.0005mf) variable condenser (C1).

35-Turn Honeycomb Good

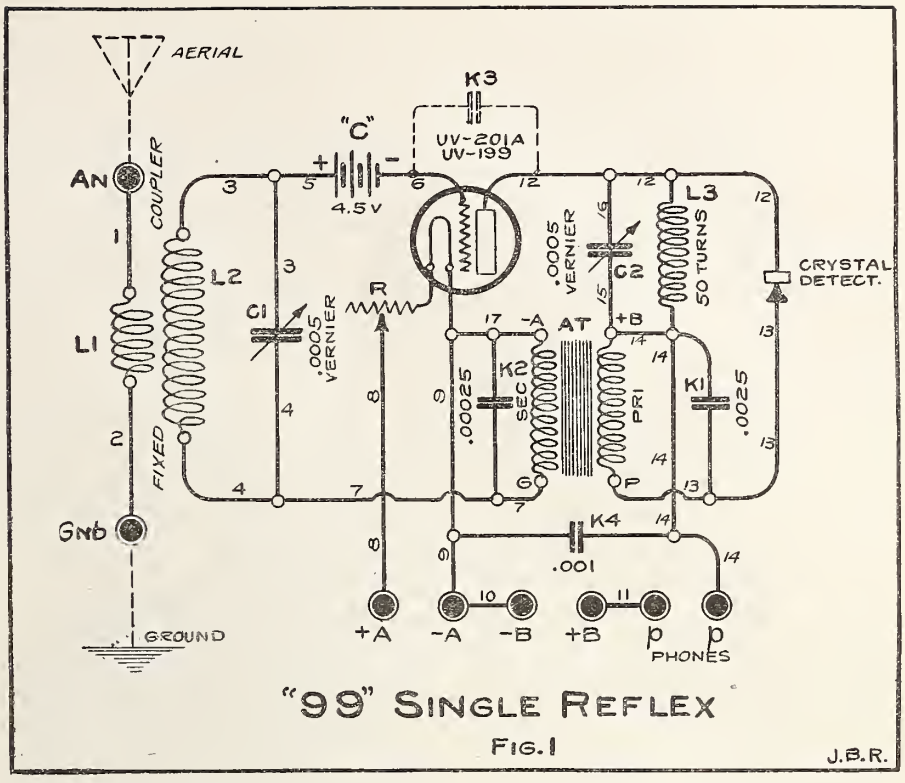
A 50 turn honeycomb coil (L3) forms the plate impedance coupling and is tuned to wave length by the second 0.0005mf variable condenser (C2). The use of the two condensers (C1) and (C1) in combination with their inductances makes tuning very sharp and selective. Don't be attached to the idea that only a 50 turn honeycomb will suffice at this point, for with many aerials a 35 turn honeycomb will give just as good results. In case that a honeycomb is not available, then about 40 turns of No. 26 D.C.C. wire on a three inch pasteboard tube, or 35 turns on a four inch tube will do just as well. The use of a four inch tube permits of the condenser (C2) being placed inside of the tube.

This circuit requires a hard amplifying tube such as the UV-201A, C-301A, UV-199 or the C-299. Soft detector tubes like the UV-200 or C-300 cannot be used owing to the high plate voltages that must be carried. Very good results can be obtained with the UV-199 or C-299, and as this is to be used principally as a portable set it is very desirable that these tubes be used. The WD-11 or WD-12 are not good as radio frequency amplifiers and should not be used, although the low voltage demanded by these tubes makes them very tempting for use on a portable receiver. It has been found by experiment that a "B" battery voltage of 67.5 volts gives the maximum results and that 90 volts gives but little improvement. A considerable degree of audio amplification is had with 45 bolts but a higher voltage is desirable.

At "C" in the grid circuit of the tube we have a three cell, 4.5 volt flashlight battery with its negative pole to the grid of the tube. This gives the grid a negative bias, and as before explained, reduces the tendency toward free oscillations and greatly increases the volume of the audio stage. No grid leak nor detector is used as the tube acts only as an amplifier.

The Crystal Detector

Now we arrive at one of the most important parts of the circuit—the crystal detector at (CD). This is in series with the plate, primary coil of the audio transformer (AT) and the "B" battery. Impulses from the plate pass through the crystal, are rectified, and then pass to the audio transformer where they are increased in voltage at the grid of the tube by the step-up ratio of the transformer (AT). The tuned impedance (L3) is connected to the input side of the crystal and to the plate in such a way that the radio frequency pulsations are forced to the crystal and yet cannot short circuit to the "B" battery because of the inductive reactance of the coil. This coil, however, allows the direct current from the "B" battery to flow freely to the plate, but will not permit of oscillating current flow in the opposite direction.



"99" SINGLE REFLEX

FIG. 1 J.B.R.

There are many crystals or minerals which will operate satisfactorily at this point and there are others which will hardly give audible signals. Galena is a poor mineral to use as it does not stand up under the heavy plate current, and the same is true of pyrites. Of all the simple crystals used, the best all around results were had with a silicon crystal combined with a silver or gold catwhisker. The silicon crystal can be used in the ordinary detector stands and seems to improve with use. The silver or gold catwhisker does not corrode nor oxidize and seems more stable in operation than the copper or bronze wire.

Best of all the crystals tried is the two crystal type in which one crystal acts in the usual capacity while the second crystal is used as a catwhisker in contact with the first. The particular make of two crystal stand which gave very satisfactory service was the "Harco," the general design of which is shown in *Fig. 2*. The signal strength was comparatively high and the adjustment was very stable so that there was little tendency toward getting out of adjustment through vibration, and the crystals were not microphonic.

It was discovered in these experiments that the design of the crystal detector stand has much to do with the efficiency of the circuit, and that certain stands gave much better results than others even when the same crystal was used in either of the holders. Crystal detector stands having large diameter end, placed close together, gave very poor results regardless of the crystal used. An example of the type of stand to avoid is shown in *Fig. 3* where the end caps (m) are large in diameter and close together, thus giving a very pronounced condenser effect which practically short circuits 50 per cent of the radio current which should pass through the crystal. Fully half the current jumps across from one end plate to the other without going through the crystal at all. The detector of *Fig. 2* suffers very little loss from this effect as the plates are well apart and of small presented area.

For Inherent Capacities

There is another stunt that may or may not improve the volume of the reception according to the design of the crystal detector stand. This is the deliberate addition of capacity across the crystal as shown by the dotted lines at (K3), to be used only with detector stands which have a very small inherent capacity. Properly proportioned, this condenser will act as a small reservoir for the waves and will prevent the flow of the reverse waves that ordinarily takes place to a small extent through all simple crystals. It is a commonly accepted idea that the crystals allow the waves to flow through the contact only in a single direction, but this is not exactly true, as there is always a small amount of leakage of the reverse waves. The small condenser, if of exactly the proper capacity, will effectively stop this leakage and will correspondingly improve the rectification. With the detectors experimented with, the capacity of this fixed condenser varied between the limits of 0.00015 and 0.00035 mf.

While almost any good audio transformer (AT) can be used in this circuit with success, I had the best results with the small "Hedgehog" transformer which at one time proved both effective and economical. As regards tone, the five to one ratio is slightly the best but the ten to one ratio gave greater amplification without introducing much distortion. For a portable set, such as we are describing, the "Hedgehogs" are ideal as they occupy only one-quarter the space volume demanded

by the more conventional types. It would seem that the very small volume of iron contained in the core of these transformers reduces the core losses to a minimum and hence the transformer is much more sensitive than those large types which contain about a quarter pound of sheet laminations.

Next we come to the subject of the fixed bypass condensers which in many circuits are considered as being so essential to the proper functioning of the circuit. Usually these fixed condensers (K1) and (K2) are shown connected across both the primary and secondary coils of the audio transformers for bypassing the radio frequency current around the high inductance of the transformer windings. While theoretically such condensers are necessary to prevent choking back the flow of the radio frequency current, yet in practice this is not always necessary or desirable, since the distributed capacity of the secondary windings of the secondary coil is usually sufficient to bypass the R.F. without the further addition of a fixed condenser. The use of (K1) and (K2) can be determined by experiment, and if the circuit works without them they should be omitted. At any rate, the circuit is not critical to the capacity of the condensers and almost anything between 0.0005 and 0.0025 will operate. Condenser K4 is always advisable.

Size of the Panel

The minimum size of panel which it is desirable to use is 6x10½x3-16 inches, but if ease in wiring up is to be considered, a 7x14x3-16 inch panel is advised. It is quite difficult to get at some of the connections for soldering on the smaller panel, but of course it can be done if one has the patience.

The isometric view of the completed set is shown by Fig. 3 where the relative location of the parts can be clearly seen. The wires in this view are numbered to correspond with the numbers on the wiring diagram of Fig. 1, but as some of the wires are necessarily hidden behind the parts in the isometric, it is best to follow the wiring connections of Fig. 1 or at least check up the connections by this diagram. While isometric views are very useful in showing the general arrangement of the apparatus and the location of the longer runs of wire, yet they often lead to discussions when they are used for making connections.

Preliminary tuning to wave length is performed by the secondary condenser (C1) while condenser (C2) adjusts the tube output frequency so that the radio frequency current will not short circuit through the "B" battery. These two controls combined give a high degree of selectivity, and powerful local stations which would ordinarily leak past the fixed coupler and condenser (C1) are met with a second check by the coil (L3) and condenser (C2). Still further, the crystal detector itself has a decided effect on selectivity, so that we have at least three adjustments which tend to filter out undesired stations.

Operation No. 1 consists of adjusting the crystal to its most sensitive point by moving the handle of the detector around until the movable contact comes into contact with a good "hot spot." This is more easily done on this set than with the ordinary plain crystal set for the reason that the radio waves acting upon the crystal are given a preliminary amplification by the tube, and secondly for the reason that the receiver will shriek or howl if the crystal is off the hot spot.

Just at this point I would like to mention that the crystal detector is an indicator of free oscillations in the tube or can be made to show whether the tube is acting properly as an amplifier or improperly as a detector. If the circuit is not balanced properly or if the "C" battery is not giving the proper negative bias to the grid of the tube, then the tube will act as a detector in a plain regenerative circuit and there will be no audio amplification. If the tube is oscillating, the crystal will not be effective and the set will operate equally well with the cat's whisker on or off of the crystal. Under these conditions, the set will operate at a fair volume without the crystal in circuit at all. When the tube is acting properly as an amplifier, there will be a terrific howl in the phones the instant that the catwhisker is lifted off the crystal. This is a sure test for free oscillations, and if good volume is expected, try the "howl test" by lifting the catwhisker.

Photo from Intl.

CARDINAL BROADCASTS

Patrick Cardinal Hayes of New York City is shown above at the microphone of Station WEAF broadcasting his first public message on his return from Rome. The broadcast was arranged through the Catholic Charities.

Save Filament Current

With the crystal properly adjusted as above, next turn the dial of (C1) to about the middle of the scale, and then rock (C2) back and forth very slowly until a signal or voice is heard. Now readjust (C1) until the signal is at a maximum, and adjust the rheostat until the filament temperature is proper for the greatest signal strength. If the first trial does not result in getting a station, move (C1) slightly and repeat the (C2) adjustments and rheostat until a station is heard. After the station is brought in at its best value by the above means, readjust the crystal detector. Some little experience will be required before you can cause the set to deliver its full volume. Never turn the tube rheostat too far as this tends to cause howling and uses an unnecessary amount of filament current.

A fixed type of crystal detector is convenient because no adjustment is necessary, but on the other hand the maximum volume can never be obtained from such a crystal on all wave lengths. A crystal detector is sensitive to variations in wave lengths; so sensitive, in fact, that a station can often be tuned in and out with a crystal adjustment alone. Hence, if we are to have maximum volume and selectivity, we must have adjustment in the crystal. This adjustment is not so difficult as with the simple crystal set, and is very easily handled when one is accustomed to a crystal and knows where to find the hot spots.

In operating this circuit it should be remembered that it is exceedingly selective and that the condenser tuning adjustments must be very carefully made to bring in a station. For this reason vernier condensers are an absolute necessity since an eighth turn of the vernier is often sufficient to bring in a station and then to knock it out completely. Fortunately the dials can be logged for different wave lengths just as with a neutrodyne, and when a station is brought in, the condenser settings should be recorded in a memorandum book so that the station can again be brought in by returning the dials to the proper positions.

Best Aerial 60-75 Feet

Now we come to the question of the aerial. For the best results this should be from 60 feet to 75 feet long. If the aerial is much shorter than this, it will be difficult to bring in distant stations and the signals will be weak on local. If much longer than 75 feet we will lose selectivity and the set will be noisy due to the greater embrace of atmospherics.

This is mentioned here for the reason that we have had reports from our readers on aerial lengths ranging from 10 feet to 400 feet, and of course no circuit will work properly at either of these extremes. Fair results, about 60 per cent of the results obtained with an outdoor aerial, can be had with an indoor aerial of about 40 in length. On local stations, not more distant than 50 miles, such aerials deliver a fair volume but are deficient in regard to distance. .

"Radio Age" Buys "Radio Topics"

WITH this issue RADIO AGE, "The Magazine of the Hour," takes over "RADIO TOPICS," formerly published by the Topics Publishing Company in Oak Park, Ill.

Henceforth the combined publications will be known as RADIO AGE, with which is combined RADIO TOPICS. Editorial, publication and advertising offices will be located at 500 N. Dearborn St., Chicago, the main offices of RADIO AGE.

The staff of RADIO AGE will hereafter be in charge of all editorial and advertising matter formerly used by RADIO TOPICS. Efforts are being made beginning with this issue to combine the best features of both magazines into one bigger and better RADIO AGE.

Readers of RADIO AGE will notice many new features on scanning the July issue, while TOPICS readers will find several departments of RADIO TOPICS incorporated in this issue, in addition to the regular RADIO AGE features.

Subscribers to RADIO TOPICS will receive the new RADIO AGE as usual, with no extra charge for the combined features. Advertisers will be given the same considerate service in the hope that readers of both publications will be united into one big happy family. No effort will be spared to turn out the most authoritative and valuable technical articles in future issues of RADIO AGE, and interesting features, liberally illustrated with up-to-the minute pictures and drawings, will attract the lay reader.

Technical inquiries sent to RADIO TOPICS during the past few weeks have been turned over to RADIO AGE and answered with the technical efficiency that has made RADIO AGE a by-word for dependability during the past few years. All other correspondence will be taken care of faithfully and carefully, with the full co-operation of the former editors and publishers of RADIO TOPICS.

RADIO TOPICS readers are urgently asked to correspond with the combined magazines and to take advantage of the many opportunities and services rendered readers without any charge. Criticism and comment are more than welcome at any time.

RADIO AGE, with which is combined RADIO TOPICS, has entered a new era in the radio field. Each issue will surpass the preceding one in every classification, and it is our earnest prediction that before the end of this year RADIO AGE will be the leader in its field and the recognized authority on radio throughout the world.

Attention of both RADIO AGE and RADIO TOPICS readers is called to the RADIO AGE INSTITUTE announcement on page 51 of this issue. The INSTITUTE is a TOPICS feature which we hope will be of particular benefit to amateur experimenters and manufacturers who want RADIO AGE'S technical O. K. on their radio sets and parts.

The results of important INSTITUTE tests will be published from time to time in RADIO AGE.

The "Radio Favorite Popularity Contest" announced on page 22 should be welcomed by the hundreds of "fans" who want to give their favorite radio announcer or entertainer a boost.

Here's hoping!

MAKING IT A RADIO SUMMER Kadel & Herbert

Hardly a camping trip this Summer will be complete without its radio equipment. No matter how far you go, you can't be so far that your radio won't reach a broadcasting station. Here "father and son" are shown whiling away a dull afternoon by tuning in the distant city on their reliable portable set.

Short Wave Transmission and Reception

By FRANK D. PEARNE

A FEW years ago, if anyone had ventured the prediction that the year 1924 would find the air so full of broadcast waves that there would be so much interference as to make good clear reception of any particular station hard to obtain, he would have been the laughing stock of the community.

But the then inconceivable troubles of the broadcast listener of today have come to pass, and unless something is done to improve these conditions, it is not very hard to see what the result will be. The United States Government, in an effort to prevent just such a chaotic condition, has allotted certain wave lengths to certain districts in order that one district will be able to tune in on stations located in other districts, while local broadcasting is carried on.

But the ever increasing number of stations has reached the point where all the allotted waves have been used up, and it is necessary in large cities such as Chicago and New York to double up; that is, several stations must use the same wave length with a consequent division of time. If such is the case at the present time, what are we to expect in the coming years? Recent experiments conducted by the Westinghouse engineers and the General Electric Company have proven conclusively that the heretofore supposed useless waveband below 150 meters may be the solution of the problem. Low wave broadcasting is no longer an experiment, but is an accomplished fact, and has proved to be one of the greatest improvements in the science of radio transmission and reception.

In 1920, KDKA, the first broadcasting station in the world, was opened at Pittsburgh. From that time on, broadcast stations sprung up all over the country. In the month of November, 1923, station KFKX was installed at Hastings, Nebraska, by the Westinghouse Manufacturing Company and operated as a relay station, by means of which programs broadcast at Pittsburgh on waves of approximately 100 meters were picked up and rebroadcast at 341 meters, thus making it possible for broadcast listeners in the far West to receive these programs just as well as those located in the East. This broadcasting at Pittsburgh takes place at the same time they broadcast their regular program on 326 meters.

Another relay station, KDPM, was opened at Cleveland, Ohio, and the most surprising thing is the fact that station KDKA is now furnishing programs to the British company in England on these low waves which are picked up by special receivers and repeated on longer wave lengths for the benefit of listeners in Great Britain and Continental Europe. Thus the people of Great Britain, France, Germany, Belgium and the Scandinavian countries are now enjoying the benefits of programs given in this country.

The progress of the experiments which made this type of broadcasting possible is rather interesting. First, a short wave station was built on the roof of station KDKA, from which waves of approximately 100 meters were transmitted to a few receiving stations located in and around Pittsburgh. Then came the receiver at Cleveland where the short waves were repeated by station KDPM. Next, between Pittsburgh and Springfield, Mass. These experiments being satisfactory, short wave receivers were installed in twenty cities in the homes of amateurs. All reported that reception on short waves was excellent and that there were none of the drawbacks to broadcast reception found in the longer waves we are using today.

These tests proved that high frequencies (low wave lengths) go much farther with the same power input than ordinary broadcast waves. Daylight has little or no effect upon their carrying power.

These two facts alone are enough to predict a change in broadcasting in the near future. Station WGY of the General Electric Company at Schenectady, N. Y., also has been doing some good work in the development of short wave broadcasting. They, too, have reached distances never before reached with the longer waves. From this station signals are transmitted on 107 meters so clearly and with such volume that it has been found quite possible to rebroadcast them 3000 miles away. Several times all eight of the British Broadcasting Company stations received and relayed WGY'S programs.

On one occasion an entire program from the Wanamaker Auditorium in New York was carried by wire to WGY, where it was put on the air at 107 meters and also on 380 meters. The short waves were picked up and relayed by the British stations, where they were reproduced as clearly as though they were played in London. These short wave signals are constantly heard in Los Angeles on a loud speaker and a two tube set, even when it was still daylight over half of the distance.

Amateurs located in Chicago, who are equipped with short and long wave receivers, say that when KDKA is broadcasting on both 104 and 345 meters, the reception on the short wave set is more than twice the volume of that on the longer wave.

Now, summing up the advantages of the short wave over the longer, we find that such reception is almost entirely free from static, even in the hottest weather, and will travel in daylight practically as well as by night. Greater distances can be covered with the same power, and, last but not least, the wave length is so far below the ordinary broadcast range that they may vary from 75 to 150 meters without any interference from any of the standard allotted waves. Very short aerials are required for both transmitting and receiving, the maximum length being a little over thirty-five feet. The greatest difficulty in this type of broadcasting seems to be in keeping the frequency constant. The frequency of a 100 meter wave is 3,000,000 cycles, and in order to keep it constant, the aerial must be so constructed that it will not swing in the wind, for this will change the frequency,

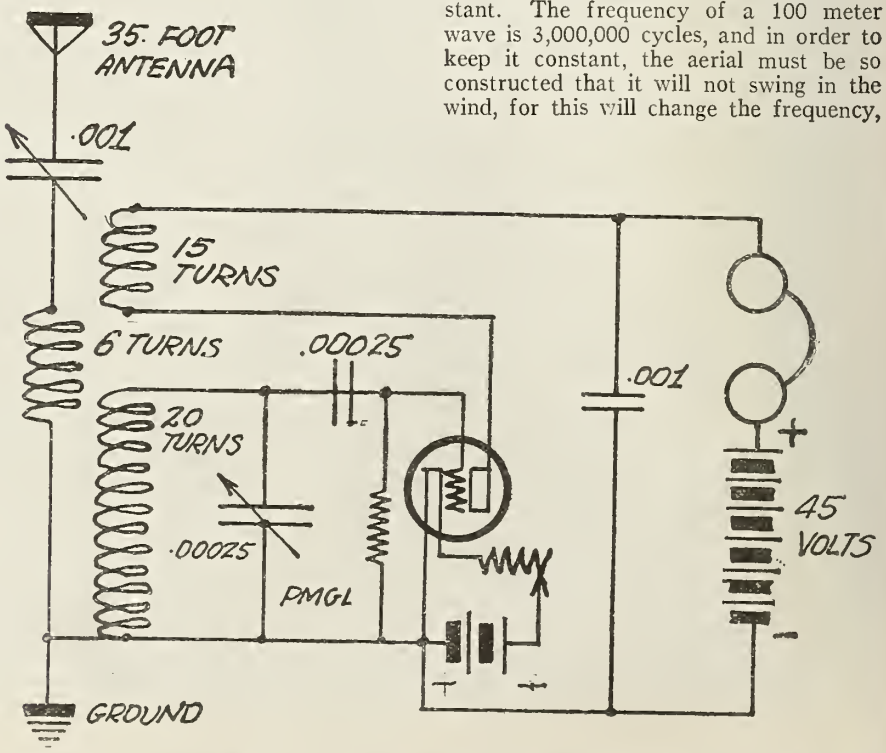


Figure 1. A diagram of a short wave receiver adapted to the signals of the broadcast relay stations. Often signals can be easily heard and distinguished on the shorter waves when not even the main wave can be heard.

and of course this changes the wave length.

The entire transmitting unit is suspended on springs in order to prevent any change in wave length from vibration. Now about the short wave tuner. No doubt there are many of our readers who would like to listen in and make tests on these waves. The construction of such a set is practically the same as the longer wave tuner, with the exception of the winding of the coils. Cutting down the number of turns in all the inductances will do the trick. For those who wish to construct a new set for the purpose, the circuit shown in Figure 1 is suggested.

The vario-coupler used here should be rewound to suit the case. After stripping off the winding, the tube should be wound wth twenty turns of No. 20 double silk, or cotton insulated wire. These turns should be wound with a piece of twine between them, and after the winding is finished the twine is removed. No taps are taken off. The ends of the coil are anchored by drilling small holes in the tube and taking the ends down through one and up through the other.

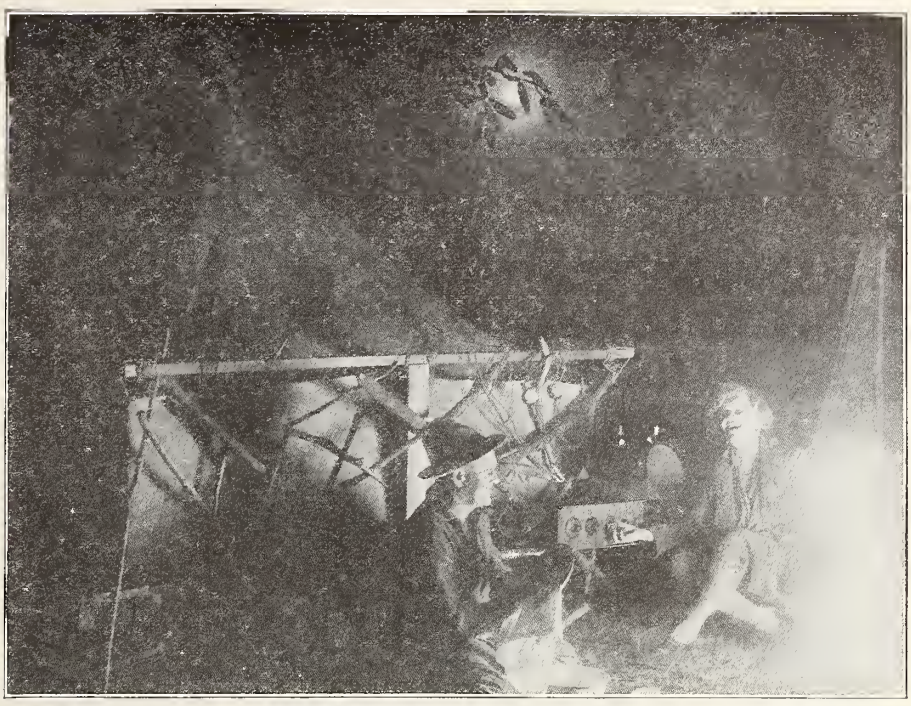
It is best not to use any cement to hold the turns in place, but if one cannot wind the coil tight enough to hold its position, then a very thin application of celluloid dissolved in acetone may be used, but it should be very thin. The primary, or aerial inductance, is wound on top of this coil. First wrap the winding with two or three layers of empire cloth. This may be a strip of cloth about one inch wide and should be placed nearer to the bottom than to the top. Over this wind six turns of No. 20 double cotton covered wire, separating the turns in the same way as those of the first coil. Before these turns are put on, however, lay a strip of cotton tape lengthwise of the coil, leaving the ends long enough to fasten the ends of the wire by means of a needle and thread. The coil, wound on the tape, will hold it in place.

The rotor is wound with fifteen turns of No. 20 wire. The condenser, which is shown as shunted across the terminals of the secondary winding, should be of small capacity. From 5 to 11 plates will do and it should be equipped with a vernier adjustment if possible. A 43 plate condenser in the aerial circuit will help in getting close tuning, and this also should be a vernier. These are about all the points which differ from the ordinary tuner. In the circuit described in Figure 1 the circuit is as follows: from the aerial to the rotating plates of the 43 plate condenser, from the stationary plates to the top end of the 6 turn coil and through this coil to the ground. The top terminal of the secondary winding (20 turns) to the stationary plates of the 11 plate condenser and through the grid condenser to the grid binding post on the tube socket. The lower end of this 20 turn coil is connected to the ground, the revolving plates of the 11 plate condenser, the negative terminals of both the filament and plate batteries, and to one side of the .001 M.F. fixed condenser. One terminal of the tickler coil (rotor) is connected to the phones and to the remaining side of the .001 fixed condenser. The other side of the rotor is connected to the plate binding post on the tube socket. The filament and rheostat are connected in the ordinary way as shown. The 2 megohm grid leak is connected across the grid binding post on the socket and the filament binding post on the socket.

The standard UV-201-A tube will work very well. This should be supplied with a plate voltage of approximately forty-five volts, and the filament should be controlled by a 25 ohm rheostat. If the 201-A tube is used, the filament may be operated with four large dry cells. The wiring should be done with good heavy wire such as No. 14 tinned copper, and all connections should be carefully soldered. There are many things to be taken into consideration in the construction of a good tuner. Larger coils and condensers than necessary are not practical. It will be noticed that short wave stations will come in at the bottom of the condenser scale and, if too many plates are used, the zero capacity of the condenser will be too high, and likewise too much wire on the coils will increase the resistance.

If the circuit has a high resistance, it will be found that it will not tune sharply, so for good construction do not neglect to keep this fact in mind. There is no immediate prospect of much improvement in clearing up the ether; consequently the interference problem will probably become worse before it gets better, and for this reason it is a good plan to take advantage of every little detail which will help in making for good reception. Most of us know from experience that many of the little things so often suggested as improvements and savers of energy do not always seem to improve the set as we

(Continued on page 40)



"THERE'S MUSIC IN THE AIR" From Foto Topics.

And what could be a better place for dreamy music than a moonlight night, with a blazing campfire and a jovial companion? Here two hike-weary campers are tuning in on the cheering melodies from some distant station. The stillness of the night adds volume to the improvised loud speaker shown in the picture.

Short Wave Experiments Succeed

Radio engineers of the U. S. Naval Research Laboratory were so impressed with their results of recent experiments with short-wave transmission and reception in daylight, that they have designed a new short-wave transmitter for the Naval Airship Shenandoah, according to Dr. A. H. Taylor, chief of the laboratory.

Through the co-operation of amateurs in over forty states, some stations a thousand or more miles distant, have secured excellent results in two-way communications on 3,000 kilocycles or 100 meters, in radio telegraphy and also in radiophone transmission tests. The reliability of short waves and their ability to carry for long distances, especially in the daytime, Dr. Taylor points out, have resulted in the construction of a transmitter which will go as low as 80 meters with a steady wave. He believes that short waves do not follow ordinary transmission laws.

The short-wave Shenandoah set just completed and tested during the past week is for use on 3,000 kilocycles. This set was designed for use when the Shenandoah goes to the North Pole, where it will be daylight most of the time. It is operated by a 24-volt storage battery, kept charged during operation, but good for a number of hours transmission in an emergency. Telephone transmission for a short distance, as in making landings and mooring the ship, can be handled by this set, and also CW transmission. A motor generator will supply a plate voltage of 750 volts. In keeping with needs for economy in weight and space aboard the airship, this one-wave set is both small and light.

Photo from Fotograms.

COLLEGE GIRL BUILDS OWN SETS

Gloria E. Hollister, daughter of Dr. Frank C. Hollister, of New York City, would rather tinker with tubes and potentiometers than attend an afternoon tea-dance with her flapper friends. She is president of the Radio Club of Connecticut College and is an expert in radio matters. Here she is shown in her laboratory, working on a set of her own design.

Congress Shelves Radio Legislation

Washington. — Adjournment of Congress left radio legislation still unenacted. The next regular session will convene in December.

Should a special session be called after the national nominating conventions, it would not take up radio.

The White bill has been meeting with some opposition, through the efforts of a lobby working against any plan that would strengthen government control of the air. It is contended the radio industry is still in its infancy and therefore should not be subjected to too much control by any government department.

In this connection, it is argued that the present plan, which was decided on through a series of voluntary conferences, is all right now and that there will be plenty of time to consider changes at the session.

That is also about the standing of the Dill bill, which is designed to amend the copyright law in order that copyright productions can be broadcast without payment of royalties.

Although the arguments of the various authors before the committee made a distinct impression at the time, yet if the bill were to come to a vote, it would stand a very good chance of passing.

But members of the committee say that there is little hope of getting it on the calendar, and they feel convinced that the bill, with all other radio legislation, will go over until next winter.

Of course, the advocates of all this planned legislation will keep at work trying to influence Congress. But they face the jam that always occurs at the close of a session, as well as the difference of opinion concerning the merits of any of the plans that have been suggested.

Music Clubs Broadcast

The musical clubs of Union College, Schenectady, N. Y., made their final public appearance for the season of 1923-24 last month when they presented a program of college music from WGY.

Discovers Radio Wave Is Slower Than Light Wave

SAN FRANCISCO, CAL.—The discovery that the radio wave travels slower than light has been announced by Capt. J. J. See, professor of mathematics in the United States Navy, government astronomer at Mare Island Navy Yard, and well known authority on the theory of ether.

According to Capt. See the radio wave travels around the globe with a velocity of 165,000 miles a second, while light travels 186,000. Capt See considers that his discovery in the velocity of the propagation of the radio wave about the earth may prove the most notable step in the development of the wave theory since Roemer's original discovery of the velocity of light in 1675.

Outline of Theory

An outline of the chief conclusions is condensed below:

"The mean velocity of the wireless wave was found to be about 173,000 miles per second. This figure is about 13,000 miles per second less than that of light, but ten years ago we did not suspect the cause.

"2. In March last a wireless signal was sent from the sending station near New York to Warsaw, Poland, and reflected back in 0.54 of a second of time. The double distance is 8,500 miles, and the transmission comes out about 158,000 miles per second.

"3. The mean of the two independent determinations of the wireless wave is 165,500 miles per second.

Phenomenon Explained

"4. What is the cause of this? This: The aetheron or particle of ether is only one-four thousandth part as large in diameter as the hydrogen molecule, so that compared to ordinary molecules of the size of oranges the aetherons would be like smoke from a cigar, and moving with a velocity of 294,000 miles per second. The wave travels through the solid earth as well as through the air and free space above the air, but is much resisted in the solid globe. As the ether is 689,321,600,000 times more elastic than air in proportion to its density—thus almost infinitely elastic—the medium cannot suffer a break in its continuity, yet the movement above the earth is held back by the slower movement of the wave in the earth. The resistance in the globe thus acts as a drag on the wave at its base. The result is that the wave bends around the earth, as long known yet heretofore not generally understood.

"5. This bending is quite analogous to the change of form of water waves as they run ashore—the top of the wave gains on the base.

"The results are of interest in connection with the wave theory of magnetism and the cause of universal gravitation, because they bear on the cause of the fluctuation of the moon's mean motion."

Operating the Detector Tube by Grid Bias

By BRAINARD FOOTE

ALTHOUGH it has long been known that it is possible to operate the gassy or "soft" type of detector tube without a grid condenser or grid leak, the latter method of detection is far more commonly employed, possibly because the listener gets his receiver working well without any knowledge of "grid bias" or of "characteristic curves."

Perhaps another drawback to former methods of showing the grid bias scheme of detection is that the required "C" battery was shunted across a potentiometer. This practice soon runs down the "C" battery and adds unnecessary expense to the set's upkeep. However, by a slightly different connection of the "C" battery, this objection is removed and the battery wears out only through the same depreciation that it would undergo were it standing idle on the dealer's shelves.

To understand just how we may detect without a grid condenser, we must study for a moment what is termed the "characteristic curve" of the tube. This is a graphical representation of the relationship between the voltages impressed upon the grid of the tube and the current in the plate circuit which is drawn from the "B" battery. Tubes differ in their characteristic curves, but a representative graph for a soft tube like the UV200 or the C300 is shown in Fig. 1. The horizontal axis is divided into units for the grid voltage, with zero or no voltage shown at the center and negative and positive voltages on either side.

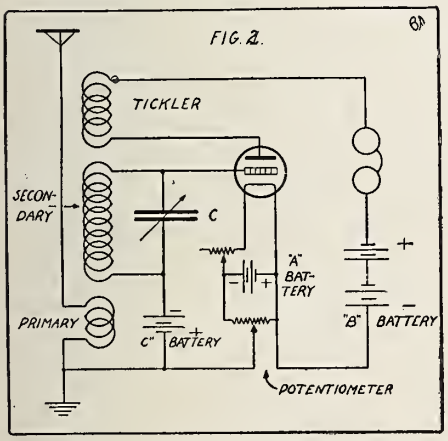


Figure 2. Grid bias control can be used to advantage with any circuit. Here's one which will work well for broadcasting or amateur waves, constants for each being given in the article.

The "Bends"

With a negative 5 volts there is scarcely any current flowing in the plate circuit. But as the voltage is increased toward the positive, the current increases sharply, being somewhat more than one milliampere (one thousandth of an ampere) at zero volts on the grid. Thence the relationship is quite uniform for a while and the "curve" is a straight line. With a positive charge or "bias" on the grid, of 2 volts or thereabouts, the curve bends over to the right and from that point on, further increases of positive voltage have less and less effect. There are two distinct "bends" in the curve, and when the grid voltage is adjusted in some way so that the tube is operated at either of these points, detection occurs.

Why is it that the tube detects only at these two bends? Assume that we set the grid voltage to negative one volt. At that point, the current through the telephone receivers in the plate circuit is about 0.7 milliampere. The incoming signal energy sets up an alternating voltage in the secondary circuit which is impressed upon the grid. As the signal energy alternates from positive to negative, it adds to or subtracts from the normal grid voltage of minus one an equal amount, perhaps changing the grid voltage from minus 2 to zero.

When the alternation on the grid is positive, the grid becomes zero, and the plate current increases to about 1.2 mils. When the alternation is negative, the plate current drops to about 0.4 mils. These variations in the plate current are not equal, even though the fluctuations of grid voltage which produces them are equal.

If the plate current changes were equal, the effects in the phones would be equal and opposite and no sound would be heard at all. The effective current which causes sound in the receivers is equal to the difference between these fluctuations of plate current and is equal to the increase, minus the decrease. The increase is about 0.5 mils and the decrease 0.3 mils. Hence the effective plate current is 0.2 milliamperes. Of course the actual voltage of the incoming signal is less than is indicated, but the result is the same.

Most soft detectors operate best with a negative bias on the grid and use therefore the lower operating point. This is more economical, anyway, since the plate current drain on the "B" battery is only about half of that required for detection on the upper point. However, both points should be tried, and it is necessary to reverse the "C" battery shown in the circuit to do this.

A Sample Circuit

This grid bias plan can easily be used in connection with any soft detector tube and any circuit. It will not work with a hard or amplifier type of tube because its characteristic curve is practically a straight line and the variations of plate current would then be equal and opposite.

Fig. 2 gives the well-known three coil regenerative receiving circuit which is so popular today because of its easy operation, selectivity and sensitivity. The primary has but a few turns and is the customary "untuned" coupling winding. The secondary is tuned by a variable condenser, while the tickler controls the feedback. The grid return lead is made through a regulation type of "C" battery of 3 to 4½ volts and thence to the movable arm of a 300 or 400 ohm potentiometer. This is shunted across the "A"

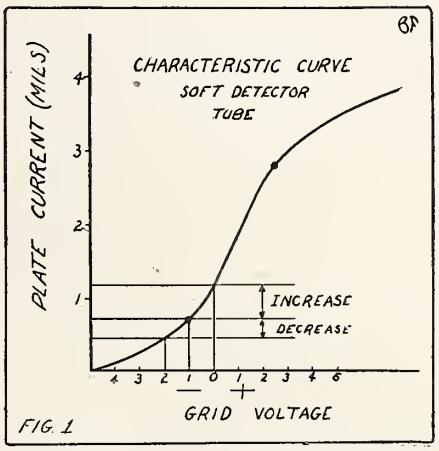


Figure 1. The characteristic curve of the soft detector tube shows the relationship between voltages impressed upon the grid and the current in the plate circuit.

battery and by the correct combination of the "C" battery voltage and the voltage picked off the "A" battery by the potentiometer contact, the grid may be varied from a normal voltage of negative five up to positive five.

A good rheostat is of value in such a circuit, for the detector voltage should be adjusted to a point just below the familiar "hissing" sound. It is not necessary to adjust it afterwards, but each time the set is turned on, the detector rheostat should be set just below the hissing point for best sensitivity. The "B" battery is 22½ volts. Sometimes variations of a few volts in the "B" battery will help a little, but generally speaking, this is not the case. When the "B" battery voltage is altered, a readjustment of the potentiometer makes the tube sensitive again. Different "B" battery voltages alter the characteristic curve and call for a different grid bias to adjust it to the above-mentioned "bend."

Fig. 3 is a photo of a model receiver constructed according to the circuit of Fig. 2. The regular 180 degree vario-coupler is used in connection with a variable condenser of .00025 mfds. capacity. For broadcast work, the coils should be wound with No. 20 wire, although a smaller size will do equally well for the tickler coil. The primary should have 15 turns. The secondary, starting one turn's space from the primary, is wound with 60 turns, while the tickler has 50.

This construction was followed in the set illustrated and then the coils were re-

wound for amateur C. W. reception. The primary and secondary were wound with No. 16 wire for sharp tuning. Five turns formed the primary and 25 the secondary. The tickler was wound with 20 turns of No. 20 wire.

Easy Regeneration

One highly desirable feature of the grid bias detection method is the great increase of sensitivity when the tube is away from the point of regeneration. When very close to regeneration, the difference in sensitivity between the two methods is not so pronounced, but without regeneration the tube is far more sensitive than with a grid condenser. At first glance this might not seem a very great advantage, but it really is, for it is possible to attain the same signal strength from a distant broadcasting station with considerably less feedback than is necessary with the grid condenser. This means that the operation of the set will be much more quiet and free from regeneration noises. And the very fact that regeneration need not be pushed quite so hard means a big improvement in quality of reception.

For reception of local concerts with a detector and two stages of audio, the quality is considerably bettered by using very little feedback and the grid bias scheme. This is only natural, for less regeneration means better clarity. And the same sensitivity can be obtained with less feedback. The grid becomes less affected by hand capacity disturbances when it is directly connected to the secondary winding and the tuning of the set is in that way improved.

All in all, the condenser-less detection idea bids fair to increase in popularity once it is tried out by a few listeners and found to be a more scientific and satisfactory fashion of detection.

War Vets Hear Convention

Salt Lake City, Utah.—Thousands of wounded and disabled American veterans of the great war, patients in hospitals and institutions "listened in" on the deliberations of their comrades of the Disabled American Veterans of the World War, at the organization's fourth annual national convention, in Salt Lake City, June 23 to 28. The elaborate musical program and addresses of the initial convention session on June 23, in the world-famous Mormon Tabernacle, were broadcast to all parts of North America over KDYL radio station in this city. Madame Schumann-Heink, famous prima donna, sang "The Star Spangled Banner" and also gave a repertoire of arias as part of the opening day's program. All of the musical and vocal selections, addresses by distinguished guests and speeches by national military and disabled veterans' leaders, were broadcast by KDYL, which is in charge of H. C. Mailander, a wounded veteran of the great war.

One of the subjects to be taken up by this Summer's radio conference will be emergency work. Secretary Hoover's radio executives are working out other details and planning for the organization of several research and development committees.

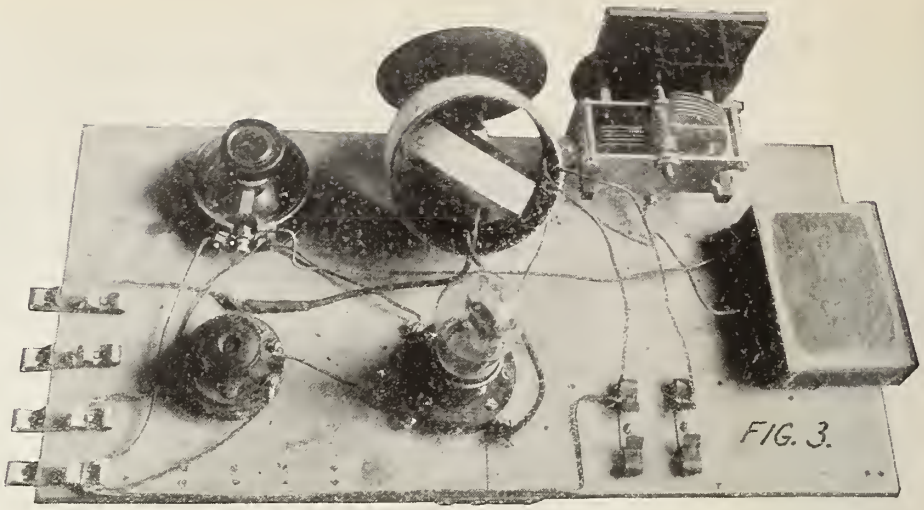


Figure 3. A board layout of the three coil tickler set which uses no grid condenser. The potentiometer and the C battery adjust the grid to the proper working potential.

The Heart of the Radio

By ERNEST WALKER SAWYER

Chief Engineer, Electrad

The grid leak is far more important an item in a radio set than the safety valve of a steam engine. It should really be called "The Heart of the Radio," as it controls the flow of electrons in the circuit.

Electrons are the little fellows who carry the music from the antenna to your ears. Your antenna may be perfect and your tubes may be operating at remarkable efficiency; but if the electrons do not move along the path to your ear in a smooth and orderly manner, the music is distorted.

Your volume depends very much on the grid current and directly on the plate current. An important factor which determines the grid current is the number of negative electrons which are attracted to the grid from the filament. The negative charges on the grid sometimes reach a point where they practically stop the flow of plate current. The grid current piles them up. Unless a grid leak is in use, the tube will become choked up and will not operate. If the grid leak is the incorrect size, the tube will only partially operate.

The grid leak condenser permits incoming signals to enter your tube without loss of energy in the grid leak; but the grid leak is the true controller of the system. If the negative charges on the grid are permitted to accumulate, they simply clog the circuit. The grid potential is lowered and the plate current is lowered. The grid leak permits the excess to leak off, thus restoring the plate current to its normal value.

Each type tube, each individual tube of same type, each variation in voltage, current or in strength of signal, requires a variation in grid resistance for maximum efficiency and that variation is covered by engineers of the Radio Corporation as follows:

WD11 and WD12	2 to 3 megohms
UV200	½ to 2 megohms
UV201A	2 to 9 megohms
UV199	2 to 9 megohms

"A grid leak resistance between 2 and 5 megohms is satisfactory for average work. A resistance between five and nine megohms is somewhat better for weak signals," according to a popular definition.

At first thought, you would naturally advise use of a variable grid leak for every set, but the public as a whole do not want so many variables; so the next best thing is to adopt for each type set, that fixed leak which gives best average results on local stations.

From the foregoing, it is easy to see that when you have once found the correct grid leak for the particular set, tubes, antenna, ground and station, you should be assured that the resistance should remain exact. You see, therefore, that you must use utmost caution in purchasing only those leaks that are properly made by responsible people. Insist that your grid leaks be certified, correct and guaranteed.

In a further article I will describe the proper method of manufacture of certified grid leaks.

MORE ABOUT TUBES

Tubes are all important in the operation of a Radio set. Another article on Tubes, by Felix Anderson, will be found on page 17, this issue.

No "Summer Slump" Found in Radio Interest

Here Are Some Suggestions to Maintain the Efficiency of Your Set

The extent to which this is turning out to be a real "radio Summer" is becoming more apparent with the ever-increasing efforts made by broadcasters, manufacturers and other interests in the industry to set a high-water mark of perfection for radio reception during the coming weeks.

Because of the flood of inquiries received during the past month, RADIO AGE has decided to publish in this issue what it considers the most vital factors for the successful operation of a radio set during the hot season.

Stations Stronger

Little difficulty should be experienced in securing good reception in the Summer, because of the fact that during the past year the power of sending stations has been materially increased.

This status is expected to eliminate many of the previous difficulties noted during the Summer season, not to mention numerous improvements and refinements in receiving apparatus now on the market.

All these situations will undoubtedly result in greater satisfaction to the radio enthusiast and the upkeep of the high pitch of interest which characterized the entire month of June.

The radio fan who heeds the following suggestions will be sure of a successful radio Summer. Here they are. Study them closely:

That Portable Set

Put your set in the pink of condition. Whether your radio receiver is to be used at home, at the seashore or in the mountains, see that the connections are gone over and tightened up, that old batteries are replaced and that a good set of tubes is installed.

Camp Aerials

In camping with a radio, if your receiver is one of the antenna type, erect your aerial wire from the camp to a branch of one of the tallest trees in the immediate vicinity. If thunderstorms are prevalent, it will be found advisable to erect an additional antenna not over ten to twenty feet off the ground. That type of aerial is not so readily influenced by atmospheric disturbances. An aerial of this character can be of any length from 100 to 200 feet.

Loose Coupling

Whether you use a receiver which operates from a loop, or a receiver which operates from an antenna, the sensitiveness of the receiver should be reduced in times of atmospheric disturbances either by reducing the filament temperature or

"UNCLE ROBBIE" TELLS 'EM HOW IT'S DONE Kadel & Herbert.

The guiding genius of the Brooklyn Nationals is telling the radio world, through WEAF, that his team is about to go into the fray and lick the New York Giants beyond recognition. By the expression on Robbie's face, he seems fairly confident that his team will turn the trick. Whether his prediction was true is another story. The New York and Brooklyn baseball clubs are using radio to good advantage this season, doing their broadcasting direct from the ball grounds.

by "loosening the coupling," so that the best results might be obtained from your local stations. On the other hand, if atmospheric conditions are good, the filament temperature should be readjusted to normal so that the sensitiveness of the receiver might be increased and reception obtained from broadcasting stations located at greater distances. The long low aerial or the loop type of receiver will give marked relief this summer from atmospheric disturbances.

Portable Grounds

See that you have a good ground connection when the aerial is used. If such cannot be obtained at the camp or at the seashore, the equivalent of a good ground connection can be had in the use of a piece of wire 100 to 200 feet in length laid over the surface of the ground and directly underneath the aerial.

Guard Against Moisture

Receiving apparatus in the camp should be duly protected from moisture and dampness. A moderate amount of moisture and dampness may not interfere with the operation of the average type of receiving set, but at least the set should not be allowed to get wet by exposure to rain or inclement weather.

Tuning Portable Sets

Broadcast listeners should bear in mind that the electrical constant of aerials erected at the seashore or in a camp, may be quite different from the electrical constant of the aerial used with the same set at home. This means that stations formerly heard at home will not come in at the same point on the dials in the camp. It should not be difficult to locate new positions for such tests after the first evening's operation.

Phone Cords

With regard to head telephones, be sure that the headset cord is not worn; that the connections are tight at the back of the headphone and that the caps are also screwed down tight.

Install fresh batteries, and new tubes; tighten up all connections; protect the receiver from dampness; use a lower aerial when atmospheric disturbances are present and a longer aerial when reception conditions are favorable, and see that your headset is in good condition.

SUMMER FANS

What results did you obtain with your radio during hot weather? RADIO AGE will be glad to print the best letters on this subject from fans.

"Radio Dead Spot" Revived

DX reception has been logged from a number of distant stations by an antennaless receiving set at Montauk Point, L. I., which until now has been believed by many radio experts to be a dead spot for other than nearby local stations.

This performance resulted from a hasty experiment conducted under the supervision of Dr. Francis LeRoy Satterlee, of Flushing, L. I., inventor of the Satterlee Coils. It adds another to the list of achievements already credited to the inventions of this well-known scientist.

Known as Dead Region

Government maps have proclaimed the narrow strip of land between Block Island Sound and the Atlantic ocean as being quite dead for western sending stations.

So far as known, previous scientific investigations for radio reception have been futile and it is generally reported that sets conveyed to Montauk Point by vacationists, even when operated under the best working conditions, with long aerials on high hills and connected to good grounds, have failed to pick up any other stations than Boston and Springfield, Mass.

Previous to Dr. Satterlee's experiment the longest distance ever known to have been brought in at Montauk Point was a Chicago station, received on a five-tube set with headphones.

Dr. Satterlee motored to his summer bungalow on Montauk and set up a four-tube antennaless receiver. Experiments ensued for several days and a number of distant stations were logged daily, including Chicago, Miami, Ottawa, Pittsburgh, Canton and Washington, D. C.

No scientific explanation has yet been made by Dr. Satterlee as to the reasons for the existing "dead spot" formerly condemned by all who had attempted reception at Montauk.

Dr. Satterlee used a Moon C2A set hooked up with his antennaless circuit with the Satterlee coils.

Radio Helps Isolated

Up in Sable Island, Canada, WGY is church, school, newspaper, and theatre for the inhabitants. Writing to WGY recently, Harold F. Henry, superintendent of Humane Establishment, stated, "We on Sable Island, being a life saving station, have no schools or church and the steamer only visits us three or four times a year. We depend on radio broadcasting for church services, concerts and news. The WGY Players have my best wishes and I hope they never fade."

ZR-3 to Use Radio

Plans for radio communication with the German-built ZR-3, the new giant airship of the Navy, when she crosses the north Atlantic early in July, are going forward through the cooperation of the U. S. Weather Bureau and the Naval Communication Service.

Kadel & Herbert.

WHAT ARE THE WILD WAVES SAYING?

This fair beach flower is demonstrating that the outdoor girl is taking to radio this Summer. Between dips in the ocean at Atlantic City and lazy canoe trips, she can tune in on a nearby hotel's syncopated music. Don't you wish you were in Atlantic City?

How to Get the Most Out of Your Vacuum Tubes

By FELIX ANDERSON, Technical Assistant

SOMEONE at some time made the remark that a chain was no stronger than its weakest link. A mighty practical and sound statement which can be applied to practically any material thing in a figurative way. Interpreting it into radio, we might say that a radio receiver is no better than its weakest part.

Much has been said about the tuning components, their construction and uses, much has been written and said about arrangements thereof, and still more has been said about circuits and methods of connecting various tuning arrangements. But in the idea of the writer, little has been said in the methods to use to coax the utmost out of the veritable heart of the circuit—the vacuum tube.

It is not the intention to furnish the reader with a lot of details of the history of the discovery and development of the receiving valves—information of that nature can be obtained from practically any collections of facts on radio and its past. On the other hand, the writer knows from bitter, expensive and heartrending experience that a few details on the most effective manner to use in approaching a vacuum tube with the intention of extorting maximum efficiency therefrom will be without question appreciated.

It brings back the fond memories of the sad end of our first tube, which passed away peacefully after long years of faithful service, because some thoughtless experimenter presented us with a drawing that applied the plate battery potential across the filament terminals. In those days we didn't know how to protect the filament with fuses, and only had a vague idea that if the B battery (which in those days consisted of flashlight batteries) were applied to the A battery posts, something would happen inside of the tube—maybe the plate would melt—it was too expensive to try it out.

In general, nowadays, about the same conditions exist among the bugs who experience the thrill of buying their first triode. They purchase one, plug it into the tube socket, and if it doesn't work, they blame it on to something. If they happen to have an incorrect connection and it burns it out, they say—well, never mind what they say, but if they miss anything it usually is not their fault.

What Kind of Tube?

One of the commonest questions that is asked a radio man is the old one with moss on it, "What Kind of a Tube Shall I Buy?"

The choice of tube depends upon several things. They are enumerated as follows:

1. Battery Supply.
2. Circuit Used.
3. Kind of Reception Desired.

So, first of all, no matter what kind of set you want to build, you have to consider the source of power for lighting the filament and whether dry cell or wet cell batteries are to be used. This goes further into the detail of how much money one desires to expend upon the original outlay and maintenance of the receiver to be operated. If you have a lot of money to spend it is a wise thing to employ the tube that uses wet cell storage batteries as a source of current supply. On the opposite side we have the man who wants to make his set economical as possible, and for him the dry cell tube is to be specified.

But we have two or more different kinds of dry cell and wet cell tubes to choose from.

Kadel & Herbert.

AN EFFECTIVE RADIO PLEA

Little Jimmy Davis, son of James J. Davis, secretary of labor, recently made a plea over the microphone at Station WRC in behalf of the starving children of Central Europe. Jimmy is a forceful orator and made a favorable impression on all his listeners. After all, "like father, like son."

Classifying the Tubes

First of all, the UV201A tube can be operated on either dry or wet cells, but it is decidedly a wiser move to operate this type of tube with a good six volt storage battery. With this tube, we have its big brother, a comparatively monster current eater, the Western Electric tube. Both of these tubes are good tubes, and both of them represent the means of obtaining the greatest volume regardless of current consumed.

The UV201A tube makes a good radio frequency amplifier, a much better audio frequency amplifier, and a fair detector. The WE tube is a wonderful radio frequency amplifier, only fair as a detector, but gives beautiful audio frequency amplification.

We therefore find that if we want a tube for detection purposes the wisest thing to do is to invest in a UV200, when the filament source is a storage battery. We do not insist that the UV201A will not detect—what we are trying to put across is that the 200 tube is designed for detection purposes, and should therefore be used.

Now if I were building a radio frequency circuit I would very seriously consider the UV199 tube as the radio frequency amplifiers. These little tubes are wonders when it comes to that, because they are built for that purpose. They make good detectors, and good audio frequency amplifiers, when one considers their input. The only thing one can possibly hold against this little triode is that its volume does not come up to the six volt tube. And that's saying a lot for a little tube like that.

We have had good success with WD11 tubes in regenerative detector circuits, but not with radio frequency circuits. At audio frequencies the tube shows up somewhat better, but all in all, we find it best this WD11 and its sister, the WD12, to straight detector circuits. In fact, we doubt if there are many sets now in use that really use more than three WD11 tubes; a detector and two stages of audio frequency, unless a push-pull power amplifier is used. Now, then, we hope that we have a sort of a basis to work from.

Handling Tubes

From the time that the tubes leave their manufacturers they are handled by this fellow and that, by this freight hand and that, and if you are a wise radio man, make the salesman whom you are bargaining with test the tube you are going to buy. We remember when they used to have sets in the stores and we used to put the tube in the socket to make sure that it was really good in an operating test.

Never handle or permit your tubes to be handled roughly. That is, if you want the filament to be in one piece, and keep the grid from touching the plate. A tube

represents a very delicate precision instrument, and to bang it around and hit it on a table is about the same as throwing a monkey wrench into a printing press. The manufacturer takes pains in packing it carefully to prevent it from becoming broken internally and externally, and you should take the same precautions.

Tube Accessories

No matter how good a tube may be, it can always be ruined insofar as its action as either radio frequency amplifier, detector audio frequency amplifier or oscillator is concerned by the use of poor accessories. One can hardly consider the tuning or transformer components of a circuit as accessories; but they can be likened to links in a chain, and as we said before, a chain is no stronger than its weakest link.

In the olden days, we used to have tubes that had the wires coming right out of the glass stems—no bases on them. The wires, of course, were delicate, and required careful handling to keep them from breaking off; but in spite of that fact, they were superior in a way to the present day tubes, because the capacity effects presented by the virtue of the long leads and the metal shell of the present day tube construction were not encountered. But we often sacrifice electrical principles for mechanical strength, and hence we have to contend with a necessary evil—the socket. Tubes often have to be changed quickly and the bayonet type of socket seems the most effective way of doing this. However, that does not mean that we cannot use a good tube socket. They should be chosen with care and consideration.

Porcelain sockets, because of their high insulating qualities, are probably the most efficient electrically that an experimenter can use. There are several good types on the market, and their use is highly advisable. Many embryo experimenters fee that because of their low price they are to be shunned, but this is not the case. Hard rubber sockets are next in line, considering efficiency from an electrical standpoint. Bakelite sockets are not bad, but beware of imitations. Fiber, moulded and composition sockets should be avoided if the utmost in radio perfection is to be sought.

Some Sockets Go Low

Incidentally, we have seen tube sockets that have as low a resistance as two megohms; their users wonder why they don't get long distance, and many others wonder why their neutrodynes won't balance. This item may seem trifling—but remember that you can't overlook trifles when you start to experiment with high frequency electricity. Radio signals are weak and elusive. The signals leak through the tube elements (especially in radio frequency amplifiers) enough without having more of it sneak to the plate post via the moulded mud route.

You can get around the whole business of using a tube socket by correctly locating the respective prongs on the tube with regard to their values as plate grid and filament contacts, and solder your wires directly thereto. This assures positive contact, and does away with any stray capacity offered by the extra metal shell that some tube sockets incorporate.

The use of adapters should be particularly avoided in circuits where it is absolutely not necessary. Use a good tube socket of the correct design for the tube used, and eliminate losses which might occur through the use of one of the substitute sockets.

The contacts on the tube socket should be very clean; if not, noises will without question be heard and blamed upon some other part of the set. The springs should be tight and firm, and care should be taken in ascertaining that the contact still touch when the tube is turned in the socket so that it will engage the bayonet slot.

The longer you make your leads to the grid and plate contacts, the greater your losses will be (especially in radio frequency circuits) because the incoming signal travels quite readily across the capacity effect presented by the wires, connections and any other surface that presents any amount of capacity. The secret of the UV199 tube as a radio frequency amplifier lies in the fact that the leads are short and direct, and the capacity effect is eliminated as much as is commercially possible.

Where binding posts are provided on the tube sockets, soldering lugs should be used; otherwise the connections should be made tightly with a pliers. Before screwing a socket to a mounting board, make sure that all the machine bolts holding the springs to the socket are tight, as a loose spring is a source of never ending noise.

Kadel & Herbert.

GIRL BUILDS SMALLEST LOOP AERIAL

This miniature loop aerial, said to be the tiniest ever constructed, was made by Helen M. Obermiller, daughter of a noted radio engineer. It is called a variometer loop because the inside winding of the loop revolves. Although small in size, it contains quite a lot of wire. Helen has demonstrated its efficiency before several radio fans by using it on her receiver, a three stage radio frequency set. Remarkable results have been obtained.

Controlling Accessories

The controlling accessories listed according to their respective importance in a circuit are as follows: The grid leak and condenser, the rheostat, the potentiometer, the plate battery, and the filament battery. In some circuits, the bypass condenser across the phones is also a necessity.

The subject of the grid leak was considered of such importance that the writer felt that a special explanation of its construction and adjustment was necessary, and readers will find a detailed review of this important control in the June, 1924, RADIO AGE, under the title of PMGL. Its adjustment in the course of getting the most out of a tube will be explained a little later.

Together with the grid leak, the grid condenser should be chosen with much care and thought. Paper makeshifts are worthless in an ideal radio receiver.

In buying a grid condenser, two or three sizes should be tried. Capacities of .00025 MFD, .0005 MFD and .0003 MFD are very useful capacities to have handy when determining the best operating features of a triode. Usually the UV201A tube works best with a .00025 MFD, as does the WD11 and 12. The UV199, however, sometimes works better with the .0003 MFD or the .0005 MFD condenser.

These condensers should be of the fixed

(Continued on page 36)

Radio "World's Fair" To Attract Thousands

New York Show Surpasses All Expectations

THE first Radio World's Fair, which is to be held in the Madison Square Garden, New York City, from September 22 to 28, under the auspices of the Radio Manufacturers' Show Association, is attracting more universal attention than any other commercial exposition ever held in this country.

Leading newspapers here and abroad are devoting columns to the coming show which promises to be the largest and most complete exhibition of scientific achievement ever staged.

As nine-tenths of the exhibiting space in Madison Square Garden has already been contracted for and as the remaining ten per cent is oversubscribed, it is practically a certainty that the exposition will be forced to spread out and take in the 69th Regiment Armory, located just across the street. Notwithstanding the fact that the coming show will be for radio manufacturers of national reputation only and the opening date is still several weeks off, Manager Kerr now has almost enough applications in hand to fill both buildings and new requests for space are coming in by every mail.

Foreign Division Planned

Among the new features to be introduced this season will be a "Foreign Division" in which many of the important radio interests abroad will be represented by carefully selected official exhibits. The European manufacturers and inventors are said to be making elaborate preparations for their initial invasion of America and they promise to furnish the radio fans of this country with a few real surprises.

Another important innovation will be a special "Board of Radio Authorities," now being chosen with great care, which will award suitable prizes to the most meritorious wireless inventions perfected during 1924. The competition will be open to all and no entry fee will be charged. In addition to presenting each successful inventor with a medal, a diploma or cash, the jury of experts will also endeavor to assist each inexperienced successful inventor to market his or her invention to the best possible advantage at no cost. Public demonstrations and tests of the new inventions will be held daily and many startling devices will probably be brought to light.

Extraordinary feature programs will be put on every afternoon and evening in which the most prominent radio geniuses of the age will appear personally. There will also be a series of broadcasting experiments made during the show which will enlist the services of the ablest radio engineers and the most powerful broadcasting stations of the entire world.

Dealers to Be Helped

Special arrangements have been made for the accommodation of dealers from all parts of the country who are expected to attend in large numbers. Two hours per day, from 11 A. M. to 1 P. M., will be set aside for the exclusive transaction of business between exhibitors and wholesale buyers. The general public will not be admitted until one o'clock every afternoon and the show will remain open until eleven o'clock every night. Through another special arrangement the exposition will be open on the afternoon and night of Sunday, September 28, which is the closing day.

At the close of the New York show the exhibits, booths and decorations will be taken to Chicago and from there the big spectacle will be moved on to Los Angeles. The local, Chicago and California expositions will be identical in almost every detail.

Manager Kerr plans to establish one of the finest experimental radio stations obtainable in the tower of Madison Square Garden at an early date for the purpose of enabling an official committee to conduct preliminary tests with the hope of solving many of the most perplexing radio problems of the present day. A detailed report by this official committee will be announced on September 22. The preliminary tests are also expected to pave the way for the success of the ultra-important trans-oceanic and trans-continental broadcasting experiments which are to be made between September 18 and 28.

Amateurs to Compete

The Amateur Builders' Contest, which will be of an international character this year, will be a good sized exhibition in itself. Entries are already coming in from Europe, South America and distant points in this country. Space enough to display several hundred sets has been reserved and twenty-five valuable prizes will be awarded to the winners.

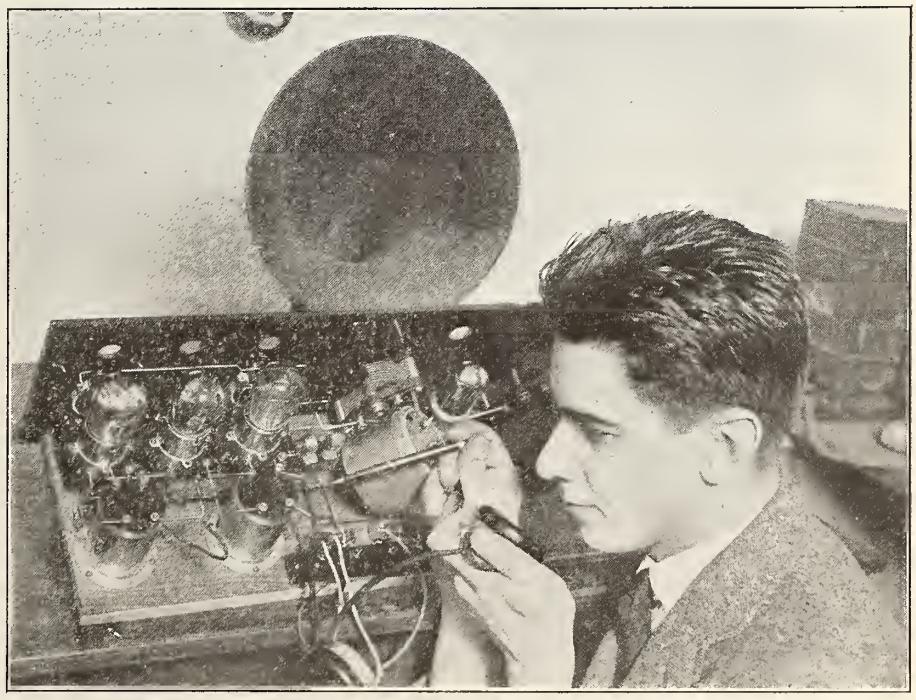
"Radio Age" to Be There

RADIO AGE, the Magazine of the Hour, will have a booth and exhibit at both the New York and Chicago radio shows. Manufacturers, dealers and "fans" attending these shows are cordially invited to "drop in" and get acquainted with the magazine and those who are helping to make it the leader in its field.

At the New York show, RADIO AGE'S booth will be Number 15 in Section L. Look for it, you eastern fans!

At the Chicago exhibition, to be held at the Coliseum, the RADIO AGE booth will be Number 4 in Section S.

A detailed program of the events and daily schedule of the New York Radio Show will be published in the next issue for the guidance of fans who expect to attend.



"THIS IS STATION 2LO SPEAKING" Kadel & Herbert.

Raymond G. Chassevant, shown in the picture, spoke those thrilling words into his receivers and the household heard them fly from the loud speaker with all the force of a local station. Many fans are having a lot of fun talking through their own loud speakers. Connect your head set across the primary of the transformer of the first stage of your amplifier, the "B" battery being connected and the tubes turned on as usual. Then talk into your head set as shown in the photo and your loud speaker will repeat what you are saying.

The Station That Happiness Built

How a Mixture of Technique and Human Nature Made WIP a Winner

By R. H. HOPKINS

WHAT is it that makes a radio broadcasting station popular in the eyes of the thousands of fans who "listen in?"

Can it be the programs alone? Or the strength of the station; the contests it holds—or merely the personality of the announcer?

If such a question could be answered, the country would know less broadcasting failures. Men venturing into the broadcasting field would be able to know beforehand just how to get that "indescribable" something that makes—or breaks—radio stations.

Station WIP, located on the Gimbel Brothers Building in Philadelphia, perhaps has come closer to solving the question of "What Makes a Successful Broadcaster?" than any other in the field.

No given recipe was followed; no stern rules mapped out and followed to the letter. Success came naturally because only a few fundamental principles were outlined at the beginning.

Happiness Succeeds

After all is said and done, the only vital reason for WIP'S success seems to be "Happiness; or a Sound Mixture of Radio Knowledge with a Liberal Dose of Human Nature." That's the prescription.

The managers of WIP looked over the long list of failures and near-failures and came to the conclusion that you can't please all the people all the time; but you can give each class of people their turn at being pleased.

This decided, WIP proceeded to pick the men to guide its ethereal destiny. They looked for radio experts where expert knowledge of broadcasting apparatus was needed. They got these men and put them where they belonged; in the technical departments of the station.

Then they looked around for some young men who didn't know so much about radio as a science, but who did know something of human nature. Men who know just when to turn off the flow of jazz music and insert a dash of Beethoven instead. They wanted men whose voices sounded as if they hadn't a care in the world, and who could be happy all evening with nothing more than a homely microphone staring them in the face.

These men were found—technical experts and human beings as well. The former were given full charge of making WIP heard for thousands of miles; the latter were told to make the station a symbol of happiness and care-free good cheer that would turn homes into rendezvous of laughter.

The technical men succeeded; but their work would have been in vain had it not been for the irresistible personalities of the men in the studio, coupled with their almost uncanny ability to tell what sixty per cent of radio listeners want to hear.

WIP Heard in Europe

"This is Station WIP, Gimbel Brothers, in Philadelphia." You have no doubt heard this announcement; it's been heard all over the United States, in England, France, Germany, South America, Hawaii and other places in the far corners of the earth. And perhaps you've wondered just what was going on behind the scenes at WIP and how it was operated.

A New Feature for Radio Age Fans

A new class of public entertainers is growing up in American public life.

A decade ago the most popular group of men and women before the public eye consisted of the motion picture and stage stars; but in the years to come it will be the radio entertainers and announcers who will hold the spotlight of favor.

Just as the "movie" stars won their army of admirers, so are the unseen radio singers, actors, announcers and other entertainers forcing their way to the coveted spot in the Great American Heart.

In the belief that radio entertainers will eventually be known in more millions of homes than the motion picture could ever hope to penetrate, RADIO AGE is beginning a new feature; the creation of a department which will deal wholly in acquainting the radio public with the men and women who broadcast their talents over the radio to an unseen but appreciative audience.

Their pictures, their life stories and the facts and thrills of their existence will be recorded for the enlightenment and amusement of the "fans" who listen to them nightly. Readers are asked to help improve this department, which begins in this issue.

WIP has two large antenna towers 200 feet above the street. The station consists of the operating room, the main studio, which is used for solos, speeches, quartets; and the studio-auditorium for large choruses, orchestras and bands. There are nine remote control rooms located in various parts of the city to facilitate broadcasting from other buildings.

In both the main studio and the studio auditorium the walls are padded and draped in such a way that there is little reverberation of sound—just a full round tone without echo. The main studio is comfortably furnished with wicker chairs, tables, settees—all the comforts of home, in fact. Fine tapestries hang from the walls. A grand piano occupies one corner and two microphones on mahogany stands are ready to catch the slightest sound.

A small black box on the studio wall controls the microphones. A large red light in the center of the box warns the artists, when the microphones are connected with the transmitter, to keep absolute silence. The transmitting apparatus feeds 500 watts of radio-frequency energy to the antenna system.

The microphones, of the duralium type, are extremely sensitive and pick up the slightest sound. The two in the main studio are connected to a "mixing panel" which blends the sounds. In this way the bass notes of an orchestra are picked up by one microphone, the high notes by another and the two blended in the "mixing panel" into perfect orchestration. It is in the "speech input amplifier" that the operator controls the sound intensity and regulates the amount of energy fed into the "main transmitter." Now the greatly amplified sound, now electrical energy, that originated in the studio, is carried through wires to the "main transmitter" where it is received by a 50-watt vacuum tube that again amplifies it. Next, it is passed to the "modulator," the two 250-watt vacuum tubes that balance and modulate the energy. The next and last step, after the energy has been amplified and modulated, is feeding it into the "oscillator," which consists of two 250-watt vacuum tubes incorporated in a circuit tuned to 509 meters or 590 kilocycles. The oscillator sends the sound that originated in the studio, out through the antenna system in the form of radio-frequency energy to be received everywhere.

The operating staff of WIP need no introduction. They are known wherever the station is heard, and they are known for their bubbling enthusiasm and perpetual desire to please their listeners and spread good cheer as far as WIP'S power can be picked up.

But the staff are known only by their operating initials, so here they are properly: "H. G." is Charles Goudy, better known as Hank, the chief engineer of WIP. "C. W." is Charles Weir, operator. "S. K." is Samuel Kale, operator. "E. D." is none other than Edward Davies, director. "H. P. I." is Helen Pulaski Innes, manager of the programs who sorts out the orchestra selections, vocal numbers and other features with surprising tactfulness. "U. W." is Uncle Wip, the kiddies' idol and the cause of frequent epidemics of heart trouble in Eastern flapper colonies. In private life "Uncle Wip" is Chris. W. Graham.

WIP'S main studio and operating room are enclosed in glass, thus giving a picturesque effect.

"Radio Age" Broadcasts from Station WTAY

RADIO AGE has taken to radio! Negotiations have been completed whereby RADIO AGE, the Magazine of the Hour, is to broadcast regularly from Station WTAY, located on the Oak Park Arms Hotel, Oak Park, Ill.

The entire technical resources of RADIO AGE will be used to present a series of programs dealing with the operation and building of radio sets. No other radio station in the Middle West, nor any other radio magazine in the country offers such a radio service to radio listeners.

HUGH B. MARSHALL

This is the popular studio director and announcer at WTAY, Oak Park, Ill., from which RADIO AGE broadcasts technical radio talks every Wednesday evening at 7 o'clock. Drake Studio.

WTAY is one of the most efficient stations in the Chicago territory and is exceedingly popular with the fans because of the fact that its wave length does not approach that of any of the other stations who are bunched together in the neighborhood of 360 meters.

220 Wave Length

WTAY operates on a wave length of 220 meters and it is possible to "tune in" at any time.

Every Wednesday evening, about 7 o'clock, RADIO AGE will come on the air for its weekly talk on technical and general radio. This service began Wednesday, June 11, and is now in effect.

J. A. Callanan, well known technical radio expert and a special writer for RADIO AGE, delivered the first two talks, which were enthusiastically received and caused considerable comment.

In the future, besides Mr. Callanan, the RADIO AGE broadcasts will be delivered by Frank D. Pearne, John B. Rathbun, Roscoe Bundy, Felix Anderson and other authorities whose contributions are a regular feature of the monthly RADIO AGE.

The subject of these radio talks are published weekly in a booklet issued by The Pioneer Publishing Company, Oak Park, Ill., for Station WTAY. Fans may obtain these programs weekly by requesting their names be put on the mailing list. A letter to the Station Editor, Care RADIO AGE, will do it.

Five Programs in July

During July the RADIO AGE programs will be broadcast from WTAY on the evenings of July 2, 9, 16, 23 and 30. Tune in and be convinced of their value! Correspondence with the experts who deliver the radio talks is urgently invited. If you wish to question the speaker on some topic he mentioned, or if you wish further information on the subject he presented, address him care WTAY, Oak Park Arms Hotel, Oak Park, Ill., or care RADIO AGE, 500 N. Dearborn St., Chicago.

There is absolutely no charge for question-and-answer service requested by fans. Drawings and diagrams will be furnished if desired.

Hugh B. Marshall is studio manager and announcer of WTAY. Assisting him are a coterie of able artists who produce jazz and classical programs throughout the week from 6:45 p. m. until after 10:30. An elaborate studio is maintained in the Oak Park Arms Hotel.

This is WTAY broadcasting! All together for RADIO AGE programs!

What Makes an Announcer?

"In the wording of a sentence or a phrase, in the choosing of a word, hinges the success or failure of the radio speaker," said Wheeler McMillen, associate editor of Farm and Fireside, who broadcast talks over the Sears-Roebuck Agricultural Foundation station — WLS, recently.

"The resonant quality of the voice plays a big part through the microphone, just as it does in ordinary conversation," continued Mr. McMillen, "but resonance is only half of the secret of effective broadcasting. Some voices, gifted with a clear, sharp, vibrating quality, capable of carrying to every corner of a lecture hall, are changed by the microphone to a series of incoherent blurs. The radio fan puts all the blame on the peculiar carrying power of the voice, but it also is due to a poor choice of words in the making of a sentence.

"Radio phonetics is a new subject. As yet no one knows very much about it. But after a few observations, I am convinced that the man whose voice is lacking in radio quality can substitute a carefully constructed speech, and the result will be at least 50 per cent improvement over ordinary efforts. Short sentences made up of simple words are the most effective. If long sentences are used, make them compound. A compound sentence is more simple than a complex. A few longer sentences always are necessary for the sake of variety. The beginning and ending of a paragraph should be made of short, pithy sentences packed with thought.

"A monosyllable with a long vowel is harder to pronounce sharply than a syllable with a short vowel. Listeners-in cannot see the periods by radio; the speaker must make them evident. This can be done if words are chosen for the endings and beginnings of sentences that are sharply defined. The sentence ending, especially, must never be ragged. Words are clearest and most easily pronounced that end in sharp consonants, such as 'p' in handicap, 'k' in overlooked, and 't' in pursuit.

"Radio talking is a good deal like magazine writing," Mr. McMillen said. "The same tactics must be employed in both. There is more in the building of a good radio talk than the planning of words and sentences. That is the beginning. The word structure must be built around a general plan aimed to attract and hold the interest. The opening sentence should strike the keynote of the speech and at the same time give a hint of suspended interest that will keep the listeners at the phones."

KGO Has New Studio

The broadcasting resources of KGO, at Oakland, California, have been greatly increased by the introduction of a San Francisco studio at the Hotel St. Francis. The new studio was opened May 28 with an address by Ralph McLaren, acting mayor of San Francisco.

Ground wires under San Francisco Bay connect the San Francisco studio with the control room and power house of KGO ten miles away. It will no longer be necessary for San Francisco artists to travel to Oakland to fill a radio engagement with KGO, the facilities of a high class, powerful station being brought to them by means of wire lines.

Vanity Fair Photo.

"UNCLE WIP SPEAKING"

.."Uncle Wip," or Chris. W. Graham, is the kiddies' friend at Station WIP, Philadelphia. His jovial voice almost makes up for the absence of his equally jovial countenance over the ether waves. Here he is shown in the act of greeting his radio admirers at the opening of an evening's program.

Who Is Your Candidate

for the

RADIO HALL *of* FAME ?

Which radio announcer or entertainer holds first place in your heart? RADIO AGE intends to find out, through the medium of a **RADIO FAVORITE POPULARITY CONTEST!**

Each month RADIO AGE will publish an intimate interview and photographs of the radio entertainers and announcers winning the greatest number of fans' votes in RADIO AGE.

This new idea is for the benefit of the great army of fans who would like to know more of the men and women who supply their entertainment over the ether waves. If you like this new feature, help us make it a permanent success. It is entirely up to you, Mr. Radio Reader.

So get busy! Read the rules printed below, get your friends together and decide on your favorite Radio Man (or Woman.) Then clip the coupon and send in your vote. Watch early issues of RADIO AGE for results of the first Radio Popularity Contest ever conducted.

Rules of the Contest

1. Readers of RADIO AGE are entitled to as many votes as they wish. Each coupon counts for one vote, and only those written on blanks clipped from RADIO AGE will be honored.

2. The candidate must be a person identified with the Radio World and may be an announcer, entertainer, inventor, manufacturer or, in fact, any person in any manner connected with the great radio industry.

3. State clearly the name of your favorite, his classification (announcer, entertainer, etc.), the station from which last heard and approximate date when you were entertained.

4. Send in the coupons at once. First tabulations of results will appear in the September RADIO AGE and monthly thereafter until a grand winner is decided upon.

5. Radio entertainers are usually announced through the microphone, but it is suggested that in the event voters do not know the name of the announcer, they should give only the station from which he announces.

POPULARITY CONTEST COUPON

Harry Aldyne,
Contest Editor,
RADIO AGE,
500 N. Dearborn St., Chicago.

I wish to cast my vote for:

Name of favorite.....

Classification .....

Station.....**Approx. date heard**.....

My name .....

My address .....

Three Tube Wizard Circuit

By JOHN B. RATHBUN

IN RESPONSE to the many inquiries for a diagram of the Wizard circuit with two stages of audio amplification, I have prepared the following hook-up. Approximately fifty sets have been built as shown and have given very good results on both local and distance reception, loud speaker operation frequently being attained on stations located 500 to 800 miles from Chicago under favorable conditions. With the local stations such as WGN, WDAP and KYW it was necessary to turn down the audio tubes very low because of the tremendous volume obtained with the speaker.

At the left is the detector portion of the circuit which is already familiar to many of our readers. This consists of the standard fixed coupler (FC) with the tuned secondary controlled by the single variable condenser (C1). At this point it might be well to mention that the number of turns in the secondary coil of (FC) are somewhat dependent upon the length of the aerial used, but for the average aerial of about 60 feet, it will be found that 60 turns on the secondary will give very good results. The turns on the primary are not critical, but with UV201A tubes or the UV199 tube I have found that 28 turns are all that is necessary to cause proper regeneration without working the filament at too high a temperature. The greater the number of turns on the primary, the lower we can turn down the filament, that is, up to a certain point. Details of this coil were published in the April issue of RADIO AGE.

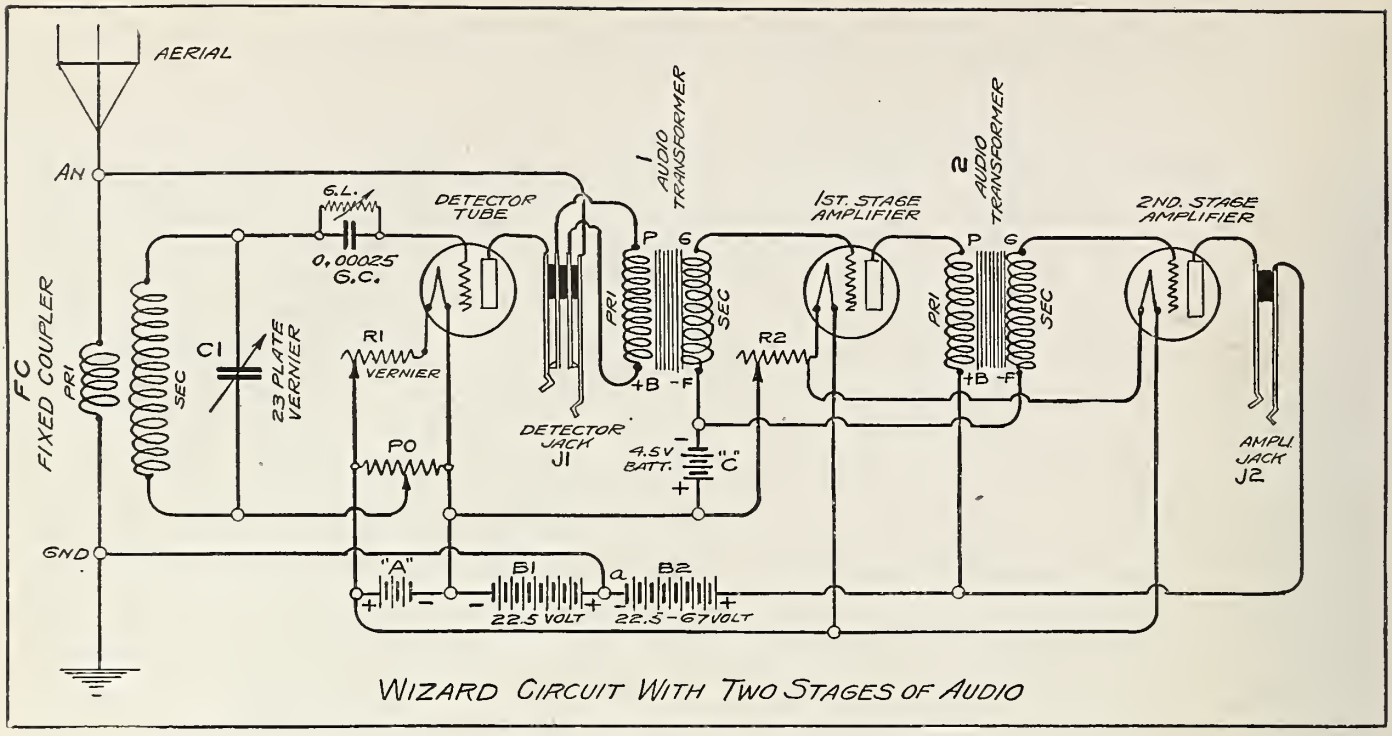
For the proper control of the regeneration a vernier rheostat (R1) and a 200-ohm potentiometer (PO) must be used. A variable pencil mark type grid leak (GL) and a 0.00025 mf grid condenser (GC) are clearly shown. Either the UV201A, C301A, UV199 or the C299 tubes give very good results both in the detector circuit and in the audio stages, but I do not recommend either the WD11 or WD12. The latter tubes tend to broaden the tuning and thus reduce the selectivity.

After much tinkering around with the audio stages, I have found that only two phone jacks are desirable, one two circuit jack after the detector tube at (J1) and one single circuit jack (J2) placed after the second audio stage. Thus, by turning out the audio stages by the rheostat (R2), we can plug into jack (J1) on the detector alone, or else can plug into (J2) and use both amplifier stages. The degree of volume can then be controlled by the single rheostat (R2). An intermediate stage jack after the first audio stage introduces unnecessary complication.

A five to one ratio was used for both stages without appreciable distortion and with very good volume. Slightly greater volume can be attained by using a ten to one ratio for the first stage (1) and a five to one ratio for the second stage (2), but with increased chances of distortion. In the diagram I have marked the transformer terminals at the ends of the coils and also the primary coils (PRI) and the secondary coils (SEC). On some trans-

WHEN RADIO BUGS GET TOGETHER

You have a congregation of experts such as shown in the above picture. They are the operators and announcers of Station WIP, located on Gimbel Brothers' Building, Philadelphia, Pa. From left to right: "Uncle Wip," announcer; Edward Davies, station director; J. G. Pollock; Charles Weir (rear), Samuel Kale; Charles Goudy, chief operator; W. P. Saunders, announcer. Between themselves they manage to make WIP one of the most popular stations in the East.



WIZARD CIRCUIT WITH TWO STAGES OF AUDIO

formers only the primary and secondary are marked, as often transformers are not critical to the location of the grid connection (G). With other transformers particular care should be taken to connect the post (G) of the transformer to the grid post of the socket.

According to conventional layout, the "B" battery (B1) is a 22.5 volt battery with the positive tap at (a) connected to the plate of the detector tube. However, we will obtain better signal strength of (B1) is a 45-volt battery but with a considerable increase in the cost. The connections are the same in both cases, and this should not cause any confusion in the hookup should a 45-volt battery be adopted.

Plate battery (B2) for the audio tubes is connected in series with battery (B1), the negative (—) of battery (B2) being connected to the positive (+) of (B1). The voltage of (B2) should be so chosen that the total voltage on the plates of the two audio tubes is from 67.5 to 90 volts for maximum amplification. The total audio plate voltage is the sum of the voltages of batteries (B1) and (B2), hence if (B1) is a 45-volt battery then (B2) should also be a 45-volt battery if we wish to obtain a total of 90 volts on the amplifiers. If 22.5 volts is used at (B1), then a voltage of 45 volts at (B2) will give us 67.5 volts on the audio tubes, and to obtain 90 volts total we must make (B2) a 67.5-volt battery.

When a total plate voltage of 67.5 volts or 90 volts is used on the plates of the amplifier tubes, a "C" battery must be used to "bias" the grids of these tubes with a negative charge. The negative terminal of the "C" battery is connected to both (-F) terminals (secondaries) of both transformers, and in this way a continuous negative charge is established on the grids which gives maximum amplification, and a minimum of distortion and plate current consumption. The "C" battery is simply a very small flashlight battery and can be connected permanently in the circuit without a cutout switch, since there is little flow of current under any conditions. A two-cell, three-volt battery can be used for a plate voltage of 67 volts, while a three-cell, 4.5-volt battery is best used with 90 volts on the plate. The higher the plate voltage on the amplifier tubes, the higher must be the "C" battery voltage.

Radio Compasses for Leviathan

Radio compasses, or direction finders, have been installed on the Leviathan and SS. President McKinley, of the Shipping Board, eight ships of the Admiral Line, nine of the Matson Navigation Company, and four of the Standard Oil Company, it was recently announced by the Department of Commerce.

Ground May Supplant Ether

The recent experiment at the University of Illinois which utilized the ground as a better means of radio communication than through the so-called ether, shows that obstacles are of temporary duration in the progress of radio.

Transmission tests during the war were successful when utilizing the ground instead of the air. Because of the stress of the war, the experiments could not be carried out at that time and it is just possible that the work now being carried on at the Illinois school is along these lines.

Experiments in ground transmission have received the serious attention of American, British and French scientists and while they were conducted privately, the results showed a big advance since the discovery of the coherer as a detector of electro-magnetic waves and the discovery of the rectification of a particular family of crystals. This is a big step toward greater efficiency, but what does this mean in comparison to the even greater discovery of the modern vacuum tube?

Science, in all its branches, is but an orderly progress toward the more efficient new discoveries which present themselves in rapid succession, until a particular branch of the art suddenly evolves into something extraordinary—a new conception—and then the smaller refinements take place as before.

It is not at all surprising to a radio engineer to hear of someone discovering something new, for this is the age of discovery and great things will be accomplished in the years to come.

Recharging Storage Batteries From 32 Volt Lighting System

ALL types of storage "A" and "B" batteries may be readily and successfully recharged from a 32 volt farm lighting system. We are printing herewith a diagram showing how the "A" and "B" radio battery may be recharged by merely using the house lighting receptacles connecting with a cord and 32 volt lamp in series with the battery.

Therefore it is advisable to purchase the 24 volt "B" batteries where the charging device is that of a 32 volt house lighting system. The accompanying diagram shows the manner in which a 48 volt "B" battery may be recharged; that is by charging only half or 12 cells at one time, then shifting the leads to the additional 12 cells or 24 volts.

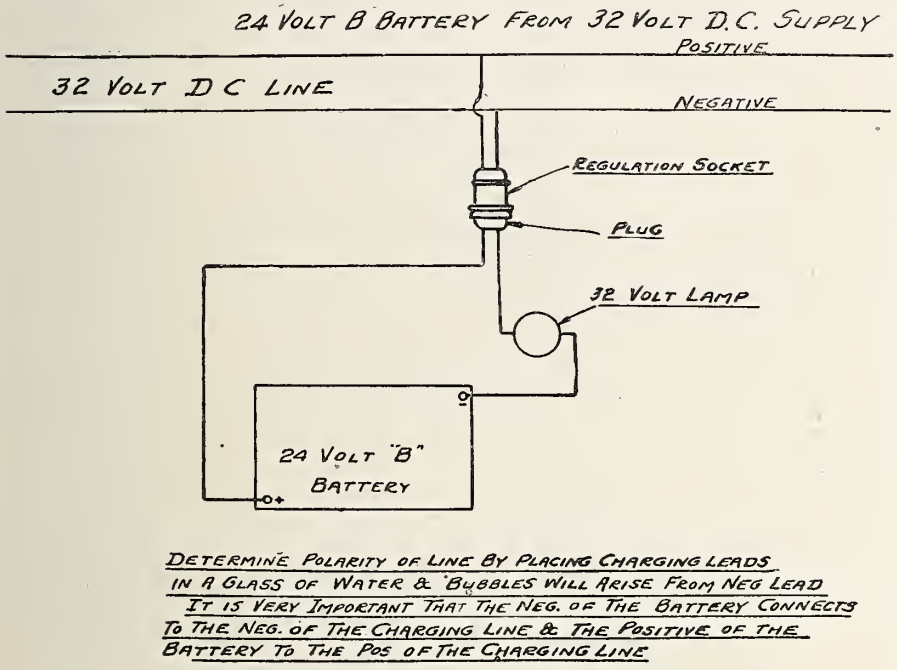


Figure 1. The above diagram shows the connections and necessary parts for charging a 24 volt storage B battery, if you happen to live in a place where 32 volt DIRECT current is available. A 20 or 25 watt lamp should be used as indicated to regulate the charging rate.

Select the socket which is most convenient for charging the battery. Screw in an attachment plug, being careful that the two wires do not touch each other. Determine the polarity of the charging wires by placing the ends of the attachment leads in a glass of water. Bubbles will form around the negative wire. If both leads show bubbles, *the negative lead will give off a far greater number.* After determining which is the positive and which is the negative lead, put some kind of a distinguishing mark on the negative and always use this particular socket when charging.

To properly recharge the batteries *the positive of the charging line must go to the positive of the battery.* This should be easy as you have marked your charging line, and the positive poles of the storage "A" and "B" batteries are usually plainly marked.

For Recharging

When recharging "B" batteries, use a 32 volt 25 watt or a 32 volt 15 or 20 watt lamp. It is possible to recharge only 24 volts of "B" battery at one time.

A fully charged radio "A" or "B" battery will have a specific gravity reading of 1.275 to 1.300 and may be considered discharged when it has a specific gravity reading of 1.175. For best radio results the battery should be recharged when it has a reading of 1.200.

It is possible to recharge higher voltages from a 32 volt lighting system; that is, batteries using up to 500 volts on power amplifiers and transmitters, by following the instructions on the attached diagram. Any multiple of this system may be used, such as 48, 72, 96 and 120 volts.

High Charge Current Needed

Owing to the very low charging current needed for a "B" battery the efficiency of a charging plant is not lowered to any great extent by charging it from the plant storage batteries, rather than from the generator. However, a high charging current is needed for an "A" battery and *it should only be charged while the generator is being operated to charge the plant battery.* After obtaining the polarity make sure that the positive of the charging line is attached to the positive of the 6 volt storage battery as indicated on the attached diagram for recharging "A" batteries.

"C" Battery Voltage

A NUMBER of radio set owners today require the use of a "C" battery. Those who possess storage "B" batteries need not purchase a separate cell or battery for this purpose.

We are printing two diagrams showing the manner in which negative "B" taps can be taken off a storage "B" battery and used for "C" battery purposes.

(Continued on next page)

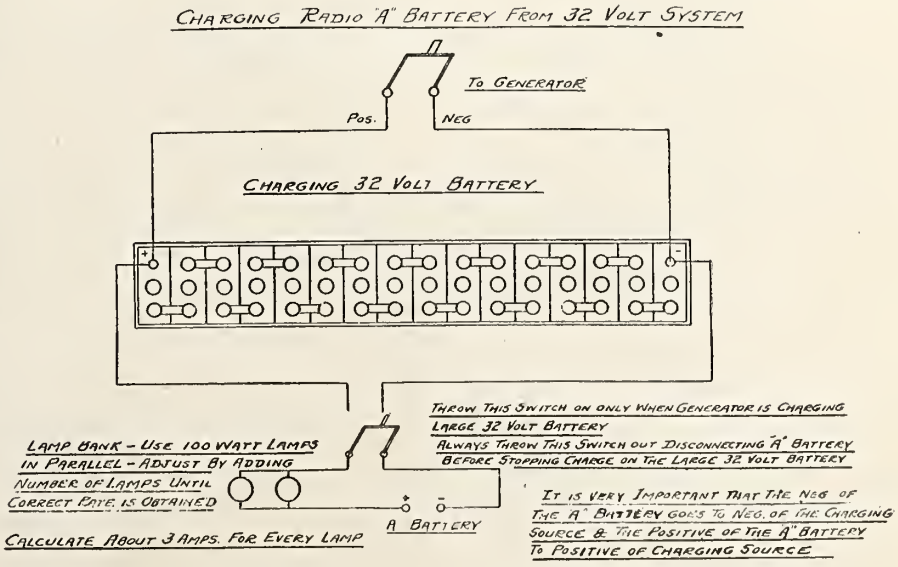


Figure 3. You can charge your A battery just like a regular charging station in the manner shown herewith. The charging is done at the same time as the household batteries are recharged. The A battery should not be charged separately.

The voltage for "C" batteries varies from 2 to 6 volts on the ordinary receiving set. If 6 volts are required, it is necessary to use three storage cells of the "B" battery, if 4 volts then two cells, 2 volts one cell.

Diagram 4 will answer the purpose for most cases. Note that the three end cells of the battery have been divided from the balance of the 24 cells. This hookup gives an individual six volt, four volt or two volt battery as a "C" battery. In rare cases it may be that more than 6 volts will be required for "C" battery. If so then the required amount of voltage may be tapped off in accordance with diagram 4 for "C" battery.

When the battery requires recharging, the "C" battery cells should be thrown in series and the entire battery recharged just the same as though it were a standard 48 volt "B" battery.

Diagram 5 shows the "C" battery as a part of the regular "B" battery and is recommended where a radio set is so wired that the negative "A" and negative "B" battery are connected together.

For proper operation as a "C" battery the negative "B" lead is extended to any number of cells which are to be used as a "C" battery. In this particular diagram, 6 volts or 3 cells are utilized. However, this hookup should not be used where the negative "B" battery lead goes to the positive "A." Diagram 4 should be used for this purpose.

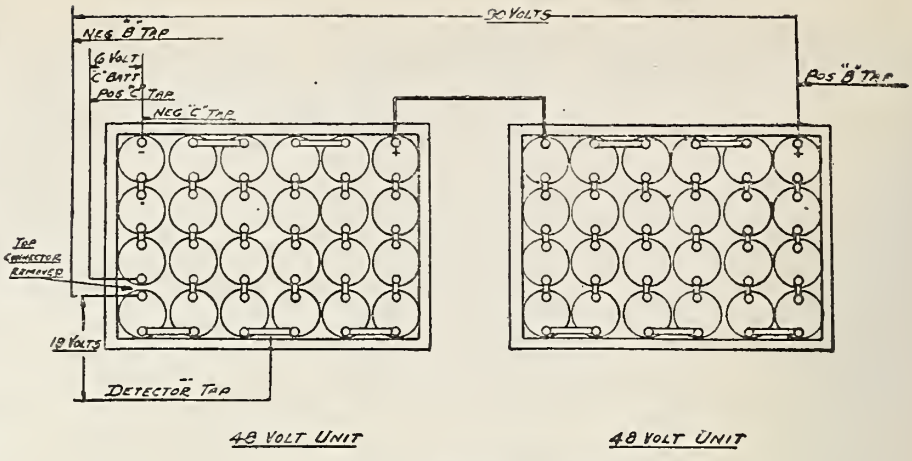
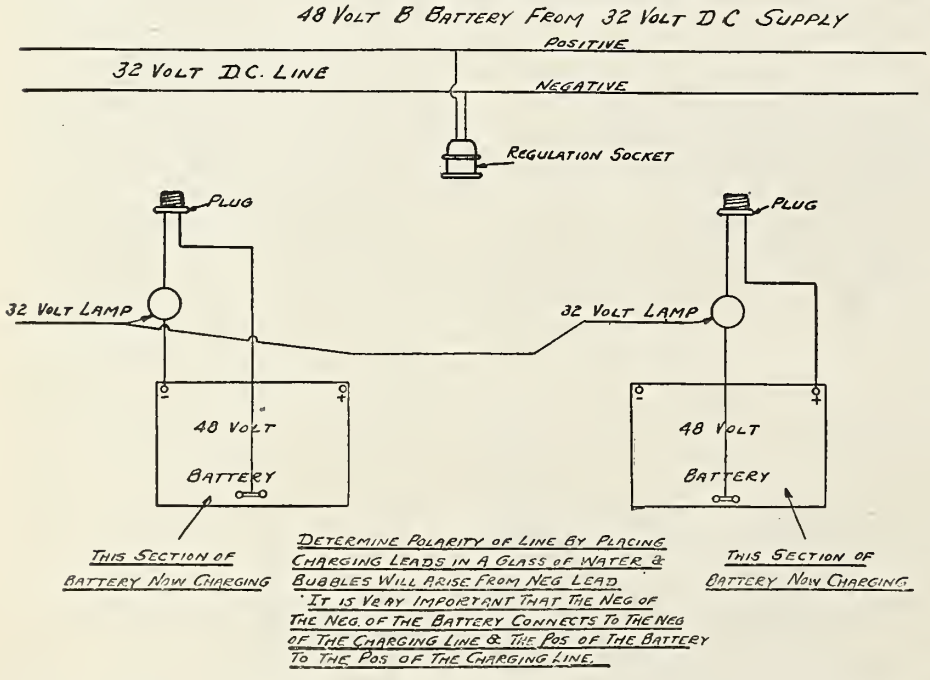


Diagram Showing How "C" Battery Voltage is Tapped From Regular "B" Battery

This is the Recommended Diagram

Figure 4. The circuit diagram shown above provides for a method of obtaining C battery for the amplifiers. This set of connections should be used when the negative B is connected to the positive A terminal.

Figure 2. The larger types of storage B batteries are charged in the manner shown below. Note especially the method of determining the polarity of the line as lettered on the diagram.



Heart Throbs Via Radio

A letter received by Station WBZ leads us to believe there are more ways than one to get heart throbs by radio. It is true they have been transmitted, but this particular letter states that the program transmitted from WBZ by one of its talented musicians caused an increase of heart throbs to a farmerette in Canada, who promptly sent in a proposal. The musician answered, "Thanks, but I'm already attached."

In another instance an announcer got all mixed up trying to put an artist's name across. In desperation he approached the artist—a pretty girl—and said, "Of all the names—why should you have such a tongue twister? Why don't you change it to something easy—my name for instance?" The girl called his bluff and made the announcer break down and confess he was already married.

Radio Enlists Nature's Aid

Recent reports from England describe an experiment which may cause some American broadcasters to stop and consider whether they have developed the art of radio entertainment to its highest degree of perfection.

The dispatches stated that British listeners were treated to a concert by nightingales and other native songbirds. The manager of the broadcasting station, who conducted the test, had the microphone cleverly concealed in the native haunts of the birds so their singing might be enhanced by the natural setting. The plan is not very different from that already accomplished and popularized by means of the motion picture camera.

Explorers have gone out into the forests and fields for the purpose of photographing wild animals in their natural surroundings. Why should not radio be utilized to accomplish for the ear what the camera has done for the eye? It would appear far better to allow the birds to roam about with absolute freedom and enjoy their singing than to keep them caged.

Moreover, it would be a rare treat for the city dweller who does not have either the leisure or the facilities to enjoy the country.

What About Europe?

What progress is Europe making in the radio field? RADIO AGE will give you the latest steps in European broadcast and reception advances. The first of an interesting series begins in this issue, page 28.

Gigantic Radio Net Ready for Emergency

WASHINGTON, D. C.—A gigantic radio net of transmitting stations is being developed throughout the United States, to connect eventually every city and town, and practically every household, as far as reception alone is concerned.

Under the supervision of the Department of Commerce, this means of disseminating important information, especially in times of emergency, would reach more individuals than there are telephone subscribers and a larger number than the combined newspaper readers of the nation. For transmission alone it would link up more radio stations than there are telegraph stations, and, considering that they would broadcast, the distribution would be available to all owners of radio sets; almost to every citizen.

The operation of this "net" would be instantaneous and direct to all parts of the country. Secretary Hoover's administration of matters radio would be broadened to the Republic at large in any hour of need.

Partially in Effect Now

This proposed radio net is partially in operation today, with the number of broadcasting stations now increasing each week, and fans estimated anywhere between five and twenty millions. But despite its growth the present system transmits only news and entertainment at scheduled intervals. What the Government wants ultimately is a system of stations that, in emergencies such as a declaration of war, the call to arms of the nation's man power or the disruption of continental communications and traffic lines, could be called on to take the air either locally by district groups or throughout the country simultaneously, and handle urgent traffic.

Details of such a gigantic scheme, the like of which has never been attempted anywhere, are already being worked out by the Department of Commerce with the close co-operation of all radio interests. The germ of the idea was started at the Amateurs' Convention in Chicago last fall, when representatives of their organizations offered to co-operate with railroads after regular communication systems failed. This work has already gone in to the test stage.

In several instances operating amateurs have aided in the transmission of railway messages successfully. The American Radio Relay League has appointed a committee to work out details. The league co-operated with the Pennsylvania System between the Atlantic Seaboard and the Mississippi River recently in an emergency test, to the gratification of the General Superintendent of Telegraph. Other railway systems have declared their desire to establish such an amateur radio auxiliary system in anticipation of a failure of their wire communications or the need for additional terminal and receiving stations along their rights of way.

18,000 Amateurs Help

The activities of between seventeen and eighteen thousand licensed amateurs, all owning listed transmission stations and all code operators, are only one phase of the general scheme of linking radio nationally. Most of the telegraph and telephone systems of the country are willing to co-operate, if the need arises, but some of them declare that interruptions in their established lines of communications are so infrequent that the necessity of using radio as an auxiliary is not needed.

Co-operation of all interests is reported from Seattle, New York, Atlanta, and Baltimore supervisors, where district emergency organizations are being formed. The Associated Press and the United Press have expressed considerable interest through their desires to supply newspaper clients with current news when regular lines of distribution fail. Details of a general national plan, with special local provisions, are being developed by the radio section of the Commerce Department at Washington.

The Radio Section of the Department of Commerce and its nine district supervisors, stationed in Boston, New York, Baltimore, Atlanta, New Orleans, San Francisco, Seattle, Detroit and Chicago, are attempting to co-ordinate the various elements of the proposed national radio net. The Post Office, Agricultural Department, and the Army and Navy are also interested. Not long ago, the chief supervisor of radio sent communications to all field supervisors directing them to make a survey of radio facilities in their districts, ascertaining the possibilities of hooking up all stations in an emergency, and the attitude of the business, railway, communication and other interests.

Replies received from practically every district show that the amateurs, manufacturers, broadcasters, railways, newspapers, civic interests, and even the telegraph and telephone companies are ready to co-operate. Many of them are anxious to test the proposed plan in an effort to establish a reliable secondary or emergency communication system.

Given Wave Lengths

The Commerce Department has authorized both amateurs and broadcasters to transmit on assigned wave lengths in emergencies, under the direction of their district supervisors. It is even suggested that licenses of stations where operators are on duty specify that the transmitter must be held in readiness to serve the community or other interests in the event of public need.

Supervisor Beane of the Ninth District, with offices in Chicago, has probably progressed further in his district than any other supervisor. He has not only secured the co-operation of practically all radio stations throughout the middle west, but has had several practical demonstrations, indicating the aid of such a voluntary radio service. Recently he called a conference on the subject, at which representatives of all branches of the art and industry were present. He reports that amateurs stand ready to handle two-way communication for railways; broadcasters volunteered to serve as point-to-point stations using CW, co-operating with amateurs for delivery of messages. It was suggested that press dispatches be handled by voice for localities not lined up for code point-to-point transmission.

Secretary Hoover is said to have obtained the hearty co-operation of President Coolidge in lining up the radio fans for the common good.

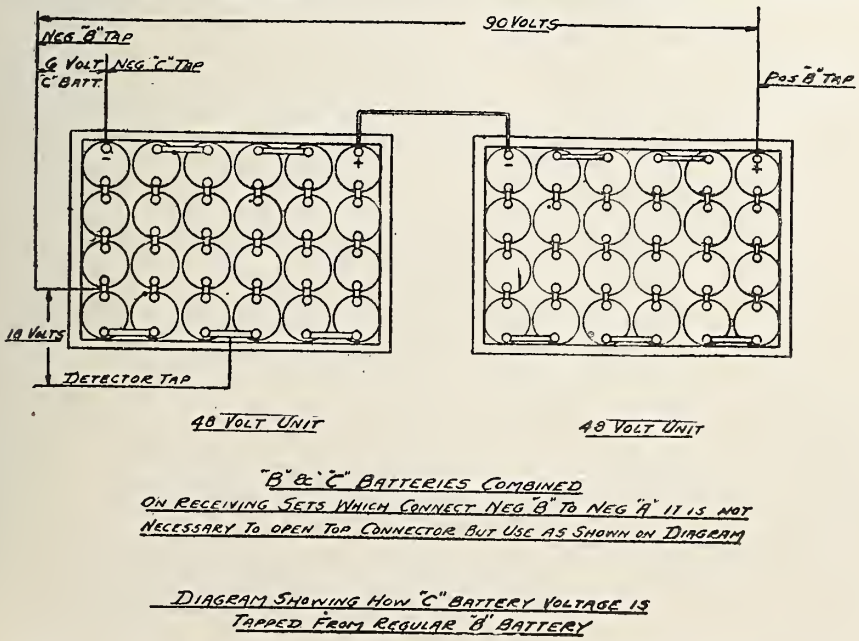


Figure 5. Another method of obtaining C battery voltage without opening any connections on the battery unit. This set of connections is used, only when the negative B is connected to the negative A battery.

Nations of World Gradually Adopting Radio

Washington, D. C.—General interest in radio, especially in broadcasting, has not only developed in this country, but its popularity has circumnavigated the globe from west to east, and is now going over the top and bottom. Recent reports indicate that this means of universal and rapid communication has reached the northern and southern extremities of the world.

Literally radio now reaches from "Greenland's icy mountains to India's coral strands," and even to the southern tips of Africa and South America.

Denmark is installing four transmitting stations in Greenland to communicate with Iceland and the main land of Europe; the Radio Club of Bengal, at Calcutta, India, is licensed to broadcast, and has installed a powerful receiving station which brings in London broadcasts.

Publicity and advertising in Chile have increased radio interest and nightly programs are sent out for urban and rural residents; while in South Africa arrangements for the broadcasting of music, instructions, etc., are planned for the natives by stations in Durban, Johannesburg, and Cape Town.

Unknown in Sicily

Radio, however, is still unknown in some countries, such as Sicily, barely introduced in Portugal, and slow to develop in Japan, despite the fact that this novelty-loving race seized upon the phonograph and camera with great interest. In other lands it is prohibited, in Jamaica, for instance. Operations are controlled by the governments in England, Germany, Denmark, Spain and Lithuania. In some countries foreign interests are striving to secure a monopoly, according to consular reports received by the Department of Commerce.

Although practically every American from the age of seven to ninety-seven knows considerable about radio, there are still countries whose citizens do not know what the word "listening-in" means, and few of them have ever tuned in a set. In Sicily, for example, the term "radio" usually means a new kind of talking machine, although perhaps there are a few who know it refers to wireless telephone, the use of which is forbidden by the government.

Out of a population approaching 2,000,000 citizens, the consul found only three of those interviewed who knew what he wanted when he asked for tubes for a radio set. In the north of Italy, there are said to be a few hundred receiving sets which receive Eiffel Tower broadcasts, and probably Berlin, Brussels and London. The Italian government is known to have issued only four permits for broadcast receivers in Palerma, and it is doubted if more are authorized.

Radio Rare in Portugal

A few months ago, radio was scarcely heard of in Portugal. There was a complete lack of interest even when the papers reported that London was broadcasting and that America had been heard. There seemed to be a disposition to frown on such things as copper wires stretched from house tops through the medium of which far distant voices and sounds of gay music were mysteriously conjured into reality. One day a local shop imported a three-tube set from France and exhibited it in a window.

The public inferred that the "thing to do" was to install a radio outfit. The machine was promptly marked "Sold," and ever since a dozen or more people have been before the window. Lisbon woke up to the possibilities of listening-in. Shortly after an evening paper devoted a column to the possibilities of catching foreign programs, the heading stating in large type:

"Here in Lisbon, we can dance to the sound of jazz music being played in London."

Popularity grew by such leaps and bounds, that the "Radio Academia de Portugal" was founded in Lisbon. This is an amateur organization composed of some forty members. The instrument now operated by this club has two headpieces and one loud speaker which so far *whispers* rather than *speaks*.

Opening Up in Spain

In Barcelona, Spain, a movement to develop the radio telephone has started, which may mean the opening of the market for apparatus to all countries. An association of radio dealers seeks to obtain a government concession to broadcast, which may be granted, as restrictions are decreasing and the Marconi Company is becoming interested. During the great war wireless operation was prohibited in Spain, and even after peace was established offenders were sometimes arrested.

Editor Leaves for Europe to Make Radio Survey

Frederick A. Smith, editor of RADIO AGE, left for an extended trip to Europe early last month to make a survey of radio conditions and prospects abroad.

During a two months' stay in all the important countries of Europe, Mr. Smith will send exclusive dispatches which will be published in RADIO AGE. These will give intimate insights into conditions as they actually exist "over there," as well as the real nature of the future of radio broadcasting and reception in principal European countries.

Mr. Smith is a former war correspondent and is therefore familiar with the countries through which he is traveling and observing for RADIO AGE. His stories will be illustrated by pictures taken by himself.

The principal countries to be visited by Mr. Smith will be the British Isles, France, Belgium, Holland, Germany, Switzerland, Czecho Slovakia, Italy and a few others.

"Many American radio fans are now receiving European broadcasts regularly," Mr. Smith said before his departure. "Communication between the two continents is becoming easier every day.

"Because of perfected radio sets and the consequent development of international radio communication, Europe will be made more of a neighbor to America. Therefore interest in what Europe is doing in the line of radio activities will be stimulated and the fans of both continents united in a closer bond of common interest. What one group is doing will soon be of utmost importance to the other group across the sea."

With the idea of creating a department of international interest, RADIO AGE in this issue begins a department known as "Radio in Other Lands." Items concerning radio development abroad, including Mr. Smith's dispatches, will be printed in this section. Correspondence is invited from home fans as well as those in other countries.

Recently, however, a proposal to establish wireless stations without government permission or regulations was suggested; or the alternative, that government concessions be made to operators. There are today about 1,000 receiving sets in Spain. This shows a fair interest.

Regular broadcasting is expected to commence in Austria on July 1, 1924, a concession for the purpose having been granted to a group composed of banks and electrical firms. The Post and Telegraph Administration will soon issue radio regulations on the basis of the new contract.

Marking the inauguration of radio activities in the Canton of Zurich, the first broadcasting station was put into operation on June 1. This station is being erected by the Swiss Radio Association, the transmitting apparatus being mainly of American manufacture.

Radio for Military Use

Two state-controlled radio stations are in operation in Lithuania, one located at Kovno, and used exclusively for military purposes, and the other at Memel, operated for both military and private communication. Preparations for broadcasting of concerts are being made under the supervision of the Ministry of Communications, equipment having been purchased in France. A bill to regulate the use of radio apparatus in Lithuania has been placed before the Parliament.

The Netherlands Indies government intends to erect two new wireless stations in Sumatra, one of which will be located at Bongkalis, a free port and transfer point for that section of Sumatra. The erection will probably begin in July, and upon its completion the installation of a station at Belawan will be undertaken and should be in operation some time during the fall of this year.

A recent German decree, regulating wireless communication, stipulates among other things that the erection and maintenance of wireless sending and receiving apparatus for communication in any form may only be carried on with the permission of the National Telegraph Administration.

Austria Wakes Up

The demonstrations of broadcasting by the Technological Trade Museum have made radio very popular in Austria, Assistant Trade Commissioner F. M. Zwickel reports to the Department of Commerce. In view of the great economic and social importance of broadcasting, which has created a new industry in Austria, a permanent service has been undertaken by the Oesterreichische Radio-Verkehrs-Aktiengesellschaft. At present this company cooperates with the Austrian Postal authorities in the matter of transmission.

It is proposed to use the radio installation on the building of the War Ministry for the first broadcasting station. Experiments have already been made with a normal sending power of one kilowatt. Different wave lengths will be used; on March 25 broadcasting took place for the first time and on a 1200 meter wave length. On Easter another trial took place, and regular broadcasting is to be started on July 1.

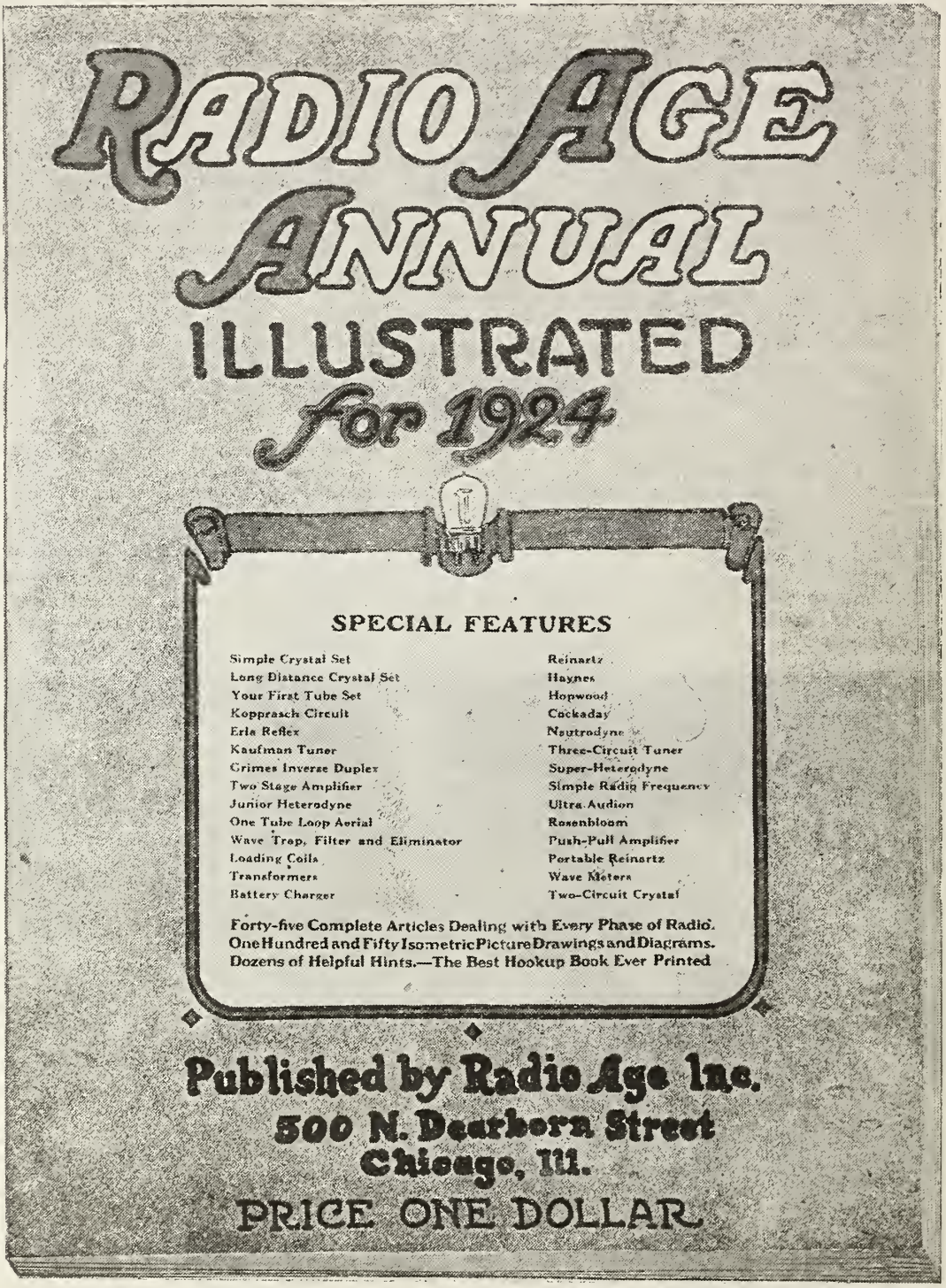
It is planned to broadcast general programs comprising musical performances, lectures, fairy tales for children, weather, market and exchange reports. Economic data, intended for a small clientele, will consist of foreign prices of commodities and stocks, tariff rates, freight rates, and other important economic reports. These reports will be given in code, which will be changed every week so as to avoid listening in by those not entitled to the service.

The tax for a radio set will be 10 gold crowns collected by the federal post-offices. To cover the expenses of the broadcasting station, every owner of a radio set will have to pay a yearly fee of possibly 50 gold crowns. This fee will be reduced considerably in cases of hospitals, associations and schools. Motion picture houses and other public places, where radio is used for advertising purposes, will pay a higher rate.

REACHING THE VOTERS THROUGH RADIO Kadel & Herbert.

French candidates for public offices are now using radio extensively in their campaigns for election. A candidate has entrenched himself in the automobile shown above, and his speech is being broadcast for miles by means of the radio microphone attached to the top of the car. Quite a crowd has gathered to witness this novel electioneering method.

Here's the Best Hookup Book Ever Printed!



Detach this Coupon, fill in, pin a Dollar Bill to it and mail TODAY!

If Paying by Check Add 5 Cents for Exchange.

RADIO AGE, Inc., 500 N. Dearborn St., Chicago, Ill.

Gentlemen: Attached find One Dollar ($1) for which kindly forward me by return mail one copy of RADIO AGE ANNUAL FOR 1924. If not satisfied with it I will return it to you within three days and you will refund my money.

Name.....

Address.....

City.....State.....

RADIOTORIALS

CONGRESS has adjourned without acting either way on pending radio legislation, according to the news dispatches from Washington.

Unless a special session is called, which does not seem likely at this time, radio will be untouched by legal attachments until next year, at least.

The two most important measures which were shelved by the adjournment of the well-meaning but unusually deliberative governmental bodies are the White Bill and the Dill Bill. The first proposes to establish governmental control over radio broadcasting, reception and perhaps the industry eventually. This bill, while not viciously attacked, did not go through because some representatives of the people wanted to know just why such a young and untried industry as radio should suffer the bonds of law so soon. Accordingly, it is unlikely that the White Bill will ever become a law—so the fans may rest assured they will not be hindered for some time to come in that respect.

The Dill Bill is more far reaching in its scope. It is liberal and fair-minded. It asks that the copyright laws be amended so that copyrighted music can be broadcast without the payment of levies to the music publishers. Although this bill has been opposed at every step by huge organizations and moneyed interests, as well as several prominent music publishers, it was about to be passed with a fair majority when Congress adjourned.

There is still hope for the Dill Bill, then, and we hope that when it finally reaches the President's desk it will represent the result of a fair compromise between the broadcasters and the music publishers, in the interests of the fan who listens to broadcast music and helps the sale of the published article by buying the pieces he likes best.

Government legislation, we believe, appears to be the only means yet suggested which offers any kind of a solution to the bitter enmity between the broadcasters and the so-called music "trust."

Radio's recent jump to prominence in official circles such as Congress is only one indication of its growing importance. Big capital interests, legislators and public spirited citizens are realizing more and more that radio will some day control the destinies of our nation; and accordingly they are setting out to prevent its too sudden growth to an unwieldy influence. Quick government control, the legislators aver, will prevent radio from becoming a menace instead of the help and pleasure it should be.

In a measure these radio-legislators are right. Something must be done to prevent the air from becoming a bedlam of tangled wave lengths. Something must be done to prevent the ether from being clogged with propaganda and useless stuff that will discourage interest in the world's latest miracle.

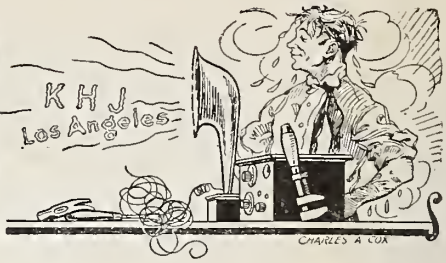
If legislation works along those lines, it will be beneficial. But if it takes a political trend, this country will see a united uprising of righteously aroused fans—lovers and promoters of the good in radio.

RADIO followers who are interested in the probable outcome of the maze of overlapping wave lengths which are now exasperating the fan with the small set will do well to read Mr. Pearne's article on short wave transmission and reception in this issue of RADIO AGE. Experts in the radio broadcast field are racking their brains daily in an effort to solve the problem of too many broadcasting stations and their effect on the amateur, who is growing tired of trying to tune out the stations he does not want to hear. If short wave transmission—or the broadcasting of programs in a wave band below 150 meters, will solve the problem, no effort should be spared by the big experimental stations to reach this desired state of ethereal bliss. Heretofore a wave band below 150 meters was considered practically useless; but, now experiments actually show that it may be the ultimate salvation of an overworked broadcast system. All of which goes to show that radio is only beginning to uncover its surprises.

IS THE SUMMER radio bugaboo finally being overcome? It looks like it. Radio manufacturers, broadcasters and even the fans themselves held their breaths during the first warm days of June, in fearful anticipation of what was going to happen to radio reception when the weather started to perform its seasonal antics. The radio legion remembered with a sigh that the few summers radio has seen have been more or less unsuccessful and the object of much harsh criticism. But they are beginning to realize that the radio bugaboo of former years was principally a state of mind and the result of overheated talk by those who didn't know how radio could be adjusted to suit the seasons. Stronger broadcasting stations, better sets and more technical information in the minds of the set users are making this a real Radio Summer and a pleasant one at that, with a surprising lack of such bugbears as static, weak broadcasting and the childish fear of lightning. Let's get together and end the summer in a blaze of radio success!

WHAT wonders radio has wrought! The thrill that accompanied the first transmission of a telegraph message shrinks into historic background when we think of how the deliberations of a huge presidential nominating convention were sent to a waiting world over the ether. The broadcasting of the Republican and Democratic national conventions last month marks a decided step forward in the radio world. These events show that there will be no excuse in the future for ignorance on the part of the masses, and that no great happening need be missed just because a person can't attend in person. The United States is being bound into one united and patriotic mind by the magic voice of Radio.

Pick-ups and Hook-ups by our Readers



The material appearing under the title "Pickups and Hookups by Our Readers" in RADIO AGE, is contributed by our readers. It is a department wherein our readers exchange views on various circuits and the construction and operation thereof. Many times our readers disagree on technical points, and it should be understood that RADIO AGE is not responsible for the views presented herein by contributors, but publishes the letters and drawings merely as a means of permitting the fans to know what the other fellow is doing and thinking.

BACK in the May Pickups Pages, we printed a good-natured letter containing what Earl Fetty of Tekmah, Nebr., thought was a correction and contested one of the stations listed by Curtis Springer and Kenneth Fischer of Indianapolis, Ind. Now we appreciate this spirit of watchfulness of our readers and it is our sincere desire to have fellows keep their eyes open for errors in our pages and report them.

However, Mr. Fetty was in error, and we have no less than fifteen letters of various nature from scathing to gentle corrections telling us that our Pickups Pages are the "stuff" and not to let anyone tell us different. By that, we don't mean to criticize Mr. Fetty's correction—by all means *NO*. We thank him for his watchfulness, and hope the other DT's will keep alert likewise so that no one puts anything over on our section.

Some time ago the editor of RADIO AGE asked us how we could print all these lists without some kind of proof as to their authenticity and correctness. Our reply was that all of the radio fans are strictly honest when it comes to asserting themselves on paper, and while they may exaggerate when they are verbally giving some story of a long distance reception, they always are very careful about convicting themselves as prevaricators when it comes to putting any such stories down on paper. The editor was a little skeptical as to our theory—but this proves quite conclusively that no fan attempting to enter the Dial Twisters columns will intentionally submit things that are not true, and clinch the whole business by putting his name to it.

We print Mr. Fetty's endeavor to get himself out of the "mess," as he terms it, just to show you what good sports we have among our reading clientele:

RADIO AGE,
Gentlemen:

I am in receipt of a letter from A. E. Fischer in reply to my letter to you, published in your May issue, in which I stated that station KFSG was not authentic.

He informs me that it is operated by Aimee Semple McPherson, of Echo Park, Los Angeles, California, on 278 meters with 750 watts.

Now I got myself in wrong depending on you, and I'm passing the buck. How come it isn't listed in your broadcast list? For the Luvvamike, square you and me both at the earliest possible date.

Yours respectfully,
EARLE FETTY.

Tekamah, Nebr.

So now we have a bakelite crepe on our hands, and about the only excuse we can give is that in spite of the fact that we maintain a special Washington News Service for the purpose of letting us know of changes in station calls and new licenses, the Department of Commerce puts one over on us once in a while by sneaking out a call or two that never comes to our notice. Now this happens to be one of them, and in such instances, we have to rely upon the interest of our reader friends to point out errors in the broadcasting lists. Our Editor even offers a free copy of RADIO AGE for every error reported. If you can find enough errors, you can get a year of RADIO AGE free.

The Pickups Editor wants to thank all those concerned, and all those who were kind enough to drop a card with the nota-

CONTRIBUTORS

Kenneth Glass — Clarence B. Gannon — A. J. Baumgardner — D. F. Howe

DIAL TWISTERS

Name	Address	Circuit
Hilmar T. Boehm	636 Fifty-first Street, Milwaukee Wis.	Grebe
W. J. Waterson	Lorrain Avenue, Montreal, N., Quebec, Canada	Reinartz
Joseph A. Ratte	175 Lagauchertieres Street, Montreal, P. Q., Canada	Blooper
W. S. Stringall	Albion, Calif.	Crosley XJ
Irving Q. Miller	Tarrytown, N. Y.	Blooper

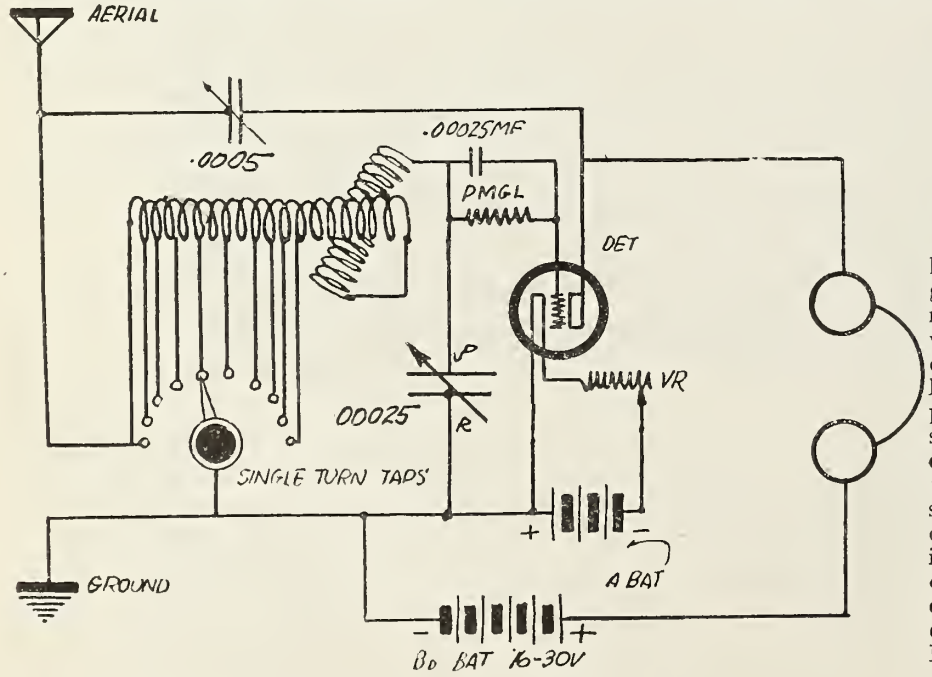


Figure 1. A diagram of the detector circuit devised by Kenneth Glass, using the Reinartz Audio Regenerator principle.

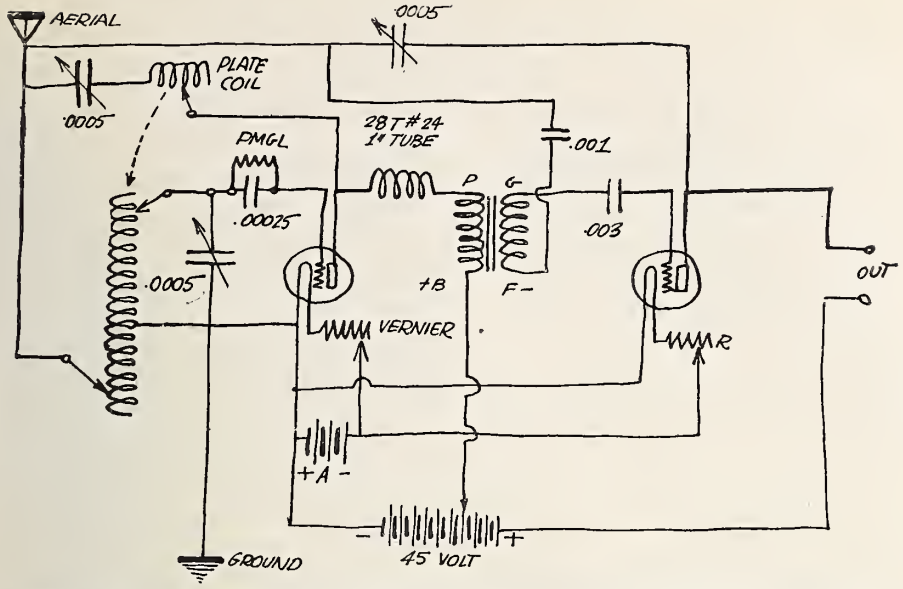


Figure 2. An exact reproduction of the sketch submitted by Clarence Gannon of Baltimore, Md., who gets results with the Reinartz Audio Regenerator hooked up as shown. This circuit uses the standard Reinartz coil.

tion, and hopes that this same warm interest in the Pickups Pages will continue.

—*The Pickups Editor.*

Last month we promised to print the letters which contained the suggestions and reports submitted by two of our reader friends who have built the Reinartz Audio Regenerator. Kenneth Glass has devised a way of making a one tube regenerator and describes his results in the following:

RADIO AGE,
Gentlemen:

I have read with interest your one night reception records published in the several numbers of RADIO AGE. I tried several times to see how many stations I could get one night, and found that Monday night seems to be when most of the stations in the East are on the air. I am enclosing my two best records of fifty stations each received on the nights of Monday, March 17th, and Monday, March 31st. I hope you will see fit to publish these, as I have noticed that most of your Dial Twisters are located in the Central States which I believe gives them a better chance for a record.

I have a one tube Reinartz Audio Regenerator. To this I have added a regular two stage audio frequency amplifier. Both of these records were made on two tubes. I am enclosing the diagram of my detector circuit, and I hope that these records are good enough to get me in the D. T. column.

Yours sincerely,
KENNETH GLASS.

144 S. Mt. Vernon Ave.,
Uniontown, Pa.

The following list is the record of stations heard by Mr. Glass on the Regenerator in 5 hours and 20 minutes of listening, Mr. Glass explaining that he stopped at 11:15 P. M. on account of static.

Kenneth Glass
144 South Mt. Vernon Avenue
Uniontown, Pa.

Stations heard Monday, March 17

WCAU, WBZ, KGO, KDKA, WRC, WCAE, WMAQ, WGY, WNAC, 8DBH, 8BRM, WBT, WOR, WABL, WJAK, WDAR, WCAP, CFCF, WDAF, WWJ, WHAN, WPAB, WJAS, WAAM, WEAN, WEAF, CFCA, CFCR, WOO, KSD, WSB, WOS, WBAV, KQV, WFI, WFAA, WSAI, WHAZ, WCX, WBBG, WMC, WRAX, WBBN, WLW, WTAS, WBBF, WCBD, KFKX, KFOP, WTAX.

Stations heard Monday, March 31

KDKA, WBZ, WDAR, KGO, WNAC, WABL, WEAN, WOC, WWJ, KQV, WOO, WEAF, WCAP, WJZ, WOR, CFCA, CFCF, WGY, WBAK, WBBM, WPAB, WTAS, WKAR, WBBR, WGR, WLW, WOS, WRC, WSB, WHN, WCBD, WPAH, KSD, WCX, WFAA, WCAE, WBAV, WDAF, WBBG, WBBF, WJAS, WMC, WOAW, WBAP, WBAH, KFOP, KFKX, WRAX, KFI, KHJ.

Semi-daylight reception of KGO both times VERIFIED. Also KFI and three stations from Texas. I have also verified reception of KHJ.

Does that make him a Dial Twister? It sure does. We thank him for the report, and print his diagram showing the connections of the detector circuit (regenerator bugs, please notice) in Figure 1.

Now herewith we present the suggestions and results of another fan's experimenting with the same circuit. He uses a circuit more like the original, and gets good results as well.

RADIO AGE,
Gentlemen:

Referring back to the Reinartz Audio Regenerator, described by Felix Anderson in the February, 1924, issue, I would like to make a few suggestions:

(1) For higher waves 400 to 600 meters, shunt coil of coupler with a 23 plate condenser.

(2) A standard spider web coil can be used as is indicated on the accompanying diagram (Figure 2). Shunt the coil with a .0005 condenser. A grid leak and condenser of .00025

MF with a PMGL should be used.

(3) UV201A and UV199 tubes are good in this circuit. Do not use soft tubes. The nearer the plate voltage is to normal the better. If UV201A's are used, set the detector at 36, and the amplifier 45.

I have been running tests with this hookup, and I find it satisfactory. Very good for distance, sharp tuning (if good condensers are used) and volume enough on 1,000 mile receptions to remove headphones from head and still hear concert plainly.

The minor details of this circuit are few and one owning a Reinartz can easily make the changes. For beginners, I strongly recommend the coupler as specified in RADIO AGE of February as the tuning unit.

This is a summary of a few months of work with the old circuit, and with the necessary amplification, it should equal a super-het.

Very truly yours,
CLARENCE B. GANNON.
1731 Ensor Street, Baltimore, Md.

The Wizard Fans will probably welcome this letter containing suggestions with reference to the Wizard circuit described in the April, 1924, issue by J. B. Rathbun. One of our readers contributes the following:

RADIO AGE,
Gentlemen:

I have been experimenting with the Rathbun "Wizard $10 Receiver," the hookup of which was published in RADIO AGE for April. I have devised a hookup for adding a two-stage amplifier.

I find this receiver very selective and if a variometer of a good make is inserted at the point marked X on diagram almost unbelievable amplification may be obtained.

The tuning is accomplished with the variable condenser, variometer and the detector rheostat, and, by the way, this is an extremely critical unit of this set. It should have a good variable grid leak of from 1 to 10 megohms.

A word about the coil for those who do not have this magazine. It was wound on a bakelite form, 3½ inches in diameter and 3 inches long, using No. 18 S. C. wire, with 22 turns on the primary, leave a space of one-half inch and wind the secondary with the same size wire and IN THE SAME DIRECTION AS THE PRIMARY. (This is very important.) Put 60 turns on the secondary.

After being wound the coil is mounted directly on the terminals of the variable condenser as shown in Figure 1.

This improves tuning, looks and also conserves space.

The whole set may be mounted on a panel 6x21 inches. A switch may be provided at X for the purpose of cutting the variometer out of the circuit when not wanted.

I have found the amplification tremendous with this set, often working loud speaker on two tubes.

The audio frequency transformers may be of any good make and preferably of low ratio, such as 3 or 3½ to 1, as this cuts down distortion.

I am over 1,800 miles from station WBZ at Springfield, Mass., and they have come in on loud speaker, using only two tubes, with plenty of volume to enable them to be heard anywhere in a seven-room house.

This is a neat, well operating set, as well as an economical one for the average amateur to build and operate, and if one uses *GOOD* materials and uses care in building he will be greatly repaid for the trouble

Very truly yours,
D. F. HOWE,
302 Chestnut Street, Quincy, Ill.

Readers who are using this circuit might try out the suggestions outlined by Mr. Howe, and write him of their results. We feel that the idea is logical. Good work, Mr. Howe.

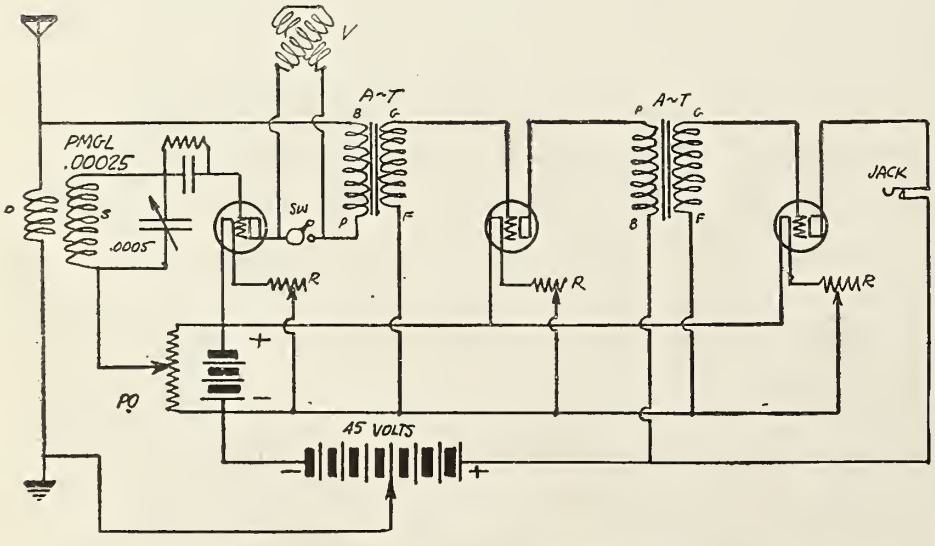


Figure 3. D. F. Howe suggests using a variometer in the plate circuit of the Wizard circuit as shown when audio amplification is used. A switch enables the user to throw it or out of the circuit at will.

Back in our October, 1923, issue we published a description of what is known as "Your First Tube Set." Here it is July, 1924, and we are still getting letters of interest, records and suggestions with reference with this little receiver. Fans who write in have learned to call it the FT set, and we feel that it probably did more good with fans who fondly handled their first vacuum tube than any other. The supply of October back numbers has long since been exhausted, but nevertheless we still get requests for its description. Incidentally, the description has been reprinted in the *RADIO AGE ANNUAL,* and fellows who are not acquainted with it can get the details of this little "kindergarten" receiver, together with forty-five other good hookups, for $1 from the circulation department.

Now we hear from another fan who has long been an admirer of the set with the following communication addressed to the writer of the article describing the set:

RADIO AGE,
Chicago, Ill.
Gentlemen:

I was very glad some time ago to be of assistance to a gentleman in Nashville, Tenn., whom you referred to me for advice upon circuits for improvised aerials, etc., and have thought some time since of letting you know about a stunt I have developed in my experimenting along Ultra Audion lines. The instrument is so wonderful that I wish you could listen over it.

In your regular "First Tube Set" I wound a plain 56 turn spiderweb coil on the common black fibre form so commonly used, and tapped the coil every 7 turns. These taps lead to common unions with two separate sets of switch points joined together. Aerial lead from primary condenser goes to first switch centre, and grid lead runs from second switch centre. Both condensers are low loss, and act like the finest vernier condensers I ever used. The plate lead is continuous from first switch point of first switch to outer tap of the coil then on to the plate terminal of socket. A .001 fixed condenser for by-pass from plate lead to Plus "A" terminal I find best by all means for getting distance and giving latitude to the dials.

I have heard all over the United States with this thing, loud and clear, using 130 foot aerial, W. D. 12 tube. Until Edgewater Beach station was changed in wave length I could absolutely tune in and out all Chicago stations perfectly without overlap. I use a wave trap and listen to them only when I desire to. The new Rainbow station is so near me that I can see their towers and aerial a half mile from my window, but I can tune them in and out perfectly without the trap, and the reception from them is something beautiful. There are scores of combinations to be had with use of the two sets of switches

and one can play upon them like a piano.

Find circuit drawing herewith, also accept my sincere thanks for your most valuable contributions to the world of radio.

Yours truly,
A. J. BAUMGARDNER.
4840 N. Lincoln Street, Chicago, Ill.

Now we want to explain the first part of Mr. Baumgardner's letter by saying that we referred a fellow Dial Twister to him for some information on antennæ which we happen to know he used while engaged as a traveling salesman. He took one of these little FT sets with him, and used it on various kinds of aerials at the places he stopped when on the road. And Mr. Baumgardner, being a true radio bug, gladly furnished the information. His experiments with the FT set as described in the letter are shown on the diagram in Figure 4. Before we go on with the rest of the contributions, we want to extend to him our cordial thanks, and express our wish that if he has any more finds that he thinks may be interesting, we would be glad to hear from him.

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636 Fifty-first Street,
Milwaukee, Wis.

RADIO AGE,
Gentlemen:

I purchased your magazine for the first time last night and I assure you that from now on I'll buy a copy every month it is issued. I was particularly interested in your club of SQUEAL HOUNDS or DIAL TWISTERS, so I am submitting my list of stations for a membership in the club. The following stations I received in two weeks on my GREBE:

KDKA, KFGD, KFHD, KFI, KFIX, KFKB, KFKX, KFLZ, KFNF, KFOP, KGO, KGW, KSD, KYW, WAAW, WABA, WBAH, WBAP, WBBD, WBL, WBT, WBZ, WCAE, WCAL, WCAP, WCAS, WCAU, WCBD, WCK, WCX, WDAF, WDAP, WEAF, WEAH, WEAN, WFAN, WFAA, WGN, WGR, WGY, WHA, WHAA, WHAD, WHAS, WHAZ, WHB, WIAO, WJAK, WJAX, WJAZ, WKY, WLAG, WLS, WLW, WMAJ, WMAQ, WMAY, WMC, WNAC, WOAV, WOAW, WOC, WOO, WOQ, WOR, WOS, WPAB, WPAH, WRC, WSAI, WSB, WTAM, WTAQ, WTAS, WTAY, WWAE, WWJ, 2XD, 2XB, WFAH, WBAK, KFIM, CFCA, CKAC, CJCE.

Yours truly,
HILMAR T. BOEHM.

P. S.—Please inform me who has the slogan, "In the Heart of La."

Can anyone tell Mr. Boehm who makes use of the slogan he mentions? We don't happen to be acquainted with it—but we do know a good list when we see it.

Some time ago we printed a letter from a Montreal fan. He said he wanted competition from Montreal—here he is. We have several letters from fans up there—but space is limited and we can't print all of them, unfortunately.

RADIO AGE,
Gentlemen:

With reference to the Pickup Pages of your fine magazine, I see that Mr. Winkle is probably the first Reinartz booster to have his name inscribed on the Dial Twisters list for Montreal. I think that Reinartz wants some beating. I submit herewith a list of stations received on a single peanut tube, over a period of five months, most of them at any time they are broadcasting, given fair conditions.

In Mr. Winkle's list of stations, I notice he has not received direct those elusive stations at Ottawa. However, I must congratulate him on receiving KYW at Chicago, on 536 meters, which I cannot seem to receive in spite of an excellent location.

I would like to say in passing that H. Hardman's article on the Reinartz modification was very interesting and would be glad if that gentleman would, through you, Mr. Editor, give us some more facts on rewinding the coil, number of turns, etc.

In closing I would like to express my appreciation on the works of the various contributors to the "*AGE*" and the clean-cut illustrations that accompany them.

Having been confined to bed all the winter through ill health, I must say that my Reinartz has been a splendid companion to me during the long, dreary evenings.

Thanking you for taking up so much space, I shall be curious to see next month's magazine, and how many stations constitutes the record for Montreal.

Yours faithfully,
W. J. WATERSON.
Lorain Avenue, Montreal, North,
Quebec, Canada.

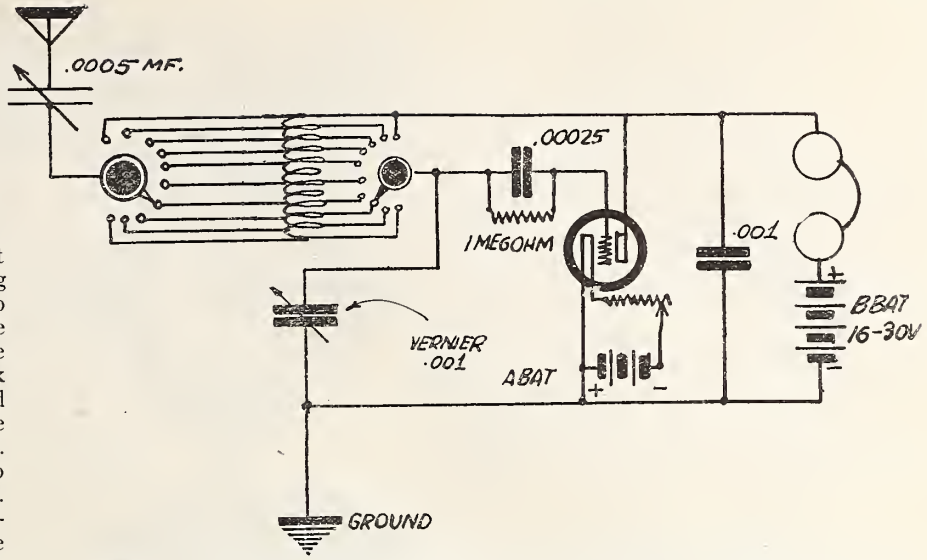

Figure 4. The FT circuit as revised by Mr. Baumgardner of Chicago. He finds this circuit very selective, and extremely sensitive to long distance stations.

Calls heard by
W. J. Waterson
Montreal, Canada

KDKA, WBZ, WCAE, WCAP, WCBD, WDAP, WDAR, WEAF, WFI, WGA, WGY, WHAZ, WIP, WJAR, WJAX, WJAZ, WHY, WJZ, WLW, WOC, WOO, WOR, WHB.

It is a pleasure to learn that *RADIO AGE* may have helped you to spend some of those lonely hours pleasantly, and feel that some of our readers might like to drop you a few lines to compare notes and results. We shall be glad to have you "visit" the department again.

RADIO AGE,
Gentlemen:

After reading the list sent in by Mr. Winkle of Bordeau Street, Montreal, I am sending mine hoping it will interest you and other readers of your magazine which I cannot praise too much, even though I only know it for three months. As others say, "it certainly is the goods."

I hook as many as nine stations the same evening, and as I only have had the set for a short while, I think twenty-five stations is not so bad. Here's hoping to hear from other Montrealers.

Truly yours,
JOSEPH A. RATTE.
175 Lagauchertieres Street,
Montreal, P. Q., Canada.

Calls heard by
Joseph A. Ratte
175 Lagauchertieres Street
Montreal, P. Q., Canada

KFKX, WLS, WGN, WJAZ, WDAP, WLW, WEAR, WWAD, WDAR, WFI, WOR, WJZ, WJAR, WBZ, WHAZ, WGY, WGR, CKCZ, CFCX, WJAX, WTAM, KDKA, CFCF, CKAC, CHYC.

RADIO AGE,
Gentlemen:

Having read the May *RADIO AGE* and stubbed my toe into the Dial Twisters Club, I concluded to write. Perhaps it will get the gate or the waste basket, but we should try anything once. How many of the fans will agree with me if I say that it is very much harder to get the Eastern stations than it is for the East to get the West?

I've got six tubes in my set. Don't think I use 'em all on the head phones. I don't. Six UV199, I use

(Continued on page 44)

Getting the Most Out of Your Vacuum Tubes

(Continued from page 18)

mica type, and should be purchased only when they are marked "tested capacity" and not "tested mica" or other misleading terms. They should be firmly soldered in the circuit, the condenser being as close to the grid post of the tube socket as it possibly can be. Sometimes sockets are so constructed that they can be mounted directly thereon.

If a circuit is noisy when all other precautions have been taken, it can invariably be traced to a poor grid condenser. The thing to do is to substitute it with one that is as near perfect as possible.

Rheostats

Faulty rheostats or rheostats with adjustments that are too coarse are often the contributors of noises in sets, especially in detector circuits. The proper rheostat to use in a detector circuit is the carbon type, which permits an even straight flow of increasing or decreasing current as the controlling knob is turned. Wire rheostats are satisfactory in amplifying circuits, and at present there has appeared on the market a small cartridge resistance of the proper resistance for the popular tubes now on the market to be used in conjunction with various battery supplies.

These cartridge rheostats have no controls, and are inserted into clips connected in the filament circuit, and provide automatically the proper resistance. These are not recommended for detector circuits, however.

Potentiometers

Wire potentiometers, like rheostats, unless of good design are apt to inflict noises upon the ears of the listener. There are several types on the market, but the writer much prefers the carbon disk or graphite sector type to the wire ones. They are usually furnished in 200 ohm (maximum) and 400 ohm (maximum) sizes. The 400 ohm size is the most satisfactory for all around purposes.

"A" and "B" Batteries

The subject of A batteries will be discussed in a later article; especially the connections for dry cells to give longer life and more efficient service.

B batteries, whether dry battery type or storage type, should have provision made for taps so that the plate potential of the tube may be varied at will. A difference of one or two volts often makes all the difference in the world.

It is quite advisable to have a voltmeter with a scale reading of from 0 to 10 volts DC handy, and it is very desirable where eight or ten tubes are used as on a Super-Heterodyne. This meter will enable the operator to tell just what each and every tube is consuming, and more intelligent operation together with economical upkeep in battery consumption is possible.

Dividend for RCA

The board of directors of the Radio Corporation of America, at their meeting, May 23rd, declared a dividend payable on all preferred stock of the Radio Corporation to stockholders of record on June 6th. The dividend will be 3½ per cent, being 1¾ per cent, respectively, for the first and second quarters of 1924.

EDITOR'S NOTE—In our next issue, Mr. Anderson will take up in detail the use of these various controlling accessories, their relative positions in circuits, and the subject of grid return lines together with some other valuable data on the most effective methods to employ in getting the very most out of your vacuum tubes.

TROUBLE CHARTS (Q-20-22)
VACUUM TUBE TROUBLES

TUBES—Continued.

(8) TUBE SOCKETS. The tube socket is very frequently the cause of weak signals or open circuits. The fact that the filament lights up does not mean necessarily that the socket is perfect. It may be that the grid and plate prongs are not making the proper contact with the contact springs in the socket, and this will stop the action of the tube just as surely as an open filament line. Clean off the tube prongs and springs, scraping them to a bright surface, and then bend up the springs to insure proper contact with the prongs.

Only the highest grade sockets should be used, in which the insulation is of hard rubber, bakelite, porcelain or similar approved type. Cheap sockets are often made of soft compositions which are partial conductors, and which may short circuit the feeble radio frequency currents. This of course reduces the range and signal strength of the set.

Wherever possible, connections should be soldered to the socket binding posts. Contact must be perfect at this point. Clean the socket perfectly from dirt, grease, pencil marks, etc., as these are partial conductors which will short circuit the radio frequency current.

(9) ADAPTERS. The adapters used for carrying dry cell tubes in standard sockets often fail to make the proper contact with the socket. See that they are clean and that all connections are tight. Adapters reduce the output even when in good condition.

(10) DIRTY TUBE BASES. The insulating plate at the bottom of the tube, which supports the four tube prongs, must be perfectly clean and free from pencil marks. If this is not the case, then you may be reasonably sure that the radio frequency current is short circuited to some extent in the base. The practice of dealers in marking their name on the base of the tube with a rubber stamp cannot be too thoroughly condemned.

(11) DETECTOR WILL NOT OSCILLATE. When the detector tube in a regenerative circuit will not oscillate properly or give the proper range and signal strength, the trouble may be due to the tube itself, but it is much more likely that it is due to trouble in the circuit. When in proper condition, the tube should squeal or howl when the tube is turned up so that it burns above normal brightness or when the tickler or plate variometer is turned way over into the position of maximum regeneration. Turning the rheostat of the detector above normal should first cause distortion, and then should follow by giving a sharp "Click" and then howling.

In the tuned plate type, the trouble may be that there is not sufficient inductance in the plate circuit due to a defective plate variometer. In the feed-back type it may be that the tickler has not a sufficient number of turns or that a short circuit exists in the plate or tickler line. A weak battery or high resistance rheostat will cause the trouble.

(12) TUBE HOWLS AT ALL TIMES. This is due to the tube breaking down into free oscillations because of excessive regeneration or too much filament current. It may be that the "A" battery voltage is too high for the tube or that the resistance of the rheostat is not sufficient to control the current properly.

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BATTERIES (DD-50-1)
STORAGE BATTERIES

GENERAL PRINCIPLES. As in the case of the primary battery (dry cell), the elements of the storage cell consist of two chemically dissimilar plates or electrodes immersed in a fluid electrolyte. During the discharge of the cell the electrolyte attacks the plates and chemically reduces them to the same chemical compound. When completely reduced, there is of course no electrical difference of potential between the plates and the cell is said to be completely discharged and has no longer the ability to cause the flow of current.

By passing current from an outside source through the cell in the reverse direction to the flow of current during discharge, the chemical composition of the plates is restored to its original condition and again is capable of supplying current. The process of restoring the plates to a condition where a difference of potential again exists between them is known as "charging" and is a distinctive property of the storage or "secondary" cell. This charging process can be repeated a great number of times until the plates are finally wasted away by the losses that take place within the cell.

From the above it will be seen that the storage battery does not actually store electricity as electricity, but simply stores the energy expended by the charging current in the form of latent chemical energy. As soon as the electrodes are connected by an electrical conductor, the chemical reaction of the electrolyte with the plates begins, and this reaction (discharge) results in the liberation of energy in the form of electricity. The difference of electrical potential between the plates is due to a difference of chemical potential, and no flow of current takes place without an equivalent change in the chemical nature of the plates.

While there are a great number of combinations possible, the commercial storage cell consists of two or more coated lead plates immersed in a dilute solution of sulphuric acid in water. This is known as the "lead-sulphuric cell" and is in great favor because of its high voltage and low internal resistance. Another commercial type, not so commonly used, is the Edison cell in which an alkaline electrolyte is used in combination with iron and nickel electrodes. The voltage of the Edison cell is considerably lower than the lead-sulphuric type.

THE LEAD-SULPHURIC CELL. In its simplest form the lead-sulphuric cell consists of two latticed lead plates or "electrodes" which are coated with lead salts. When fully charged, the positive electrode coating or "active material" is lead peroxide while the coating on the negative plate is spongy metallic lead. The positive plates when fully charged are chocolate brown in color, while the negative plates have the characteristic dull gray or slate color of metallic lead.

When the cell is being discharged, the sulphuric acid of the electrolyte gradually combines with the active material to form lead sulphate, and as the discharge continues the sulphuric acid gradually disappears from the solution to enter into combination with the lead. When fully discharged, most of the acid has disappeared leaving almost pure water behind, and as the acid is heavier than the water the specific gravity gradually falls off as the cell approaches the discharged condition. So closely is the specific gravity related to the amount of charge in the cell that we can use a hydrometer to determine the current still remaining.

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Get a Job Like These

Earn $3500 to $10,000 a Year

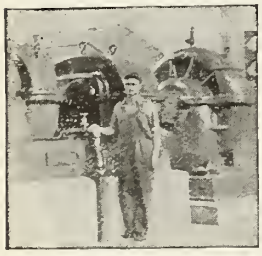
in the Big Pay Field of ELECTRICITY

20 Years Old—Makes Almost $500 a Month

Harold Hastings of Somers, Mass., says: "The profit on my electrical business amounts to $475.00 a month. My success is due entirely to your instruction. You make your men just what you say—Electrical Experts. No man will ever make a mistake enrolling for your course."

Dickerson Gets $7500 a Year

"I earned $30 a week when I started with you—$50 a week when half through your course. Now I clean up at the rate of $7500 a year. Thank you a thousand times for what you did for me. Electricity pays big on the farm." Herbert M. Dickerson, Warrentown, Va.



$20.00 a Day for Schreck

"Use my name as a reference and depend on me as a booster. The biggest thing I ever did was answer your advertisement. I am averaging better than $500 a month from my own business now. I used to make $18.00 a week." A. Schreck, Phoenix, Ariz.

Pence Earns $9000 a Year

W. E. Pence, Chehalis, Wash., says: "Your course put me where I am today, Mr. Cooke—making $750 a month doing automobile electrical work—think of it—$9000 a year. Besides that I am my own boss. My wife joins me in thanking you for what you did for us."

$30 to $50 a Day for J. R. Morgan

"When I started on your course I was a carpenter's helper, earning around $5.00 a day. Now I make from $30 to $50 a day and am busy all the time. Use this letter if you want to—I stand behind it." J. R. Morgan, Delaware, Ohio.

Spare Time Work Pays Stewart $100 a Month

"Your course has already obtained a substantial increase in pay for me and made it possible for me to make at least $100 a month in spare time work. You can shout this at the weak fellows who haven't made up their minds to do something yet." Earl Stewart, Corona, Calif.

It's your own fault if you don't earn more. Blame yourself if you stick to your small pay job when I have made it so easy for you to earn $3500 to $10,000 a year as an electrical expert. **Electrical Experts** are badly needed. Thousands of men must be trained at once. One billion dollars a year is being spent for electrical expansion and everything is ready but the men. Will you answer the call of this big pay field? Will you get ready now for the big job I will help you get? The biggest money of your life is waiting for you.

I Will Train You at Home

I will train you just like I trained the six men whose pictures you see here. Just like I have trained thousands of other men—ordinary, everyday sort of fellows—pulling them out of the depths of starvation wages into jobs that pay $12.00 to $30.00 a day. Electricity offers you more opportunities—bigger opportunities—than any other line and with my easily learned, spare time course, I can fit you for one of the biggest jobs in a few short months' time.

Quick and Easy to Learn

Don't let any doubt about your being able to do what these other men have done rob you of your just success. Pence and Morgan and these other fellows didn't have a thing on you when they started. You can easily duplicate their success. Age, lack of experience or lack of education makes no difference. Start just as you are and I will guarantee the result with **a signed money back guarantee bond.** If you are not 100% satisfied with my course it won't cost you a cent.

Free—Electrical Working Outfit and Tools

In addition to giving my students free employment service and free consultation service, I give them also a complete working outfit. This includes tools, measuring instruments, material and a **real** electric motor—the finest beginners' outfit ever gotten together. You do practical work right from the start. After the first few lessons it enables you to make extra money every week doing odd electrical jobs in your spare time. Some students make as high as $25 to $35 a week in spare time work while learning. This outfit is all FREE.

Mail Coupon for FREE BOOK—
The Vital Facts of the Electrical Industry

The coupon below will bring you my big free electrical book—over 100 interesting pictures. The real dope about your opportunities in electricity—positive proof that you, too, can earn $3500 to $10,000 a year. Send for it now. Along with the book I will send you a sample lesson, a credit check allowing you a $45.50 reduction, my guarantee bond and particulars of the most wonderful pay-raising course in the world. Send the coupon now—this very second may be the turning point in your life. Send it while the desire for a better job and more money is upon you, to

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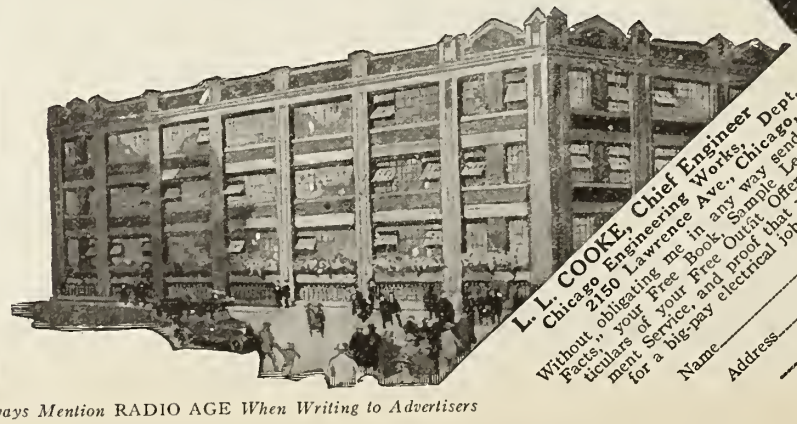

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BATTERIES (DD-50-2)
STORAGE BATTERIES

CHARGING. When fully discharged, practically all of the active material or coating has been reduced to lead sulphate, and as both plates are now in equilibrium from a chemical standpoint there is no longer an electrical difference of potential between them. The voltage of the cell gradually falls off until it becomes zero at full discharge.

By passing a charging current in the reverse direction to the discharge, the lead sulphate is broken up chemically into the original lead peroxide and spongy lead, and the resulting sulphuric acid turned loose returns to the electrolyte. The return of the acid to the water during charge of course increases the specific gravity until at full charge the gravity is again the same as in the beginning. The discharge of the acid causes the active material to contract during charge and thus there is a strong tendency for the active material to work loose from the plates and to become detached. To prevent the coating from falling off the lead electrodes, the latter are latticed and grooved in such a way that the pellets are held firmly in position under ordinary charging conditions.

During the charging process the water of the electrolyte is partly decomposed into hydrogen and oxygen gases. The hydrogen gas can be seen bubbling up rapidly around the negative plate while smaller quantities of oxygen appear around the positive plate. The gases are produced in the proportion of two parts of hydrogen to one part of oxygen, or in the same proportion that these gases exist in water. As the charge proceeds, the gas is produced in increasing quantity until at full charge the electrolyte bubbles or "boils" with considerable vigor. This is known as "gassing" and is an indication that full charge is being approached.

At the start of the charge, the hydrogen gas at the negative electrode enters into chemical combination with the lead sulphate coating to form reduced metallic lead, hence there are not so many bubbles at the beginning of the charge as part of the gas is being absorbed by the plates. At the positive plate, the oxygen is attacking the lead sulphate to form the oxide of lead known as the "peroxide" and little oxygen is therefore in evidence in the form of bubbles until the lead sulphate is well reduced.

UNIT CAPACITY OF CELLS. The unit of capacity of a storage cell is the "amperehour," or the product of the amperes and time in hours for the complete safe discharge. Thus, if a cell can maintain a flow of two amperes for 20 hours between full charge and full safe discharge, then the capacity of the cell is equal to: $2 \times 20 = 40$ ampere hours. Practically, however, the capacity varies somewhat with the rate at which it is discharged so that under standard conditions the cell is assumed to completely discharge within eight hours time. The greater the flow in amperes, the less will be the capacity in amperehours.

Under a standard rating, a 40 amperehour cell will be discharged at the rate of: $40/8 = 5$ amperes. This is the rate at which the cell is assumed to develop its full capacity.

When we refer to the complete "safe discharge" we mean the lowest point to which the cell can be discharged without danger of sulphating or other trouble. It is never safe to fully discharge a lead-sulphuric cell to the point where the voltage drops to zero for the reason that a hard impenetrable insulating coat of lead sulphate is likely to be formed which will make re-charging difficult or even impossible. As a general rule it is not safe to discharge a lead-sulphuric cell below 1.8 volts or below 1150 as determined by the hydrometer.

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BATTERIES (DD-50-3)
STORAGE BATTERIES

CAPACITY OF BATTERIES. The capacity of a battery in amperehours is proportional to the exposed area of the plates, that is, the area to which the fluid electrolyte has free access. The greater the area of the plates, the greater will be the capacity in amperehours and the rate of discharge in amperes. The voltage of the cell, however is independent of the area and depends mostly upon the amount of charge remaining and upon the nature of the plates and density of the electrolyte.

It is for this reason that we make every attempt possible to increase the effective area of the plates by latticing them and by the use of spongy materials which will allow the electrolyte to penetrate to greater depths into the active material.

In order to make the storage cell more compact it is the usual practice to use a number of small plates connected in parallel rather than one pair of large plates. Thus a small battery of the radio type may have five positive plates and six negatives, the positives and negatives forming in effect two large single positive and negatives. One more negative than positive is used.

Commercial batteries used for radio and automobiles are arranged with the following number of plates in parallel: 3, 5, 7, 9, 11, 13, 15 and 17. However, the very small storage cells used for "B" batteries usually have only two plates, one negative and one positive. In terms of amperehours the more common "A" storage cells are rated at 20, 40, 60, 80, 100 and 150 ampere hours, although certain makers sometimes depart from this practice in special cells.

The variation of capacity with the rate of discharge is shown by the following average figures. Here the discharge rate is given in hours while the second column shows the capacity as a percentage of the rated capacity at an eight-hour standard rate. The discharge completed in eight hours is taken as 100 per cent of the rated capacity.

DISCHARGE RATE (IN HOURS)	PERCENT OF 8-HOUR CAPACITY
8 hours	100%
6 hours	96%
4 hours	88%
2 hours	70%
1 hour	48%

In other words, if we completely discharge a battery in one hour, we will only obtain 48 per cent of the number of amperehours that we could get if we discharged it at a slower rate in eight hours. For this reason a battery should not be overloaded, and if the rate of discharge in amperes is greater than one-eighth the capacity in amperehours, we had better use a larger battery or else use two batteries in parallel.

Owing to losses which take place within the cell, such as resistance losses for example, the number of amperehours supplied to the cell in the form of charging current is greater than the amount recovered on discharge. The ratio of the amperehours discharged to the amperehours of charging current is called the "efficiency" of the battery and seldom exceeds 60 per cent in the smaller radio batteries when charged at home. Thus, if we supply 100 amperehours by means of the charger we can hardly expect much more than 60 amperehours during full discharge. This also varies with the discharge rate.

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Scientific

Short Wave Transmission

(Continued from page 11)

expect. But this is due to the fact that the human ear is not so sensitive as it might be, and one little improvement may not appear to make much difference in the reception.

If we take the trouble to watch all of the places where losses may occur and correct several, or all of them, we shall at once notice the difference in reception. One of the most important items is the resistance of the circuit.

Just where resistance in a set may occur is a question not very well understood by the layman. First, we often have too much resistance in the different coils used as inductances. Then there is the resistance offered by poorly constructed condensers. Usually we think that resistance means too great a length of wire which has too small a cross section, but, as a rule, while this may be true to some extent, it is more often caused by the material on which the coil is wound, or in the varnish which is used to hold the turns in place.

Some sort of a support is necessary for the coils, so we cannot escape this loss, but we can reduce it considerably by using the right kind of material. The best tube known on which a coil may be wound is not high priced insulating material, but is a good oven dried paper or cardboard tube without the use of any kind of insulating varnish. The wire used should have the largest possible cross section, which, while it may be very stiff and hard to wind, will give better results than the smaller wire having a higher resistance.

For the frequencies used in ordinary radio reception, the use of stranded conductors is of no avail, and a good heavy solid wire is to be preferred. In selecting the proper variable condenser, the builder is confronted with another problem. It is much better to purchase a high priced condenser having a very low high frequency resistance than to play around with one of inferior quality. There are several scientifically constructed condensers on the market at the present time and one should not be satisfied with merely obtaining one which is supposed to have the right capacity, and it is earnestly suggested that the user make a careful study of variable condensers before making a selection.

In constructing the aerial for a short wave tuner, use a good heavy single strand of copper wire and keep the length at approximately thirty-five feet or less.

COMING IN SEPTEMBER

A new technical feature, never before undertaken by a radio magazine. Watch RADIO AGE for this unusual innovation.

Club Meetings by Radio!

Dallas, Texas.—An experiment to determine whether it is possible to hold a club meeting by radio with all the members seated comfortably in their homes, has been tried out successfully by radio fans in this vicinity. The meeting was called to order by the president, motions carried and all business transacted with as much ease as though the members were gathered in one room.

The idea was conceived by members of the West Gulf Amateur Phone Club, which was started by local representatives of the American Radio Relay League. Practically all members have installed radiophone transmitters in their homes.

Due to bad weather the suggestion was made that members hold their meetings "on the air."

Notices were sent to all club members, suggesting a wave length of 190 meters. At the appointed time the president called the meeting "to order" through his radiophone. The roll was called by the secretary and as their names were spoken the members picked up their microphones and answered, "present."

As each set had been carefully tuned in advance all members of the club could hear everything that took place. The session lasted two hours and met with such general approval that it was voted to hold subsequent "ether meetings" every Sunday afternoon thereafter.

Fans See Auto Race by Radio

Radio fans who found themselves unable to attend the International Motor Sweepstakes, the 500-mile race at Indianapolis on May 30, had it brought right to their homes by radio.

A soundproof booth was constructed under the judges' stand and in addition

there were microphones in the pits. The broadcaster in the booth had the race information "fed" to him by racing experts furnished by the Prest-o-Lite Company, battery manufacturers.

The broadcaster in turn sent out the descriptive news directly through Station WGN on the Edgewater Beach Hotel, Chicago. With a corps of ten men, the broadcasting was kept "up-to-the-minute" throughout the entire racing period. The first story was on the air at 9:30 a. m. and was kept up until late in the afternoon. "Sen" Kaney, WGN announcer, was in personal charge.

Through the word pictures from the trackside the listener-in was transported there in spirit and actually was able to visualize the hurry of the crowd as it made its way to the seats in the mile and a half of grandstands; the vivid colors of the women in gala attire were picturized graphically and the strident call of the refreshment vendors and program boys preceded the hustle of the track itself as the race neared.

The fans heard the roar of the racing motors and the howls of the thrill-mad spectators as a favorite driver came hurtling down the stretch. At last they were able to get the terrific uproar which greeted "Jo" Boyer as he crossed the finish line first.

In between the reports of the races Mr. Kaney gave intimate human interest sketches of the crowd, the drivers and the officials.

Radio Aids World Flight

Despite the fact that the Army-world-flight planes are not equipped with radio receiving or transmitting apparatus, radio aided these airmen in their trip westward from the Aleutian Islands to Japan.

The Coast Guard Cutter "Haida" and the Fisheries Steamer "Eider" stood by along the westward route of the Army aviators, virtually establishing a radio chain between the American radio stations and those of Japan. They furnished advance data as to weather conditions along the route, relaying their dispatches to the planes before they "took" off on their 860-mile jump.

The first aid of radio and the government vessels on the long flight was planned before the planes left Chicagoff, on the Island of Attu, en route to Kashewabara Bay on Japan's Island of Paramushiru in the Kuriles group.

Major Blair of the Signal Corps, who has charge of the radio communication for the Army and is aboard the "Haida," returned to the United States when the flyers reached Japan, where both Japanese and U. S. naval vessels took up the radio service. It is expected that later on he will be sent to Labrador to establish a system of radio communication for these airmen on their trans-Atlantic flight back home. Weather forecasts are already arranged for on the Atlantic route, and it is planned that at least one of the Army planes will be equipped with radio before the last leg of the flight starts from England.

A Physicist's View of Sound Waves and Radio Rays

By Frank D. Pearne

Carl Pfanstiehl, noted radio engineer and scientist, addressed the radio division of the Electric Club of Chicago last month on the subject, "Sound Waves and Radio Rays."

Mr. Pfanstiehl, who is president of the Pfanstiehl Radio Service Company, Highland Park, Ill., presented his up to date views and theories from the standpoint of the physicist rather than that of the conventional radio engineer, however. It was this method of delivery that proved novelly interesting to his expert listeners.

Mr. Pfanstiehl stated that the science of radio had grown so fast and contained so much of the spectacular that in his opinion, too little attention has been given by radio fans to the underlying principles of the science. Therefore, he was going to confine his address to a few of the fundamental principles involved, and tried to make his audience visualize what actually takes place with the aid of various electrical demonstrations.

He discussed air vibrations, or waves, which strike our ears and give us the sensation of sound. While air can sustain waves from less than eight to probably more than one hundred thousand cycles per second, the average human ear is capable of responding only to frequencies of about sixteen to approximately twenty thousand cycles per second. He explained that air waves consist of alternate areas of compression and rarification above and below normal atmospheric pressure, which expand in ever widening circles from the source of the vibration. A so-called noise is merely a jumble of air vibrations without any rhyme or reason and usually unpleasant to the ear, while a tone is caused by periodic vibration.

Explains Musical Tones

The most interesting part of the discussion was an explanation of what gives various musical tones their particular and distinctive quality. For instance the pitch of middle C is usually taken as 256 complete vibrations, or cycles, per second. (One compression and one rarification constitute one complete vibration, or one cycle). But what is it that enables the ear to distinguish between middle C when played on the violin, harp, piano, or when intoned by the human voice? Why is it that some tones sound thin and lifeless, while another tone of the same pitch and loudness sounds rich and full and much more pleasant to listen to?

Tone quality is entirely dependent on the number and character of smaller and more rapid waves that exist simultaneously with the fundamental or principal wave. The fundamental wave is always the one of the lowest frequency and determines the pitch of the tone, while the little waves, or ripples on top of the fundamental, give the tone its characteristic quality. A number of lantern slides were shown, made from photographs of sound waves coming from various musical instruments, and also the human voice. In some cases, such as tone coming from a single organ pipe, the smaller or harmonic waves almost completely overwhelm the fundamental, or principal wave. The smaller waves are called overtones. The overtones whose frequencies are an even multiple of the fundamental are called harmonic overtones. The individual frequency of certain of the higher overtones may be more than twenty times the frequency of the fundamental.

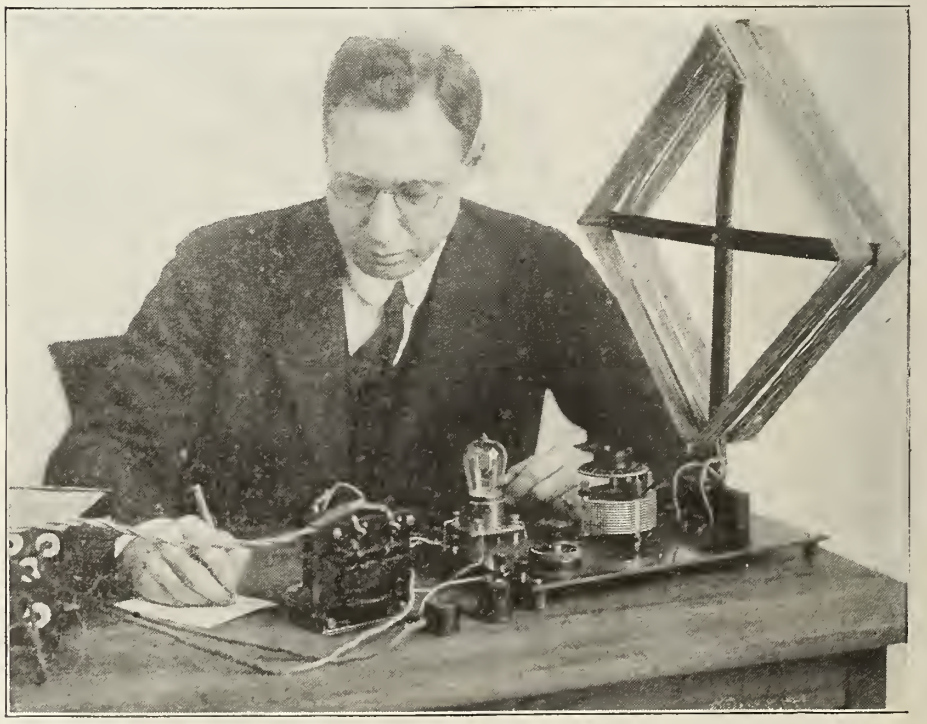
Therefore, it is wonderful that radio transmitting and receiving instruments can transmit and record the extremely complicated and rapid vibrations constituting music with any degree of fidelity. The speaker then urged the radio engineers to combine their best efforts toward developing radio apparatus that would transmit and receive music of better quality than that usually accomplished. The low base voice vibrates at about 60 cycles per second and a high soprano at about 1,300 per second. The range generally employed in music is from 27 to 4138 cycles.

Mr. Pfanstiehl then explained the newest theory of the constitution of matter that is generally accepted today by the physicist. He stated that all the atoms of the different elements are made of much smaller pieces of matter called protons and electrons. In other words, the two elements from which everything in the universe is made are the proton and the electron. The only thing that differentiates an atom of one element, say silver, from an atom of another element, say oxygen, is in the number and arrangement of the tiny electrons that rotate in regular orbits around a central nucleus which consists of various numbers of electrons and protons packed very tightly together. The simplest element is that of hydrogen, which consists of one electron rapidly rotating in an orbit around a nucleus which consists of one proton. The proton is 1,845 times as heavy as an electron, but is believed to be about the same size as an electron. The size of a hydrogen atom therefore is really the size of the orbit of its revolving electron. The actual size of the proton and electron taken together is only about 100,000th of the size of the orbit of the electron of the size of the atom as a whole.

The most complicated element known is uranium, which is believed to consist of ninety-two planitary electrons revolving in various orbits around a very complicated central nucleus consisting of 238 protons and 146 electrons, very tightly packed together. The uranium nucleus is so complicated and compact that some of these constantly explode. When this occurs, the atom is broken up and simpler atoms are formed. This process is called "radio activity" and the element radium is one of the principal radio-active elements which lends itself most readily to experimental work, and is therefore usually thought of in connection with radio activity. In fact, all of the elements constituting our world have sprung from a disintegration of uranium atoms.

The Source of Energy

This disintegration process is the final source of all forms of energy. It follows that matter is continually disinte-



ASTOUNDS RADIO EXPERTS

Carl Pfanstiehl, noted radio expert, thrilled an audience of technical men at the Electric Club, Chicago, last month, when he delivered an authoritative discourse on radio progress and technicalities. It is recorded in this issue of RADIO AGE by Frank D. Pearne.

grating into energy, or it can be said that all matter is a form of more or less stable energy. Whenever an electron which is rotating around nucleus of an atom is jarred, or knocked out of its regular orbit, it throws off into space, in a straight line, a tiny particle of free energy, or a tiny chunk of matter much smaller than an electron, whichever way you want to think of it. The little particles of electron dust are so tiny that they travel through space with the speed of light; namely, 186,000 miles per second. These little particles of radiant energy are called "quanta," according to the so-called quantum theory. The energy shot off from the electrons which are rotating nearest to the nucleus of an atom are of higher frequency than when they are shot off from electrons rotating in outer or larger orbits inside of an atom. Therefore the larger the orbit of the exciting electron, the lower will be the frequency of the emitted radiation.

In order to produce radiations of a low enough frequency suitable for use in radio communication, an artificial orbit must be established for the electrons in order to get one large enough. This is accomplished by causing a disrupted electric current, which is merely a stream of free electrons traveling along a wire, to circulate around a coil of wire and very rapidly alternate its direction. By frequency is meant the number of volleys of particles shot off in a second. The highest frequencies known are produced by spontaneous distortion of a radio-active atom that originates in the nucleus. These rays are called "gamma rays" and have frequencies of several hundred million, million, million cycles per second. The next lower group of frequencies is called "X rays" and are of the order of one million, million, million cycles per second. The next lower group are called "ultra violet" or actinic rays, having frequencies of around fifteen thousand million million cycles.

Just below this comes the very narrow range of frequencies to which our eyes respond as visible light. The range covered by our eyes is very small and varies from 750 million, million cycles, which gives us the color of violet, down through the other colors to red which has a frequency of 375 million cycles. The next lower range is the infra red, which includes the heat rays which our skins detect as heat. Below this there is a range of frequencies that have not yet been produced or detected. Below this unknown range begins the "Hertzion," or radio waves. The range used at present for radio communication is from three million cycles to about fifteen thousand cycles.

The question of resonance, or tuning, was demonstrated with various mechanical and electrical apparatus. Small electric light bulbs were lighted by radiant energy sent from one table to another.

Amateurs Break Records

The breaking of a world's record coupled with other long distance work, during the Pan American amateur radio tests just concluded by the American Radio Relay League in co-operation with the Revista Telegrafica, demonstrates that the South American amateurs are becoming as efficient in short wave transmission as those in this country.

Pickups
By Our Readers

(Continued from page 35)

a Crosley Model XJ receiver with a 2 stage push and pull power amplifier. Anyone will recognize the fact that 3 tubes are used to tune in. On the 3 tubes I have had the following stations loud and clear:

KGG, KGW, KGO, KPO, KOP, KZN, KDYL, KFI, KHJ, KFAU, KDKA, WDAP, WBAP, CFCN, CHBC, KDPT, KDYW, KFAY, KFCF, KFJX, KFKX, KLX, KJQ, KJS, WDAF, WFAV, WOS, WOAW, WLW, WJAZ, WOAG, CKCK, CKCH, CKCD, WSAI, and once WDAM.

I have had many others but they were not logged because they would not come in regularly.

Perhaps this won't interest you, but I think it was pretty good, as most of these were logged during August and September, 1923. Here's hoping that you don't think I'm too big a prevaricator. I have had loud speaker reception on all. KDKA came in wonderfully on loud speaker, using six tubes.

Very sincerely yours,
W. S. STRINGALL.
Albion, California.

P. S.—I don't suppose you know it, but RADIO AGE is the best magazine that I've seen yet.

Just because some of the fellows have been doing good work on one tube sets doesn't mean that the fellows with the super-heterodynes, plexes, reflexes and radio frequency receivers should hold back. Probably they do get distance—so does the fellow with the bigger sets. The difference lies in the fact that when the big boys get them they get them good. The secret of the smaller sets lies in the fact that one can tune faster, and you are more apt to do freak receiving. By that we mean that you can follow practically any noise that peeps by with more ease than you can with a larger set, due to the fewer controls. Mr. Stringall has a good set, and from experience, we know that it takes a good set to reach out over the mountains like his does.

RADIO AGE,
Gentlemen:

I'll bet yours must be a pleasant job, reading over all those records! Well, I'll slip you mine. Glance over it, and let me know if it makes me a Dial Twister?

KDKA, KFGZ, KFKX, KQV, KYW, WAAM, WABL, WBBG, WBBR, WBZ, WCAD, WCAE, WCAP, WCBD, WCX, WDAF, WDAP, WDAR, WEAF, WEAM, WEAN, WEAO, WFAB, WFI, WGI, WGN, WJAZ, WGR, WGY, WHAA, WHAM, WHAS, WHAZ, WHB, WHN, WIAD, WIP, WJAR, WJAS, WJAX, WJY, WJZ, WKAQ, WKAR, WLS, WLW, WMAK, WMAQ, WNAC, WOAX, WOC, WOO, WOR, WOS, WPAB, WPAJ, WQAM, WRC, WRW, WSAD, WSAI, WSB, WTAB, WTAM, WTAS, WTAY, WTAT, WWAD, WWJ, NAA, CFCF, CHYC, CKAC, CKCH, PWX.

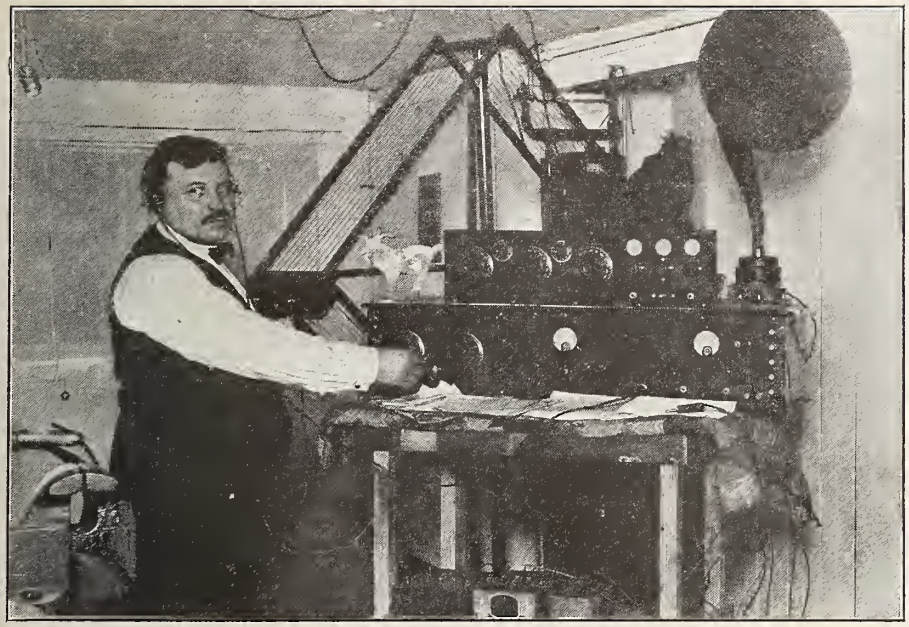
Add to these the experimental stations 1XAL, 2XB, 2XI and the amateur phone station 1KR, and I think there is a record quite worth reading. Hi!

Does that let me in? Anyway, here is the main dope. My set is a single circuit (Squak box or Blooper). It is a one tube affair with the WD11 tube being used. It was built last September but failed to function until January. The reason for this continued silence is quite a joke (but not to me). The set is homemade, and constructed of parts purchased in the local 5 and 10 cent store. The coupler which I built myself had pigtail connections. The pigtails were green, and flexible. One day, disgusted with the set, I cut open all the connections. Imagine my joy (?) when I found that the pigtails were constructed entirely out of cloth with no wire inside.

I'm going to let the single circuit slide for a while, and try the condenser variocoupler and variometer set. I would appreciate any help from some of the fellows who may have had experience with this hookup. I don't believe there is any circuit as good as the little old single circuit if it is properly operated. Let's hear from you on that.

Sincerely,
IRVING Q. MILLER.
Tarrytown, N. Y.

Quite an experience—trying to tune with cloth pigtails on a coupler rotor. It reminds us of the joke about the fellow who had heard of using a bedspring of a bed for an antenna, and after trying it



NEUTRODYNE VS. SUPER-HETERODYNE

Charles Zeman of 2400 South Fifty-eighth Court, Cicero, Illinois, is the engineer of the building in which RADIO AGE is located. He is an ardent booster of The Magazine of the Hour, and is very proficient in the art of making good sets. The illustration shows Mr. Zeman at work comparing the results and actions of an eight-tube super-heterodyne of his own make, and a neutrodyne. Note especially the well made loop antenna and the businesslike appearance of the super-het. Evidently radio "has got his goat" for if you will look real closely you will notice it standing on top of the super-het just above his hand.

cut unsuccessfully for some time investigated and found the bed didn't have a spring at all. The bottom was made up of wooden bed slats!

RADIO AGE,

I recently purchased a copy of the RADIO AGE, and one copy was enough for me to want it for a year. *May the distance between your covers ever increase.*

F. W. CUMMINGS.

So if we don't stop writing and printing letters and contributions now, Mr. Cummings' wish may come true to the extent of our having to print the last couple of lines on the front cover. In closing, we wish to remind you of that Portable Set Static Puncturing contest. Don't forget to have a happy vacation.

British Favor Amateur Union

Hartford, Conn.—Further impetus to the movement for uniting transmitting radio amateurs into a world association was given when Gerald Marcuse, secretary of the Transmitters' Section of the Radio Society of Great Britain, visited America recently.

Mr. Marcuse is making a tour of the country to study American and Canadian amateur methods. While in Hartford he told Hiram Percy Maxim, president of the American Radio Relay League, that he would lend his personal support to the International Amateur Radio Union. The first plans for this world association of amateurs were drawn up during Mr. Maxim's recent European trip, and the final organization will take place at a special radio congress in Paris during the Easter holidays of 1925.

Maj. William C. Borrett of Dartmouth, Nova Scotia, manager of the League's Maritime Division, visited Hartford at the same time and asserted that Canadian amateurs were ready to become connected with such a union, and predicted it would be invaluable as a means of establishing friendly relations among the peoples of the countries represented.

"RADIO ON THE FARM" IN AUGUST RADIO AGE.

C. K., Chicago, Ill.

Question: Kindly inform me if an aerial attached to a pole which swings and sways would have any effects directly or indirectly on the signals received. Is a steady, rigid pole more satisfactory?

Answer: It is advisable to have the antenna system stretched taut and tight so that no part of the system will sway. Swaying antennas cause fading signals and uncertain tuning. In an ordinary receiver it becomes impossible to log with any degree of accuracy. Furthermore, the Fire Underwriters specify that all antenna installations must be rigidly secured, the antenna must not be allowed to sway, and must be constructed in such a manner that it shall not in any way endanger the lives or property of people by coming into contact with live wires or to cause damage by falling. By all means, make a creditable looking job with the aerial system. Solder all the joints and make approved splices. The added gain in the form of strong signals on the DX stations will amply repay your trouble.

F. J. J., Vera Cruz, Ind.

Question: On pages 50 and 51 of your RADIO AGE ANNUAL you show an Erla single tube reflex circuit, but I can't quite understand all of the details. Page 50 shows fixed condensers of .002 and .002 MFDS capacity. It also calls for one switch blade. The list of materials calls for condensers of .001 and .002 MFDS capacity and the same list specifies two switch blades. Which is right, and how is this explained? Will this circuit tune easily? Will it operate a table talker and to what extent? Is the circuit fundamentally noisy? How is it for getting DX? Is it good for Summer reception? How does it compare with the Cockaday circuit described on page 37? About how much should the materials cost without phones, batteries, tube and other accessories? Will it easily and with volume tune in stations broadcasting on the higher wave lengths? Thanking you for your trouble, and knowing you will give me a reliable and accurate reply, I shall watch your columns for my answer.

Answer: Relative to the condenser connected across the B battery, this is not important, and may be a large capacity without detracting from the effectiveness of the circuit. On the other hand, it is important that the condenser across the transformer have the correct capacity. If the coupler has two sets of taps provided for in its primary winding, it becomes necessary to use two switch blades. It depends entirely upon the type of coupler you use. I would advise that you get one that has windings tapped in a series of about 8 coarse taps consisting of about 10 turns to each tap with about 8 more consisting of one turn each. This will permit you to make very close adjustment of the aerial circuit. However, a fixed coupler or a Selectoformer can be used to advantage as in the Sure Fire Reflex circuit of the May issue of RADIO AGE. The losses of the taps can in this way be eliminated. If a variocoupler with a tapped primary is used, it is not possible to accurately log a DX station, unless the dial position, the switch blade and filaments settings are noticed. If a fixed coupler or Selectoformer is used, the logging can be done accurately. The set will operate a table talker to good advantage on local stations. The volume will of course not be terrific but will be of sufficient quantity to entertain in a small room. This depends entirely upon where and how the set is operated and constructed. The set is very quiet and the crystal detection provides a beautiful tonal quality. The DX range is average. I believe the Cockaday beats it for DX, but bows to it for beauty in tone and volume. It makes a good portable set. Cost of the set should be around $20 with average parts. Tuning depends upon the type of tuning system you use. If you provide yourself with a coupler of the correct range, it will cover the entire allotment of broadcast waves.

W. B. R., Roanoke, Va.

Question: I am a regular reader of your valued publication. From the February issue of this year I built the Reinartz Audio Regenerator. WGY at

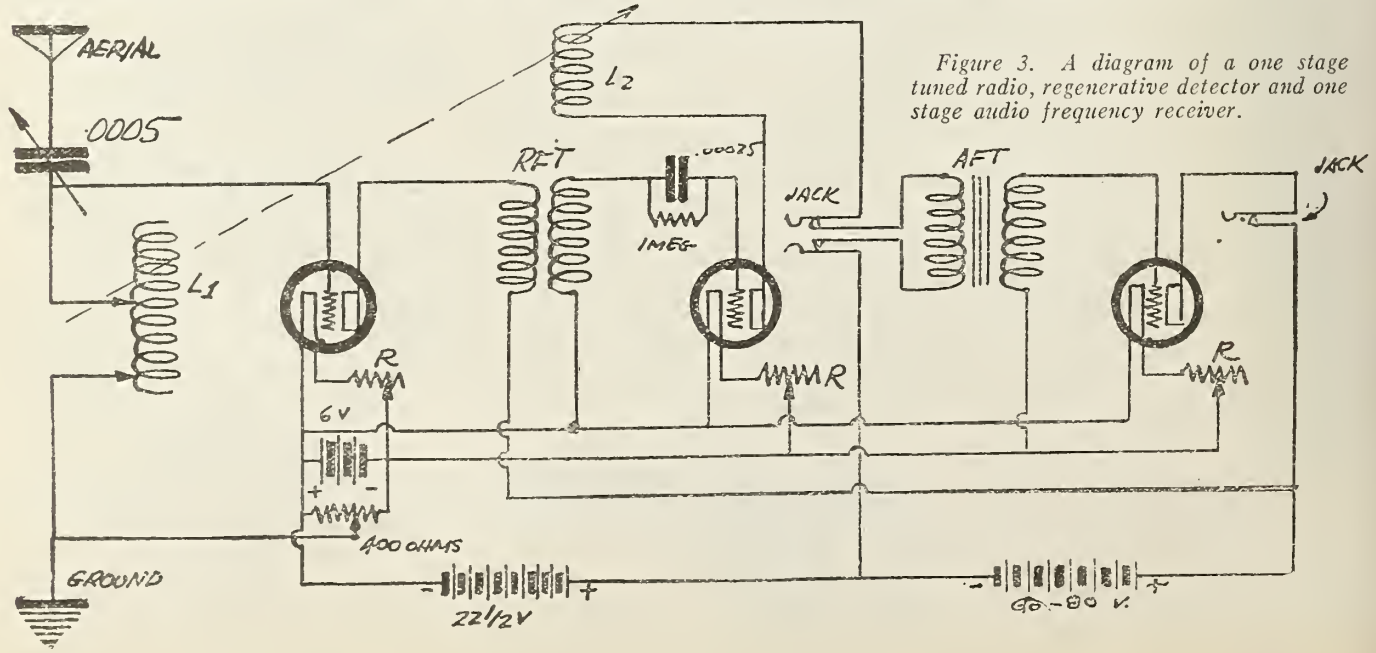


Figure 3. A diagram of a one stage tuned radio, regenerative detector and one stage audio frequency receiver.

Schenectady, New York, comes in with terrific volume but I have trouble in getting other stations. When I hold my hand on the grid wire it seems to improve reception on these stations. I used only high class parts. Could you offer some suggestions as to how I could improve the all-round effectiveness of the set?

Answer: The action of the grid circuit you speak of suggests that you might get better results by using a regular .00025 MFD. grid condenser with a pencil mark grid leak. I find that it is almost a necessity with the dry cell tubes if DX stations are desired. The audio component remains the same. If you find that this change does not bring the desired results, connect the parts in the circuit shown in Figure 1. I find that this arrangement is very effective in every case.

E. H. D., Papillion, Nebr.

Question: We would appreciate a little explanation of a few problems with reference to a Reinartz circuit with which we have been experimenting. While working with the circuit, we chanced to place a makeshift coupler in the antenna circuit in place of the usual variable condenser used to tune the antenna, which consisted of 18 turns of wire on a rotor with a stator of 22 turns. This we found increased both our range and distance, and makes the set very much easier to tune. The only drawback is that we find it difficult to tune in the wave lengths over 500 meters. We get them, but only faintly. Could you suggest any arrangement to use with this discovery, which would help us to get the higher wave stations more clearly? Is there any way to wind a coil that would help? What do you think of a set using one stage of radio frequency, detector and one stage of audio frequency amplification, using the Reinartz system of tuning? Kindly let us have a diagram of the connections.

Answer: The action you describe is a well known argument in tuning. In some cases it will be found that inductance variation is superior to capacity tuning. It seems that you find the former more efficient in your case. It is a fact that inductance variation, accomplished as a rule with variometers or coupler of the type you speak, give a higher voltage variation than condenser tuning will. The drawback is as you describe; the tuning range is limited and you cannot cover the same scale as you can with a condenser. The inductance variation method also has higher losses than a good condenser tuned circuit unless it is very carefully constructed. At the risk of losing the reception of the very low wave stations, you can add a few more turns to either of the coils (stator preferred) and increase the efficiency of the set on the higher waves. It would be a good plan to use a basket-weave variometer in the circuit. It has low losses, and low distributed capacity, and at the same time because of its sharp tuning qualities, it will cover a greater wave length range than the ordinary composition, high leakage variometers. Your experiment sounds interesting, and logical. It might be a good plan for some of our

(Continued on next page)

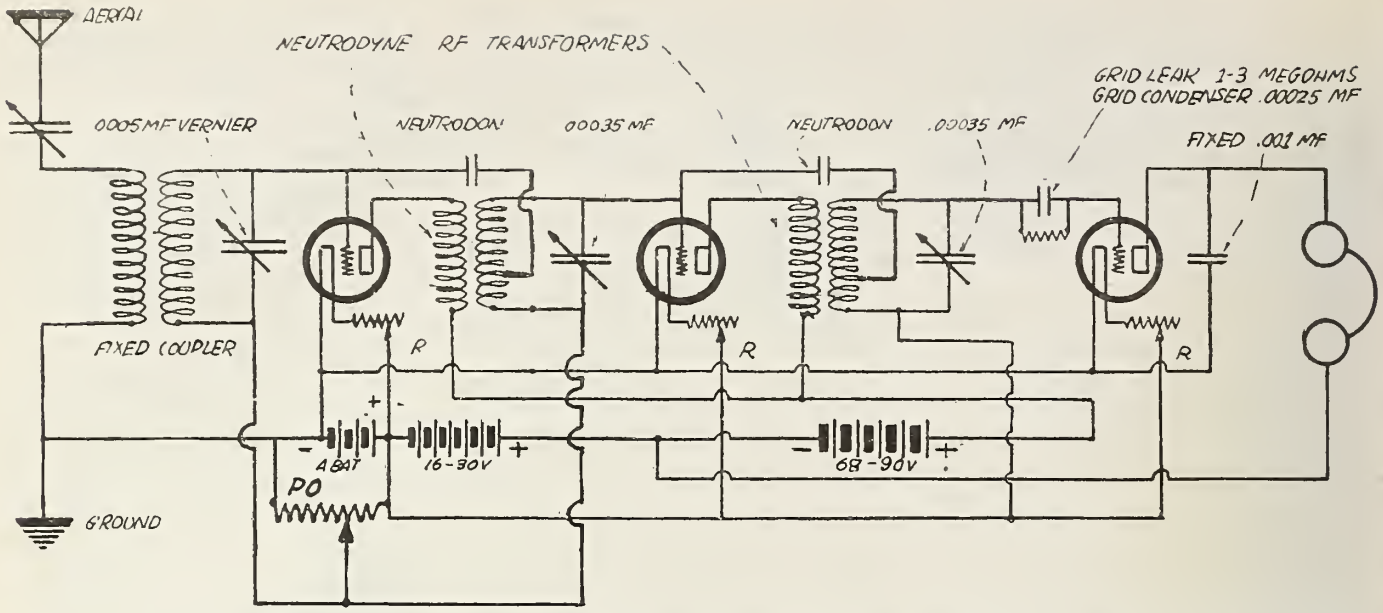


Figure 2. The above diagram shows how you can add a potentiometer to your neutrodyne receiver, and balance out any parasitic oscillations which may escape balancing by the regular neutrodons.

other readers to try out the scheme. If I am to judge by the number of letters from reader friends who have made radio frequency Reinartz circuits, I would say that the combination you list is not a popular one. For some reason or other, the regenerative component of the Reinartz won't mix with the radio frequency end, and usually fans who try out the idea find that the circuit only gives satisfaction over a small band of waves, due to the fact that the transformers used have a definite peak; i. e., they are tuned to one wave length at which they operate at maximum effectiveness. Then, too, I notice that they usually have to cut out the regenerative action with some kind of a switch or other before they get results. I would not recommend that one add the radio frequency. Make it two stages of audio instead, and keep the highly desirable features of the Reinartz as they should be kept.

H. C., New York, N. Y.

Question: I have a neutrodyne receiver on my hands that cannot be balanced under any circumstances. I have tried and tried, and yet cannot get it to work properly. The set squeals unmercifully when I tune the RF stages to resonance with the signals I want, and no amount of adjusting with the neutrodons will eliminate the trouble.

Answer: For those who have the misfortune of having a neutrodyne receiver on hand that won't neutralize, no matter how hard you try, I extend my sympathies. However, don't give it up. First of all, procure enough copper sheeting (the thickness is not important) to make four squares an inch and one-half on each side. Solder these squares to two small brass rods. Procure two double hole binding posts with holes large enough to mount the brass rods. Use these as neutrodons instead of the regular small ones supplied. More detail on this type of neutrodon can be had from the January, 1924, issue of RADIO AGE. Balance the receiver in the usual manner. If the set still refuses to balance properly, the remaining tube oscillations can be dispensed with by placing a potentiometer as shown in Figure 2. This makes the receiver a sort of a neutrodyne-tuned radio frequency receiver.

E. J., Washington, D. C.

Question: Please print a wiring diagram for a three tube set, showing one stage of transformer radio frequency amplification, detector and one stage of audio frequency amplification, using a variocoupler, variable condenser, three separate rheostats and a potentiometer.

Answer: I am printing in Figure 3 a circuit diagram showing the connections of the apparatus you list. It is a good idea to place a three plate variable condenser across the P and positive B posts of the radio frequency transformer or across the G and negative filament (potentiometer) connections of that transformer. This will permit you to vary the natural peak wave length of the transformer and will increase the wave length range of the circuit to an appreciable extent. This circuit will be most effective on a narrow band of wave lengths, depending upon the peak wave length of the radio frequency transformer. A good variable condenser should be used in the input circuit, one with metal end plates, with the rotor grounded. The stator plates should be connected to the grid. In non-regenerative circuits, this is of the highest importance. A good condenser *must* be used in a circuit of this type,

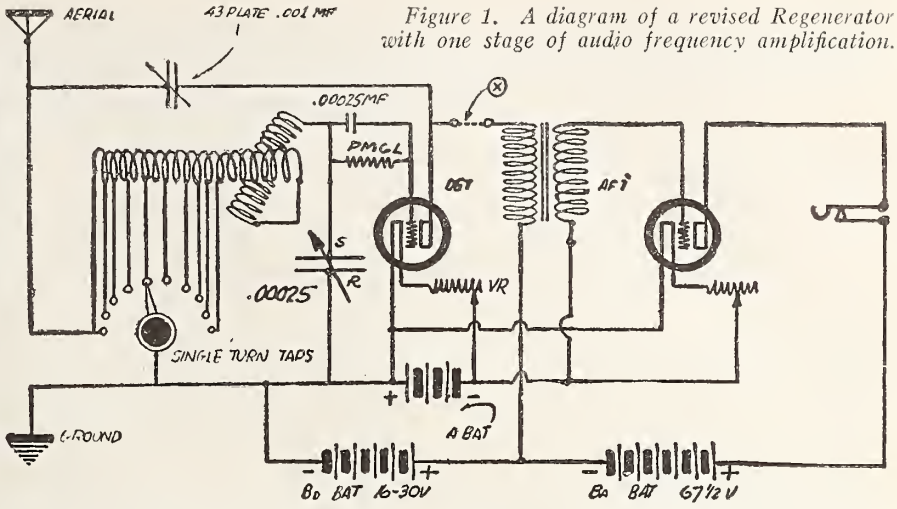


Figure 1. A diagram of a revised Regenerator with one stage of audio frequency amplification.

and the variocoupler coil should have as few losses as possible to make up a good receiver. I would also advise the use of a pencil mark grid leak.

V. A. B., Kokomo, Ind.

Question: From your February, 1924, issue, I built the Baby Heterodyne receiver, and I have with it enjoyed many receptions from long distance stations. I am now seeking to improve it. I already have two stages of audio which operates a loud speaker with wonderful volume on both long distance and local stations. I am now looking for a diagram showing how to add one stage of radio frequency to the hookup. Kindly print a diagram of the circuit with additions I desire. I would also like a list of parts necessary.

Answer: I am printing in Figure 5 a diagram of the Baby Heterodyne showing the addition of a stage of radio frequency. The only other parts you will need are as follows:

1 50 turn honeycomb coil.
1 23 plate .0005 MFD variable condenser.
1 200 to 400 ohm potentiometer.
1 tube UV199 or UV201A.
1 rheostat to suit tube.
1 tube socket.
Binding posts and other makeup.

In making up the radio frequency unit you must use an amplifier tube for the first stage of radio. You can use anything you like for the detector tube as long as it is not a WD11. For the radio frequency tube on the diagram, use a

(Continued on page 53)

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers and broadcasters.

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh	326
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270
KDPT	Southern Electrical Co.	San Diego, Calif.	244
KDYL	Telegram Publishing Co.	Salt Lake City, Utah	360
KDYM	Savoy Theatre	San Diego, Calif.	244
KDYQ	Oregon Institute of Technology	Portland, Oreg.	360
KDYX	Star Bulletin	Honolulu, Hawaii	360
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZE	Rhodes Department Store	Seattle, Wash.	270
KDZI	Electrie Supply Co.	Wenatchee, Wash.	360
KDZQ	Nichols Academy of Dancing	Denver, Colo.	360
KDZR	Bellingham Publishing Co.	Bellingham, Wash.	261
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	360
KFAE	State College of Washington	Pullman, Wash.	330
KFAF	Western Radio Corp.	Denver, Colo.	360
KFAJ	University of Colorado	Boulder, Colo.	360
KFAN	The Electrie Shop	Moscow, Idaho	360
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif.	280
KFAU	Independent School Dist. of Boise City, Boise High School, Boise, Idaho		270
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280
KFAY	W. J. Virgin	Medford, Oreg.	283
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Azbill	San Diego, Calif.	278
KFBE	Reuben H. Horn	San Luis Obispo, Calif.	242
KFBG	First Presbyterian Chureh	Tacoma, Wash.	360
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and the Chroniele News	Trinidad, Colo.	360
KFBU	The Cathedral (Bishop N. S. Thomas)	Laramie, Wyo.	283
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFCF	Frank A. Moore	Walla Walla, Wash.	360
KFCH	Electric Serviee Station (Inc.)	Billings, Mont.	360
KFCP	Ralph W. Flygare	Ogden, Utah	360
KFCV	Fred Mahaffey, Jr.	Houston, Texas	360
KFCY	Western Union College	Le Mars, Iowa	252
KFCZ	Omaha Central High School	Omaha, Nebr.	258
KFDA	Adler's Music Store	Baker, Oreg.	360
KFDD	St. Michaels Cathedral	Boise, Idaho	252
KFDH	University of Arizona	Tuscon, Ariz.	368
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	360
KFDO	H. Everett Cutting	Bozeman, Mont.	248
KFDR	Bullocks' Hardware & Sporting Goods (Rob. G. Bullock)	York, Nebr.	360
KFDV	Gilbreck & Stinson	Fayetteville, Ark.	360
KFDX	First Baptist Church	Shreveport, La.	360
KFDY	South Dakota State College of Agrieulture and Mechanics Arts	Brookings, S. Dak.	360
KFDZ	Harry O. Iverson	Minneapolis Minn.	231
KFEC	Meier & Frank Co.	Portland, Oreg.	360
KFEL	Winner Radio Corp.	Denver, Colo.	254
KFEQ	J. L. Scroggin	Oak, Nebr.	360
KFER	Auto Electrie Service Co.	Fort Dodge, Iowa	231
KFEV	Radio Electrie Shop	Douglas, Wyo.	263
KFEX	Augsburg Seminary	Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining and Concentrating Co.	Kellogg, Idaho	360
KFEZ	Asso, Engr. Societies of St. Louis	St. Louis, Mo.	248
KFFB	Jenkins Furniture Co.	Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.	Pendleton, Oreg.	360
KFFO	Dr. E. H. Smith	Hillsboro, Oreg.	229
KFFP	First Baptist Church	Moberly, Mo.	266
KFFQ	Marksheffel Motor Co.	Colorado Springs, Colo.	286
KFFR	Nevada State Journal (Jim Kirk)	Sparks, Nev.	226
KFFV	Graeeland College	Lamoni, Iowa	360
KFFX	McGraw Co.	Omaha, Nebr.	278
KFFY	Pineus & Murphy	Alexandria, La.	275
KFFZ	Al. G. Barnes Amusement Co.	Dallas, Tex. (portable)	226
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	273
KFGL	Arlington Garage	Arlington, Oreg.	234
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFGV	Heidbreder Radio Supply Co.	Utiea, Nebr.	224
KFGX	First Presbyterian Church	Orange, Tex.	250
KFGZ	Emmanuel Missionary College	Berrien Springs, Mieh.	268
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHB	Rialto Theater (P. L. Beardwell)	Hood River, Oreg.	280
KFHD	Utz Electrie Shop Co.	St. Joseph, Mo.	226
KFHF	Central Christian Church	Shreveport, La.	266
KFHH	Ambrose A. McCue	Neah Bay, Wash.	283
KFHJ	Fallon & Co.	Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.	Seattle, Wash.	270
KFHX	Robert W. Nelson	Hutchinson, Kan.	229
KFI	Earle C. Anthony (Ine.)	Los Angeles, Calif.	469
KFID	Ross Arbuckle's Garage	Iola, Kans.	246
KFIF	Benson Polyteehnie Institute	Portland, Oregon	360
KFIL	Windisch Electric Farm Equipment Co.	Louisburg, Kans.	234
KFIO	North Central High School	Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association	Yakima, Wash.	224
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIV	V. H. Broyles	Pittsburg, Kans.	240
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huelsman	Fon Du Lac, Wis.	273
KFJB	Marshall Eleetrical Co.	Marshalltown, Iowa	248
KFJC	Seattle Post Intelligeneer	Seattle, Wash.	233
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	252
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg.	252
KFJK	Delano Radio and Electric Co.	Bristow, Okla.	233
KFJL	Hardsacg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	229
KFJQ	Valley Radio, Div. of Elee. Constr. Co.	Grand Forks, N. D.	280
KFJR	Ashley C. Dixon & Son	Stevensville, Mont. (near)	258
KFJV	Thomas H. Warren	Dexter, Iowa	224
KFJX	Iowa State Teachers' College	Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	248
KFJZ	Texas National Guard, One hundred and twelfth Cavalry	Fort Worth, Texas	254
KFKA	Colorado State Teachers College	Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association	Milford, Kans.	286
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark.	224
KFKV	F. F. Gray	Butte, Mont.	283
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	286
KFKZ	Nassour Bros. Radio Co.	Colorado Springs, Colo.	234
KFLA	Abner R. Willson	Butte, Mont.	283
KFLB	Signal Electrie Manufaeturing Co.	Menominee, Mieh.	248
KFLD	Paul E. Greenlaw	Frankliuton, La.	234
KFLE	National Educational Serviee	Denver, Colo.	268
KFLH	Erickson Radio Co.	Salt Lake City, Utah	261
KFLP	Everette M. Foster	Cedar Rapids, Iowa	240
KFLQ	Bizzell Radio Shop	Little Rock, Ark.	261
KFLR	University of New Mexico	Albuquerque, N. Mex.	254
KFLU	Rio Grande Radio Supply House	San Benito, Texas	236
KFLV	Rev. A. T. Frykman	Rockford, Ill.	229
KFLW	Missoula Electrie Supply Co.	Missoula, Mont.	234
KFLX	George Roy Clough	Galveston, Tex.	240
KFLY	Fargo Radio Supply Co.	Fargo, N. Dak.	231
KFLZ	Atlantie Automobile Co.	Atlantic, Ia.	273
KFMQ	University of Arkansas	Fayetteville, Ark.	263
KFMR	Morningside College	Sioux City, Iowa	261
KFMS	Freimuth Dept. Store	Duluth, Minn.	275
KFMT	Dr. George W. Young	Minneapolis, Minn.	231
KFMU	Stevens Bros.	San Mareo, Tex.	240
KFMW	M. G. Sateren	Houghton, Mieh.	266
KFMX	Carleton College	Northfield, Minn.	283
KFMY	Boy Scouts of America	Long Beach, Calif.	229
KFMZ	Roswell Broadcasting Club	Roswell, N. M.	252
KFNC	Alonzo Monk, Jr.	Corsicana, Texas	234
KFNF	Henry Field Seed Co.	Shenandoah, Iowa	266
KFNG	Wooten's Radio Shop	Coldwater, Miss.	254
KFNH	State Teachers College	Springfield, Mo.	236
KFNJ	Warrensburg Electrie Shop	Warrensburg, Mo.	234
KFNL	Radio Broadcast Ass'n.	Paso Robles, Calif.	240
KFNV	L. A. Drake Battery and Radio Supply Shop.	Santa Rosa, Calif.	234
KFNX	Peabody Radio Service	Peabody, Kansas	240
KFNY	Montana Phonograph Co.	Helena, Montana	261
KFNZ	Royal Radio Company	Burlingame, Calif.	231
KFOC	First Christian Chureh	Whittier, Calif.	236
KFOD	Vern Peters	Wallace, Idaho	224
KFOF	Rohrer Electrie Co.	Marshfield, Oregon	240
KFOH	The Radio Bungalow	Portland, Oregon	283
KFOJ	Moberly High School Radio Club.	Moberly, Missouri	246
KFOL	Leslie M. Schafbush	Marengo, Iowa	234
KFON	Echophone Radio Shop	Long Beach, Calif.	234
KFOO	Latter Day Saints University	Salt Lake City, Utah	261
KFOP	Willson Construction Co.	Dallas, Texas	268
KFOQ	Ora William Chancellor	Galveston, Texas	240
KFOR	David City Tire & Electric Co.	David City, Nebraska	226
KFOT	College Hill Radio Club	Wichita, Kansas	231
KFOU	Hommel Mfg. Co.	Richmond, Calif.	254
KFOV	Davis Electrical Corporation	Sioux City, Iowa	234
KFOX	Board of Education, Technical High School	Omaha, Nebraska	248
KFOY	Beacon Radio Service	St. Paul, Minn.	226
KFOZ	Leon Hudson Real Estate Co.	Fort Smith, Ark.	233
KFPB	Edwin J. Brown	Seattle, Wash.	224
KFPG	Garretson and Dennis	Los Angeles, Calif.	238
KFPH	Harold Chas. Mailander	Salt Lake City, Utah	242
KFPL	C. C. Baxter	Dublin, Texas	242
KFPM	The New Furniture Co.	Greenville, Texas	242
KFPN	Missouri National Guard	Jefferson City, Mo.	242
KFPP	G. & G. Radio & Electric Shop.	Olympia, Washington	236
KFPQ	Clifford M. Esler	Denison, Texas	231
KFPR	Los Angeles Co. Forestry Dept.	Los Angeles, Calif.	231
KFPS	Carter A. Ross Motor Service Co.	Casper, Wyo.	242
KFPV	Heintz & Kohlmoos, Inc.	San Francisco, Calif.	236
KFPW	St. Johns M. E. Church, S.	Carterville, Mo.	268
KFPY	Symons Investment Co.	Spokane, Wash.	283
KFPX	First Presbyterian Church	Pine Bluff, Ark.	242
KFQA	The Principia	St. Louis, Mo.	261
KFQB	The Searchlight Publishing Co	Fort Worth, Tex.	254
KFQC	Kidd Brothers Radio Shop.	Taft, Calif.	227
KFQD	Chovin Supply Co.	Anchorage, Alaska	280
KFQE	Dickenson-Henry Radio Laboratories	Colorado Springs, Colo.	224
KFQF	Donald A. Boult	Minneapolis, Minn.	224
KFQG	Southern Calif. Radio Ass'n	Los Angeles, Calif.	226
KFQH	Albert Sherman	Hillsbourgh, Cal.	231
KFQI	The Thos. H. Ince Corp.	Culver City, Calif.	234
KFQG	Angelus Temple	Los Angeles, Calif.	278
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service	Portland, Oreg.	360
KGN	Northwestern Radio Mfg. Co.	Portland, Oreg.	360
KGO	General Electrie Co.	Oakland, Calif.	312
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach	360
KGW	Portland Morning Oregonian	Portland, Oreg.	492
KGY	St. Martins College (Reb. Sebastian Ruth)	Lacy, Wash.	258
KHJ	Times-Mirror Co.	Los Angeles, Calif.	395
KHQ	Louis Wasmer	Seattle, Wash.	360
KJQ	C. O. Gould	Stockton, Calif.	360
KJR	Northwest Radio Service Co.	Seattle, Wash.	270
KJS	Bible Institute of Los Angeles	Los Angeles, Calif.	360
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	360
KLX	Trihune Puhlishing Co.	Oakland, Calif.	509
KLZ	Reynolds Radio Co.	Denver, Colo.	283
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif.	273
KMO	Love Electric Co.	Tacoma, Wash.	360
KNT	Grays Harbor Radio Co. (Walter Hemrich)	Aberdeen, Wash.	263
KNX	Electric Lighting Supply Co.	Los Angeles, Calif.	360
KOB	New Mexieo College of Agriculture & Meehanie Arts	State College, N. Mex.	360
KOP	Detroit Poliee Department	Detroit, Mich.	286
KPO	Hale Bros.	San Francisco, Calif.	423
KQP	Apple City Radio Club.	Hood River, Oreg.	360
KQV	Doubleday-Hill Electric Co.	Pittshurgh, Pa.	360
KQW	Charles D. Herrold	San Jose, Calif.	360
KRE	V C Battery & Electric Co.	Berkeley, Calif.	278
KSD	Post Dispatch (Pulitzer Puh. Co.)	St. Louis, Mo.	546
KTW	First Preshyterian Church	Seattle, Wash.	360
KUO	Examiner Printing Co.	San Francisco, Calif.	360
KUY	Coast Radio Co.	El Monte, Calif.	256
KWG	Portahle Wireless Telephone Co.	Stockton, Calif.	360
KWH	Los Angeles Examiner	Los Angeles, Calif.	360
KYQ	Electrie Shop	Honolulu, Hawaii	270
KYW	Westinghouse Electrie & Mfg. Co.	Chicago, Ill.	536
KZM	Preston D. Allen	Oakland, Calif.	360
KZN	Cope and Johnson Co.	Salt Lake City, Utah	268
KZV	Wenatchee Battery & Motor Co.	Wenatchee, Wash.	360
WAAB	Valdemar Jensen	New Orleans, La.	268
WAAC	Tulane University	New Orleans, La.	360
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	286
WAAK	Gimbel Brothers	Milwaukee, Wis.	280
WAAM	I. R. Nelson Co.	Newarck, N. J.	263
WAAN	University of Missouri	Columbia, Mo.	254
WAAW	Omaha Grain Exchange	Omaha, Nebr.	360
WABA	Lake Forest College	Lake Forest, Ill.	266

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Corrected List of U. S., Cuban and Canadian Broadcasting Stations

WABB	Harrisburg Sporting Goods Co	Harrisburg, Pa	266
WABD	Parker High School	Dayton, Ohio	283
WABE	Young Men's Christian Association	Washington, D. C	283
WABG	Arnold Edwards Piano Co	Jacksonville, Fla	248
WABH	Lake Shore Tire Co	Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co	Bangor, Me	240
WABL	Connecticut Agricultural College	Storrs, Conn	283
WABM	F. E. Doherty Automotive and Radio Equipment Co	Saginaw, Mich	254
WABN	Waldo C. Grover	La Crosse, Wis	244
WABO	Lake Avenue Baptist Church	Rochester, N. Y.	252
WABP	Robert F. Weinig	Dover, Ohio	266
WABQ	Haverford College, Radio Club	Haverford, Pa.	261
WABR	Scott High School, N. W. B. Foley	Toledo, Ohio	270
WABS	Essex Manufacturing Co	Newark, N. J.	244
WABT	Holiday-Hall, Radio Engineers	Washington, Pa.	252
WABU	Victor Talking Machine Co	Camden, N. J.	226
WABV	John H. De Witt, Jr	Nashville, Tenn.	263
WABW	College of Wooster	Wooster, Ohio	234
WABX	Henry B. Joy	Mt. Clemens, Mich.	270
WABY	John Magaldi, Jr	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	263
WBAA	Purdue University	West Lafayette, Ind.	360
WBAH	The Dayton Co	Minneapolis, Minn.	417
WBAN	Wireless Phone Corp	Paterson, N. J.	244
WBAO	James Millikin University	Decatur, Ill.	360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co	Columbus, Ohio	390
WBAX	John H. Stenger, Jr	Wilkes-Barre, Pa.	360
WBAY	Western Electric Co	New York, N. Y.	492
WBBA	Newark Radio Laboratories	Newark, Ohio	240
WBBD	Barbey Battery Service	Reading, Pa.	234
WBBE	Alfred R. Marcy	Syracuse, N. Y.	246
WBBF	Georgia School of Technology	Atlanta, Ga.	270
WBBG	Irving Vermilya	Mattapoisett, Mass.	240
WBBH	J. Irving Bell	Port Huron, Mich.	246
WBBJ	Neal Electric Co., P. E. Neal	West Palm Beach, Fla.	258
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	283
WBBM	Frank Atlass Produce Co	Lincoln, Ill.	225
WBBN	Blake, A. B.	Wilmington, N. C.	275
WBBO	Mich. Limestone & Chemical Co	Rogers, Mich.	250
WBBQ	Frank Crook	Pawtucket, R. I.	252
WBBR	Peoples Pulpit Asso	Rossville, N. Y.	244
WBBS	First Baptist Church	New Orleans, La.	250
WBBT	Lloyd Brothers	Philadelphia, Pa.	234
WBBU	Jenks Motor Sales Co	Monmouth, Ill.	224
WBBV	Johnstown Radio Co	Johnstown, Pa.	248
WBBW	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Infantry, Co. "B" 118th Inf.	Charleston, S. C.	268
WBBZ	Nohle B. Watson	Indianapolis, Ind.	227
WBL	T & H Radio Co	Anthony, Kans.	261
WBR	Pennsylvania State Police	Butler, Pa.	286
WBS	D. W. May, Inc	Newark, N. J.	360
WBT	Southern Radio Corp	Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co	Springfield, Mass.	337
WCAD	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co	Pittsburgh, Pa.	462
WCAG	Clyde R. Randall	New Orleans, La.	268
WCAH	Entrekin Electric Co	Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	360
WCAK	Alfred P. Daniel	Houston, Texas	263
WCAL	St. Olaf College	Northfield, Minn.	360
WCAM	Villanova College	Villanova, Pa.	360
WCAO	Sanders & Stayman Co	Baltimore, Md.	360
WCAP	Chesapeake & Potomac Telephone Co	Washington, D. C.	469
WCAR	Alamo Radio Electric Co	San Antonio, Tex.	360
WCAS	William Hood Dunwoody Industrial Institute	Minneapolis, Minn.	246
WCAT	South Dakota State School of Mines	Rapid City, S. Dak.	240
WCAU	Durham & Co	Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co	Little Rock, Ark.	360
WCAX	University of Vermont	Burlington, Vt.	360
WCAZ	Carthage College	Carthage, Ill.	246
WCBA	Charles W. Heimbach	Allentown, Pa.	280
WCBC	University of Michigan	Ann Arbor, Mich.	280
WCBD	Wilbur G. Voliva	Zion, Ill.	345
WCBE	Uhalt Radio Co	New Orleans, La.	263
WCBF	Paul J. Miller	Pittsburgh, Pa.	236
WCBG	Howard S. Williams (Portable)	Pascagoula, Miss.	236
WCBI	Nicoll, Duncan & Rush	Bemis, Tennessee	226
WCBJ	J. C. Maus	Jennings, Louisiana	244
WCBK	E. Richard Hall	St. Petersburg, Fla.	266
WCBL	Northern Radio Mfg. Co	Houlton, Me.	280
WCBM	Charles Swarz	Baltimore, Md.	229
WCBN	James P. Boland	Ft. Benj. Harrison, Ind.	266
WCBO	The Radio Shop, Inc	Memphis, Tenn.	250
WCBQ	First Baptist Church	Nashville, Tenn.	236
WCBR	University of Mississippi	near Oxford, Miss.	242
WCBR	Charles H. Meester (Portable Station)	Providence, R. I.	246
WCBT	Clark University, Collegiate Dept	Worcester, Mass.	238
WCBU	Arnold Wireless Supply Co	Arnold, Pa.	254
WCBV	Tullahoma Radio Club	Tullahoma, Tenn.	252
WCBW	George P. Rawkin, Jr. and Maitland Soloman	Macon, Ga.	226
WCBX	Radio Shop of Newark (Herman Luhinsky)	Newark, N. J.	233
WCBY	The Forks Electrical Shop	Buck Hill Falls, Pa.	268
WCBZ	Coppotelli Bros. Music House	Chicago Heights, Ill.	248
WCK	Stix, Baer & Fuller Dry Goods Co	St. Louis, Mo.	360
WCM	University of Texas	Austin, Texas	360
WCX	Detroit Free Press	Detroit, Mich.	517
WDAE	Tampa Daily Times	Tampa, Fla.	360
WDAF	Kansas City Star	Kansas City, Mo.	411
WDAG	J. Laurence Martin	Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South)	El Paso, Tex.	268
WDAK	The Courant	Hartford, Conn.	261
WDAO	Automotive Electric Co	Dallas, Tex.	360
WDAP	Board of Trade	Chicago, Ill.	360
WDAR	Lit Brothers	Philadelphia, Pa.	395
WDAS	Samuel A. Waite	Worcester, Mass.	360
WDAU	Slocum Kilburn	New Bedford, Mass.	360
WDAY	Radio Equipment Corp	Fargo, N. Dak.	244
WDBA	Fred Ray	Columbus, Ga.	236
WDBB	A. H. White & Co., Inc	Taunton, Mass.	229
WDBC	Kirk, Johnson & Co	Lancaster, Pa.	258
WDBD	Herman Edwin Burns	Martinsburg, W. Va.	268
WDBE	Gilham-Schoen Electric Co	Atlanta, Ga.	252
WDBF	Robert G. Phillips	Youngstown, Ohio.	246
WDBH	C. T. Scherer Co	Worcester, Mass.	268
WDBI	Radio Specialty Co	St. Petersburg, Fla.	226
WDBJ	Richardson Wayland Electric Corp	Roanoke, Va.	229
WDBK	M. F. Broz Radio Co	Cleveland, Ohio	248
WDBL	Wisc. Dept. of Markets	Stevens Point, Wisc.	278
WDBN	Electric Light & Power Co	Bangor, Mc.	252
WDBO	Rollins College, Inc	Winter Park, Fla.	240
WDBP	Superior State Normal School	Superior, Wis.	261
WDBQ	Morton Radio Supply Co	Salem, N. J.	234
WDBR	Tremont Temple Baptist Church	Boston, Mass.	256
WDBS	S. M. K. Radio Corp	Dayton, Ohio	283
WDBT	Taylor's Book Store	Hattlesburg, Miss.	236
WDBU	Somerset Radio Co	Skowhegan, Maine	258
WDBV	The Quimby Enterprises, The Strand Theatre	Fort Wayne, Ind.	258
WDM	Church of the Covenant	Washington, D. C.	234
WDZ	James L. Bush	Tuscola, Ill. Star Store Bldg.	278
WEAA	F. D. Fallain	Flint, Mich.	280
WEAF	American Telephone & Telegraph Co	New York, N. Y.	492
WEAH	Wichita Board of Trade	Wichita, Kans.	244
WEAI	Cornell University	Ithaca, N. Y.	286
WEAJ	University of South Dakota	Vermillon, S. Dak.	283
WEAM	Borough of North Plainfield (W. Gibson Buttfield)	North Plainfield, N. J.	252
WEAN	Shepard Co	Providence, R. I.	273
WEAO	Ohio State University	Columbus, Ohio	360
WEAP	Mobile Radio Co	Mobile, Ala.	360
WEAR	The Evening News Publishing Co	Baltimore, Md.	261
WEAU	Davidson Bros. Co	Sioux City, Iowa	360
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Texas	360
WEB	Benwood Co	St. Louis, Mo.	273
WEBH	Zenith-Edgewater Beach Broadcasting Station	Chicago, Ill.	370
WEV	Hurlburt-Still Electrical Co	Houston, Texas	360
WEW	St. Louis University	St. Louis, Mo.	261
WFAA	Dallas News & Dallas Journal	Dallas, Texas	476
WFAB	Carl F. Woese	Syracuse, N. Y.	234
WFAF	H. C. Spratley Radio Co	Poughkeepsie, N. Y.	360
WFAH	Electric Supply Co	Port Arthur, Texas	236
WFAJ	Hi-Grade Wireless Instrument Co	Asheville, N. C.	360
WFAM	Times Publishing Co	St. Cloud, Minn.	360
WFAN	Hutchinson Electric Service Co	Hutchinson, Minn.	360
WFAQ	Missouri Wesleyan College	Cameron, Mo.	360
WFAT	New Columbus College	Sioux Falls, S Dak.	258
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr.	275
WFBW	Ainsworth-Gates Radio Co	Cincinnati, Ohio	309
WFI	Strawbridge & Clothier	Philadelphia, Pa.	395
WGAL	Lancaster Electric Supply & Construction Co	Lancaster, Pa.	248
WGAN	Cecil E. Lloyd	Pensacola, Fla.	360
WGAQ	Glenwood Radio Corp. (W. G. Patterson)	Shreveport, La.	252
WGAW	Ernest C. Albright	Altoona, Pa.	261
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGI	American Radio & Research Corp	Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett	Philadelphia, Pa.	360
WGN	Chicago Tribune Broadcasting Station	Chicago, Ill.	360
WGR	Federal Telephone & Telegraph Co	Buffalo, N. Y.	319
WGV	Interstate Electric Co	New Orleans, La.	242
WGY	General Electric Co	Schenectady, N. Y.	380
WHA	University of Wisconsin	Madison, Wis.	360
WHAA	State University of Iowa	Iowa City, Iowa	484
WHAB	Clark W. Thompson	Galveston, Texas	360
WHAD	Marquette University	Milwaukee, Wis.	280
WHAG	University of Cincinnati	Cincinnati, Ohio	222
WHAH	Hafer Supply Co	Joplin, Mo.	283
WHAK	Roberts Hardware Co	Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y.	283
WHAP	Otta & Kuhns	Decatur, Ill.	360
WHAR	Paramount Radio & Electric Co. (W. H. A. Pulus)	Atlantic City, N. J.	231
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAV	Wilmington Electrical Specialty Co	Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	380
WHB	Sweeney School Co	Kansas City, Mo.	411
WHK	Radiovox Co. (Warren R. Cox)	Cleveland, Ohio	360
WHN	George Schubel	New York, N. Y.	360
WHO	Bankers Life Company	Des Moines, Iowa	526
WIAB	Joslyn Automobile Co	Rockford, Ill.	252
WIAC	Galveston Tribune	Galveston, Texas	360
WIAD	Howard R. Miller	Ocean City, N. J.	254
WIAF	Gustav A. DeCortin	New Orleans, La.	234
WIAH	Continental Radio & Mfg. Co	Newton, Iowa	258
WIAI	Heey Stores Co	Springfield, Mo.	252
WIAJ	Fox River Valley Radio Supply Co. (Quinn Bros.)	Neenah, Wis.	224
WIAK	Journal-Stockman Co	Omaha, Nebr.	278
WIAO	School of Engineering of Milwaukee	Milwaukee, Wis.	246
WIAQ	Chronicle Publishing Co	Marion, Ind.	226
WIAS	Home Electric Co	Burlington, Iowa	283
WIAT	Leon T. Noel	Tarkio, Mo.	360
WIAU	American Trust & Savings Bank	Le Mars, Iowa	360
WIAY	Woodward & Lothrop	Washington, D. C.	273
WIK	K. & L. Electric Co. (Herbert F. Kelso and Hunter J. Lohman)	McKeesport, Pa.	234
WIL	Continental Electric Supply Co	Washington, D. C.	360
WIP	Gimbel Brothers	Philadelphia, Pa.	509
WJAB	American Electric Co	Lincoln, Neb.	229
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	360
WJAG	Norfolk Daily News	Norfolk, Nebr.	283
WJAK	Clifford L. White	Greentown, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAN	Peoria Star	Peoria, Ill.	280
WJAQ	Capper Publications	Topeka, Kans.	360
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	250
WJAT	Kelly-Vawter Jewelry Co	Marshall, Mo.	360
WJAX	Union Trust Co	Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	448
WJD	Richard H. Howe	Granville, Ohio	229
WJX	Deforest Radio Telephone & Telegraph Co	New York, N. Y.	360
WJY	R. C. A.	New York, N. Y.	405
WJZ	R. C. A.	New York, N. Y.	455
WKAA	H. F. Paar	Cedar Rapids, Iowa	268
WKAD	Chas. Looff (Crescent Park)	East Providence, R. I.	240
WKAE	W. S. Radio Supply Co	Wichita Falls, Texas	360
WKAN	United Battery Service Co	Montgomery, Ala.	226
WKAP	Dutee W. Flint	Cranston, R. I.	360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	360
WKAR	Michigan Algriculture College	East Lansing, Mich.	280
WKAS	L. E. Lines Music Co	Springfield, Mo.	360
WKAV	Laconia Radio Club	Laconia, N. H.	254
WKAY	Brenau College	Gainesville, Ga.	280
WKY	WKY Radio Shop	Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corp	Minneapolis, Minn.	417
WLAH	Samuel Woodworth	Syracuse, N. Y.	234
WLAJ	Waco Electrical Supply Co	Waco, Texas	360
WLAK	Vermont Farm Machine Corp	Bellows Falls, Vt.	360
WLAL	Naylor Electrical Co	Tulsa, Okla.	360
WLAP	W. V. Jordon	Louisville, Ky.	360
WLAQ	Arthur E. Shilling	Kalamazoo, Mich.	283
WLAV	Electric Shop	Pensacola, Fla.	254
WLAW	Police Dept., City of New York	New York, N. Y.	360
WLAX	Putnam Electric Co. (Greencastle Community Broadcasting Station)	Greencastle, Ind.	231
WLB	University of Minnesota	Minncapolis, Minn.	360
WLS	Sears, Roebuck Co	Chicago, Ill.	345
WLW	Crosley Manufacturing Co	Cincinnati, Ohio	309
WMAB	Radio Supply Co	Oklahoma, Okla.	360
WMAC	J. Edw. Page (Olive B. Meredith)	Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp	Dartmouth, Mass.	360
WMAH	General Supply Co	Lincoln, Nebr.	254
WMAJ	Drovers Telegram Co	Kansas City, Mo.	275
WMAK	Norton Laboratories	Lockport, N. Y.	273
WMAL	Trenton Hardware Co	Trenton, N. J.	256
WMAN	First Baptist Church	Columbus, Ohio	286
WMAP	Utility Battery Service	Easton, Pa.	246
WMAQ	Chicago Daily News	Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute	Auburn, Ala.	250
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	280
WMAZ	Mercer University	Macon, Ga.	261
WMC	"Commercial Appeal" (Commercial Publishing Co.)	Memphis, Tenn.	500
WMH	Precision Equipment Co	Cincinnati, Ohio	248
WMU	Doubleday-Hill Electric Co	Washington, D. C.	261
WNAC	Shepard Stores	Boston, Mass.	278
WNAD	University of Oklahoma	Norman, Okla.	360
WNAL	R. J. Rockwell	Omaha, Nebr.	242
WNAM	Ideal Apparatus Co	Evansville, Ind.	360
WNAN	Syracuse Radio Telephone Co	Syracuse, N. Y.	286
WNAP	Wittenberg College	Springfield, Ohio	231
WNAQ	Charleston Radio Electric Co	Charleston, S. C.	360
WNAR	C. C. Rhodes	Butler, Mo.	231
WNAS	Texas Radio Corp. & Austin Statesman	Austin, Texas	360
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa.	360
WNAV	Peoples Telephone & Telegraph Co	Knoxville, Tenn.	236
WNAW	Peninsular Radio Club (Henry Kunzmann)	Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co	Yankton, S. Dak.	244
WNJ	Shotton Radio Manufacturing Co	Albany, N. Y.	360

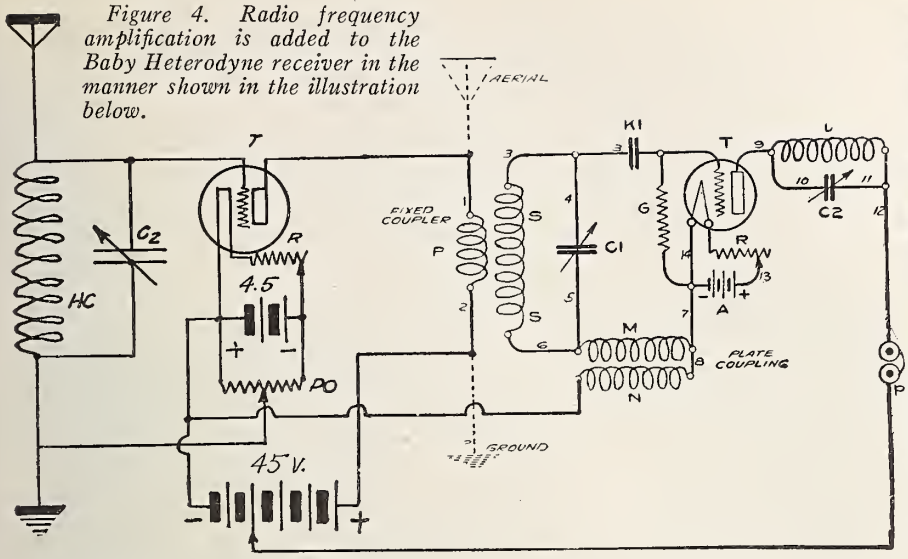


Figure 4. Radio frequency amplification is added to the Baby Heterodyne receiver in the manner shown in the illustration below.

The Trouble Shooter

(Continued from page 49)

UV201A or UV199. The UV199 works exceptionally well as a radio frequency amplifier. A potentiometer must be used as shown, in order to keep the radio tube from oscillating. It maintains a positive bias on the grid of sufficient strength to keep the free oscillation (howling) of the tube from distorting the signal. Use 45 volts B battery on the tube as shown. Higher voltages do not greatly increase the efficiency of the circuit, but do add greatly to the life of the B battery, upon which there is a considerable drain.

These questions are picked from the steady quota of mail which arrives daily. Technical service is free to all those who carefully observe the rules and requirements set down in the announcement printed in this issue. Use the department for your problems, but don't forget to comply with the rules. Letters that do not follow the required lines cannot be answered.—Technical Editor.

Three Chicago Stations Change

Three Chicago broadcasting stations have been affected by shifting and shake-ups during the past month.

The stations are WGN, WDAP and the old WJAZ. When the shifters got through with their work, WDAP had passed out of existence, WJAZ was tabled for a time, and a new station, WEBH, had entered the ethereal activities.

The change follows the sale of the equipment at the Edgewater Beach station by Eugene F. McDonald Jr., president of the Zenith Radio corporation, to W. H. Dewey, manager of that hotel. The rearrangement, it is hoped, will go a long way toward clarifying the ether of interference and will be a move welcomed by the fans.

The Chicago Tribune succeeds the Board of Trade in control of the station at the Drake Hotel, hitherto known as WDAP. Those call letters passed into radio history and the call letters at the Drake will be WGN.

The Board of Trade has relinquished control of the station but the service furnished by it—crop and market reports, weather forecasts and standard time signals—will be continued in addition to the Drake features—Jack Chapman's orchestra, Drake concert ensemble, Blackstone quintet and the Barton organ programs.

WGN will be under the microphone guidance of two of the country's best known announcers, "Sen" Kaney and Jack Nelson.

Mr. McDonald's decision to sell the station at the Edgewater Beach was made early this month. He offered Mr. Dewey the opportunity to purchase it and was accepted. Mr. Dewey plans to continue its operation as the Edgewater Beach Station under the call letters WEBH.

Mr. McDonald reassumes control of the old call letters of the Edgewater Beach—WJAZ—by which that station was known from the time it was established, May 12, 1923, until it was taken over by the Tribune last March. These letters will be used temporarily at the Zenith experimental station on the McCormick building, but later Mr. McDonald plans to establish a broadcasting station in some outlying section with a studio in the downtown district.

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

WOAA	Dr. Walter Hardy	Ardmore, Okla.	360
WOAC	Maus Radio Co.	Lima, Ohio	266
WOAD	Friday Battery & Electric Corp.	Sigourney, Iowa	360
WOAE	Midland College	Fremont, Nebr.	360
WOAF	Tyler Commercial College	Tyler, Texas	360
WOAG	Apollo Theater (Belvedere Amusement Co.)	Belvedere, Ill.	224
WOAH	Palmetto Radio Corp.	Charleston, S. C.	360
WOAI	Southern Equipment Co.	San Antonio, Texas	385
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	360
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	360
WOAP	Kalamazoo College	Kalamazoo, Mich.	240
WOAQ	Portsmouth Kiwanis Club	Portsmouth, Va.	360
WOAR	Henry P. Lundskow	Kenosha, Wis.	229
WOAT	Boyd M. Hamp	Wilmington, Del.	360
WOAV	Pennsylvania National Guard, 2d Battalion, 112th Infantry	Erie, Pa.	242
WOAW	Woodmen of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOI	Iowa State College	Ames, Iowa	360
WOK	Pine Bluff Co.	Pine Bluff, Ark.	360
WOO	John Wanamaker	Philadelphia, Pa.	509
WOQ	Western Radio Co.	Kansas City, Mo.	360
WOR	L. Bamberger & Co.	Newark, N. J.	405
WOS	Missouri State Marketing Bureau	Jefferson City, Mo.	441
WPAB	Pennsylvania State College	State College, Pa.	283
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	360
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College	Agricultural College, N. Dak.	360
WPAL	Superior Radio & Telephone Equipment Co.	Columbus, Ohio	286
WPAM	Auerbach & Guettel	Topeka, Kans.	360
WPAP	Theodore D. Phillips	Winchester, Ky.	360
WPAR	Ward Battery and Radio Co.	Beloit, Kans.	236
WPAT	St. Patrieks Cathedral	El Paso, Texas	360
WPAU	Concordia College	Moorhead, Minn.	360
WPAZ	John R. Koch (Dr.)	Charleston, W. Va.	273
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	360
WQAC	E. B. Gish	Amarillo, Texas	234
WQAD	Whitall Electrie Co.	Waterbury, Conn.	242
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275
WQAF	Sandusky Register	Sandusky, Ohio	240
WQAL	Coles County Telephone & Telegraph Co.	Mattoon, Ill.	258
WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Chureh	New York, N. Y.	360
WQAQ	Abilene Daily Reporter (West Texas Radio Co.)	Abilene, Texas	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAX	Radio Equipment Co.	Peoria, Ill.	360
WQJ	Calumet Baking Powder—Rainbow Gardens Station.	Chicago, Ill.	448
WRAA	Rice Insitute	Houston, Texas	369
WRAF	The Radio Club (Inc.)	Laporte, Ind.	224
WRAH	Stanley N. Read	Providence, R. I.	231
WRAL	Northern States Power Co.	St. Croix Falls, Wis.	418
WRAM	Lombard College	Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	236
WRAO	Radio Serviee Co.	St. Louis Mo.	360
WRAV	Antioeh College	Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRAY	Radio Sales Corp.	Scranton, Pa.	280
WRBC	Imanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corporation of America	Washington, D. C.	469
WRH	Chicago Herald & Examiner	Chicago, Ill.	536
WRK	Doron Bros. Electrie Co.	Hamilton, Ohio	360
WRL	Union College	Schenectady, N. Y.	360
WRM	University of Illinois	Urbana, Ill.	360
WRR	City of Dallas (police and fire signal department)	Dallas, Texas	360
WRW	Tarrytown Radio Research Laboratory (Koenig Bros.)	Tarrytown, N. Y.	273
WSAB	Southeast Missouri State Teachers College	Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural College	Clemson College, S. C.	360
WSAD	J. A. Foster Co.	Providence, R. I.	261
WSAG	City of St. Petersburg (Loren V. Davis)	St. Petersburg, Fla.	244
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	309
WSAJ	Grove City College	Grove City, Pa.	360
WSAN	Allentown Radio Club	Allentown, Pa.	229
WSAP	Seventh Day Adventist Chureh	New York, N. Y.	263
WSAR	Doughty & Welch Electrieal Co.	Fall River, Mass.	254
WSAT	Donohoo-Ware Hardware Co.	Plainview, Texas	268
WSAU	Camp Marienfeld	Chesham, N. H.	229
WSAW	John J. Long, Jr.	Canandaigua, N. Y.	275
WSAX	Chicago Radio Laboratory	Chicago, Ill.	268
WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	233
WSAZ	Chas. Electrie Shop	Pomeroy, Ohio	258
WSB	Atlanta Journal	Atlanta, Ga.	429
WSL	J. & M. Electrie Co.	Utica, N. Y.	273
WSY	Alabama Power Co.	Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAF	Louis J. Gallo	New Orleans, La.	242
WTAG	Kern Musie Co.	Providence, R. I.	258
WTAH	Carmen Ferro	Belvedere, Ill.	236
WTAJ	The Radio Shop	Portland, Me.	230
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAP	Cambridge Radio & Electrie Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gordon & Son	Osseo, Wis.	220
WTAR	Reliance Electrie Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	275
WTAT	Edison Electrie Illuminating Co.	Boston, Mass. (portable)	244
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	360
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	242
WTAW	Agricultural & Mechanical College of Texas	College Station, Tex.	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAY	Iodar-Oak Leaves Broadcasting Station	Oak Park, Ill.	220
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTG	Kansas State Agricultural College	Manhattan, Kans.	273
WWAB	Hoenig, Swern & Co. (John Rasmussen)	Trenton, N. J.	220
WWAC	Sanger Bros.	Waco, Texas	360
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	Alamo Dance Hall, L. J. Crowley	Joliet, Ill.	227
WWAF	Galvin Radio Supply Co.	Camden, N. J.	230
WWAO	Michigan College of Mines	Houghton, Mich.	244
WWI	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	517
WWL	Loyola University	New Orleans, La.	260
WYAM	Electrical Equipment Co.	Miami, Fla.	283
WYAW	Catholie University	Washington, D. C.	236

Canadian Stations

CFAC	Calgary Herald	Calgary, Alberta	430
CFCA	Star Pub. & Prtg. Co.	Toronto, Ontario	400
CFCF	Marconi Wireless Teleg. Co. of Canada	Montreal, Quebec	440
CFCH	Abitibi Power & Paper Co.	Iroquois Falls, Ont.	400
CFCJ	La Cie de L'Evenement	Quebec, Quebec	410
CFCK	Radio Supply Co.	Edmonton, Alberta	410
CFCL	Centennial Methodist Chureh	Victoria, British Col.	400
CFCN	W. W. Grant Radio (Ltd.)	Calgary, Alberta	440
CFCO	Semmenhaack-Dickson (Ltd.)	Bellevue, Quebec	450
CFCQ	Radio Specialties (Ltd.)	Vancouver, B. C.	450
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCW	The Radio Shop	London, Ont	420
CFDC	Sparks Co.	Nanaimo, B. C.	430
CFQC	The Electrie Shop (Ltd.)	Saskatoon, Saskatchewar.	400
CFRC	Queens University	Kingston, Ontario	450
CFUC	University of Montreal	Montreal, Quebec	400
CHAC	Radio Engineers	Halifax, Nova Scotia	400
CHBC	Albertan Publishing Co.	Calgary, Alberta	410
CHCB	Marconi Company	Toronto, Ont.	410
CHCD	Canadian Wireless & Elec. Co.	Quebec, Quebec	410
CHCE	Western Canada Radio Sup. (Ltd.)	Victoria, B. C.	400
CHCL	Vancouver Merchants Exehange	Vancouver, B. C.	440
CHCM	Riley & McCormack	Calgary, Alberta	415
CHCS	The Hamilton Spectator	Hamilton, Ont.	420
CHYC	Northern Electric Co.	Montreal, Quebec	410
CJCA	Edmonton Journal	Edmonton, Alberta	450
CJGC	London Free Press Prtg. Co.	London, Ont.	430
CJCD	T. Eaton Co.	Toronto, Ont.	410
CJCE	Sprott-Shaw Radio Co.	Vancouver, B. C.	420
CJCI	Maritime Radio Corp.	St. John, New Brunswick	400
CJCM	J. L. Phillipe	Monti Joli, Quebec	430
CJCN	Simons Agnew & Co.	Toronto, Ont.	410
CJSC	Evening Telegram	Toronto, Ont.	430
CKAC	La Presse Pub. Co.	Montreal, Quebee	430
CKCD	Vancouver Daily Province	Vancouver, B. C.	410
CKCE	Canadian Independ. Telephone Co.	Toronto, Ont.	450
CKCH	Canadian National Railways	Ottawa	435
CKCK	Leader Pub. Co.	Regina, Saskatchewan	420
CKCO	Ottawa Radio Association	Ottawa, Ont.	440
CKCX	P. Burns & Co.	Calgary, Alberta	445
CKLC	Wilkinson Electric Company	Calgary, Alberta	400
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	410
CKY	Manitoba Telephone System	Winnipeg, Manitoba	450

Cuban Stations

PWX	Cuban Telephone Co.	Habana	400
2DW	Pedro Zayas	Habana	300
2AB	Alberto S. de Bustamante	Habana	240
20K	Mario Garcia Velez	Habana	360
2BY	Frederick W. Borton	Habana	260
2CX	Frederiek W. Borton	Habana	320
2EV	Westinghouse Elec. Co.	Habana	220
2TW	Roberto E. Ramires	Habana	230
2HC	Heraldo de Cuba	Habana	275
2LC	Luis Casas	Habana	250
2KD	E. Sanchez de Fuentes	Habana	350
2MN	Fausto Simon	Habana	270
2MG	Manuel G. Salas	Habana	280
2JD	Raul Perez-Falcon	Habana	150
2KP	Alvara Daza	Habana	200
2HS	Julio Power	Habana	180
2OL	Oscar Collado	Habana	290
2WW	Amadeo Saenz	Habana	210
5EV	Leopoldo V. Figueroa	Colon	360
6KW	Frank H. Jones	Tuinucu	340
6KJ	Frank H. Jones	Tuinucu	275
6CX	Antonio T. Figueroa	Cienfiegos	170
6DW	Eduardo Terry	Cienfiegos	225
6BY	Jose Ganduxe	Cienfuegos	300
6AZ	Valentin Ullivarri	Cienfuegos	200
6EV	Josefa Alverax	Caibarien	225
8AZ	Alfreda Brocks	Stgo de Cuba	240
8BY	Alberto Ravelo	Stgo. de Cuba	250
8FU	Andres Vinnet	Stgo. de Cuba	225
8DW	Pedro C. Anduz	Stego. de Cuba	275
8EV	Eduardo Mateos	Stego. de Cuba	180

Eisemann Has New "Receiver"

Alexander Eisemann, treasurer of the Freed-Eisemann Radio Corporation, has a new receiver permanently installed in his home at 815 Park Avenue, New York City. It has self-moving installation. In fact, it is an eight-pound portable boy and has already shown marvelous selectivity in selecting its parents from millions who would have been honored had they been chosen. Since its initial HOWL at four o'clock Saturday morning, May 3, it has eliminated squeals with remarkable efficiency. It is equipped with an extraordinary loud speaker that is difficult to overload, and is eager for recharging. It is capable of receiving the love and homage of the universe, including DAD, and it is guaranteed to entertain all comers for many years to come. The new receiver is to be known as the Alexander Eisemann Junior. It is a model, and there isn't money enough in the whole world to buy it. Everybody's doing fine, thanks!

"Indorarial" Cuts Interference

Electrad, Inc., has placed a new and novel indoor aerial, called "Indorarial," on the market, and judging from initial comments from the large body of radio fans, the innovation is going to be exceedingly popular this Summer.

The Indorarial contains 600 feet of wire equally spaced between two pieces of specially prepared paper. It is instantly collapsible and portable without the danger of tangling wires. For best results, according to tests made in the RADIO AGE INSTITUTE laboratory, two Indorarials are used; one for aerial and one for ground.

The RADIO AGE tests revealed that this aerial affords sharp tuning and reduces static to almost a negligible quantity. Local stations especially can be brought in with amazing clearness and volume. The capacity is approximately .0006.

With the Manufacturers

Additional News on Page 56.

Crosley Portable a "Winner"

In order to meet the demand for portable radio apparatus, the Crosley Radio Corporation has made the new 51-P, which enables radio fans to "take their entertainment" with them during the months of out-of-door activities.

The portable is a regenerative detector and one-stage audio amplification outfit in a strong leatherette covered and nickel trimmed portable cabinet.

Loud speaker volume is obtained on nearby stations. The list price is $25. The Crosley 51-P is 12½ inches wide, 11¾ inches high and 7½ inches deep. It weighs twenty-one pounds with batteries, phones and aerial equipment, space being provided in the cabinet for these accessories.

Gibson Joins Freed-Eisemann

J. D. Gibson has always been a wireless enthusiast. Long before he left school, he was building sets, and back in 1910 he was operator of the "ancient" station NY on Forty-second Street. Later he was with the American Mercantile Company's traffic department and during the war he was chief electrician in charge of the Central Control Station on Whitehall Street. In 1918 he went in the Ship Owners' Radio Service as European representative, and three years ago he joined the A. H. Grebe Company in Richmond Hill, L. I. The first of June he signed up with the sales force of Freed-Eisemann Radio Corporation. In his varied experience he hasn't lost a bit of his belief in radio and is thoroughly convinced that it is the greatest discovery of any age.

WQJ Latest Chicago Station

Chicago has another broadcasting station. This time it's WQJ, the Calumet Baking Powder Company—Rainbo Garden Station, being owned jointly by both.

WQJ operates on a 448 meter wave length, and its studio is located on the second floor of the Rainbo Gardens Building, Clark St. and Lawrence Ave., Chicago. The studio is elaborate and efficient, being constructed at a cost of several thousands of dollars.

Jerry Sullivan, widely known radio musician, singer and song writer, is the director in charge, and Phil Schwartz is his assistant. R. J. Engler, recently of WOS, Jefferson City, Mo., is in charge of the mechanical equipment.

One of the features of WQJ's programs, which is expected to make it especially popular this Summer, is the dance music of Ralph Williams' famous Rainbo Orchestra and selections by his entertainers.

With the Radio Manufacturers

The Thermoformer

Engineers and inventors have long realized the importance of operating tubes directly off lighting circuits. Numerous attempts have been made to accomplish this for radio receiving sets, but the results have been keenly disappointing, except in the case of tubes used for transmitting purposes. Even so, the apparatus involved in converting the usual lighting current into usable vacuum tube current has been entirely too elaborate and out of all proportion to the cost of the batteries this replaced.

Mr. R. E. Sabin, a noted chemical engineer of Somerville, N. J., with the cooperation of L. G. Pacent, a radio manufacturer and engineer of New York City, worked out the solution of harnessing commercial lighting current to the usual receiving set. These practical men worked out an indirect method of harnessing commercial lighting current, in which such current is merely used as a source of heat.

They have adapted the thermoelectric method of energy transfer of the solution of the greatest radio problem of today—the operation of vacuum tubes on a lighting current. The thermoelectric power transformer consists of a number of pairs of dissimilar metals in contact, one junction being in close thermal relationship with, but neutrally coupled electrically from a resistor element in the power or lighting circuit. The difference in temperature between the metal members causes the flow of current, and while the potential of a single thermo-couple is quite low, any desired potential may be obtained by using a battery of bimetallic units connected in series.

Novel adjustments of the electrical resistances, thermal conductivities, emissivities, radiation, etc., of the various parts have been made, all contributory to the final perfected result.

The perfected thermoelectric transformer device, which has been given the significant name of "Thermoformer," consists of a neat pressed metal container in which are placed the several rows of bimetallic units, as well as the electrical

resistor element. The lighting current is led directly to the resistor element, which operates in much the same manner as the heating element of an electric iron. This heat is brought to bear, without any substantial electrical coupling, on special electrode castings, while the other end of each of these special castings is in contact with a strip of metal which comprises the other member of the thermo-couple. The thermo-couple units are all joined together so that their individual electrical outputs are combined for the desired output. The container is provided with screened top and bottom to permit the passage of air to carry away the undesired heat.

The "Thermoformer" can be arranged to operate the filaments of a number of vacuum tubes, which is the more difficult task, as well as the high-voltage "plate" circuits which usually call for the so-called "B" batteries. There is no hum or buzz or other indication of the lighting current used to operate the tubes.

Ogden Forms New Corporation

Clarence E. Ogden, founder and president of the Automatic Electrical Devices Company, manufacturer of the Homcharger and manufacturer of vibrating rectifiers, has recently organized and incorporated under the laws of Ohio, a new concern—The Kodel Manufacturing Company—for the manufacture of a portable radio set, of which he is the inventor, together with other electrical and radio specialties.

This company's first offering to the trade will be a small, compact and really portable long distance radio set—The KODEL—the Camera of Radio. This set weighs less than 5 pounds complete with all accessories. Contained within a neat leather covered case 5¾x4½x8 inches in size is a standard UV-199 tube, "A" and "B" dry batteries, pair of standard head phones, ground and aerial wires. This set operates quite successfully without either ground or aerial, the two wires merely being thrown on the floor. With ground connections only, surprising distances have been received, and using aerial the Kodel has a range of from 2,000 to 3,000 miles.

"Snow White Fluid" for Radio

J. W. Johnston, manufacturer of Snow White Products, in Rochester, N. Y., was surprised to learn that his "Snow White Fluid" was being used extensively for radio instrument marking purposes.

"Snow White Fluid" heretofore has been used for such applications as white shoes, dresses, golf balls and window ads, and it was quite by accident that a radio fan discovered its successful adaptability to radio sets.

According to Mr. Johnston, the Special Grade Snow White Fluid is an extraordinarily satisfactory preparation for marking curved arrow points and titles of various kinds of radio connections. It is also good for marking tie-in connections and for making figures and indentations on dials. RADIO AGE INSTITUTE has tested Snow White Fluid and found it to be all Mr. Johnston claimed in the radio building line.

New Models of Magnavox

The new model Magnavox Reproducers R3 and R2 contain refinements making for greatly increased efficiency as well as economy of operation.

Current consumption, as the result of improvements in the magnetic circuit, has been so reduced that it is now an unimportant factor. The new R3 and R2 models can be operated at any point between .1 ampere and .6 ampere when supplied with six volts. An average current consumption of one-fourth ampere results from the use of a three-volt battery of either dry cell or storage type.

Your Radio Problems Solved for 30 Cents in Stamps

IF YOU are constructing a receiving set, and you need help in the way of clear diagrams and full detailed descriptions you may have it by return mail.

We have laid aside a limited number of back numbers of Radio Age for you. Below we are listing the hook-ups and circuit diagrams to be found in these magazines. Select the ones you want, enclose 30 cents in stamps for each one desired.

We advise immediate attention to this as the stock of back numbers of several issues already has been exhausted.

May, 1922
—How to make a simple Crystal Set for $6.

October, 1922
—How to make a Tube Unit for $23 to $37.
—How to make an Audio Frequency Amplifying Transformer.

November, 1922
—Photo-electric Detector Tubes.
—Design of a portable short-wave radio wavemeter.

May, 1923
—How to make the Erla single-tube reflex receiver.
—How to make a portable Reinartz set for summer use.

June, 1923
—How to build the new Kaufman receiver.
—What about your antenna?

July, 1923
—The Grimes inverse duplex system.
—How to read and follow symbols.
—Proper antenna for tuning.

September, 1923
—Simple Radio Frequency Receiver.

December, 1923
—Building the Haynes Receiver.
—Combined Amplifier and Loud Speaker.
—A selective Crystal Receiver.

January, 1924
—Tuning Out Interference—Wave Traps—Eliminators—Filters.
The article which was announced from stations WJAZ, WOC and WOAW.
—A Junior Super-Heterodyne.
—Push-Pull Amplifier.
—Rosenbloom Circuit.

February, 1924
—How to make a battery charger.
—Improved Reinartz Circuit.
—Interference rejectors.
—Single Tube Heterodyne.
—How antenna functions.
—Adding two audio stages to selective receiver which began as a crystal set.
—Superdyne receiver.

March, 1924
—An Eight-Tube Super-Heterodyne.
—A simple, low loss tuner.
—Junior Heterodyne Transformers.
—A Tuned Radio Frequency Amplifier.
—How to make the Kopprasch Receiver.
—Adding Radio Frequency to the Variometer Set.
—Simple Reflex Set.

April, 1924
—An Efficient Super-Heterodyne (fully illustrated).
—Selecting the Right Receiver.
—A Ten-Dollar Receiver.
—Anti-Body Capacity Hook-ups.
—Radio Frequency Amplification.
—Reflexing the Three-Circuit Tuner.
—Index and first two instalments of Radio Age Data Sheets.

May, 1924
—Construction of a Simple Portable Set.
—An Ideal Set for the Summer Camper.
—A Traveling Man's Receiver.
—Radio Panels.
—Making a Baset-Weave Tuner.
—Third Instalment of Radio Age Data Sheets.

June, 1924
—Important Factors in the Construction of a Super-Heterodyne.
—A Universal Amplifier.
—A Sure Fire Reflex Set.
—Adding Radio and Audio to Baby Heterodyne.

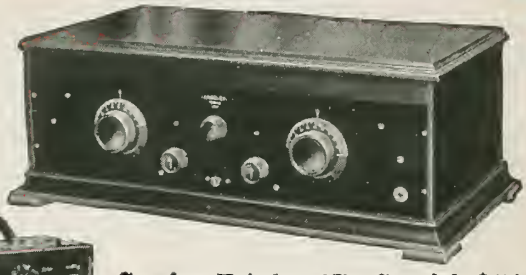
RADIO AGE, Inc.

500-510 North Dearborn Street - - - - - CHICAGO, ILL.

CROSLEY

Announcing — The New Models — each a leader in its line

Crosley Trirdyn 3R3, $65.00



Crosley Trirdyn 3R3 Special, $75.00

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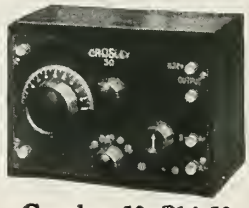
Crosley 51-P Portable, $25.00

Crosley 52, $30.00

Crosley 51-A, $14.00



Crosley 50, $14.50

Crosley 50-A, $18.00

Guaranteed Satisfaction at a Reasonable Price

CROSLEY 50—A new one tube Armstrong Regenerative Receiver. We believe this to be the most efficient one tube receiver ever put on the market. Like our present Model V, which it supersedes, it will bring in, under average conditions, on headphones, broadcasting stations at a distance of one thousand miles or more. Uses any standard storage battery or dry cell vacuum tube. ***Price, $14.50.***

CROSLEY 50-A—A new two stage Audio Frequency Amplifier to match the new Model 50 receiver. This unit is equipped with a filament switch for shutting off the current from the "A" and "B" Batteries. When used in connection with the Crosley Model 50 Receiver, it gives the equivalent of a three-tube regenerative receiver. ***Price, $18.00.***

CROSLEY 51—In twenty-four days this receiver became the biggest selling radio receiving set in the world, and it holds that position today. It uses two standard storage battery or dry cell tubes, regenerative detector and one stage of audio frequency amplification. Will bring in local stations on the loud speaker at all times, and under average conditions will also bring in distant stations on the loud speaker. ***Price, $18.50.***

CROSLEY 51-A—A new one stage Audio Frequency Amplifier to match the Model 51 receiver. When used in connection with the Crosley Model 51 Receiver it gives the equivalent of a three tube regenerative receiver. ***Price, $14.00.***

CROSLEY 52—A new three tube Armstrong Regenerative Receiver, has phone jack to plug in on two tubes and filament switch to turn off the "A" and "B" Batteries. It is unusually efficient, will provide loud speaker volume on distant stations under practically all conditions, and is in every way an ideal receiver for the home. ***Price, $30.00.***

CROSLEY 51-P—This is our new portable set. It is the Crosley Model 51 two tube receiver mounted in a leatherette covered carrying case, has a compartment for a pair of headphones and one to hold an ample power plant for the popular dry cell vacuum tubes. This receiver can be used as a stationary set in the home or as a portable. ***Price, $25.00.***

CROSLEY TRIRDYN 3R3—This three tube receiver gives the efficiency and volume of a five tube receiver. Incorporating Radio Frequency Amplification, Regenerative Detector with one stage of Reflexed and one stage of straight Audio Frequency Amplification. Can be calibrated accurately—stations logged and returned to at will. Used on outdoor or short indoor antenna and is, we believe, the most efficient and sharpest tuning receiver on the market at any price for bringing in long distance stations. ***Price, $65.00.***

CROSLEY TRIRDYN 3R3 SPECIAL—This Receiver is exactly the same as the Trirdyn 3R3 except the solid mahogany cabinet is larger, and more handsomely designed to harmonize with the most beautiful furniture settings. There is sufficient space inside for all the "A" and "B" Batteries required when standard dry cell tubes are used. ***Price, $75.00.***

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Powel Crosley, Jr., President

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Better-Cost Less
Radio Products

AUGUST 1924

RADIO AGE

The Magazine of the Hour

WITH WHICH IS COMBINED

Radio Topics

In This Issue

Price 25 Cents

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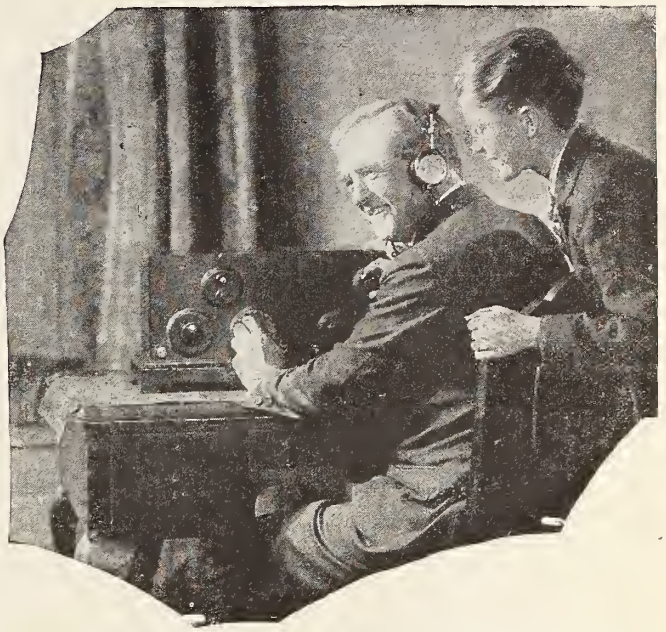
How I Average $12 a Day in RADIO WORK

By Howard Houston



"YES, Mr. Crosby, I'll have the set installed tonight . . . yes, all ready to 'listen-in' . . . sure you'll be able to get Washington by 9 o'clock."

Another hour and a half job! And another ten dollar bill in my pocket! It all seems like a dream. But let me tell you the whole story from the very start.

A few months ago, I was driving a bread wagon, selling bread to retail stores. I had a good route though, and if I do say so myself, I had built up a pretty good business. But try as I could, thirty-five dollars a week was all I could make that job pay.

I'd be working there now if it hadn't been for Mary. We'd been "keeping company" for about two years, and everything was all set for our getting married as soon as I would be earning more money. But the old job didn't hold out much promise—and I didn't see how I was qualified for any other work that would pay more.

It was Mary who gave me the tip. "You can't earn big money," she said, "unless you're some kind of a specialist. Learn some line of work—become an expert in it." But what business, profession or trade was there that wasn't overcrowded? Where could an ambitious fellow stand a good chance to earn big money and get ahead? Stenographers, accountants, clerks—all down the line—every well established line of work was overcrowded, and the pay was small.

Then Mary said, "Why not find a new field?" That was a good thought. The men who went into the railroad business early "cleaned up." The same was true of the movie game, the automobile business—but what was the coming field? What new development was there that looked like a new promising industry?

We both jumped to our feet.

"RADIO."

Why hadn't we thought of it before? All around us was the evidence of the tremendous development of Radio. The broadcasting stations sprouting up all around—the rapid increase in Radio Stores—new radio manufacturing plants — everybody talking about the latest radio program. Radio had captured America almost overnight—and thousands of men who were on their toes were due to make fortunes out of it.

Thousands of Men Needed

The very next day after I had finished my route, I went to several radio business firms. "Sure, there was an opening. Oh, they'd pay big money—but did you know Radio?"

That was my cue. Learn Radio. Become a Radio Expert—and I did!

Well, that really is my whole story. I've only started. I've followed the path of least resistance. Sort of built up a business of my own installing, building, and repairing radio sets. Any small job pays me at least $5—and usually $10. I can easily make from $50 to $100 a week—and more as I get my work systematized.

What Mary and I have got to decide after our honeymoon—oh, yes, we are soon having a very quiet wedding—what we must decide after that—is which end of Radio will be best. You see, there are dozens of different kinds of work in this field, it's so big. I've already had several offers—one to take charge of a radio department, another with a broadcasting station, another to give radio entertainments, and a good offer as superintendent of construction in a radio plant. What we want to decide on is which will not only pay the most money now but will lead to the most rapid advancement in the future.

Easy to Learn Radio at Home in Spare Time

Just a word about this Radio business. Some fellows think you've got to have some training before you start to learn Radio. That's bunk. I didn't know the difference between an amplifier and a doorknob before I started. But let me give you a tip. Don't experiment with your radio course. Get the best. The National Radio Institute has been teaching Radio ever since 1914. The government recognizes its course by allowing credits to its graduates when they are trying for a license, so you see you can be confident you're getting the best training possible—and that means a lot.

Send for Free Book "RICH REWARDS IN RADIO"

Incidentally, the National Radio Institute publish a mighty interesting book on Radio. They send it out without cost to anyone who wants to learn about Radio. It is filled with facts, photos, and figures on the Radio Industry, and tells all about its course which quickly prepares you right at home in spare time for one of the big pay positions in Radio.

Take my advice and Mary's—and send for that, no matter how little you know of Radio, or what your plans are. Just mail the coupon for it now. Address the National Radio Institute, Dept. 53HA, Washington, D. C.

NATIONAL RADIO INSTITUTES,
Dept. 53HA, Washington, D. C.

Please send me without cost or obligation your Free Book "Rich Rewards in Radio," which tells all about the opportunities in Radio, and how spare time study at home will qualify me for a big paying radio position. Also full details on your Free Employment Service.

Name..... Age.....

Address.....

City.....State.....

Pay Increases Over $100 a Month

I am averaging anywhere from $75 to $150 a month more than I was making before enrolling with you. I would not consider $10,000 too much for the course.

(signed) A. N. Long,
121 No. Main St.,
Greensburg, Pa.

Doubles Salary

I can very easily make double the amount of money now than before I enrolled with you. Your course has benefited me approximately $3,000 over and above what I would have earned had I not taken it.

T. Winder,
731 Bedford Ave.,
Grand Junction, Colo.

From $15.00 to $80.00 a Week

Before I enrolled with you I was making $15 a week on a farm. Now, I earn from $2,080 to $4,420 a year and the work is a hundred times easier than before. Since graduating a little over a year ago, I have earned almost $4,000 and I believe the course will be worth at least $100,000 to me.

(Signed) George A. Adams,
Route 1, Box 10,
Tamaqua, Pa.

RADIO AGE

The Magazine of the Hour
Established March, 1922
WITH WHICH IS COMBINED
Radio Topics

Volume 3 *AUGUST, 1924* *Number 8*

CONTENTS

Radio Age is published monthly by
RADIO AGE, Inc.

Advertising, Editorial and Publication Offices,
500 N. Dearborn St., Chicago

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Advertising forms close on the 5th of the month preceding date of issue
Applicants for membership in A. B. C.

Issued monthly. Vol. 3, No. 8. Subscription price, $2.50 a year.

Entered as second-class matter April 4, 1924, at the post office at Chicago, Illinois, under the act of March 3, 1879.

A Chat With the Editor

THE most modest-appearing departments of a magazine like RADIO AGE usually are the most valued in the minds of the readers. This was especially evident recently, when M. C. Williams, of Rantoul, Ill., wrote us he received 1,180 letters within ten days after the June RADIO AGE appeared on the news-stands, because of the publication of one of his hookups in the "Pickups" section.

Just 1,180 readers thought enough of Mr. Williams' short article to write him immediately and ask for more information. We have yet to learn the total number of readers who have communicated with Mr. Williams since the June issue.

To augment RADIO AGE'S powerful influence over followers of the latest and best in radio development, we are continuing our policy of keeping the "fans" informed on the most recent discoveries and theories in the scientific field. In this issue, which has not been decreased one iota in interest because of the presence of Summertime, especial attention is paid to plans now under way for circumnavigating the globe with radio.

Last month we started a series on this subject by delving into the mysteries of short wave transmission and reception. This same subject is taken up again in the following pages to show how world-wide co-operation of radio stations will enable the fan in Cleveland to tune in on a broadcast from Berlin whenever his fancy desires.

The foregoing is just a sample of what is offered to RADIO AGE readers every month in our technical columns alone. This careful selection of editorial content has made RADIO AGE a by-word for reliability, and old and new readers are assured this steady improvement will be carried on more intensively than ever in the September number—which, by the way, has a "surprise" feature that will revolutionize the radio magazine field. On the stands about Aug. 26.

Frederick Smith

—Editor, RADIO AGE

America's Best Known Amateur

Fotograms.

Harry H. Carman, of Freeport, L. I., or, technically speaking "2EL," is called the country's best known amateur radio broadcaster. He has been heard in England, France, San Francisco, and other distant points. He has received cards from all over the country acknowledging reception of his station. He is shown above in his broadcasting room seated at his apparatus.

RADIO AGE
The Magazine of the Hour
M. B. Smith
Business Manager
A Monthly Publication
Devoted to Practical
Radio
Frederick A. Smith
Editor

The Invisible Circuit

By FRANK D. PEARNE

A Novel Explanation of Jinx That Often Causes Two Sets of Same Circuit to Function Differently

IN THE construction of radio sets it very often happens that the same kind of a circuit assembled by two different individuals will not give the same quality of reception. They look alike, contain the same apparatus and to all appearances they are the same, but one works better than the other.

Where is the jinx that selects some poor hard working fan as the object of his attention? Why is it that one set will work better than another, when they are apparently just the same? The answer is that there is so much going on inside of a receiving set that the eye does not see and, in fact, the circuit itself is such a very small part of the set, that the builder does not realize what is going on in the invisible circuit. The "invisible circuits" in a receiving set are those formed by magnetic and electro-static fields which are set up by the rapidly oscillating currents flowing through the different parts used in it; and in most cases little or no attention is paid to them. More trouble and dissatisfaction are caused by these magnetic and electro-static couplings than from any other source, although many radio enthusiasts do not even know that they exist.

FIRST of all, let us consider the magnetic field which is produced in and around the coils used. Figure 1 shows the lines set up in one turn of wire through which a current is flowing. This pictures the lines in a small way and represents the two sides of the loop through which the current travels. The rapidly oscillating current makes these lines whirl about the conductor, first in one direction and then the other, their direction changing with each alternation of the current. If another coil which is in no way connected to the first one is placed close to it, these invisible lines of force cut through it, and in doing so will produce a current in this second coil which will have the same characteristics as the current in the first coil.

Any inductively coupled circuit operates upon this principle. The most unfortunate part of it is that these lines do not confine themselves to just cutting through the turns of the second coil, but if the coil happens to be of the type shown in Figure 2, consisting of many turns wound side by side on an insulating tube, the lines arrange themselves somewhat as shown. It will be seen that some of the lines never even get far enough out to reach the second coil, while some of them travel out for some considerable distance from their source, often going far enough to cut through other coils used in other parts of the set, which they are not intended to cut through. When this occurs, then, currents are set up which cause iinterference; and these currents are due to undesired magnetic coupling. In this type of coil there are many lines produced by the coil which are not utilized, and many of them will cause interference.

Now, by referring to Figure 3, we find another type of coil. This is of the honeycomb or spider web variety and it is not hard to see that in such an arrangement the magnetic circuit is concentrated in a very small space. In this case, nearly all of the lines get out far enough to do useful work, but do not travel far enough to cause interference with other coils. Consequently there is much less loss from stray fields than will be found in coils shaped like that in Figure 1.

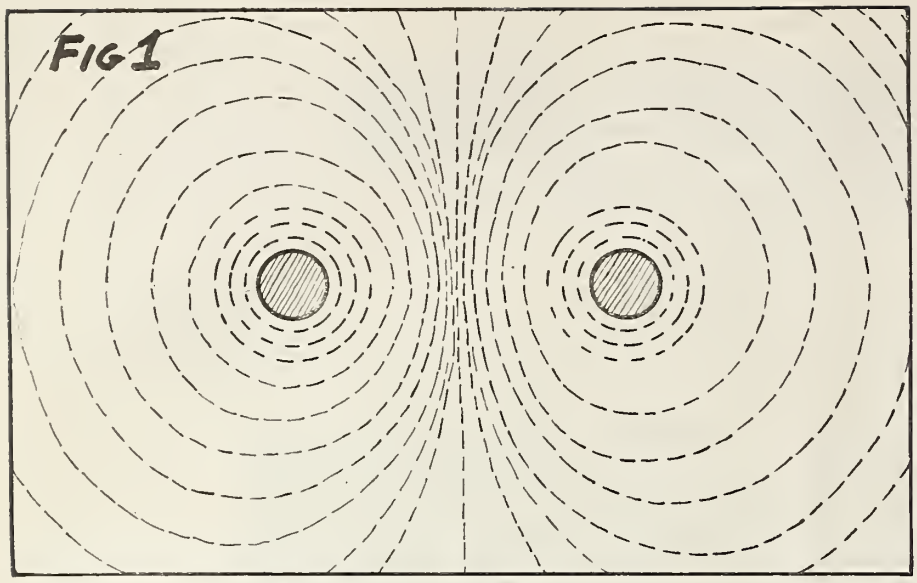
Let us suppose, for example, that we have two radio receiving sets which are apparently just alike, but some of the parts are not located in exactly the same position. In one case an offending stray magnetic force may reach just far enough to cause interference in another part of the set, while in the other case the parts are so located that they cannot quite reach the danger line. How are we to know how far apart these parts may be located with safety? This is a question, indeed, and one which only may be answered by experience and past performances of a similar nature. One is very much surprised to find how far these magnetic fields will sometimes stray.

IT IS possible to find stray lines of force from the field of a direct current generator as far as ten feet from the field. At a distance of six feet, a small piece of very thin iron pointed toward it at just the right angle may be made to support small nails and tacks, by the stray lines which are collected and concentrated in this way. Naturally the magnetic field set up in the neighborhood of such coils as are used in radio receiving sets never reaches anywhere near the strength of the field of a generator, but it must also be remembered that a radio receiver is about the most sensitive piece of apparatus known and extremely weak magnetic fields will have a very noticeable effect upon them.

It is not very difficult to realize how very little we know about the invisible magnetic field which is ever surrounding the different parts of the set. Our troubles do not stop here, either, for there is another invisible force at work which destroys much of the energy which really ought to be harnessed and made to do useful work. This is the electro-static field to which many losses in the receiving set may be directly traced. Electro-static losses are always present where currents of high frequencies are employed and the places where they may occur are many indeed.

How many of us have tried the old experiment of rubbing the glass, or hard rubber rod with a silk handkerchief and seeing it attract small tissue paper pieces just as a magnet attracts a piece of iron? Did you ever at the time stop to consider how much energy was used up in rubbing the dielectric, compared to the small amount of work which was required to lift the small pieces of paper? Well, at any rate, it is not the most efficient means of transferring energy from one form to another. Insulation such as hard rubber is absolutely necessary in the construction of a radio set and it makes wonderful insulators, but it also saps the energy away from the places where it is needed most. We do not, however, rub the insulators or insulating materials with silk in the radio set, but the high frequency currents which are used do practically the same thing.

IN ORDER that we may understand just what a dielectric material is, let us refer to the variable condenser. Here we have two sets of metal plates which



Magnetic field between conductors.

are separated by air. Air is, of course, an insulator and in this case is the dielectric between the plates. Now let us set the movable plates in a certain position and notice the capacity. If thin sheets of mica are placed between the plates, it will be found that, although the plates are still in the same position and the same distance apart, the capacity of the condenser has been considerably increased. The reason for this is the fact that the dielectric constant of mica is much higher than that of air. But what does this all mean? The ordinary definition of the word dielectric would be "a non-conductor of electricity." Some of these non-conductors are better insulators than others. In all cases they have the property of absorbing electrical energy under certain conditions and they also have what is known as specific inductive capacity, which means "ability to convey the influence of an electrified body."

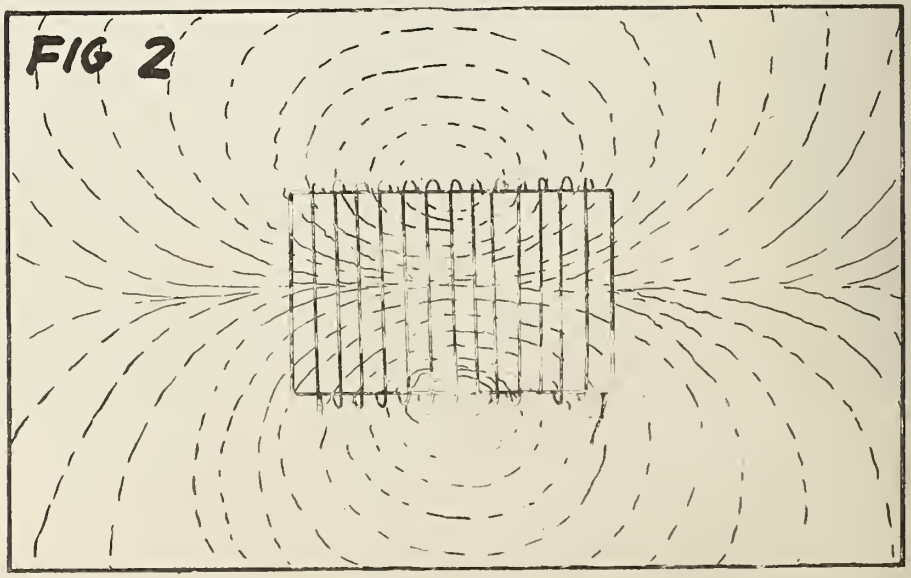
The dielectric constant of air is taken as unity and the dielectric capacity value of other substances are reckoned from this value. When a rapidly oscillating current is passed through a condenser, the plates are first charged in one direction and then the other as the current oscillates. This produces a strain on the dielectric material between the plates and these lines of strain may be made visible by sprinkling finely powdered mica around and about the plates and the insulating material between them. Figure 4 shows how a map of the electro-static field between two oppositely charged conductors would look. It will be noticed that these lines of strain are at right angles to the magnetic lines of force and Figure 5 shows the combination of both the magnetic and electro-static fields around two wires of a circuit.

When an insulating material is under the influence of a rapidly oscillating current, it absorbs energy which seems to be caused by the molecules of the material moving back and forth with each reversal of the current. When the current passes through in one direction, the molecules all are forced around so that they point in the same direction. When the current is reversed, then they are all swung around so that they point in the other direction. As the direction of the position of these molecules is changed with each reversal of current, it may be easily understood that the more rapid the oscillations, the faster these molecules will move back and forth and also that considerable energy is required to move them at this high rate of speed. When the rapidly oscillating current is passed into a condenser, the plates receive a charge, first in one direction and then in the other.

EACH charge so received on the plates, however, is retained for a fraction of a second and at the next reversal of the impressed current this charge travels with it with its energy added to it, so that the energy used in charging the plates is not all wasted, but in many other cases where insulating materials are used, this energy which is absorbed is absolutely lost so far as radio reception is concerned. The energy consumed in moving these molecules back and forth must come from somewhere, and the only energy coming into the receiving set is from the transmitting station, so it is not very hard to see that when the high frequency currents act upon insulating bodies in a receiving set, much of the energy which should be giving up useful work is entirely wasted and lost so far as reception is concerned. Therefore the reception is materially weakened.

Just where do these losses occur? In the first place, most of the coils used in radio work today are wound upon insulating tubes and as these tubes come under the influence of the electro-static field set up in the coils by the rapidly oscillating currents, all the energy used in swinging the molecules back and forth is wasted energy which is supplied by the very feeble current received upon the aerial. It may be readily understood that there is not very much energy to do the required work, to say nothing of throwing most of it away in useless work. How, then, may this loss be eliminated? Some kind of a foundation or support must be used to hold the turns of wire in place. If these coils could be made self-supporting, our troubles from this source would be over, but this seems an impossibility. The efficiency of a coil having only an air core would certainly be a valuable asset to the radio receiver. The nearest thing to perfection is the honeycomb and the spider web coil. This type of coil is wound in a zig-zag manner in such a way that it is self-supporting and at the same time the turns are widely separated, which is another great advantage.

Let us analyze this coil before going any farther and see just what can be gained by using it instead of the long type with many turns spread out over the surface of an insulating tube. Referring again to Figure 3, we find that the windings are concentrated within a very small space. This, as previously explained, keeps the magnetic field within bounds so that it is not scattered all through the other apparatus and at the same time the coil is small and takes up less space than the one which is wound on a tube.



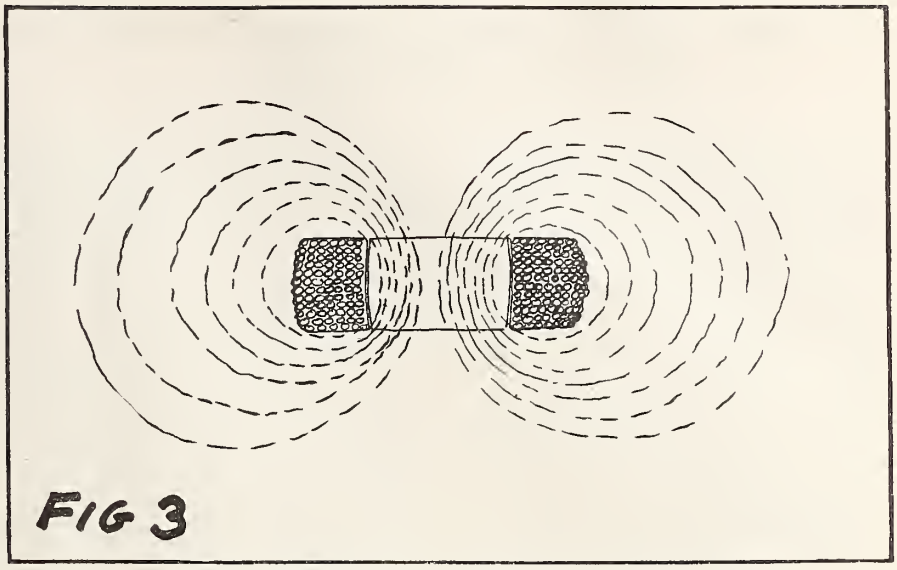
Magnetic lines produced by current passing through a coil wound on a tube.

IT IS self-supporting, as it has no tube in the center to hold the turns together. Another thing in its favor is the fact that the turns are so arranged that there is considerable space between them. Here we have another advantage not yet mentioned. In any coil where the turns are close together there exists what is known as distributed capacity. That is, one turn acts like a plate of a condenser with reference to the turns close to it and the more turns the coil contains, the higher will be the distributed capacity. The effect of this capacity when added up means that here again much energy is lost, as it is the same as though a high resistance is connected across the terminals of the coil, through which much of the energy supposed to be passed to other parts of the circuit leaks away.

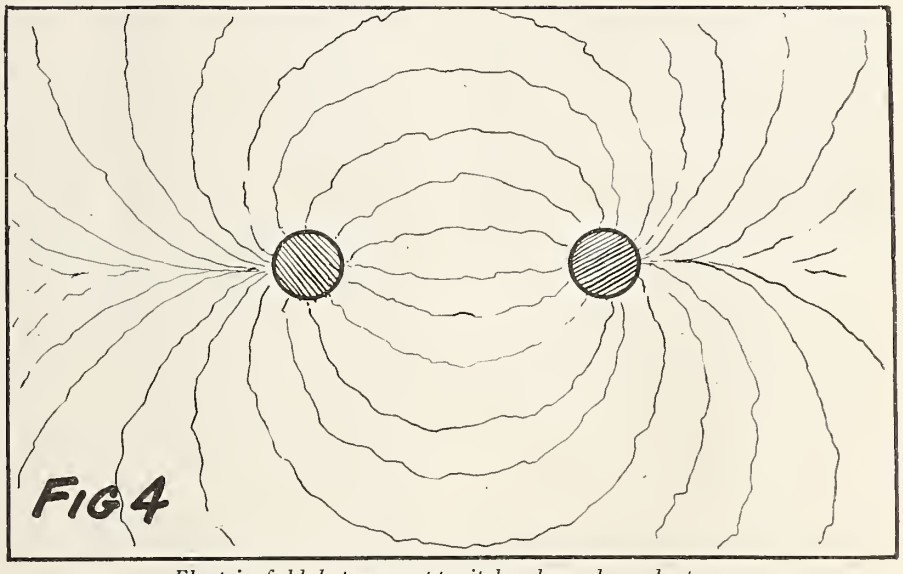
Many radio engineers recommend a method of reducing this distributed capacity in long coils consisting of a single layer. This is accomplished by winding a piece of cord beside the wire and after the coil is completed, the twine is removed, leaving a coil in which the turns are separated far enough to reduce the capacity to quite an extent. But in the honeycomb and spider web windings we find that the particular form of winding gives to the turns even a greater separation than the twine method, and we also have the benefit of the advantages before mentioned.

There is one very important point to remember in the construction of such coils, and that is not to make them too small in diameter, as this will have a tendency to crowd too many lines through the center and over-saturate the air space within the coil. Naturally, the smaller the coil, the smaller will be the opening in the middle, and if the lines become too crowded in this space, then the nice circles shown in Figure 3 are very much distorted and are forced out farther than they would be if the air core were not saturated.

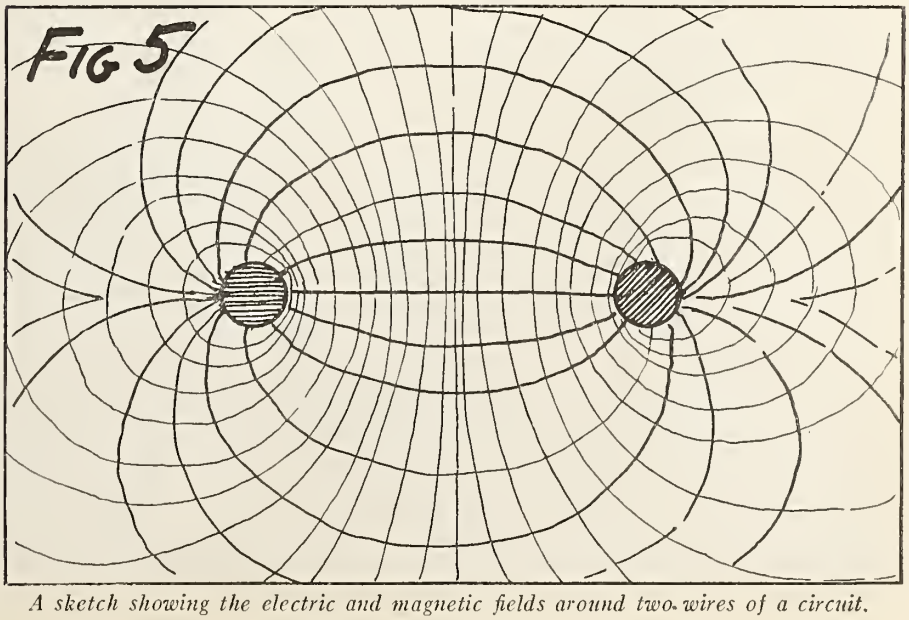
Thus it would seem that the use of this type of coil would eliminate many of the troubles so common to the radio receiver and also serve to unravel the mystery of why one set should work better than another.



Magnetic lines produced by honeycomb or spiderweb coil.



Electric field between oppositely charged conductors.



A sketch showing the electric and magnetic fields around two wires of a circuit.

Dry Cell Standards Under Way

Representatives of nine dry battery manufacturers, four electric companies, two telephone companies, a railroad, the American Railway Association, and nine Government departments met at the Bureau of Standards recently at a preliminary conference on dry cell standardization. Standard performance tests for radio filament and plate batteries were adopted at the conference, and the standardization of B battery sizes, or at least a standardization of the unit cells, was proposed. A special sub-committee will shortly be appointed by Dr. G. W. Vinal of the Bureau of Standards to make recommendations as to the B battery specifications.

The committee decided not to require a "noise" test of batteries since they were not believed responsible for sufficient noises to make such tests worth while.

Short Wave Transmission and Its Recent Phenomena

THE development of short wave radio transmission, which has resulted in the rebroadcasting of American signals by eight English stations, has produced some interesting phenomena. As high as ten kilowatts have been impressed on one antenna in starting the 107 meter pulsations on their long journey and, because of this great power, special precautions must be taken by those who handle it.

For months experiments have been carried on by a group of General Electric radio engineers in a small isolated building, a mile from the transmitter of WGY. In this building has been assembled, in the apparent disorder of most laboratories, the equipment necessary for a high-powered radio transmitter. The station, because of the power and variety of wave lengths used, operates on the experimental license of the General Electric Company, 2XI.

Because of the intense field about the transmitter it is possible to light an ordinary sixty-watt lamp to full brilliancy by holding the lamp in the hand. Two men, standing on insulated stools, and each holding a metal rod in his hand, can draw a six-inch arc between the rods. No shock is felt because current of this nature travels through the skin rather than through the body. However, if bare hands were used instead of the metal rods, a severe burn would be the result. The building is heated by a small coal stove and the engineers have learned that care must be taken in transferring coal from the coal bucket to the stove. If the body comes in contact with any metallic object. arcs will jump from stove to shovel.

Precautions Necessary

Metal pencils, watches or similar articles containing metal cannot be carried on the person on account of the small sparks which will jump to them. Shoes with nails cannot be worn because of the sting experienced when the wearer steps on nails in the floor.

By the use of its short wave transmitter, WGY has reached distant places with a fair degree of reliability which were only occasionally reached on long wave lengths. The signals are also transmitted so clearly and with such volume that it is possible to rebroadcast them 3,000 miles away. On several occasions all eight stations of the British Broadcasting Company relayed WGY's broadcast programs. The most successful experiment was that of April 5 when an entire program of organ, tenor and trumpet solos and an address, was carried by wire from the Wanamaker auditorium in New York to the transmitter of WGY in Schenectady.

This entire program was sent out on 107 meters and also on 380 meters, and the signals on the former wave length were picked up and relayed by the British stations. According to a radiogram received from London during the progress of the program the transmission was: "All as clear as if played in London." The short wave signals have also been heard consistently in Los Angeles with loud speaker strength on only two tubes, and this at times when daylight covered the Western half of the country. Tests have shown that the signals are remarkably free from fading, which is experienced on the longer wave lengths.

Novel Sets Used

While the design of a short wave transmitter is similar to that of any broadcasting set, the enormously high frequency involved—2,803 kilocycles—requires the use of some unusual and novel apparatus. The antenna is of the fan type, but it differs in some respects from the conventional antenna. In order to decrease resistance losses its conductors are made of three-eighth inch hemp, over which is braided many fine strands of bare copper wire. The two wooden poles supporting the antenna are much larger than necessary to support a structure of this size but they are essential to prevent the antenna from swinging.

The building sheltering the transmitter is located a short distance to one side, allowing the counterpoise to come directly underneath the center of the antenna, and greatly increase the radiating efficiency of the system. The antenna is eighty feet high and sixty feet in width at the top part of the fan. It has a fundamental of 160 meters.

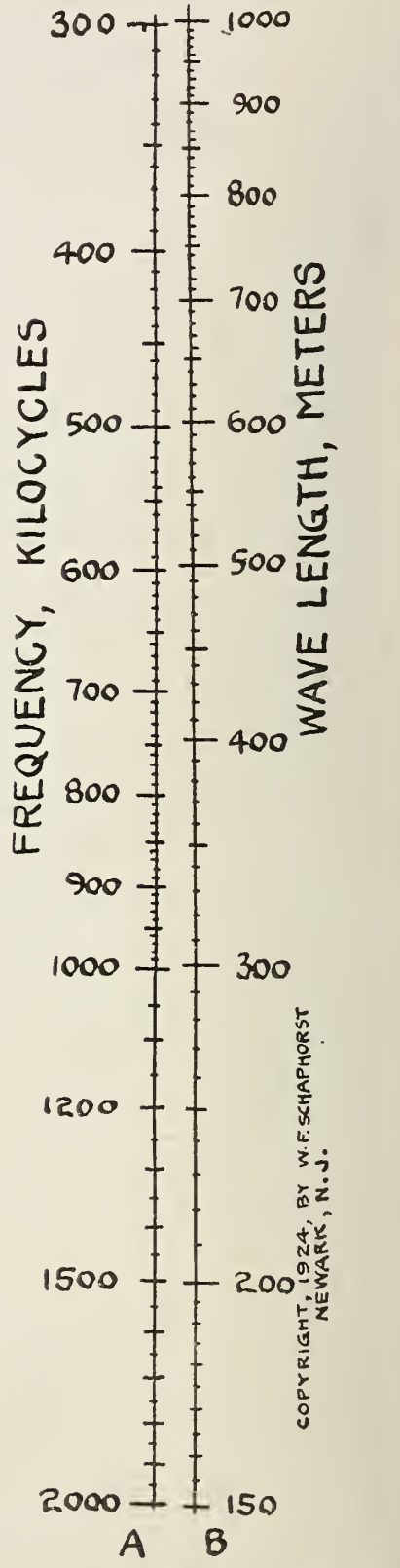
The oscillating system is of the conventional coupled-type in which the frequency is controlled by a tuned circuit rather than the antenna circuit. This eliminates the possibility of frequency change due to the swinging of the antenna in the wind. The primary coil consists of one and one-half turns of copper ribbon two inches wide tuned by an air condenser made of aluminum plates three feet square. In solving the problem of a spacer for these plates that would not break down, the use of very thin hard rubber strips was decided upon. Power tubes are of the water-cooled type and are connected through a pump to a large radiator which insures an uninterrupted water supply.

Modulator Tube Cooled

The modulator tube is water-cooled and it is connected to the same cooling system as the oscillator. The speech power amplifier is a 250-watt radiotron, and, because of the intense field from the oscillator and its associated apparatus, it is shielded by a copper box to prevent regeneration and the resulting loss in quality. All wires connected to the amplifier are shielded and the lines to the studio and control room are covered with lead and are buried to prevent the radio signal from getting back into the input circuit.

The plate power supply to the water-cooled tubes is a three phase, full wave rectifier capable of supplying thirty kilowatts at fifteen thousand volts. Filaments are lighted by special direct current machines to eliminate the ripple which results from the use of alternating current on tubes employing a high filament current.

A Handy Wireless Chart



Here is a chart that will be found useful for quickly converting kilocycles into wave lengths or vice versa.

If the frequency is known, find it in Column A and look across to Column B, where it is instantly converted into wave lengths.

For example, if the frequency is 1,500 kilocycles, what is the wave length? Find the 1,500 in Column A. Directly opposite it in Column B is 200 meters—the wave length.

Again, if the wave length in meters is 300, what is the frequency? Find the 300 in Column B and directly across in Column A the answer is found to be 1,000 kilocycles

How Soon Will We Have Radio Movies?

By S. R. WINTERS

Experiments by Noted Inventor Show Radio Entering Magic Realm of Visual Broadcasting

"FROM our easy chairs by the fireside we stay-at-homes will soon be able to view the bleak ice fields as the broadcasting lens is carried over the North Pole in that great ship, the Shenandoah."

Thus spoke C. Francis Jenkins of Washington, D. C., as he contemplated the possibilities of the transmission and reception of motion pictures by radio. He had just completed the apparatus for accomplishing this epochal achievement, and the photograph illustrating this article is the first one showing this mechanism.

The inventor claims that only refinements in this apparatus are necessary before a football game played in Philadelphia may be witnessed in San Francisco.

Already moving objects—the movements of a hand, for instance, have been sent from one point to another in the laboratories of Mr. Jenkins. The extension and application of this demonstrated experiment, in accordance with theory, would seem to bring within the realm of accomplishment the flashing on the screen of an event transpiring at some distant place. For instance, the President of the United States in exchanging greetings with the Premier of France could look upon the countenance of the latter, or vice versa. Similarly, the chiefs of staff of our Navy and Army could view at headquarters all that the lens records as it is carried aloft in scouting aircraft.

Not So Complicated

THE mechanical units for the sending and receiving of motion pictures by radio, as apparent in the accompanying photograph, are not as complicated as one would think. The essential parts consist of a glass prism and another glass disc which contains a plurality of lens elements. Immediately in front of these prismatic rings is an electric lamp, similar to the light bulbs in homes, and an electric motor for rotating the prismatic rings. Light from this high-frequency lamp shines through the large number of lens prisms or holes in one of the discs as it revolves, fluctuating in value in order to make the moving pictures on the screen. The entire apparatus may be enclosed in a small box.

The transmission and reception of photographs by radio is already an accomplished fact—this feat being daily demonstrated over a distance of seven miles, and in one instance, pictures have been sent and received between Washington and Philadelphia, a distance of 135 miles. The principle applied in the transmission of "still" pictures and motion pictures differs only with respect to speed. Demonstrations in sending photographs have required three minutes for completing the process, whereas, the sending of moving objects involves a speed of sixteen pictures a second.

The prismatic lenses or revolving prisms serve the purpose of cutting up the light rays as they emanate from the high-frequency lamp stationed immediately in front of them. In the path between the conventional radio-transmitting apparatus and the revolving prisms is a light sensitive cell, for instance, a Case Thalafide cell, through which the fluctuating electric currents are given passage before being put on the air by the transmitter. The principle involved, in general, is that electro-magnetic waves are susceptible to the impression of picture characteristics just as electrical waves may be translated into speed if voice characteristics are impressed thereon.

How Rays of Light Work

THE new optical shape in glass makes possible the transmission of photographs and ultimately motion pictures by radio. The warped contour of this ring of transparent substance, when rotated across a beam of light from this high-frequency lamp, produces an effect on the latter comparable to that of a glass prism which changes the angle between its faces. Or, putting it differently, there is a constant change in its retracting angle.

The effect on a ray of light passing through this glass ring, having a fixed axis on one side of the latter, is to give to the ray of light on the other side of the glass prism an oscillation or hinged action in the plane of its diameter. Consequently, a ray of light passing through this prism and spending its force on a picture surface at the top will travel across the picture surface to the bottom as the prismatic ring rotates. By the same token, the identical ray of light passing through a second prismatic ring, with its diameter set at right angles to the first, will embrace the picture surface from left to right. If, then, one of the prismatic rings is rotated one hundred times faster than the other, it is seen that the picture surface would be covered horizontally in one hundred parallel stripes by the pointed beam of light.

"But have you never put a nickel under a piece of paper and by drawing straight lines across it with a very dull pencil made a picture of the Indian appear?" inquired Mr. Jenkins in reducing the process to a simple analogy.

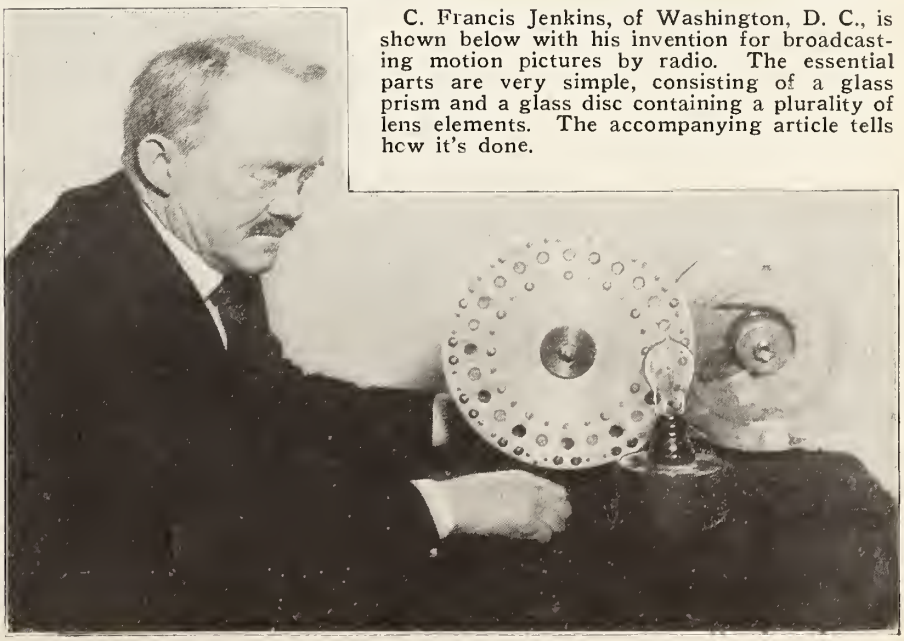
"Well, now, that isn't so very different from the way we do it. In place of the crayon pencil we draw lines across the white surface with a pencil of light, the image of light being the source of high intensity and high frequency.

"When the machine (referring to the glass discs) is turned over slowly, this little light looks for all the world like a tiny twinkling star as it travels across the white surface in adjacent parallel lines, changing in light values to correspond in position and intensity to the light values of the scenes before the lens at the broadcasting station.

A Magic Picture

"BUT when the machine is speeded up until the succession of lines recur with a frequency that deceives the eye, because of persistence of vision into the belief that it sees all these lines all the time, then a picture suddenly flashes out on the white screen in all the glory of the pantomime mystery."

The equipment for the reception of photographs and motion pictures by radio duplicates the units used in their trans-



C. Francis Jenkins, of Washington, D. C., is shown below with his invention for broadcasting motion pictures by radio. The essential parts are very simple, consisting of a glass prism and a glass disc containing a plurality of lens elements. The accompanying article tells how it's done.

mission. The modulated electro-magnetic waves, arriving at the receiving station, are translated from electrical characteristics to picture characteristics by means of another pair of prismatic rings and a light valve or lamp. The latter unit, which is now subject to refinements in order to transmit motion pictures over distances, may be filled with carbon bisulphide and the tube is wound with wire somewhat similar to the winding formation of the tuning coil used in radio telephony and telegraphy. The electric waves as they come into the receiving station light and extinguish this small lamp thousands of times a second—with such rapidity, in fact, that the human eye is deceived in believing that the light is burning constantly without fluctuations. Once the light rays pass through the prism lenses at the receiving station, the picture sent out by the broadcasting station is automatically reproduced on a screen.

"The whole apparatus," to quote the inventor, "is comparable to a camera with a lens in Washington and its photographic plate in San Francisco; with this difference, that the one lens, in Washington, may put its picture on ten, one hundred or one thousand photographic plates in as many different cities at the same time, and at distances limited only by the radio power of the broadcasting station.

"With this new apparatus wireless distribution of news pictures for daily paper illustration insures the distribution of picture news as promptly as telegraphic news; which means that pictures of news events get into the daily papers as early as telegraphic text. It means just exactly that, and it takes no particular imagination to visualize the value of such service to the newspapers.

"IT IS even more than this, for these radio news pictures projected from magic lantern slides on to the screens of the best picture theaters in the cities, enable the theater to put news events before the public sooner than the newspapers can print and distribute telegraphic news; that is, the daily paper is now threatened with second place as a means of news distribution, for no newspaper can possibly put a distant news event before the public as quickly as the theater can with radio pictures."

Photography is the most rapid means of copying and radio is the swiftest means of intelligence. C. Francis Jenkins, inventor of the motion picture projecting machine universally used in theaters, claims to have wedded the two.

"Radio vision" is the term he employs, and it differs from the telescope in that the latter covers great distances only by following straight lines which lead off into space. Radio vision, on the other hand, is enabled to see along curved lines, and, therefore, mountains and other common obstructions do not mar the view. In fact, Mr. Jenkins contemplates the time when the President of the United States may look upon the face of the King of England as he talks with him; and radio vision around the globe is not, according to this distinguished inventor, beyond the realm of future possibility.

Fifteen Million Homes to Have Radios

Atlantic City, N. J.—"The many technical improvements in the art of broadcasting and in the manufacture of receiving apparatus during the past year have given such impetus to the development of the radio industry in the United States that radio now occupies a leading place in American life," David Sarnoff, vice-president and general manager of the Radio Corporation of America, declared recently in an address before the annual convention of the National Electric Light Association.

"Present indications point to two methods of operating radio receivers in the future," he said. "These might be classed as follows:

Kadel & Herbert

HERE'S A NEW ONE.

When you tire of that old phonograph record, don't throw it away or let it collect dust on the shelf. Follow Rudolph Arnold's novel scheme of using an ordinary 12-inch phonograph record as a panel for a one-tube receiving set. He reports more than satisfactory results.

The Future of Radio

"Type 1—The home receiver that will draw its vacuum tube energy through such a current supply device operated from the lighting circuit now supplied by the Central Station.

"Type 2—The rural home receiver, or the portable receiver that obtains operating power from storage or dry batteries."

Discussing the many contacts which radio has made with other industries, Mr. Sarnoff pointed out that radio already has affected the electric light and power situation in the United States.

"More people," he said, "now stay at home to enjoy radio, which means more use of lights and greater current consumption. Radio enthusiasts who stay up until the small hours of the early morning to get distance still further increase the drain on your lighting supply mains.

A 75 Million Increase

"At the present rate of progress in the radio industry, it will not be long before radio will add $75,000,000 yearly to the aggregate income of the Central Station industry, while daily it becomes more convenient and economical for the public.

"It is more than a mere prediction to say that 10,000,000 radio receivers will be in operation within the next five years. My understanding is that the lighting industry serves approximately 10,000,000 wired homes, with an expected annual increase of 1,000,000 homes per year.

"At the end of five years you would supply electricity to at least 15,000,000 homes and we might safely predict that at least one-half of these wired homes will be equipped with radio."

Amateurs Help Station

Dartmouth, Nova Scotia.—Frustrated in his attempt to get a "repeat" on an important European news article by a sudden break in the trans-Atlantic cables, the operator of the local radio receiving station, maintained by several American newspapers, called on amateur radio men to help him resume his schedule with the British transmitting station. As the station is equipped for receiving purposes only, the operators are seriously handicapped whenever the reception is broken and a "repeat" is desired.

In such cases they make a practice of calling upon the cable companies to forward requests that the transmitting station resume schedule at the place where the break occurred. On this occasion, it was impossible to get even this help. The operator of the British transmitting station, unaware of the difficulty, continued to send. In about an hour and a half the schedule would be over and it would be impossible to get the particular portion of the item that had been lost.

The local receiving operator communicated with Major William C. Borrett, operator of Canadian amateur station, 1DD, and manager of the Maritime division of the American Radio Relay League. Major Borrett asked several Halifax and Dartmouth amateurs to listen on short waves and, if a European amateur was heard, request him to have the British operator repeat.

Half an hour was consumed in listening but, as no European amateurs were heard, the operators of 1BQ and 1DD decided to send out a "general call" in the hope that some listener in England would pick it up. The call was kept up for fifteen minutes; then another fifteen were spent in listening.

Finally they received a telephone message that they had been successful. The superintendent of the transatlantic receiving station was heard saying "Thanks, you have put it over all right. We are getting our repeat." A British amateur had heard the message and informed the operator of the transmitting station.

Breaking Into Radio Without a Diagram

A Simple Receiver Which Will Work Without Outside Wires

By BRAINARD FOOTE

ARE YOU afraid of "diagrams," of "hook-ups?" Do you hesitate to join the radio game because you have heard that you can't work a radio set costing less than $150 on anything but an outside aerial? Did you realize that you can assemble your own receiving set from a mere photograph without previous radio experience of any kind and at a cost of about $25 all told? You can.

Even if your landlord won't let you hang wires on his roof, you are already provided with an aerial in the form of your electric lighting wires, your telephone line and your door-bell wiring. Of course, I don't mean to imply that such a method of receiving will bring in stations from across the continent, but it will work well up to 25 or 30 miles, and if you have a broadcasting station in your own town, you are well equipped. No doubt the simple set illustrated is not the handsomest model in the world, but its chief merits lie in its simple construction and equally simple operation. And you don't have to buy instruments which look exactly like those shown to secure successful results either, but, nevertheless, the pictures will tell you how to make the connections.

What You'll Need

Identification marks after the parts listed below appear in *Fig. 1.*

Four spring clips or binding posts (A, G, T).
Two .002 mfds. fixed condenser (1) (9).
Two single honeycomb coil mountings (2, 2).
One 17-plate variable condenser (4).
One fixed or variable grid condenser (5).
One 2-megohm grid leak and mounting (6).
One porcelain tube socket (7).
One 6-ohm filament rheostat (8).
One 1½-volt dry cell (12).
One variometer (10).
One 22½-volt "B" battery (11).
One board about 8 by 18 inches.

Other parts not in *Fig. 1* are:

One WD12 detector tube.
One 25-turn honeycomb or Coto-Coil.
One 75-turn honeycomb or Coto-Coil.
One telephone head set.
½ lb. of bell wire for connections.
One separable plug for connection to lighting socket.
Two small spring clips for making contact to radiator, etc.
Dials for condenser and variometer if not furnished with them.

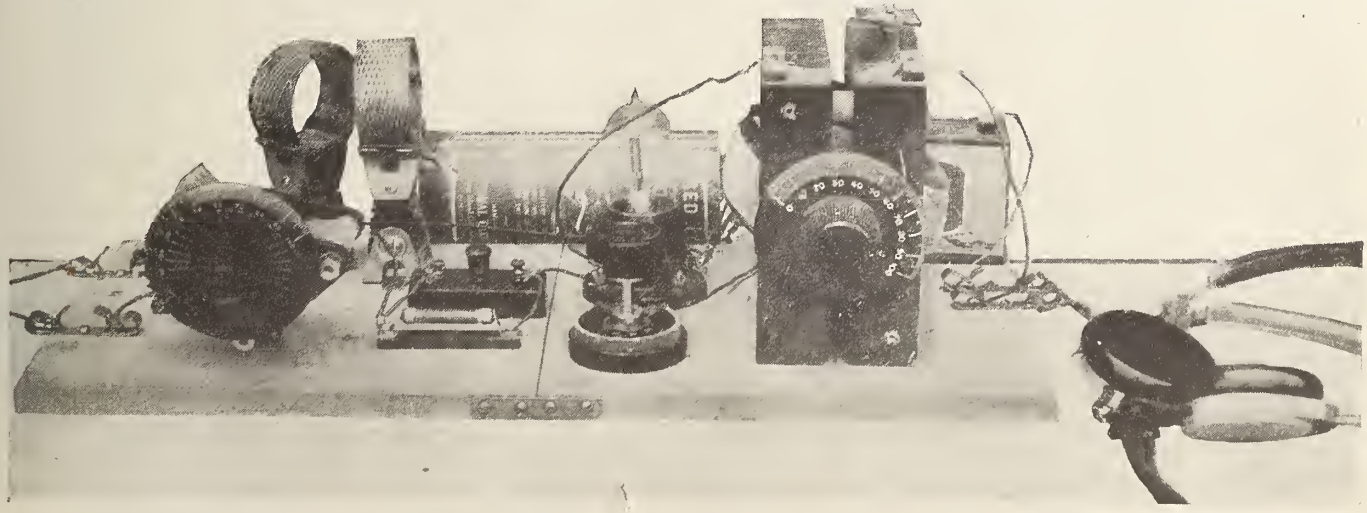
Even though the grid condenser you purchase doesn't look just like the one illustrated, it will have two binding posts which are connected in circuit as in *Fig. 1.* This, in fact, is true of the variometer and the variable condenser. Don't get the very cheapest in each line and you'll be rewarded with better results and more durability.

The first part of your program is to mount the instruments on the board after the fashion of *Fig. 1.* They will all be easy to screw in place except the variometer and the condenser. These may be fastened down with small brass brackets such as hardware stores carry, removing one of the mounting screws of the instrument and using it as a holding post for the bracket. The batteries may merely be stood in position. The socket is mounted with the slot toward the left.

The Wiring

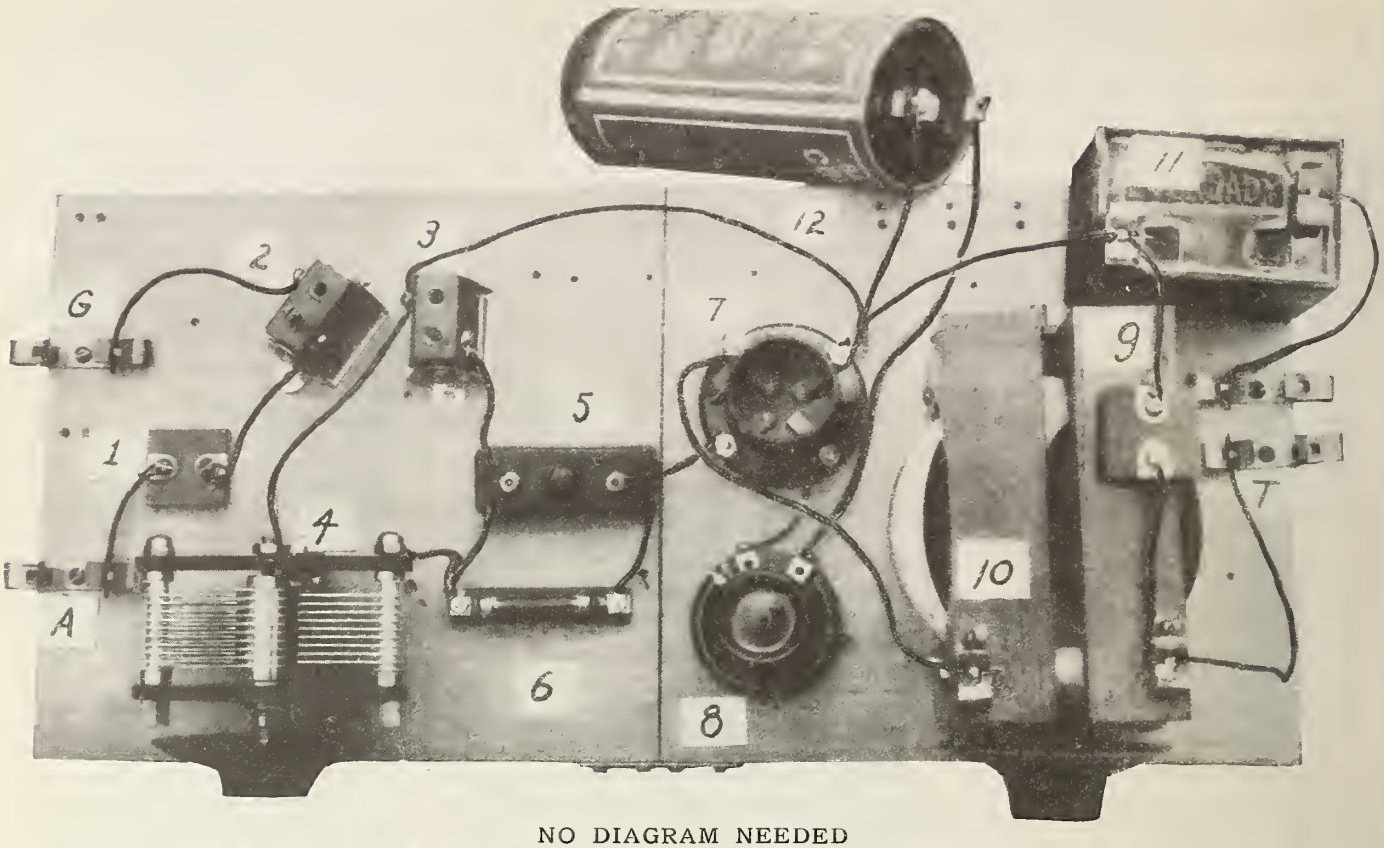
Lengths of the bell wire are cut off to make the connections. The pieces should be slightly longer than necessary to allow enough for bending the end around the binding posts. "Skin" the insulation off the ends with a knife and use pliers or a wrench to tighten the binding posts securely. The wiring list is as follows, and you should check it against the photograph as you make each joint:

Post "A" to left side condenser "1."
Right side of condenser "1" to right side mounting "2."
Left side mounting "2" to post "G."
(These connections finish the "primary" circuit.)
Rotary plates of variable condenser "4" to left side mounting "3."
Left side mounting "3" to socket "7" post marked "F+."
Right side mounting "3" to left side grid condenser "5."
Fixed plates variable condenser "4" to left side grid leak "6."
Left side grid leak "6" to left side grid condenser "5."
Right side grid condenser "5" to socket "7" post marked "G."
Right side grid leak "6" to right side grid condenser "5."
(These connections form the "secondary" circuit.)
Socket "7" post marked "F—" to left side rheostat "8."
Right side rheostat "8" to outer post of dry cell "12."
Socket "7" post marked "F+" to center post of dry cell "12."
(These connections form the "filament" circuit.)
Socket "7" post marked "P" to left post of variometer "10."
Right side of variometer "10" to front post "T."
Rear post "T" to right side (plus) post of "B" battery "11."
Left post (negative) of "B" battery "11" to socket "7" marked "F+."



THE SET ASSEMBLED

Figure 2. The completed model with tubes and honeycomb coils in place. The left-hand dial tunes in the stations while the right-hand controls the loudness.



NO DIAGRAM NEEDED

Figure 1. This is your wiring diagram, and it should be checked with the list of connections given in the text. Technically, this is a "Tuned Plate Regenerator."

Right side variometer "10" to front side fixed condenser "9."

Rear side fixed condenser "9" to left side (negative) of "B" battery "11."

(These connections complete the "plate" circuit.)

After the connecting wires have been put in and carefully checked up, you are ready to learn something about the principles upon which the set operates. Connect the phone cord terminals to posts "T," insert honeycomb coil of 25 turns into mounting "2" and the 75-turn coil into mounting "3." Then set the rheostat to the "Off" position, where the contacting blade does not touch the wires of the little coil but rests upon the fiber. Next insert the tube into the socket, handling it carefully, as it is valuable and delicate. Turn on the rheostat slowly until you can see a faint cherry red glow in the center of the tube, showing that current from the battery is passing through the "filament" circuit and illuminating the tube.

At this juncture, you should hear a bell-like ringing note when you touch the tube or the table, and if you do not, it is a sign that something is wrong with the plate circuit or with the telephones. These can be tested quickly by touching their terminals to the posts of the dry cell, where a loud click should be heard if they are O. K. Verify the plus and negative connectins to the "B" battery.

Getting Oscillation

Now set the condenser "4" at about half scale, or with the rotary plates half way in between the fixed plates. Then turn the variometer slowly. At a certain point you will hear a click, and then you will find that if you place your finger on the left post of the variometer a click is heard. As you take your finger off, another click is heard. When your set is so adjusted that you hear a click when you place your finger on that binding post and hear another one as you take it off, the tube is actually a low power transmitting or sending outfit. Were the aerial and ground wires connected, the set would send out disturbing noises and might interfere with reception by some neighbor within a few blocks. Hence you should be careful not to allow your set to transmit any more than you can help. Your tube is said to be "oscillating" when it is in the sending condition. However, the most sensitive point is found just below the actual oscillation, so when turning the variometer, get as close as you can to that point without actually allowing the tube to send. The sensitive condition is indicated by a sort of breathing sound.

Now you will find that if you increase the "capacity" of the variable condenser by turning the movable plates further in between the fixed plates you will have to move the variometer to again locate the "clicking" point. You will find that you can follow the condenser up and down the scale by readjusting the variometer.

Next turn off the rheostat. If you have a telephone in your house, this makes the best receiving aerial. Locate the receiving set near the phone and at the same time near a cold water pipe or the radiator. Cut two lengths of the bell wire about the correct size and fasten one of the extra spring clip connectors to an end of each. One wire should run from the "G" post of the set to the radiator or pipe. If the radiator is employed, just clip on to the nickel plated outlet valve or to the screw of the control handle. Be very careful when you connect to the phone, for the wire must not touch anything but the "A" post of the set. Condenser "1" prevents any interference with the phone conversations, but permits radio currents to pass through the coil of the primary circuit. Attach the clip to the nickel plated screw which fastens the microphone to the stand.

Other Aerials

You should try your set in connection with some other antenna system, too. Of course, if you have the space for an outdoor wire, erect one by all means—a well-insulated antenna of about 100 feet direct length will do very well. The wires of the doorbell system always operate with considerable success as an aerial, and connection to them may be made by attaching the clip connecting to the "A" post to either binding post of the doorbell. Where the electric light wires are elevated on poles in the street, or in a building containing a large amount of wiring, the lighting wires sometimes form a better aerial than the phone line. Remove the spring clip from the "A" wire and attach, instead, one post of the separable socket plug. Insert the plug in a suitable lamp socket, turning the switch "on" and trying a reversal of the plug to make contact to the side of the line which works the better. As in the case of the phone, the condenser "1" insulates the set from the

(Continued on page 61)

Broadcasting by Repeating Will Enable Radio to Encircle Globe

H. P. DAVIS, vice-president of the Westinghouse Electric and Manufacturing Company, universally known as the "Father of Broadcasting," has made public a plan for world-wide programs combining all the modern engineering achievements of radio transmitting and forecasting the marvelous development radio will make in the next few years.

The plan Mr. Davis proposes makes use of radio repeating, eliminates interference possibilities and shows how, in the near future, the radio listener will be enabled to hear programs from London, Paris, Tokio, in fact any part of the globe, with the same ease as programs from local stations are now heard.

The plan shows a marvelous vision for the future of radio and indicates how radio will eliminate time and distance.

In detail it follows:

"In the past few months the public has heard much regarding radio repeating without realizing, perhaps, just what this extraordinary achievement of radio engineering means to the future of radio. If the public knew that when the first radio repeating was successfully accomplished, the entire course of future radio development has been changed and the practically unlimited possibilities of radio broadcasting had at last been opened, it would have given the idea even more attention than was granted when it was announced.

Opens Way to World Wireless

"Radio repeating is the 'open sesame' to world-wide wireless and will make possible the receiving of programs from any part of the globe, with the same ease with which we now hear programs from stations located only a few miles from the radio receiver.

"Naturally, before world-wide wireless is a reality, there will have to be installed special stations in various parts of the globe and these stations must be located advantageously.

"Radio repeating when it was first successfully accomplished was the outcome of the development of short wave transmitting. Short wave transmitting means the sending of radio signals on a wave length of 100 meters or lower. Because this wave length is so low it is not heard on the ordinary receiver, and we therefore call it the inaudible wave. The ordinary broadcasting wave length band for 250 meters to 600 meters is heard, of course, on the ordinary receiver and is termed the audible wave. Inaudible wave transmitting forecasts the following radio development:

"Certain well designed central stations will be located at the world centers. These stations will be equipped to transmit on the audible or the inaudible wave length or both as desired. The audible wave transmitter need not have excessive power, so that its operation will not interfere with distant tuning by adjacent receivers if

Davis Predicts Advent of Super-Station Chain

desired. These transmitters will not need any more power than have the leading stations of the United States today. The inaudible transmitters, however, may be highly powered to give them the ability when necessary to maintain a constant range. As their signals will be transmitted on the inaudible wave length, the power used will not cause interference with receivers.

New Stations Needed

"There will be located, at advantageous points, inaudible wave length repeating stations whose sole duty it will be to receive these inaudible waves from the central stations and pass them along. These repeating stations will act as 'booster' stations to amplify over and over again the inaudible signals.

"Certain other stations, and there may be as many of these as desired, will be equipped with short wave receivers with which it is possible to pick up the short wave signals and repeat them on a low power audible wave. These stations, which are to serve local districts only, will merely repeat the signals caught on the low wave length and rebroadcast them for the benefit of the listeners in their immediate vicinity. These local broadcasters, therefore, need only a small amount of power. This interconnected international system will have a despatching organization to direct how and when the various programs of the central stations will be sent and what stations should stand by to handle the program circuits.

"Such a system will also need a world-wide and very efficient program-collecting organization. This program organization will be operated somewhat in the manner of the great news agencies of today, and will continually be on the search for interesting programs from every point in the world.

"A famous statesman—a world-wide figure of interest—is speaking in Paris. He faces the microphone which leads to the station located at one of the central broadcasters. This central station sends out his speech on the audible wave which can be heard on the ordinary receiver operated in the district surrounding Paris. Then, if desired, the inaudible wave transmitter also sends out the speech for world-wide transmitting.

"The despatchers have selected the route for transmitting the 'booster' stations who by prearrangement pick up the inaudible wave coming from Paris. These stations will then 'boost' the inaudible Paris wave so that anywhere in the world, as has previously been determined, it may be received on the short wave receivers of the local broadcasting stations.

"In Pittsburgh, KDKA, being equipped with a short wave receiver, could pick up these repeated short wave Paris signals and repeat them through its own transmitter with the result that everyone within the range of KDKA's signals could hear the Paris speech with receiving apparatus no more sensitive than is required to pick up the broadcasts originating in KDKA's studio.

(Continued on next page)

Kadel & Herbert

SPEAKING OF POLITICAL EXPERTS

Graham McNamee, the "sport reporter" of Station WEAF, ought to be one by this time. For he reported the daily doings of the hectic Democratic nomination convention at New York last month. His voice was heard by inestimable millions of radio fans throughout the country when several stations co-operated in simultaneous broadcasting of the historic event. McNamee is a St. Paul native and was a concert singer before taking up the microphonic profession.

"Perhaps an event of world-wide importance takes place in Pittsburgh. KDKA could duplicate the inaudible and audible wave length transmitting and the despatcher would instruct the 'booster' station to send along only KDKA's inaudible wave length signals.

"Thus this station's program would be the one that would be repeated by repeating stations located at any prearranged points on the globe and the signals could be received in Shanghai, San Francisco, London and Sidney, Australia, with the same intensity as signals are now received when transmitted by stations located at those points.

"This system means world-wide radio and it also means less interference to the radio listener, for, with a selective receiver, he could still hear long distance stations, even though the local station should be repeating a London program picked up from the inaudible wave source."

Radio Association Official Raps Plan for Super-Stations

The recent announcement of the Radio Corporation of America that the big electrical and radio companies of the country had decided to establish ten super-broadcasting stations in zones throughout the country is of considerable interest to radio manufacturers, broadcasters, dealers and the public at large, according to Alfred M. Caddell, secretary of the American Radio Association, New York City.

"The proposed blanketing of the country by super-broadcasting stations certainly blankets a lot of opinions that might want to be expressed before such a policy would be put into effect," said Mr. Caddell.

"While it is stated that such a broadcasting system would not interfere with local stations which take care of local needs, experience has shown that unless exceptionally selective receivers are used, it is impossible to tune out stations using a carrier wave of high power. This was demonstrated recently when the Republican National Convention was broadcast over the entire country—very few other stations could be picked up by average radio receivers in any section of the country.

"The radio business has been built largely on the thrill of getting distance, and if this thrill (and therefore other stations) becomes destroyed by blanketing the country steadily with high power, it might lead to serious consequences in the radio world.

"Everyone knows that radio broadcasting needs a complete overhauling and that the present lack of economic stability surrounding broadcasting cannot endure, but the public and the independent broadcasters naturally want to be heard when it comes to the overhauling.

"To this end the American Radio Association is conducting a contest in which a $500 prize is offered for the most practical solution of the problem, and it may reasonably be expected that a constructive solution will be found."

Kadel & Herbert

AMPLIFYING SPEECH ONE BILLION TIMES

That's what this bunch of lily-like amplifiers does when someone talks into the microphone connected to it. Twenty-four amplifying horns are shown in the photograph, which was taken recently in Madison Square Garden, New York. This huge radio attachment will be used in future meetings, including the Radio World's Fair next month, to speed the proceedings to a listening world.

Common Law Could Handle Radio, Claim

Legal questions arising out of interference between users of radio could probably be settled by common law, in the opinion of Hon. Stephen B. Davis, solicitor for the Department of Commerce. In speaking on this subject before a recent meeting of the Federal Club at the Bureau of Standards in Washington he called attention to the fact that, while common law is based almost wholly on precedent, it is often modified by court decision to meet new conditions, such as have been created by radio and aircraft.

Under the constitution, Judge Davis stated, the control of radio apparatus with regard to structural and safety features properly belongs to the individual states, but the Federal Government would control the interstate commerce features, and could regulate any broadcasting station whose signals could be picked up outside the boundaries of the state in which it is located.

There has been some fear of a radio monopoly, the judge said, but if this monopoly came about through the suppression of competition and unfair trade practices, the present anti-trust laws could handle it. A monopoly arising from patent ownership, however, could not be broken, for reasons that are inherent in the patent law.

The most difficult communication problem in the army, according to Maj. J. O. Mauborgne, the next speaker, has heretofore been that of keeping in contact with advanced troops in battle. All forms of communication in use in the past war proved inadequate, he stated. He then told of a portable radio set developed toward the end of the war which is expected to solve this problem.

There are a great many radio sets on the battle front, he said, and the problem of assigning wave lengths to them all is a very complicated one. The wave lengths and call letters must be changed every day or so, in order to avoid giving the enemy a clue to the nature of the sending station. Radio sets are carried by tanks, airplanes, and advanced infantry units, and form part of the equipment of all grades of headquarters and of artillery brigades

Vacuum Tube Circuits Without "B" Batteries

By JOHN B. RATHBUN

English 4-Element Tube Based on 'Unidyne' Idea; Has Faults, But Tests Indicate Possibilities

A CONSIDERABLE amount of interest has been awakened in this country as well as in Europe by the appearance of an English four-element tube which does away with the necessity of the usual plate or "B" batteries. This tube, the joint invention of K. D. Rogers and G. V. Downing, is based on what they term the "Unidyne Principle" and is applicable to regenerative circuits where the three-element tube is commonly used. While the idea is not basically new, and experiments in this country have shown that the principle has several inherent disadvantages, yet the four-element tube shows promise and we will undoubtedly hear more of it in the future.

In Fig. 1 we show a sketch of a four-element tube in which the terminal (A) is the connection of the second grid to the positive side of the "A" battery. The remaining connections to the plate, the first grid and the filament, are made through the four prongs in the base as with the conventional three-element tube. For convenience, the terminal (A) can be connected to the metal sleeve of the tube mounting, and can thus be used without much complication in metal sockets. It should be understood at this point that the second grid, or the fourth element of the tube, is maintained at a positive potential and in close proximity to the filament so that the electrons are set free by the attraction between the minute negative electrons and the positive grid. In other words, the second grid (A) performs a part of the functions of the plate used in the triode tube—that of increasing the electron emission of the filament. The plate now is simply the output terminal with the first grid functioning in the usual way.

Fig. 2 is a schematic diagram or symbol of this tube where the elements bear the same letters as Fig. 1.

To understand the operation and construction of the four-element tube we must first take up the construction of the simpler tubes, such as the two-element and three-element types so common on the market at the present time, for it is only by this comparison that we can see how the four-element tube functions.

The Two-Element Tube

In Fig. 3 we show an ordinary incandescent lamp bulb containing the usual hairpin filament (F). The filament is heated to incandescence by the battery (A) and the temperature is controlled by the filament rheostat (R). At high temperatures, electrons are emitted from the surface of the filament as indicated by the short arrows (e), and as there is no control over these small negative charges, they fly off the filament in every direction.

Now consider the case where the plate (P) is placed in the vacuous space with the filament (F) as in Fig. 4. The plate (P) is given a slight positive charge by induction, and as the negative particles or electrons are attracted by the opposite positive plate, they stream across between (F) and (P) and form a continuous bridging current. This effect was discovered by Edison many years ago. As long as the electrons are emitted by the filament, a current will be established through the inductance coil (L), the phones (H) and the gap between the filament (F) and the plate (P). This is the simple two-element tube commonly known as the "Fleming Valve" and is now represented commercially by the Electrad Diode and the Dietzen tubes.

THE aerial (An) and the variable condenser (C) are connected to the upper end of the inductance (L), while at the lower end is the usual ground connection at (g). Impulses entering the aerial cause variations in the electron stream between (P) and (F) and these variations in current flow cause sounds in the phones (H). The plate (P) is not strongly charged to a positive sign, and the electron emission is comparatively weak, so that the signals at the phones are not much stronger than with the ordinary crystal detector. By connecting the positive pole of a high voltage battery to (P) the stream or emission is greatly increased and the signals are correspondingly increased in volume.

In Fig. 5 we have the two-element tube to which the high voltage plate battery "B" is added with the positive pole connected to the plate. The battery "A" is simply used for heating the filament as before. As the plate (P) is now given a strong positive charge there is a powerful attraction for the negative electrons and the velocity and rate of emission is very much greater than in the case where the positive plate charge was maintained simply by induction. A comparatively heavy current now flows in the plate and "B" battery circuit, and also through the vacuous space between the filament (F) and the plate (P). This system, however, will not give a signal in the phones since the current is continuous and unvarying. To produce a sound in the phones there must be a variation in current strength in the phone circuit.

The Three-Element Tube

The three-element tube of Fig. 6 is basically the same as that of Fig. 5 so far as the output circuit is concerned and includes the "B" battery for maintaining the positive plate charge. Interposed between the filament (F) and the plate (P) is the "Grid" marked (G) which is used for the control of the electron stream passing between the filament and plate. The grid in practice is a cage surrounding the filament (F) composed of a spirally wound wire coil, and in order to reach the plate the electrons must pass through

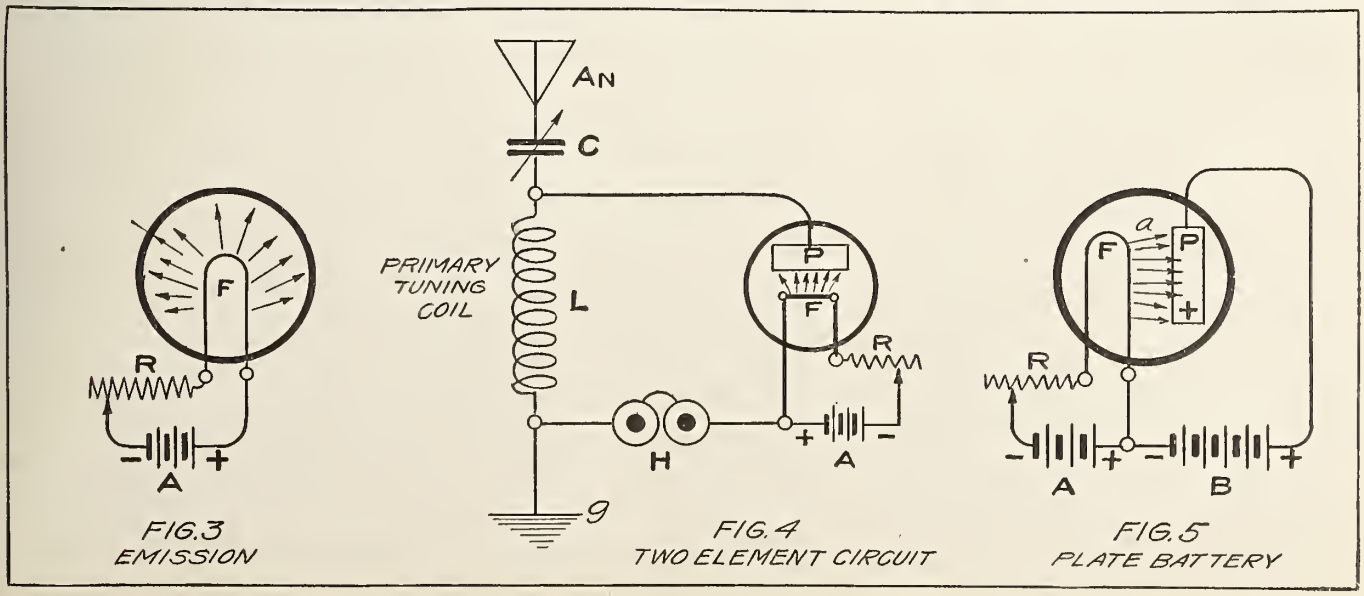
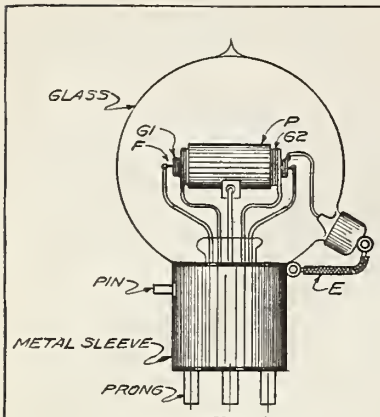


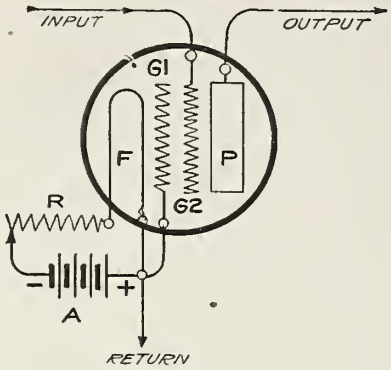
FIG. 3 EMISSION

FIG. 4 TWO ELEMENT CIRCUIT

FIG. 5 PLATE BATTERY



F16.1
TUBE ASSEMBLY



F16.2
SYMBOLS AND CONNECTIONS

the meshes of the grid.

By means of the tuning inductance (L) and the variable condenser (C), the circuit is tuned to the frequency of the incoming radio waves, and when tuned in, the impulses from the aerial are communicated directly to the grid (G) through the grid condenser (K). As these radio currents are alternating currents, the grid is given alternate positive and negative charges which vary in amplitude with the sound or modulation impressed upon the carrier waves at the transmitting station. The charge on the grid now corresponds to the charge on the aerial circuit, and the grid in turn varies the flow of electrons between (F) and (P) to correspond exactly to the variations taking place in the aerial.

As a result, the current flowing through the phones (H) pulses in step with the modulation (sound) waves and the transmitted speech or music is heard at (H). The grid can be really considered as a valve which controls the relay battery current in the plate circuit, the valve being opened or closed to check or accelerate the electron flow by the very feeble impulses acting on the grid.

WHEN a negative charge enters the grid (G) the grid is charged negatively. and the circuit is interrupted for the reason that the negative electrons are repelled by the grid and returned to the filament, therefore never reaching the plate (P). This interruption gives a click or sound in the phones (P). A succeeding wave of positive polarity charges the grid with a positive charge and this attracts the electrons and accelerates the flow between (F) and (P) at a speed above normal. This increased plate current gives a second sound in the phones. A very feeble charge in the aerial and grid is therefore capable of controlling a considerable flow of battery current, and the initial wave is therefore "Amplified" or multiplied many times. The positively charge plate (P) tends to maintain a steady flow of battery current through the tube, while the grid charge varies the amplitude or magnitude of the phone current in direct proportion to the amplitude of the incoming radio waves.

A positive charge on the grid (G) increases the rate of electron flow or emission while a negative charge tends to impede to flow. The exact degree of acceleration or impedance depends upon the magnitude of the voltage applied to the grid. For each volt impressed on the grid there is a definite flow of current in milliamperes through the phones with a constant "B" battery voltage. A milliammeter placed in series with the phones and "B" battery as at (MA) will plainly indicate the fluctuations of current taking place when the circuit is receiving signals. The needle of the meter will swing back and forth in almost direct relation to the intensity of the sounds heard at (H).

The strength of the received signals is roughly proportional to the plate voltage impressed by the "B" battery when a hard amplifying tube is used. Thus, with 16 volts on the plate, the voice and music may be quite faint on local stations, but when the "B" battery voltage is built up to 67.5 or 90 volts the signals are very much stronger because of the increased emission and velocity imparted to the electrons. This, however, is not so marked on distanct stations for the reason that the grid potentials are now too feeble to entirely control the tremendous emission and hence the electron stream is not so completely modulated by the grid as when the grid potentials were stronger.

Three Elements Without "B" Battery

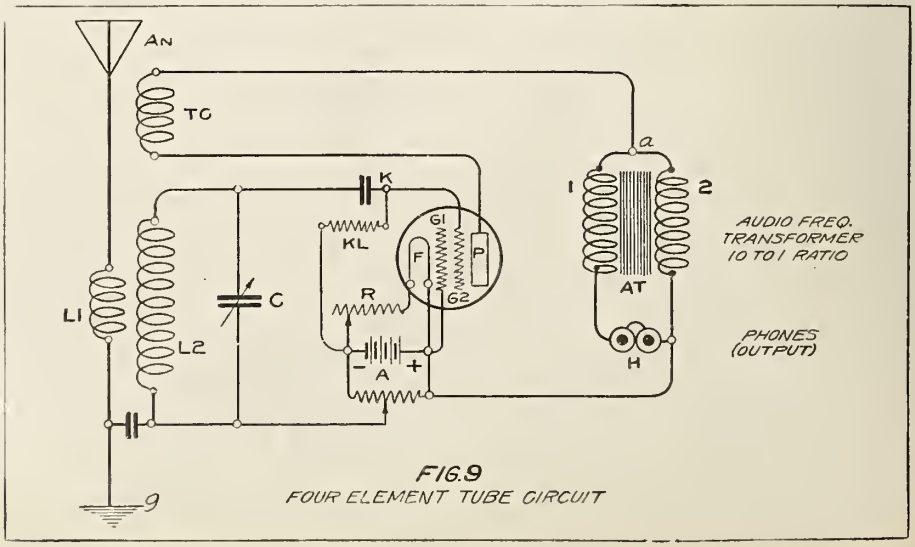
Now let us consider that we have disconnected the "B" battery in Fig. 6 and have then connected the phones in the plate circuit directly from (2), or in other words, have short circuited the posts where the "B" battery was formerly connected. The positive pole of the "A" battery will now maintain a low voltage positive charge on the plae (P) and the signals will continue to be heard, but with greatly reduced strength owing to the lower voltage of the "B" battery. This circuit is shown by Fig. 7 with the "B" battery removed and where the "A" battery alone maintains the plate at a positive potential. This arrangement works fairly well on strong local signals with six-volt tubes, and would no doubt work very much better with tubes having the filaments designed for a 22.5 to 45-volt "A" battery, as then we would have a much more effective voltage on the plate.

Signal strength and distance are both very much increased by the adoption of the "Regeneration" or "Feed-back" principle by which a part of the plate circuit is fed back into the aerial circuit for reamplification in the tube. Thus, in Fig. 8 we have a typical regenerative circuit for a three-element tube where the aerial impulses pass through the primary coil (L1) and induce charges in the secondary coil (L2) which is connected to the grid (G) of the tube. The plate output at (P) is very much stronger than the aerial currents, as before explained, due to the relaying with local battery current. Hence, if we feed back this amplified current into the secondary coil (L2) by means of the "Tickler coil" (TC), we will gain an additional amplification since the impulses will be fed through the tube a second time and will receive a second amplification. Instead of the feeble aerial impulses acting on the grid (G) alone, we will also have the stronger plate impulses acting inductively on the grid, which very greatly increases the effective grid potential.

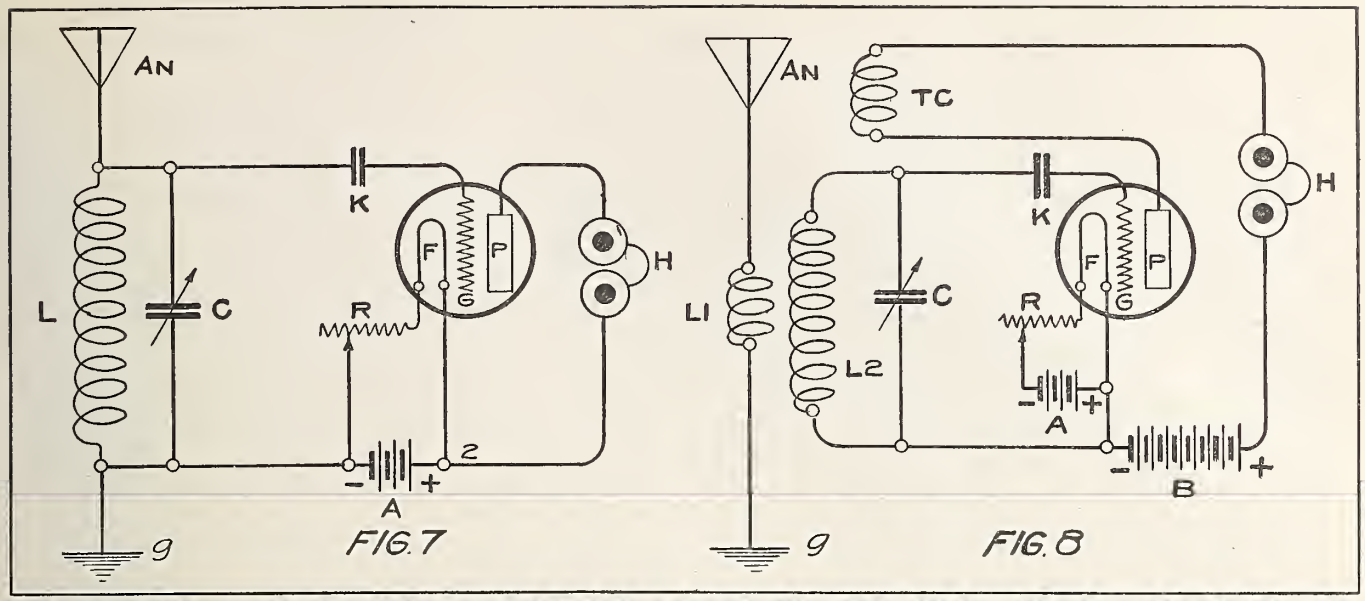
The Four-Element Tube

WE now arrive at the four-element tube, which in many respects resembles the three-element tube. We have the same filament and plate and also the same control grid as before, but in addition to these elements is a second grid which maintains a positive potential independently of the plate. The plate in this case is simply an output electrode.

In Fig. 2 we show the four-element tube



F16.9
FOUR ELEMENT TUBE CIRCUIT



in diagrammatic form so that its relation to the three-element tube can be more easily followed. Here we have the filament (F), the plate (P), and the aerial grid (G2) as before. Placed close to the filament is the second grid (G1) which connects to the positive side of the (A) battery and which is therefore constantly maintained at a low positive potential. No "B" battery is necessary for the reason that the positively charged grid (G1) pulls the negative electrons from the filament and increases the emission in the same way as the older charged plate did the job but at a lower potential. In fact, the whole scheme is reminiscent of Fig. 7, except that the extra grid is located more advantageously than the plate of the ordinary tube.

The tube shown in Fig. 1 is a development of Fig. 7 made some time ago by the writer in which a commercial tube was remodeled on the score of economy. Owing to more recent schemes the idea was finally discarded in favor of more promising fields.

The Four-Element Circuit

Fig. 9 is a general schematic circuit of the regenerative type in which the four-element tube is used. This is only one of a great many such circuits possible, and it is likely that expediments in four-element hookups will develop more highly efficient schemes. The plate (P) output is fed back inductively into the secondary coil (L2) of the coupler in the usual way by (TC), the secondary being tuned by the variable condenser (C). The grid (G2) is connected into the secondary circuit through the grid condenser (K) and grid leak (KL).

At (G1) is the second grid, which is connected to the positive side of the "A" battery. The phones (H) can be placed in series with the plate and tickler (TC), or else the special audio transformer (AT) can be connected as shown to increase the volume of the signals. Here, the phones (H) are in series with the secondary (1). The primary and secondary have a common connection at (a) and both coils are in series with the plate circuit.

This is a rather novel connection and it would seem at first glance to partake somewhat of the reflex principle. This, in general, is the "Unidyne" circuit, which, however, is subject to as many modifications as the circuits of a three-element tube.

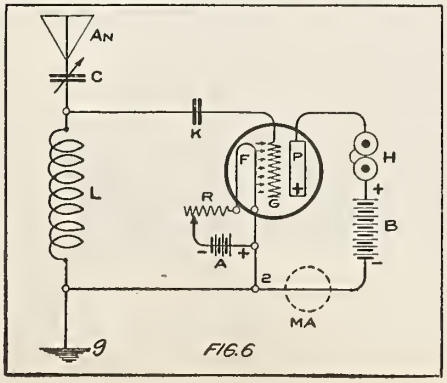
Original "Unidyne" Developed by U. S. Manufacturer?

There has recently been released in various radio publications information concerning a circuit brought out by two radio men of London, which does away with the separate "B" battery.

This circuit employs a four-element tube which contains two grids as indicated in the diagram above. The extra grid is inserted between the usual grid and filament. It is made positive by being connected to the positive of the "A" battery and it is placed so close to the filament that the electrons are pulled away from the filament and hurried to the plate. Added velocity is given them by the extra grid.

This circuit has been named by its English inventors, the Unidyne. However, the original "Unidyne" circuit was developed by the engineers of the United Manufacturing & Distributing Company of Chicago, and they have the name "UNIDYNE" registered in the U. S. Patent Office, according to a bulletin released by the United Manufacturing Company last week.

The United "Unidyne" Receiver is the result of over a year of experimenting and development work by renowned engineers.



Tubes Replace Spark Signals on Lighthouses

Marked improvement in the sending of wireless fog signals from lightships and lighthouses has been achieved through the development by radio engineers of the General Electric Company of a vacuum tube radio transmitter expressly designed for this sort of work.

In tests which have just been completed on Staten Island, the new tube set showed superior efficiency as compared with the typical spark set of the type used for a number of years by the United States Bureau of Lighthouses.

During the tests both of the fog signal radio transmitters were adjusted to about ten amperes in the antenna. It was found that the total power consumed by the spark set averaged around 2,300 watts, nearly 50 per cent greater than the power consumption of the tube set, the latter being about 1,650 watts.

This will have a direct bearing on the question of fuel supply to lightships and lighthouses, since the power for these sets is supplied by gas-engine driven generators, in which kerosene is usually burned.

If the lightship or the lighthouse is located in an inaccessible position, as is often the case, a considerable saving in fuel and other expenses can be effected if fuel ships are not required to make the trip as frequently as at present.

The tube set was shown to be safer to operate and much more simple than the spark sets heretofore used, and the signals were clearer and better toned, making them easier to read.

The spark sets heretofore used have caused many complaints to be sent in by listeners to broadcasting stations because of their tendency to originate interference. This condition will be remedied by the use of the tube sets, which possess a non-interference characteristic.

The outcome of the tests with the new set was a recommendation by J. T. Yates, superintendent of lighthouses of the third district, to the Bureau of Lighthouses in Washington, asking that these tube sets be adopted generally for the bureau's radio beacon stations.

The Heart of the Radio

By ERNEST WALKER SAWYER
CHIEF ENGINEER, ELECTRAD, Inc.

PART 2.

IN A previous article I showed you the importance of the proper size grid leak. I hope you had the opportunity of testing my advice by trying a different size leak in your set.

Now I want to explain to you why it is so important for you to have grid leaks which are manufactured by responsible people who will certify they are correctly made and guaranteed.

Here is the Heart of the Radio. The source of success or failure of the set and yet a careless pencil mark has, until recently, been permitted even in expensive sets of well known manufacturers.

In the grid leak, you are dealing with minute electrons of electricity passing over a path of extreme high resistance 500,000 to 30,000,000 ohms. Here is the essence for a great deal of research work. The problem of handling such minute portions of electricity at such extraordinarily high resistances resembles somewhat the problems of dealing with lightning. Two storm clouds are filled with energy. The electricity generated is enormous; the path between the clouds or from the cloud to the earth is possibly a mile of thin air. Its resistance is beyond comprehension. Finally the pressure becomes so great the electricity jumps.

If there was a copper wire or other easy conducting path, there would be no zigzag and no thunder. It is exactly the same in the receiving set. The accumulated charges jump along the grid leak. If the path is a perfect conductor, there is no noise. If the grid leak element is uneven or only partially a conductor, then the grid leak actually creates noises in your set. You will realize from this the importance of a proper element in the grid leak.

Just as a copper conductor carries low frequency currents in a smooth, proper manner, because each molecule of copper has its functions to perform harmoniously with its neighbor; so likewise or even more so should the substance of your grid leak element be so composed that the molecular displacement of the carbonaceous conducting material should be equal throughout the entire cross sectional area. In plain English, the grid leak element should be made of a material which is exactly the same in the interior as on the surface or you will get the zigzag jumps together with the noises as in lightning.

The elements of many grid leaks are made of a paper in which carbon in the form of lamp black has been defloculated through the pulp during the process of the paper manufacturing. This is one method of obtaining the desired result.

After the paper is cut to the desired size for the grid leak required, copper or brass clamps are fastened to each end or some special method is used to make contact between the element and the ferrules or ends of the grid leak. These contacts likewise are extremely important, as a loose contact means a noisy grid leak or one of very high resistance.

An electric current is now passed through the element to season it. An analogy to this might be shown as the passing of a current through a piece of iron to form a permanent magnet. The atoms of lamp black align themselves in perfect regular order, end for end, so as to offer the smoothest possible path to the passage of the small current for which it is intended.

Next the elements are treated with waterproofing compounds, usually of secret formulae, as the waterproofing matter must not affect the element adversely.

The leaks are now seasoned a few days just as you bake steel.

Next, the element is carefully inserted in the glass tube or other insulating case, and the ferrules are soldered on each end to further protect the element from contact with fingers and atmosphere. Glass cases are most common, but there are other insulating materials now in use, where the dielectric losses and insulating qualities are considered better.

The finished grid leak is again tested and labeled or stamped and certified correct. It is now ready for use.

There has in the past been considerable propaganda on grid leaks to the effect that if your grid leak is the incorrect resistance, you can compensate by adjustment of your variable condenser. This is an absolutely incorrect method of procedure. As you can readily see, one cannot adjust resistance by altering capacity. If your grid leak is the wrong size, you must get another. If they are certified correct, then you know what you are getting and can try out several sizes until you find the one best suited for your particular requirement.

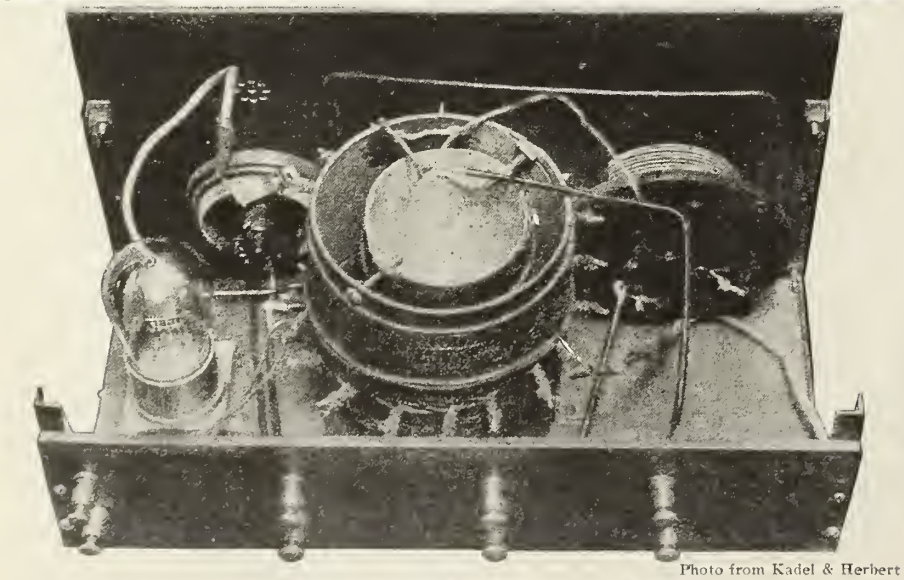


Photo from Kadel & Herbert

A ONE TUBE TRANSMITTING SET

The photo shows the interior of a transmitting set built by George B. Myers of Athenia, N. J. It operates on a U. V. 201 tube, 23 plate condenser and an inductance. Also a Ford spark coil is used and a glass plate condenser for supplying the high plate voltage.

Canadian Tries to Reach MacMillan

Toronto, Canada.—William Choat, local radio amateur and radio operator for the Canadian government steamer "Arctic," which left Quebec the first of July on her annual trip to Baffin Bay, may be the first amateur operator to relay back to Canada and the United States the complete details of the Winter experiences and home-coming arrangements of Captain Donald B. MacMillan, Arctic explorer.

The departure of the "Arctic," under the Northwest Territories Branch of the Canadian Department of the Interior, comes at a time when the arrival of daylight in the Far North is beginning to shut off the radio contact between MacMillan and radio amateurs of the United States and Canada.

The radio messages that have come from Donald Mix, the explorer's radio operator, last Fall and Winter have become gradually less frequent as darkness began to leave the polar regions. Of late there have been only a few weak messages that have sufficed to show the "Bowdoin's" crew have come through without hardship. The last one told of the explorer's plan to start for home soon.

On its annual trip, the "Arctic," which this time is in charge of J. D. Craig, M. E. I. C., and Captain Bernier, famed Canadian explorer, sails as far north as Etah, Greenland. Last Fall, on their arrival in that harbor, the "Arctic's" crew found the "Bowdoin" there and one of them took a snapshot of MacMillan's little schooner as she lay at anchor near the shore.

This year the "Arctic" will carry a short wave I. C. W. outfit which will enable its operator to transmit on the amateur wave lengths between 100 and 150 meters. This equipment is in addition to her two regular sets, consisting of a standard 600-meter, 2 k. w. spark transmitter and a continuous wave transmitter working on a 2,100-meter wave length.

Radio Drawn Into Field of Magic by Queer Tales of Ether Bogies

Scientists Are Baffled by Accounts Verging on Supernatural

By CARL H. BUTMAN

WASHINGTON.—Radio supervisors and inspectors hear many queer tales of strange messages, sounds and calls emanating from somewhere within the boundless realms of radio land. Some complaints are weird, a few pathetic and still others almost convince one that there are Ethereal Bogies.

Radio is of itself more or less of a marvel and a mystery, with the rapid advancement of its range, manipulation and scope, and it is small wonder that certain susceptible fans and even operators long in the game hear or imagine they hear curious and unaccountable messages verging on the supernatural.

There is the story of one old-timer who declared that he no longer needed head phones, his ears having become so tuned to the notes of code stations that he could pick up messages from almost anywhere.

Some of these complainants perhaps improperly classified as bugs of the ether, insist that they are haunted by "Hertzian spooks," which in certain cases seem to approach from the spiritual angle and assume radio control of their victims. They not only exercise an undue influence but create actual fear in the hearts and minds of those persecuted. Certain students of the problem refuse to believe that it is all imagination, attributing the influence to something supernatural or at least a power not yet understood.

Does Radio "Control" Exist?

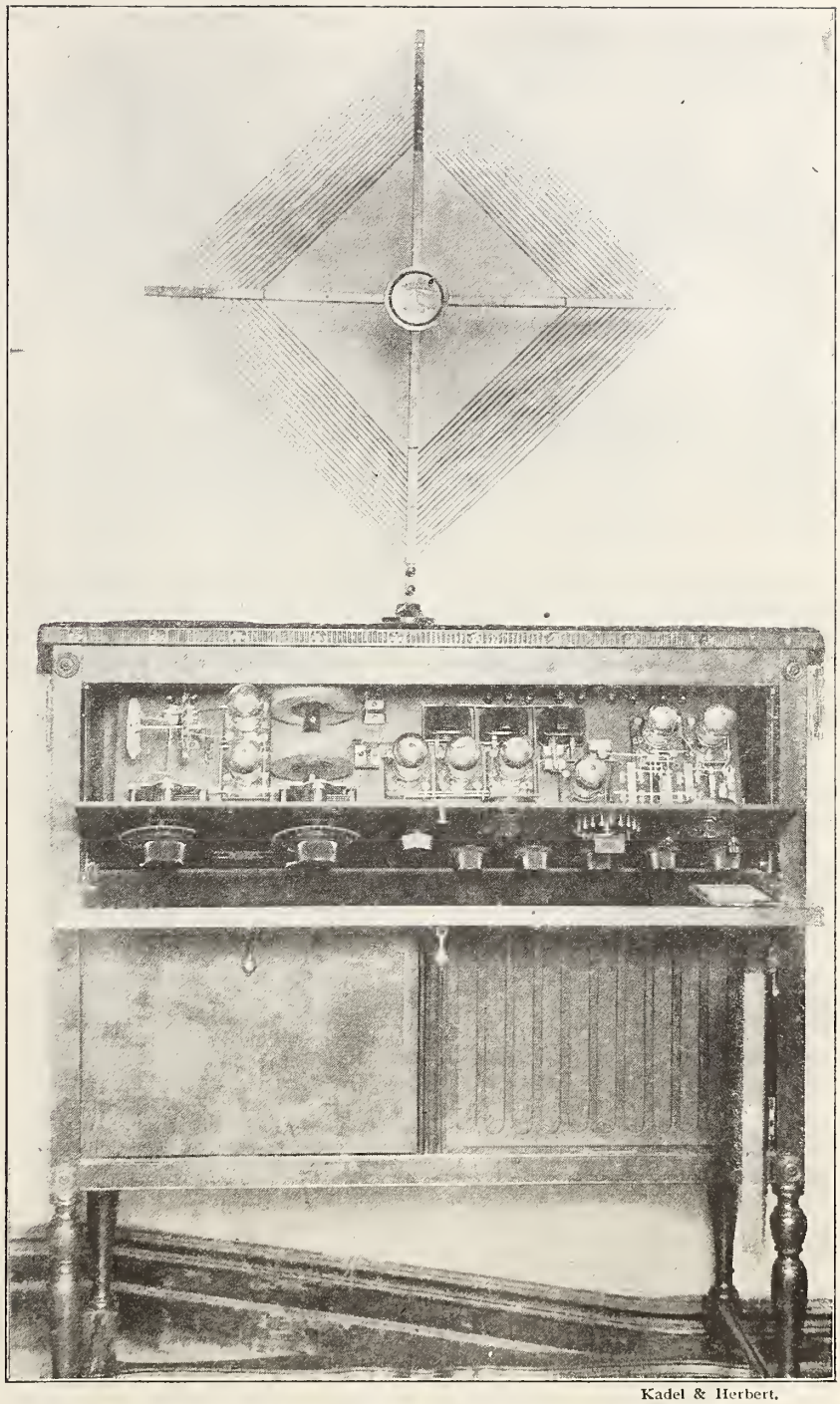
Of many cases reported to the Department of Commerce, there is none so striking as the "Strange Case of Operator Blank," on which there is a thick file of papers.

Nearly four years ago a sea-going radio operator of twenty years' experience reported to the supervisor of a coastal district that he was the object of radio persecutions in the form of radio telephonic messages which were transmitted to him continually by virtue of wired-wireless when he was ashore.

Three unprincipled young operators, he asserted, kept a surveillance over his every move, reading his thoughts, and at times "neutralizing" his brain action. These three persecutors relieved each other, but kept up their vocal messages day and night, no matter where he was. Their sinister influence, he felt sure, was affecting his young daughter when she was near him, and practically broke up his home. He appealed to scientists, doctors, radio experts, the government and police without benefit, as the source of the radio emanations could not be traced. They seemed to come from a coastal point. Even while on an automobile trip across the continent and into Canada, the "phantom" radiophone or photophone messages pursued him. The messages were transmitted on various frequencies and were impossible to ignore.

Operator Blank believed the young men had invented an ultra-modern transmitting set of which no one knew the circuit. He said the boys told him it was a wired wireless psychometer affecting the transmission of speech by a therapeutic oscillator, and received by triplex phantomining attunement. He couldn't get away from the messages, and he was certain that the boys kept a log of his thoughts.

(Continued on next page)



Kadel & Herbert.

CABINET AUTOMATICALLY CONTROLS TUBES

This unique set, constructed by Harold Herbert, radio engineer of New York, and valued at more than $500, operates when the cabinet is opened and automaticaly turns off the tubes when the front is closed. It is an eight-tube Super-Heterodyne with two tuning controls entirely self-contained.

And Still They Pursue

Later on, when he was again at sea, the messages pursued him, evidently through the medium of radio. In the Atlantic or Pacific the effect was the same, and the operator came to believe that the primary phonetic effect kept his head aching continually; sometimes he was driven from his radio shack. He was certain his death could be caused by these boys if they desired. He again took up the matter of locating the station with authorities in New York, San Francisco and Washington, but no one was able to aid him nor locate the unknown station. Unofficial and unsigned messages continued to follow him, causing interference with his regular traffic, his sleep and his mental stability. Investigations showed him to be in good physical and mental state, but although pronounced sound in his mind and body and only about 42 years old, he was literally driven from the sea and his profession.

Following up some of his suggestions, radio officials report that spiritualists have been affected in a similar way, and from New York came information that complaints of this character were increasing—in fact, becoming quite common. Department of Commerce radio officials say that during the full of the moon complaints of weird and unnatural radio messages in the ether come in with a strange regularity. Even to date the department and its field staff have not been able to solve the mystery of Operator Blank's persecution nor the source of the phone messages he reported.

Other curious cases reported to the department include the Western farmer who, whenever he was plowing in a field near an insane asylum, declared that he was influenced and persecuted by voices which seemed to come from a queer box on the sill of a window in the institution. He came to Washington in an effort to rid himself of this "radio control." When he returned the box was no longer visible, and it is understood he was bothered no further, though it was never wholly explained.

From Philadelphia came a story of a woman who was constantly hearing radio voices, especially when riding on a train, although it was long before trains were equipped with receiving sets. Another woman out West recently wrote that waves from a certain radio station pass through her house and her person, causing a most unpleasant effect; she said she could never sleep until the station closed for the night.

Now Come Radio Sleuths

During the World War, complaints of this type and others attributed to German spies, codes, etc., came to the department's supervisors in great numbers, some of them obviously from people with unsound minds, who sought to become radio sleuths and desired special transmitting licenses and stations. Such desires, however, were almost always in the interest of defending the government, and differed from the case of Radio Operator Blank, and a few others whose radio troubles have never been solved.

Getting a Stranglehold on Static

Explaining that static is usually due to distant electrical disturbances in the upper atmosphere, and the trouble is generally less the higher the frequency to which the receiving set is tuned, the radio laboratory of the Bureau of Standards, of which J. M. Dellinger is chief, offers the following suggestions for meeting the difficulty:

"There are no known methods of completely eliminating interference caused by atmospherics in receiving sets tuned to the commonly used radio frequencies," he says.

"Methods are available which partly overcome the trouble. One is the use of a small receiving antenna. This may be a relatively low and short outdoor wire, or may be an indoor antenna. Such an antenna receives less powerful signals, but this may be compensated by using a more sensitive receiving set, employing regeneration or radio-frequency amplification. A small coil antenna or loop antenna, consisting of a few turns of wire on a frame a few feet square may be used, provided the receiving set is so designed as to permit operating with such an antenna. The coil antenna has the added advantage that it can eliminate, by virtue of its directional characteristics, the atmospherics that come from a specific direction.

"Another means of reducing the interference from atmospheric disturbances is to use a very selective receiving set. Two-circuit receiving sets, using loose coupling, are preferable to single-circuit sets for this reason. Radio-frequency amplification, with sharply-tuned transformers, is helpful. Well designed regenerative sets are also very selective.

"A specialized method is the use of a 'wave antenna,' which is a very low antenna, one wave length or more long. Another way of decreasing interference from atmospheric disturbances makes use of a combination of several antennas in such a way as to partly balance out the atmospherics. Also, a long antenna may be buried a short distance underground. This type of antenna reduces both the signal strength and the strength of atmospherics. Some evidence has been obtained to show that certain types of local atmospherics are reduced in a greater ratio than the signal strength.

"Still another method which has been reported to be of some use in reducing interference makes use of the limiting action of an electron tube used in conjunction with tuned audio-frequency amplification. It is stated that this method is based on the theory that an electron tube, when worked at a certain point on its characteristic curve, possesses a limiting action restricting the strength of the signal heard in the telephone receivers to a definite maximum. Thus atmospherics, although stronger than the signal being received, are equal in intensity to it, as heard in the telephone receivers. This equality in signal strength having been obtained, the advantage of audio-frequency tuning may be utilized. The result is a partial elimination of interference from atmospherics. This method is not adapted to broadcast reception."

To Eliminate Radiation

"How can I prevent other radio sets from interfering with my reception?" ask many readers and radio fans continually.

A special organization has recently been formed among radio engineers to formulate some method by which radiation or "canary bird" interference can be eliminated.

Users of Antenella aerial plugs report that this ingenious light socket aerial has solved this problem for them and many have taken down their aerials because they can get just as good results with the Antenella.

The construction of the Antenella is such that it makes the house wiring system act as an antenna, and because these lines are self-shielding due to conduit wiring, they do not pick up outside aerial radiation and are accordingly ideal to eliminate such interference, as well as static.

Filtered Heterodyne Audio Stages

By MARVIN HUGHES

REFERENCE has frequently been made in these columns to the fact that some sort of filter must be used in the audio stages of a Super-Heterodyne receiver to eliminate the noises and distortion which frequently are unpleasantly apparent in this circuit. This filter system must not be confused with the so-called "filter" or transfer coupler working at radio frequency which is installed at the beginning of the radio frequency stages, or rather between the first detector and the first radio amplifier tube. The audio frequency filter referred to here damps down the "Bumps" and harmonies developed in the first radio stages and is effective in clarifying speech and music when the loud speaker is used. It is almost a necessity with the two stages of audio amplification.

In general, the audio frequency filter system can be divided into two principal divisions: (1) That part which comes between the second detector tube and the first audio stage which damps down undesirable oscillations emanating from the detector, and (2) That part which prevents direct "B" battery current from entering the loud speaker and introducing distortions due to the constant deflection of the diaphragm under the stress of the "B" battery current. The first element precedes the audio amplifier, while the second comes between the amplifying stages and the speaker. In addition to these devices the conventional grid biasing "C" battery is installed, which is a further aid to clarity and which materially increases the volume.

Two Inductances Needed

FIG. 1 is a diagram of the complete two stage filtered amplifier which is connected to the second detector tube at the "INPUT" end or at the left of the diagram by the connecting posts (x) and (y). The connection (x) is made to the plate of the detector tube (P') as usual. The circuit can be installed in the same cabinet with the main heterodyne circuit or in a second cabinet. The former, of course, is preferable, but one should note that at least two inches more will be required on the length of the panel than with the more straight audio stages, owing to the introduction of additional apparatus.

Two large inductances of the iron core type are used. This rather complicates matters, since we must arrange these parts so that there will be no inductive interference or transfer of energy through the wild flux issuing from the coils, and this is not always a simple matter in the limited space that we have at our disposal.

Preceding the first audio frequency transformer (AFT1) is the preliminary filter circuit consisting of the two 12,000 ohm non-inductive resistance (R1) and (R2). Connected to the mid point of these resistances is the 100 millihenry iron cored choke or inductance (L1) in series with the 0.01 Microfarad fixed condenser (K2). Across this assembly is the 0.005 mf. fixed condenser (K1) which functions in the ordinary capacity of a phone condenser. The reactance of (L1) and (K2), together with the damping effect of the resistances (R1-R2) eliminates the high frequency disturbances which may originate in the radio frequency stages and detectors, and "irons out" the bumps before passing to the primary coil of the first audio frequency transformer (AFT1). Also see Fig. 2 for assembly.

Watch Detector Tubes

Connections at (B1) and (+22) depend largely upon the nature of detector tube used and on the "B" battery arrangement. If a soft detector of the UV200 or the C300 type is used, then a tap is made at the 22-volt terminal of the "B" battery. If a hard tube such as the UV201A or C301A is used which, by the way, is better practice, then (y) can be connected to the 45-volt tap. For the best results it is very desirable that the first radio stages, the detectors and the oscillator be carried on one "B" battery with the audio stages on an independent "B" battery as at (B2). However, this is very expensive and greatly increases the complexity of the circuit so that a single "B" is imperative. With a single "B" connections can be made as per dotted lines.

IT WILL be noted that the first single circuit jack (JD) for the detector circuit is connected directly across the primary posts (P) and (+B) of the first audio frequency transformer (AFT1). This arrangement does away with the contact troubles often encountered with a conventional two circuit jack and insures that the primary coil is always connected permanently in circuit without danger of noise due to poor contacts. The first audio stage jack (J1) is connected across the primary of the second audio transformer (AFT2) in the same way, so that in all we have three single circuit jacks in parallel on a continuous circuit which are not interrupted by the insertion or removal of the plugs nor by vibration. This is of the utmost importance in a circuit of this sort where the great amplification and the heavy "B" battery current makes jack contacts a serious problem.

The secondary coil of the first audio transformer (AFT1) connects to the grid of the first audio tube (T1) in the usual manner. Both tubes are given a negative bias by the "C" battery shown which has its negative pole connected to both the (—A) posts of the two transformers by a common connector. The positive pole of the "C" battery goes to the (—A) lines. For a 90-volt potential on the plates, the "C" battery biasing voltage should be about 4.5 volts, and from 6 to 9 volts for plate voltages much above this. So much has been said upon the subject of the "C" battery in its relation to volume and grid stability that it seems almost unnecessary to enter into a discussion of its functions at this point, but it should be understood that it is one of the most important adjuncts to the system and should not be omitted under any conditions. Condensers (K4) shown dotted are optional and may or may not give improved results. (.0005 mf.).

To minimize the number of controls on the panel, both tubes (T1) and (T2) are controlled by the single rheostat (M) inserted in the negative lead of the tubes. Separate rheostats can be used of course, but it is not advisable to enter into more complication than absolutely necessary, even at the expense of an extra tube burning when only the first audio stage is being used. Under most conditions, the set will be operated on both audio stages with the speaker plugged in on the output jack (J2).

The Output Circuit

Now we come to the final or output circuit of the second tube (T2). Ordinarily the connections from the plate and (+B) are connected directly to the output, but this introduces certain difficul-

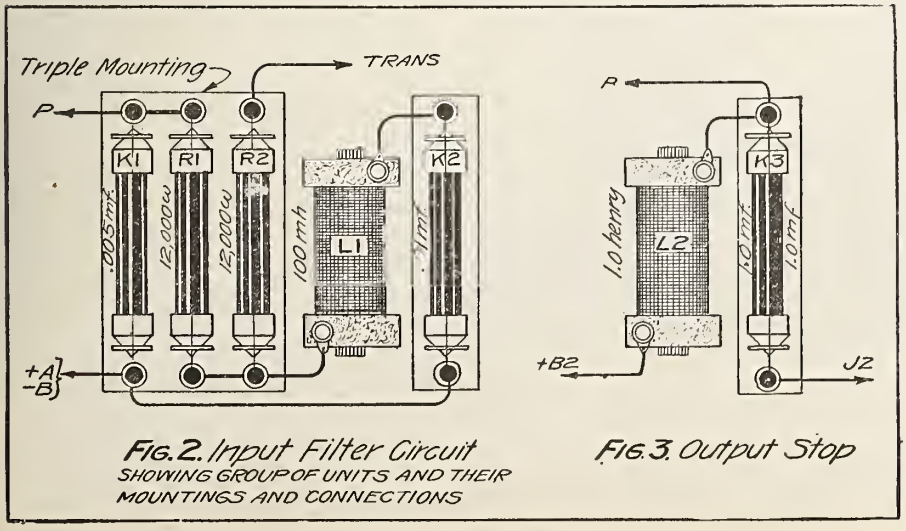


FIG. 2. Input Filter Circuit SHOWING GROUP OF UNITS AND THEIR MOUNTINGS AND CONNECTIONS

FIG. 3. Output Stop

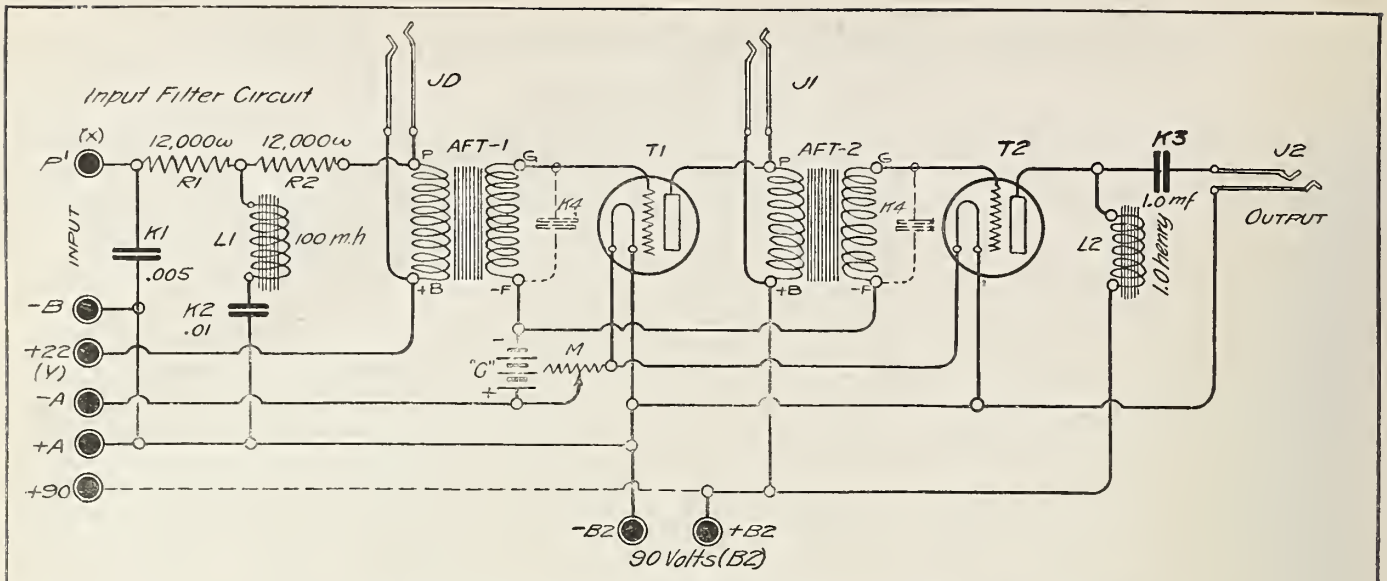


Fig. 1. Filtered Two Stages of Audio for Heterodyne

ties in the loud speaker and distortion in the final stages. To remedy this defect, the fixed stopping condenser (K3) of 1.0 mf. capacity is inserted in the plate circuit to interrupt the flow of continuous "B" battery current that ordinarily takes place through the coils of the loud speaker. This relieves the speaker diaphragm of the magnetic stress imposed upon it by the battery current and makes it more responsive as only the alternating audio currents can pass to the coils of the speaker.

As equal deflection is now imparted to both negative and positive waves there is no distortion due to diaphragm reaction. Current from the (+B) leads to the plate of tube (T2) and passes through the iron core choke (L2), which permits free flow to the plate, but which chokes down and prevents the audio frequency currents from short circuiting back through the battery. Some amplification is also due to the "kick" from (L2), and in general this combination not only improves the quality of the reception, but also adds considerably to its volume. Inductance value about 1.00. See Fig. 3 also.

IT IS imperative that both (L1) and (L2) be iron core inductances of the value given, owing to the low frequencies of the currents dealt with in this part of the circuit. The impedance of air core inductances while effective with the high frequency radio currents, offers very little opposition to the flow of audio frequency currents which are in the nature of 5,000 cycles per second. The inductance (L1) can be obtained from the better class of radio supply houses or from the various telephone manufacturing firms. Inductance (L2) can be a 1.0 henry iron cored inductance, or if desired, the secondary coil of an audio frequency transformer can be connected into circuit for this purpose. The latter, however, is rather bulky and takes up valuable room, but on the other hand, it is comparatively well shielded and causes practically no interference.

In locating (L1) and (L2) we must take every precaution against magnetic coupling and interference. The coils should be kept as far apart as practicable and well away from tuning inductances and the transformers. In all cases they should be laid out with the cores at right angles to one another and at right angles to the coils of the transformers so that the flux will not induce wild currents in the circuits. Enclosing the coils in grounded metal boxes is a great help, for the boxes shield the adjacent apparatus from the intense magnetic fields of the coils.

Our 12,000 ohm non-inductive resistances are of the type commonly used by telephone companies and are now to be obtained from the larger and better radio supply houses. As in Fig. 2, their general appearance is similar to that of a grid leak and they can be held in the same sort of clips and stands. Their value is not critical, but in general they should be as nearly 12,000 ohms as possible and of exactly equal resistance. Further, they must be truly non-inductive so that there is no phase displacement. No opposition to the radio frequency component which passes from the plate of the detector tube.

The Tubes

Regarding the tubes to be used for the amplifying stages (T1) and (T2), it may be said that the UV201A or the C301A are the best all around tubes to use. Of the dry cell tubes the UV199 or C299 are by far the best but, of course, do not deliver the volume attained with the power tubes before mentioned. Still further amplification can be had by the use of the Western Electric 216A tubes or the five watt transmitting tubes such as the UV202 or C302, but these latter tubes take a great deal of filament current and with the heterodyne any additional filament current is to be looked upon with disproval.

Both the 216A tube and the five watt tube permit of very high plate voltages and for this reason are essential where the maximum volume is to be obtained when the set is to be used in large halls or for outdoor service. Up to 350 volts may be used on the plates of these tubes and the amplification is in proportion, but it must be borne in mind that such voltages call for heavy plate currents and put a heavy demand on the "B" battery. The use of storage type "B" batteries is almost necessary if plate voltages of over 100 volts are to be used.

Figs. 2-3 show the general arrangement of the units used for the filters and stops, and their mountings. Fig. 2 is the input filter with the condensers and resistances placed in the usual spring clip mountings connected up for use. This arrangement probably gives the shortest leads. Fig. 3 shows the condenser and choke for the output "stop." It is likely that the least room is taken up when these parts are mounted on a small vertical panel placed near the rear edge of the baseboard, and as no adjustment is required there is no reason why this will not prove satisfactory.

100-Meter Transmitter Tested on the Shenandoah

That radio messages can come from a point high up in the air as well as "through it" was demonstrated recently when the radio operator on the Navy's big airship "Shenandoah" gossiped for a while with radio amateurs below.

"To the Rochester amateurs," read the message in code. "You are the first bunch that have woke up today. Best regards."

This was not a casual greeting, attempted as a pastime for the "Shenandoah's" crew, but part of a systematic program for testing out the possibilities of short wave amateur communication. Some time ago the American Radio Relay League learned from the Navy Department that a short wave transmitter was being installed on the airship for the express purpose of enabling its operator to communicate with amateurs should it be needed in emergency during flights.

Radio is no Longer "Seasonable"

By ROBERT J. CASEY

The Vest Pocket Anthologist

WHY should radio be a seasonable affair—like the flu and the winter coal bill?

It seems to be the accepted psychology in the radio business to shut up shop and go fishing at the first breath of Spring. But why? That, Oswald, is one of the real mysteries of radio. It ranks in interest with static, body capacity, and the proposed tax on broadcasting and it outclasses them in importance. But it is undeniably a mystery.

According to the popular conception of the thing, the entire world goes deaf in the Summer time. All the stations quit broadcasting simultaneously — or simultaneously quit broadcasting, depending on your particular situation. All the batteries die. And all the "gyp distributors" have their annual fires.

The Cause of It All

A survey recently completed by the Electrical Research Laboratories of Chicago may furnish a clew to the causes of this phenomenon. Two years ago a hard Summer followed a particularly soft Winter. Many a manufacturer sighs at the memory of that glorious period when a brace of static-sifters euphemistically called head-phones brought an unquestioning $15 and a wooden variometer was considered cheap at $7. Every second-hand clothes dealer who could make a Chinese copy of a piece of wireless apparatus went into the radio manufacturing business and took out more fire insurance.

Along about Spring the great mass of radio pioneers had become convinced that radio was a myth. But why go on? The story of that fearful Summer is written in records of the bankruptcy courts of every county in the United States. The public had suddenly become convinced that short-circuited coils and contact-less rheostats are an expensive attic decoration. That radio ever recovered from this period of disillusionment is proof enough of its permanence, and of American adjustability.

A manufacturer of loud speakers referred to those days last week as he paid off the last of the loan that had saved him from wreckage.

Radio revived because it changed. The Gyps are always with us. But their numbers are decreasing and it has become possible for a fan to buy standard parts with fair assurance that they will work. The elementary telephone circuits are fairly well understood by a majority of amateurs. And the sounds that come over the radio are quite similar to those sent out by the broadcasting station. Prospects for continuous popularity should be good. But in the background is the memory of that terrible Summer.

Because of one "silent Summer" it seems likely that all Summers are doomed to the gag rule. A matter of psychology, Oswald, that only the nimble of wit can explain.

Taking Off the "Curse"

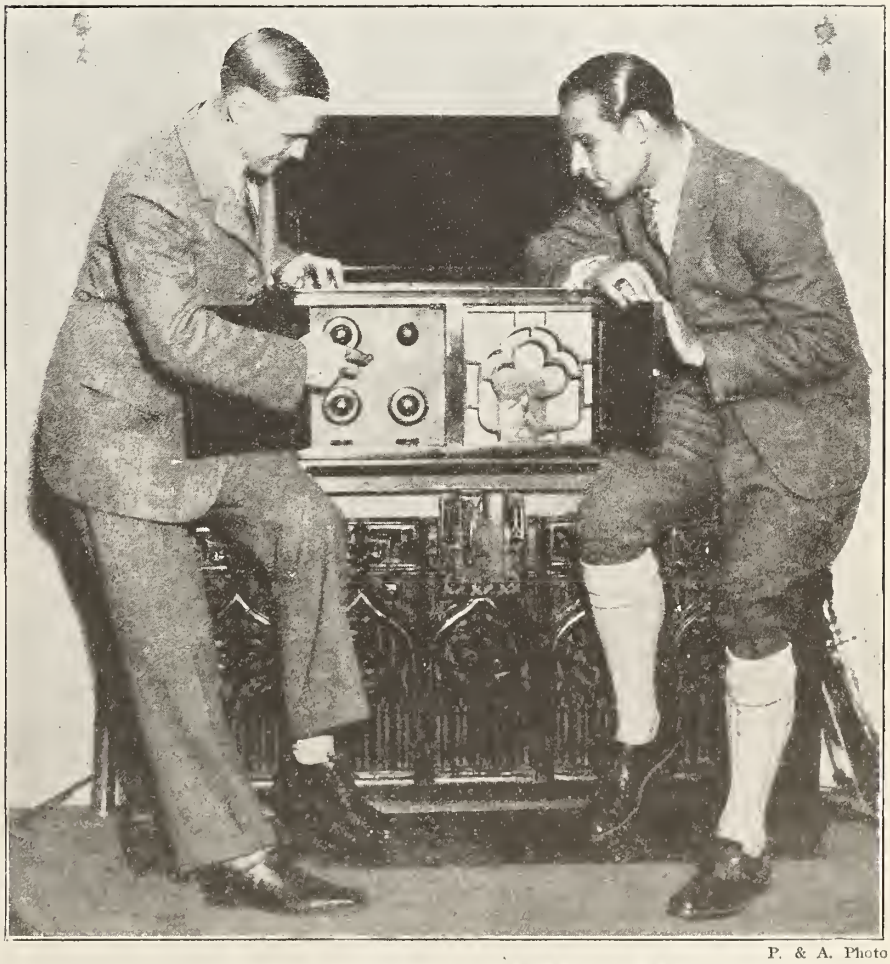
Application of the reflex principle to radio sets with dry battery tubes has made possible the construction of efficient receivers, all contained in cabinets a foot long or less, that will operate a loud speaker on a loop. A Summer evening on the front porch or the lawn certainly is no less enjoyable for a radio concert, and a radio set more than once has been known to take the curse off a Summer resort vacation.

As for static, most of it disappeared with the wooden variometer and its rough looking cousins. Inbuilt crackles in radio sets went out of style with switch arms and taps and Mexico City sounds just as bad in Summer as it does in Winter.

The Erla canvass shows that distributors and set builders throughout the country see no good reason for a warm-weather depression and look upon the annual vacation from broadcast as a tribute to the memory of the inefficient sets of two years ago. The material works of the hay-wire mechanics' guild have vanished. But only a patient and honest campaign of education extending over a period the length of which no one can forecast will destroy the psychological bugaboos that Gyp built.

Radio Technical Talks Over WTAY

RADIO AGE broadcasts technical talks every Wednesday evening from Oak Leaves station WTAY on 283 meters at 9:00 o'clock. Tune in your receivers to this wave some Wednesday evening and listen to the various members of the staff of RADIO AGE tell you the most recent developments in the radio field.



P. & A. Photo

EVEN "THE SHEIK" IS A RADIO FAN

Rudolph Valentino, a favorite with thousands of movie fans he never sees, is himself one of the great invisible audience which listens nightly to radio programs. He started by making a crystal set and has worked his way up to the most complicated hookups. Here he is shown with Alfred Grebe, the radio engineer, testing a new 5-tube set designed by the inventor for Valentino.

"This is WMC, 'Way Down in Dixie!"

How Local Talent Made WMC Popular

"STATION WMC, the Commercial-Appeal, Memphis, Down in Dixie," has been heard from London to Hawaii by countless thousands of loyal radio fans. From latitude 20 degrees South and longitude 97 West—a spot in the Parific Ocean—to MacMillan's expedition at 97 North, within 11 degrees of the North Pole, the ethereal concerts of this popular station have traveled.

WMC is owned and operated by the Commercial-Appeal at Memphis, Tenn. It was first opened in Januady, 1923, and soon became one of the best known stations in the United States because of the high quality of its programs and the bubbling exuberance radiated by the men and women who operated its studio.

Depending on local orchestras, with some aid from outside entertainers, WMC built up a reputation that meant "Varied programs with good music and excellent vocalists." Especially were its "genuinely Southern" jazz orchestras popular with the Northern and Eastern fans who received WMC's broadcasts.

Then came George D. Hay, better known as the "Solemn Old Judge," who is now with WLS at Chicago. With his Good Ship Huspuckiny and its famous whistle, he inaugurated a bit of foolish and good-natured byplay that took well with the listeners-in and established WMC as a real "human station" with human folks behind it.

The station, its mythical ship and the announcer soon became nationally known and recognized.

Dearing Now Announces

The newest announcer, Gerald L. Dearing, has picked up where the "Solemn Old Judge" left off and is working to make still better the reputation and popularity of WMC. Dearing is known in the air as "Jerry," while the operating staff, Percy Root and Joseph Kabakoff, are known to ether fans as "The Gold Dust Twins."

Incidentally, WMC has the smallest studio personnel of any 500-watt station in existence. Four persons outline and arrange the programs, announce, and operate the station. Two work in the studio itself and two in the operating room, the two rooms adjoining.

The transmitter at WMC is the 1A type—a 500-watt Western Electric. The power supply consists of a three-unit Robbins-Myer motor generator set, employing one low-voltage generator for filament supply and one high-voltage generator for plate circuit supply.

The regulation speech input equipment is used for both studio and remote control programs, while the usual two-button microphone is used at all times.

The antenna is of the four-wire inverted L type supported by two 70-foot steel towers, 150 feet apart and located on the four-story Commercial-Appeal Building in Memphis. The ground connection for the transmitter is made to the iron frame of the building.

Receivers at All Points

The monitoring of the transmission speech and music is acomplished by means of receivers located both at the station and at remote points.

WMC has operated on wave lengths from 345 to 500 meters, but has accepted 500 as producing the best all-around results. It has been at this wave length that the longest distance records have been made.

WMC's daily correspondence from fans all over the country is amazing, Mr. Dearing reports.

'Tis a Pleasure

"Entertainers like to broadcast from WMC because they always receive such good response from the eager fans who listen to them," he explained. "And the cheery spirit we try to maintain at all times makes it a real pleasure to listen in with us for an evening."

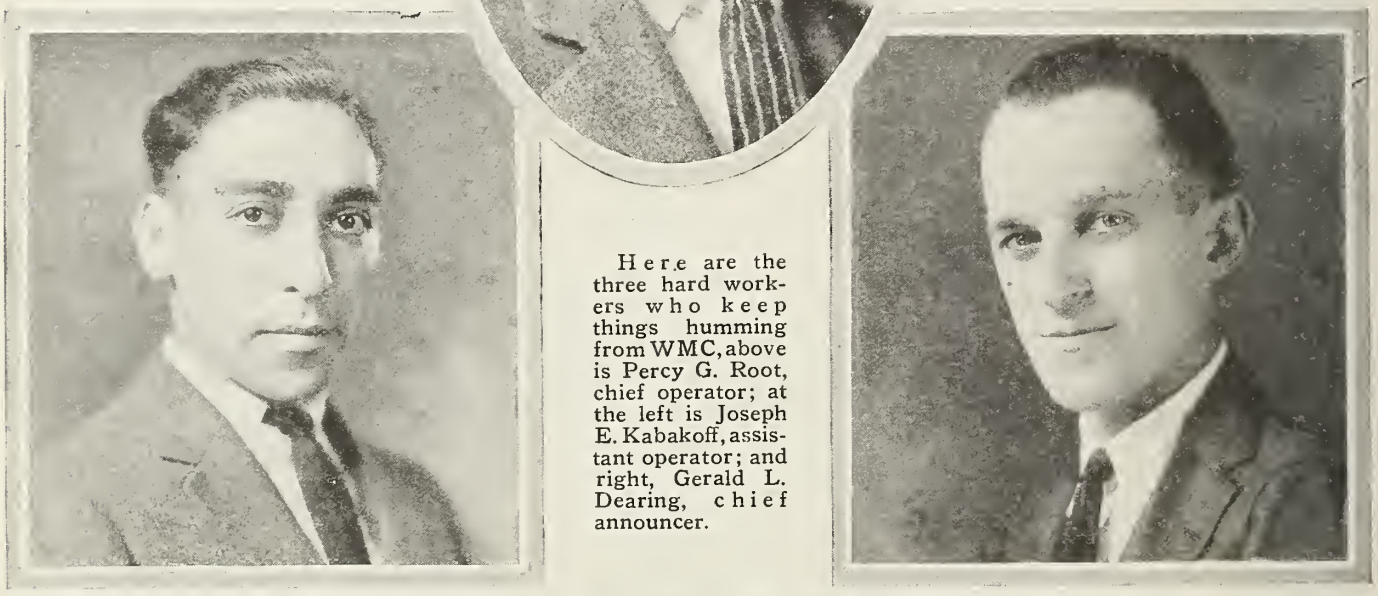
Try it some time. You'll know WMC by that "Down in Dixie" flavor of its programs.

WMC is virtually the leader of all Southern stations, having to compete only with those in Birmingham, Dallas and Fort Worth for first honors.

Hardly a visitor can stay in Memphis for more than a day without being asked the familiar question: "Have you seen our WMC yet?

(Another interesting broadcast feature in the September RADIO AGE.)

Meet the "Gold Dust Twins" of Radio Land



Here are the three hard workers who keep things humming from WMC, above is Percy G. Root, chief operator; at the left is Joseph E. Kabakoff, assistant operator; and right, Gerald L. Dearing, chief announcer.

How to Tune WLW's 423-Meter Wave Length

When the Crosley Radio Corporation's WLW broadcasting station began using their new 423-meter wave length it was discovered that several owners of receiving sets did not know how to adjust their receivers to tune in on the high wave length. E. J. Bussard, of the engineering department, prepared the following information for those who desire to make the necessary changes in their radio sets:

There are quite a number of receiving sets on the market, sets manufactured one to three years ago, which will receive wave lengths no higher than 400 meters. It can be readily seen that a receiver of this nature is of no value for receiving wave lengths between 400 and 600 meters.

In the majority of cases these receivers are of the single circuit type. It is relatively easy to correct this type of receiver to receive higher wave lengths. The most common method is to insert a small loading coil in the antenna circuit. In quite a few cases it is only necessary to increase the length of the receiving antenna. Another common method is to remove the condenser from the series connection with antenna circuit and place it in parallel with the antenna inductance coil of the receiver.

By a loading coil is meant an inductance coil; usually only a few turns of wire are necessary, placed in the antenna lead, one side of the coil being connected to the antenna lead-in and the other to the antenna binding post.

Should the circuit be tuned by a condenser used in series with tuning coil or tuned inductance, the wave length range may be sufficiently increased by shunting this condenser or connecting it in parallel with the tuned inductance or untuned inductance, as the case may be. This can usually be done by connecting the antenna binding post to the ground binding post with a piece of copper wire and then connecting the antenna lead-in to the wire connecting the antenna condenser to the inductance coil, should the condenser be in the antenna side of the circuit.

A few complaints have been received from people using three-circuit tuners. The difficulty here lies in the type of variometers used and it will be necessary to substitute variometers having the proper characteristics for tuning between 200 and 600 meters. In a few cases it may be possible to wind a few turns of wire on the variometer and correct this defect to some extent, but the novice will find no little difficulty in doing this.

"Quiet Hours" Changed

Hartford, Conn.—The changes in radio transmitting schedules caused by the observance of daylight saving time in some sections and standard time in others have prompted the American Radio Relay League, at the suggestion of the Department of Commerce, to agree to the temporary expansion of amateur "quiet hours" from 7:00 to 10:30 p. m., standard time, 8 to 11:30 p. m. daylight saving time. Amateurs are being advised of the expansion by the Department and are asked to attach the notice to their station licenses.

How Radio Waves Travel

The fact that radio waves can be made to go "there and back in nothing flat" was demonstrated at WTAM, radio station of the Willard Storage Battery Company, broadcasting from the Cleveland *Plain Dealer* studio.

A late dance concert of request numbers was being put on the air when a fan called the studio by long distance telephone from St. Thomas, Ontario, placed his loud speaker to the telephone and sent back over the wire the same music that was being sent out by wireless fifteen feet away.

The speed of the round trip of the signals was so great that the music came back from Canada at the same instant that it was going into the microphone in the next room.

To complete the circuit of sound, telephone wires carried the signals from the studio to the transmitting set, seven miles away. From there the ether carried them to St. Thomas, about 100 miles away, straight across Lake Erie. From St. Thomas they were put on the wire again, going about 400 miles around the lake to get back to the studio. And the return was instantaneous with the start!

ESSAY WINS RADIO SET

Grace Ann Yaeger, an opera star, of 23 W. 64th St., New York City, was awarded a $250 radio set recently by the Associated Exhibitors for her prize winning criticism of "The Chechahcos," a motion picture. More than 700 criticisms were submitted in the contest.

WJAX Studies Remote Control

WJAX, the Union Trust broadcasting station, Cleveland, has been a pioneer in Cleveland, as far as remote control broadcasting is concerned; that is, broadcasting from points distant from the actual radio studio.

Besides Symphony Orchestra Concerts, which were given at Masonic Hall, there have also been broadcast the organ of the Cleveland Public Auditorium, where the big Republican Convention took place; the orchestras of the Cleveland Hotel and the Winton Hotel; the Boys' Choir of Trinity Cathedral; and a number of Cleveland's best known dance orchestras.

A great many people have been under the impression that when a concert is broadcast from some point away from the studio, it is necessary to install complete broadcasting equipment at the place where the concert is being given. Of course that is not the case.

No matter from what point WJAX broadcasts concerts, the transmitters, generators, and all other standard station equipment, are undisturbed and are operated within the studio.

The concert is carried to the station by telephone wires. This involves the use of a private line direct from the place of the concert to the radio station, together with three pairs of conductors—one pair for regular telephone equipment, in order that the operator at the station and the operator at the remote control panel may have physical means of communication, the remaining two pairs of conductors being installed so that in case one pair should develop trouble, broadcasting could be continued over the other pair. These conductors are given a special test and all line noises and cross talk eliminated.

After the lines have been made ready, special input equipment including an amplifier and microphone are installed at the place where the concert is to be given and are connected to one pair of conductors.

The lines are then connected to the speech amplifier equipment at the station and tests are conducted for both audibility and quality. The volume is adjusted to a certain level in order to insure perfect broadcasting.

Portugal Adopts Radio

Authority to install and operate radio telephone apparatus in Portugal is granted in a recent decree of the Portuguese Government, says Vice-Consul Moers of Lisbon. Prior to this action no legal right existed whereby amateurs could install receiving sets, although no objection had been interposed by the government. Stores and novelty shops are now beginning to put in stocks of radio apparatus.

But in Roumania

Roumania has not given as yet official sanction for the use of private receiving sets, nor is there any broadcasting service, a statement from Bucharest announces. A government commission, however, is now studying the question and legislation permitting the use of radio by the public under governmental regulation will soon be requested.

Here Is Your Chance

to Pick

YOUR FAVORITE RADIO STAR!

RADIO AGE is conducting a **RADIO FAVORITE POPULARITY CONTEST** to determine which radio announcer, entertainer, musician or other personage is the most popular in the minds of the thousands of fans who listen in on their concerts nightly.

Beginning with the next issue, the first tabulation of results will begin. Fans are responding with a will, and several broadcasting stations already have enlisted their co-operation in this contest.

RADIO AGE wants to give its readers more news stories and pictures of the men and women who supply their radio entertainment. And in order to do so, we want to find out just WHO are the most popular and who shall be given first consideration in our columns. It is up to you to select your choice.

Read the rules below, get your friends together and send in your vote by clipping the coupon on this page. All together for the big competition among the studio stars!

Rules of the Contest

1. Readers of RADIO AGE are entitled to as many votes as they wish. Each coupon counts for one vote, and only those written on blanks clipped from RADIO AGE will be honored.

2. The candidate must be a person identified with the Radio World and may be an announcer, entertainer, orchestra, manufacturer or, in fact, any person in any manner connected with the great radio industry.

3. State clearly the name of your favorite, his classification (announcer, entertainer, etc.), the station from which last heard and approximate date when you were entertained.

4. Send in the coupons at once. First tabulations of results will appear in the September RADIO AGE and monthly thereafter until a grand winner is decided upon.

5. Radio entertainers are usually announced through the microphone, but it is suggested that in the event voters do not know the name of the announcer, they should give only the station from which he announces.

POPULARITY CONTEST COUPON

Harry A'dyne,
Contest Editor,
RADIO AGE,
500 N. Dearborn St., Chicago.

I wish to cast my vote for:

Name of favorite.....

Classification .....

Station.....**Approx. date heard**.....

My name [optional].....

My address [optional].....

Radio—the "Great Discoverer"

How One *Ambitious* but *Unknown Youth Won Fame* and *Fortune Overnight*

Being the Almost Incredible Story of the Jump to Prominence of "Sen" Kaney, Chicago's Veteran Radio Announcer

RADIO has made scores of interesting personalities, all of whom have profited greatly because they had the good fortune to become associated with a new and mysterious pastime. But the real personalities are the young men—and some women—who had the foresight to jump into the doubtful radio fray before it became the rage it is today.

Two years ago A. W. ("Sen") Kaney was a wandering youngster of about 25 years of age, flitting from place to place without a definite destination—just as thousands of other pleasing but unknown young men were doing.

Kaney had done some local theatricals and was popular among both sexes at any social event. But that popularity could not be translated into dollars and cents, and his personality was too young and not widely enough advertised to deserve a prominent place on a vaudeville bill.

Trusting to Luck

So Kaney went along unappreciated, trusting to luck something would happen.

It did. When the Westinghouse Electric and Manufacturing Company opened its station, KYW, in Chicago—and, by the way, it was one of the first to be started in that city—a call was sent out for announcers and entertainers.

Very few responded. The art of radio broadcasting was new and untried. The money end of it was uncertain, and altogether the new profession seemed more of a temporary occupation than a permanent calling.

But young Kaney had been keeping his eyes open. He grasped at this straw of hope and got a job as part-time announcer and fill-in entertainer. He could sing a little, talk a lot and keep up a running fire of conversation that was pleasing to the ear.

KYW grew. Other promising but unknown young men came over to the ranks, and by the time the station was well under way, Kaney was the acknowledged "guiding genius."

Kaney Guides It All

Elaborate programs were arranged. Famous stage and movie stars contributed their talents to the ethereal concerts—and all with the dominant personality of "Sen" Kaney hovering about. Before a few months had passed Kaney was flooded with offers from every section of the country, to go on the stage—take charge of other stations—and what not. Prospective offers ran into several figures, and Kaney found himself blinking in a new calcium of public favor—a new experience for him.

Finally he realized he was a star in every sense of the word—and after a few "rounds" of vaudeville and "personal appearances" in Chicago, he signed up with a local newspaper as Chief Announcer of WGN, Chicago, a new station. He was to receive a fat sum to transfer the "fans" from KYW to WGN and retain their favor with the same humanness that made his voice a byword in thousands of households.

No sooner had Kaney become established at WGN than that station was again sold and moved to another location and given a new wave length. This time—and at latest writing, Kaney is Co-Announcer with Jack Nelson at WGN, formerly WDAP, on the Drake Hotel, Chicago.

Owners of the station declare Kaney has accomplished a radio miracle of which he can be proud; namely, he has created a following of radio listeners who have shown by their correspondence with KYW, WGN and the old WDAP that they care more for Kaney's announcing and chatty talk than they did the programs he announced. Such an accomplishment is indeed a compliment.

One of Kaney's greatest successes in the broadcasting line was his broadcast of the automobile races from Indianapolis on Memorial Day, through WGN. This feat—accomplished in the pit alongside the track at Indianapolis Speedway, precipitated an avalanche of praise for Kaney

that has been unrivaled in the history of broadcasting.

Kaney has made broadcasting his *forte*. He has found his bent and he plans to "stick" until his voice gives out.

A Human Calling

"I believe announcing is the greatest human job there is," this young philosopher says. "You get to more people, and gain more friends, than in any other way. I never realized how many people 'knew' me until I began to meet a lot of them in person, in theaters and elsewhere.

"It isn't the glow of satisfaction alone that makes my work worth while; it's the thought that I'm bringing cheer and friendliness to someone alone by a fireside, or helping to inject pep into a party or meeting of some kind. Announcing is a public service and an art that's going to be as necessary as life in a very short time. I started with radio and I hope to finish with it."

Therein lies "Sen's" reason for his success.

Perhaps it was luck that Kaney was without prospects of a promising nature when radio made its debut. For it brought him fame and fortune and made him the reputed leader of his profession—or at least one of the leaders—and one of the profoundest students of the radio industry as a science and as a cog in human life.

After all, Kaney has been successful because he's the kind of a soul who makes friends easily. And that's what makes a successful broadcasting station.

WLW Heard in England

There have been many attempts made by stations in this part of the United States to reach England with their broadcasting, but it remained for WLW at Cincinnati to reach the goal. Henry Field, who operates Radio Station 6ZX in Baggrave Hall, Leicestershire, England, heard the station clearly as it broadcast the Chubb-Steinberg orchestra's regular midnight concert.

This is a remarkable achievement which marks a new era in broadcasting. The recent success of sending photographs by wire will no doubt soon be possible with radio and then the dreams of scientists will come true.

Another interesting reception of the broadcast concerts from WLW was aboard the U. S. S. Orion, when Stanley E. Wolf heard the music while his ship was 750 miles off the Florida coast.

In contrast to the reception of WLW on the water, A. K. Almon, operator on the train between Vancouver and Montreal, heard the broadcast concert very clearly. This radio set was installed aboard the Canadian Railways train and is a regular feature of the service for the convenience and entertainment of the passengers.

A Foreign Radio Record

An amateur in the Pyrenees district of France claims a record for the reception of American broadcasting. With only two tubes he receives nightly the American stations WGY, on 105 meters, and KDKA —both on the loud speaker. He has also to his credit over 500 American amateur stations.

AND ANOTHER REDSKIN BIT THE DUST!

It takes considerable imagination to convey realism by radio waves. Here is a "terrible" fight scene from "Pierre of the Plains" as produced from WGY. "Jap" Durkin has fired from ambush at Pierre, who feigns death and falls in the "dead leaves" which carpet the forest floor. When Durkin approaches, Pierre grapples with him and "slays him with his bare hands." Pierre then escapes on his trusty steed. Edward St. Louis, the player at the left, fires the shot; Edward Smith as Pierre is stifling the cries of Frank Oliver, alias Durkin, who is knee deep in onion-skin paper. A microphone on the floor picks up the sound of the struggle and the young woman at the piano depicts the clattering of the horse's hoofs. Quite exciting, eh?

How an Announcer Feels

By KOLIN HAGER
Chief Announcer of WGY, Schenectady, N. Y.

FEW people realize how earnestly we who are connected with the WGY studio hope they will listen to our nightly request for their comments and suggestions. We know that, if we are to succeed at all, it will be by carefully watching the attitude and following the wishes of the public.

Those who have followed the programs of WGY perhaps have noticed that the average week's broadcasting is carefully proportioned. On Monday evening a brass quartet might be scheduled with half popular and half classical music. Tuesday evening we would endeavor to offer either a drama, a comedy, or a program of music in contrast to the previous evening.

Radio Turns to New Field

The travelogue programs, embracing stories of trips through different countries of the world; the series of addresses by college instructors; and the many talks on various phases of manufacturing by numerous experts and scientists; all these help to give greater variety to our broadcasting. The predominance of music, which a year or more ago was very evident, is changing now to a greater emphasis on educational material in the form of school or college instruction, and talks by men who are specialists in their particular field. Indeed, if radio is to keep up its popularity, it must offer a greater proportion of programs which will make people think rather than cause them to sit back and merely be amused or entertained.

There isn't any reason why broadcasting can not be made the school and the college for all kinds of listeners. Its faculty members can be drawn from instructors throughout the country, and its classroom may extend even to the humble farmhouse and far into remote places. This should make for a magnificent organization, but to create and carry on such an undertaking the government will be obliged to take an active interest and be a part in the creation and continuance of this work.

My faith in the future of this development is in part due to the sensible letters we receive. The type of our audience is, I believe, superior to that of the average theater. The better things are preferred, and even strongly urged.

It may surprise many to know that we have five times as many requests for classical music—the compositions of the masters and oldtime American songs—as we have for popular, present-day music. The general opinion seems to be that popular dance music is the all desirable thing, but according to the requests we receive, it is the reverse. I believe, too, that this is a representative judgment. WGY's mail will shortly approach a quarter of a million communications of one kind or other, cablegrams, telegrams, letters and post cards. Doesn't it seem logical that if the people want the better music, they also want other features of a high quality?

The WGY announcers have all caught this spirit and have confidence in this broadening.

Two Stations Help

Not so long ago WGY and WJZ joined forces, with the result that many good events from New York have already been broadcast, notable among these, the luncheon of the Associated Press, when President Calvin Coolidge was the principal speaker. Incidentally, the President's father in Vermont heard the broadcasting of the address.

Several weeks ago WGY took part in a coast-to-coast program, when we relayed the alumni dinner of the Massachusetts Institute of Technology. Six other stations carried this program on; so that it is estimated fifty million people heard it and England and Cuba received clearly the music and part of the speeches. This is opening up a new phase of broadcasting, which by the several relays from one station to another, can give the listeners a program from the far West, the far North, or perhaps from Cuba. We may some day relay the English programs to America with the same ease that our own programs are transmitted today.

The studio broadcasting at the present time at the major stations is being better and more carefully prepared. The announcing which plays an important part in every program is more dignified and has not the former careless tone which some may remember. As much personality as possible should be in the voice of the announcer, and whatever he says ought to add to the program, and help in its success. There must be an optimism and brightness in all he says, if he is to hold the interest and have the favor of his audience.

A CO-ED RADIO STAR

Rey Marchant, between musical activities at the Mills College, manages to maintain her popularity as a violinist at Station KGO, Oakland, Calif. She is a member of the Mills College Trio and can manipulate popular and classical airs with equal dexterity. Whenever Rey's picture is published, her mail at KGO is doubled. Do you wonder?

Broadcast With Storage Batteries

"The Storage-Battery Station of the East" is the new designation of Broadcasting Station WDAR, Lit Brothers, Philadelphia, which recently changed its source of transmission power from motor generators to storage batteries.

The results obtained, in increased strength and clearness of signals, are reported as astonishing. Letters and telegrams commenting on the vast improvement were received by the station from listeners all over the country.

WDAR is the first big broadcasting station in the East to equip for operation with storage batteries. Heretofore the universal practice has been to use motor generators for supplying the large filament current and high plate voltage required by the main oscillator and modulator tubes of the transmitting set.

Lit Brothers, who have led the way in making other recent innovations in broadcasting, decided that the time had come for improving the quality of broadcasting by eliminating the commutator hum and other objectionable features of motor generated power. Philco Diamond-Grid Batteries were used.

Seek a Better Word Than "Jazz" By Radio

According to Meyer Davis, head of one of the largest orchestral organizations in the country and whose music is familiar to millions of radio fans, the word "Jazz" does not represent a true description of modern music for dance or song.

Mr. Davis further states that the dance music demanded today is far removed from the style of a few years ago, when the wheeze and shrill of the clarinet, the blare of the trumpet and the banging of the drums pleased the majority of people who became dance enthusiasts for the first time. This taste has changed for the better to a remarkable degree, and dance music has improved accordingly. But we still call it "Jazz."

Mr. Davis, in his desire to obtain a more truly descriptive word for dance music of today, has offered a prize of $100 cash for a name to displace the word "Jazz." This prize will be given to the person—man, woman or child—who sends in the name which will be acceptable to himself and to the executives of his organization.

There are no restrictions in this contest, except that the number of names submitted by any one person must be limited to five and must be mailed to Meyer Davis' Music at the New Willard Hotel, Washington, D. C., or the local or nearby radio broadcasting station on or before August 15, 1924. The award will be made September 1, 1924, by the broadcasting station which receives the winning word.

An Audio Amplifier Without an "A" Battery

How to Extract Filament Current from the A. C. Lamp Socket

By BRAINARD FOOTE

MANY a man is the owner of a one tube dry cell tube receiving set. Perhaps he's had it quite a while and feels that the next step for him is to get an amplifier into operation so that the whole family can enjoy the broadcasting. He can still use his headphones when he's after DX, but for fairly short range reception, a loud speaker will suit him much better; for after all the headphones are a rather selfish proposition unless you have four or five sets of them.

Yet, there are numerous listeners who don't want the trouble of caring for a storage battery and perhaps don't wish to spend $15 extra for a battery charger to avoid the inconvenience of carting the battery around to the service station every now and then. But, unless dry cell tubes are used, such an amplifier requires a storage battery, and at best, the dry cell tubes can scarcely compare with larger tubes for volume output.

Alternating Filament Current

However, it is now possible to secure equally good results without employing a storage battery, providing you have alternating current supplied for lighting and electric power in your home. Through the use of a simple transformer which may be had anywhere, the necessary filament current may be drawn from the lamp socket at scarcely any cost.

THE photograph shows a power supply unit comprising this transformer, a 30 ohm rheostat and a potentiometer, from 200 to 400 ohms resistance. The parts are mounted on a regular radio panel, with three outlet binding posts. Two of them are for connection to the filament circuit, while the third is connected to the movable contact of the potentiometer.

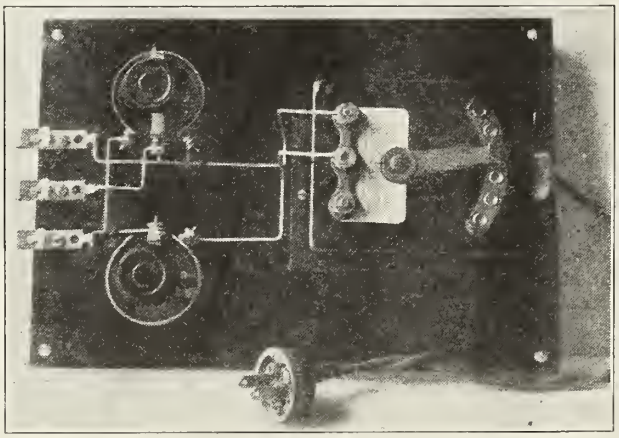
Any department store with a good sized toy department, or any large electrical supply house has the toy transformer in stock. The cost will be between $3 and $4.50, depending upon the make. There should be adjustable means for securing various voltages for lighting the filaments, and if the output voltage is between 6 and 12 volts, the proper amount of current can easily be applied to the two amplifier tubes through the 30 ohm rheostat. UV201-A or C301-A tubes are used.

In case you may wish to try smaller tubes than these, the transformer chosen should supply lower voltage, perhaps 2½ as a minimum. To use the A. C. filament supply with an amplifier already completed, mount the parts as in the photograph and wire them together in accordance with the section of the circuit diagram to the right of the dotted line. This includes the rheostat, the potentiometer and the toy transformer.

Changing the Amplifier

Certain alternations must be made in the amplifier, although these are very simple. The rheostats should be turned to the "full on" position and the entire filament adjustment of the audio amplifier tubes done by the rheostat on the supply unit. Then, the two grid return leads from the "F" posts of the two audio transformers are connected to the negative terminal of a 4½-volt "C" battery, the positive side of which is connected to the minus "B" battery post and to the arm of the potentiometer. The negative "B" post is disconnected, of course, from its usual position on the plus side of the "A" battery wiring.

It is assumed that a separate battery is used for lighting the detector tube, since alternating current cannot be employed



A unit arranged to secure filament for an audio amplifier from the alternating current lighting socket. The panel measures 7x10 inches, and the instrument by which the correct voltage is obtained is a toy transformer.

the wiring for an audio amplifier which may be mounted with the rheostat and potentiometer, but for which the toy transformer is laid on the floor or shelf under induction between the grid leads and the filament wires or the transformer itself. The transformer should not be mounted in the amplifier cabinet.

THE audio amplifier wiring is quite standard, although no jack is shown for the second stage, it being assumed that if phones are used, the amplifier will be turned off altogether, but that if the loud speaker is employed, both tubes will be necessary for sufficient volume. Special precautions should be taken with the grid leads and the grid return wires. These must all be short and carried above or away from the filament wires. A separation of four or five inches is desirable.

There is a very slight hum caused in the speaker, but this is much weaker than the actual carrier wave noise of the broadcasting station itself, and the faintest sounds of speech and music drown it out immediately, even with one's ear close to the for the purpose. The circuit gives also horn. But this slight hum is caused by the reversal of current in the filaments, since for a small fraction of a second the filament current falls to zero and then comes back the other way, as the 60-cycle A. C. reverses itself 120 times every second. This varies the plate current slightly, but the effect is not trouble-at all.

Avoid Grid Induction

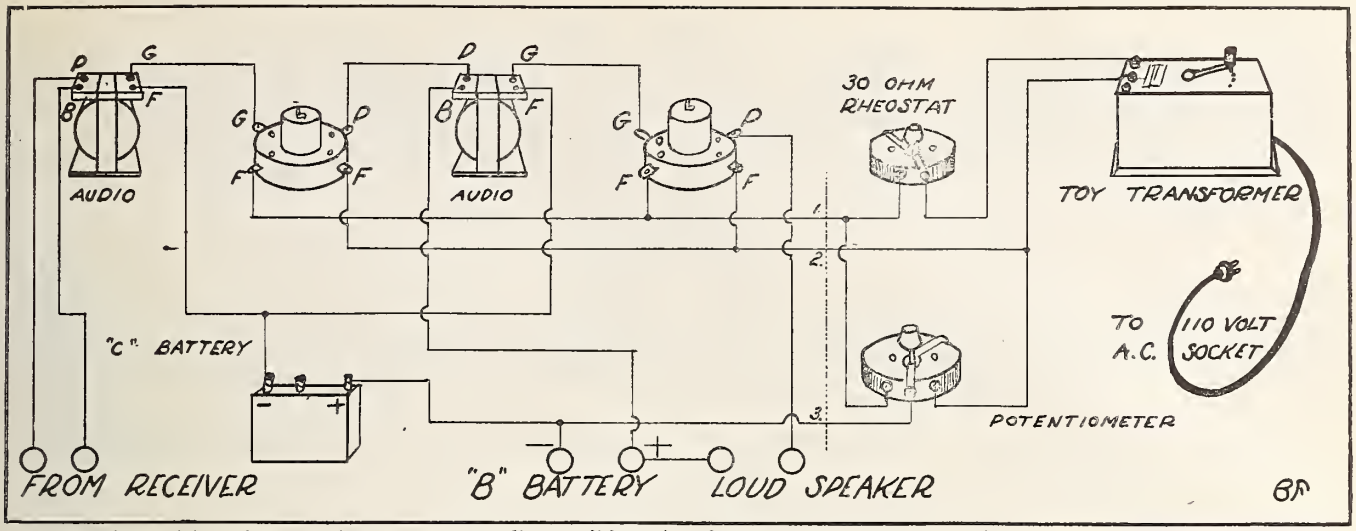
Therefore, any noticeable hum is caused by induction between the filament wiring, which carries alternating current, and the grid or grid return leads. This means that special precautions must be taken to keep them four or five inches away from other wires in the set, and to make them as short as possible besides. If any A. C. induction affects the grid, the amplification constant of the tube (about 7 or 8) will make the noise a whole lot louder.

Ordinarily, the grid return leads are run to the negative side of the filament to secure the necessary negative grid bias for clear amplification. Here, however, the filament's poliarity changes continually, so a "C" battery is used to get the negative bias. If the positive of the "C" battery were now connected to either end of the filament wiring, there would be a very strong hu min the speaker. This is due to the fact that every time the grid is charged positively by the voltage at the end of the filament, some electrons are drawn to the grid and it thereby reduces the plate current a great deal. In order to avoid this alternating charge on the grid, it would be necessary to connect the grid return lead to the center point of the filament, inside the tube.

THE situation is similar to that of a man walking up and down a large see-saw. When he stands at either end, he is bumped up and down a great deal; the nearer he gets to the middle, the less he's jolted, and finally right at the center of the board, he doesn't go up and down at all. But since it's physically impossible to make that center connection, we shunt a potentiometer across the filament and run the grid return lead to its movable arm. This is then placed at the electrical center of the winding, or at the center of filament resistance and the A. C. hum is nicely balanced out.

Preventing Tube Danger

It is usually necessary to connect the ground to the negative "B" battery binding post of the amplifier, in order to ground the central balance point of the potentiometer. Care must be exercised in



Complete wiring diagram of a two stage audio amplifier with filament current from the lamp socket. Ninety volts of "B" battery are used, with a potentiometer and 4½ volt "C" battery to eliminate the A. C. "hum."

first lighting the tubes to use a combination of binding posts and switch lever adjustments on the toy transformer to give a voltage of about 6 or 7, to prevent danger to the tubes. The rheostat should not be turned on farther than is necessary for good volume and clear results on the loud speaker.

The A. C. system is bound to come into wide use shortly, because it can be applied to radio frequency tubes also, by a similar treatment of the grid return leads. Moreover, it is now coming into use for delivering plate voltage, too, when used with a proper rectifier and filter system. Hence the man who starts in to become familiar through practice with the use of A. C. is the one who will first succeed in cutting his battery upkeep expense to about one-tenth or less of its present cost. The A. C. is always on tap, never runs down, and is used for filament lighting at a cost of less than $2 a year, even if the set is used three hours a day every day in the year

The Importance of the Loud Speaker

By WILLIAM CULLENS

Not long ago, when broadcasting was more or less of a novelty, it was common with many enthusiastic experimenters to entertain their friends with a radio concert. After the loud speaker had been induced to operate, the congratulations of the guests were made with effort, the more candid of the critics declaring that if the barnyard chorus coming from the horn was radio, they would be content with a phonograph.

There were many fans, it is true, who overlooked the obvious imperfections in the reproduction of the human voice. The marvelousness and mystery of radio itself was quite sufficient to outweigh any shortcomings of the loud speaker. Recently the demands have become more critical, and the radio public have been insistent that the loud speaker should not be the cause of imperfect reproduction.

In its present usage, the term loud speaker is applied generally to electrophonic devices employing some means of distributing sound over an area. It is possible to divide loud speakers into three separate and distinct classes, however:

1. Those which make use of existing telephone receivers by means of rubber connectors or clamps to attach a pair of phones to a horn.

2. The type of speaker that uses a single telephone receiver equipped with a cap to permit its being fastened to the small opening of a horn. In this class can be included the numerous loud speakers that incorporate a telephone of some sort in the base of the horn.

3. The loud speakers constructed on the solenoid principle, in which the currents act on a coil placed in the field of a strongly energized magnet.

The first and second types of loud speakers are excellent in their own limited way; however, there are a few serious faults that entirely prevent them from being considered as first class loud speakers. One is that they cannot be used on very strong signals without causing the diaphragm to strike the pole pieces of the small fixed magnet and produce a rattle in the loud speaker.

Another serious limitation to this class of loud speakers is that when high B battery voltages, such as are common in most audio frequency amplifiers, are used, a DC current flows through the windings of the phone and exerts a strong downward pull on the diaphragm. This causes the metal diaphragm to be drawn out of shape and will cause the loud speaker to have a hollow or tinny sound.

Impedance Shouldn't Vary

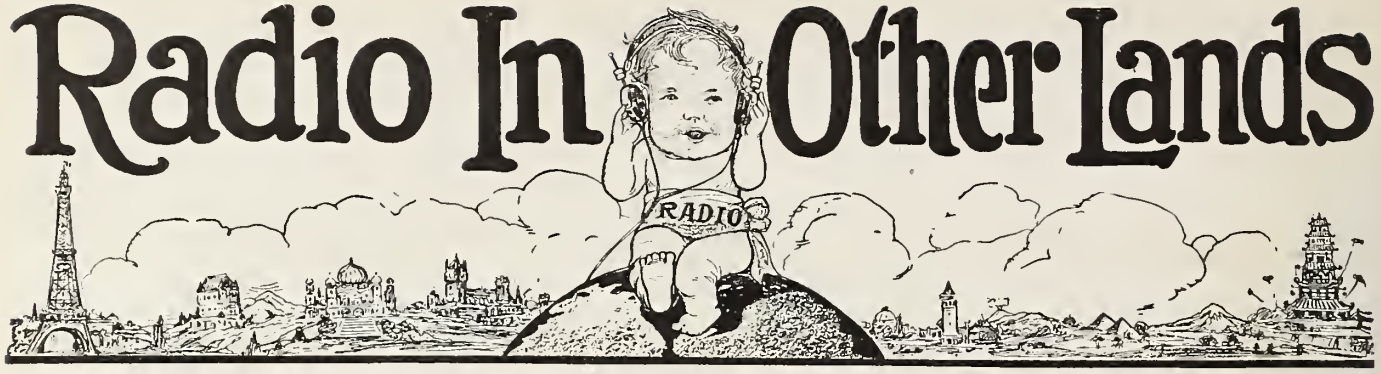
The vibration of the metal diaphragm toward and away from the poles of the magnet in the unit will cause the air gap to vary. This, in turn, will cause the impedence (alternating current resistance) of the loud speaker to vary and has a great deal to do with the proper operation of the receiving set itself on weak or distant signals. The impedance of the loud speaker has its function in the tuning and balancing of the receiver, and if it is fluctuating, will have its effect in upsetting the accurate tuning of a receiver.

The third type of loud speaker this factor need not be considered as the air gap is constant and fluctuations of current through the windings of the loud speaker does not change the impedance of the circuit. The DC current from the B battery does not act on the diaphragm of loud speakers such as the Thorophone and less distortion may be expected.

At the same time the third type of reproducer will not rattle or "freeze" on extremely loud signals, yet will give a greater amount of sound on extremely weak or faint signals. A mica diaphragm one of the most perfect substances known for sound reproduction, is used, whereas in most of the other classes of speakers a metal diaphragm must be used, resulting in a greatly inferior tone quality.

The particular shape of the horn has a great deal to do with the performance of any loud speaker. From a theoretical point of view, a straight horn is better than a curved one, and the amount of increase in the size of the horn in proportion to its length must be very carefully calculated for best results. When this is once obtained the horn can be curved into most any shape without destroying its amplifying value or tonal qualities.

The material of which the horn is composed of is very important in regards to the quality of music that will be received, and with the faithfulness with which the sounds are reproduced. A horn made of wood or paper mache gives a purer tone than a metal one, which is liable to produce brassy overtones or vibrations. Horns made of some inert material and which will not vibrate or absorb the sound waves, have been found to be the most satisfactory for loud speaker use.



New French Theory Opens Way to Solution of Static

PARIS:—General Ferrié and Monsieur R. Bureau have just completed a most interesting study of the occurrence of static disturbances—the so-called "atmospherics"—and of their possible causes. The result is a novel theory of the air currents in the atmosphere; a suggestion that is perhaps the most important contribution made so far to the explanation of static.

The new theory is already the focus of active discussions among French scientists and radio amateurs. It seems certain that it will play an important role in the study of static everywhere; a study now actively under way all over the world.

The outstanding conclusion from the observations collected and analyzed by General Ferrié and Mr. Bureau is the close relation between the occurrence of static and the presence of currents of cold air above the great mountain region of the Alps.

During the Winter the correspondence in time between these Alpine air disturbances and the onset of static is practically perfect. In the Summer the results are more complicated. The static seems to come then from every direction at once.

Cold Air Not So Disturbing

This is explained, the French investigators believe, by the fact that currents of cold air do not cause so much disturbance in the atmosphere during the Winter as they do in the Summer. The difference between them and the main mass of the atmosphere (all of which is then cold) is not so great.

ACCORDINGLY, during the Winter it is only in the much confused atmosphere over the Alpine regions that the air disturbances are great enough to produce important amounts of static. In other seasons the atmosphere as a whole is warmer. Cold air currents disturb it everywhere. Much static is produced, therefore, in all districts.

The observations also bring out the fact that in the latitude of France the occurrence of static is favored by the prevalence of cool winds coming from the polar regions. On the other hand, the warmer air currents that come from equatorial regions not only yield less static but seem actually to suppress a period of static arising from the previous prevalence of the cooler polar winds.

The electromagnetic disturbances—that is, the static—are parallel in every way with the more familiar meteorological disturbances such as hot waves, thunderstorms, and the like. The cool polar winds bring on these disturbances; the warmer winds from the equator are calming and quiet.

Technical Expert Will Send Radio Data From France

C. R. Bluzat, formerly technical editor of RADIO TOPICS and at present a special technical writer for RADIO AGE, is in France visiting relatives and studying the latest developments that country has made in the field of radio.

M. Bluzat is a native Frenchman and is thoroughly familiar with both American and French radio circuits. In the September RADIO AGE his first article on the latest steps in French radio science will be published, approaching the subject from an authoritative technical angle.

M. Bluzat's article, along with those to be published next month by Frederick A. Smith, editor of RADIO AGE, who has been in Europe making a radio survey for the past two months, will give "The Magazine of the Hour" a truly distinctive foreign radio department second to none.

The Source of Trouble

The chief place of disturbance is the plane of contact—what is called in French the "front"—between a mass of cold Northern air and one of warm Southern air. Such a "front" is the seat of exchange of a large amount of energy; both gravitation and electrical. The gravitational energy is expressed in upward or downward currents of great masses of air.

Such "fronts" between hot and cold masses of air may exist high in the atmosphere without being perceptible in any way on the ground. Gradually they equalize themselves either by the mixture of the two currents of air or by the transfer of heat energy from the warmer air to the cooler. This explains the effect of a warm, equitorial current in causing a decrease in static. The warm air arrives, usually, at a high level in the atmosphere. It mixes slowly with the underlying cooler air. As it does so the disturbance in the atmosphere is decreased; the "front" between the two air currents becomes less marked and the static disturbances die away.

The reverse case can also occur. Whenever a mass of cold air sweeps down over France from the Northwest toward the Southeast (which is the usual direction of such currents in France) great atmospheric disturbances are produced, with accompanying interference with radio. These disturbances become more pronounced as the cold air approaches the Alps and is forced to rise to higher altitude.

In this way General Ferrié and M. Bureau have been able to trace the static produced by individual "fronts" of cold air in their progress across France from the northwest coast clear to, and even across, the Alps.

EVERY radio fan knows that static is extremely prevalent in mountainous regions. The new investigations give the first real evidence as to why this is so. They provide, in addition, the first consistent theory of the hitherto mysterious relations between radio disturbances and the weather. Hot weather means much static because it is usually a time of intense atmospheric movement and mixture, at least in a part of the country.

"Fronts" Help Static

Again, the supposed relation between static and the occurrence of areas of high barometric pressure may be due not to any effect of the air pressure itself, but to the fact that high-pressure areas are frequently surrounded by one of General Ferrié's "fronts," that is, by a region of contact between a central mass of warm air and surrounding masses of cooler air.

Wherever warm air and cold air meet and mix there is in active exchange of

thermal energy. A part of this energy seems to be translated into electrical energy; to be expressed either in thunderstorms or in static disturbances or in both. The ultimate origin of static, like the ultimate origin of our weather, seems to be the fact that the poles of the earth are cold, whereas the tropics are hot.

World's First Tri-Lingual Station

Fans who receive broadcasts from Canada's premier radio station are familiar with the fact that all announcements are made in French and English.

Soon a third language will be added: "La Internaciona Linguo"—Ilo, the perfect radio auxiliary international language—simple, neutral, harmonious, flexible, expressive, logical.

Jacques N. Cartier, director, and his staff of announcers and story tellers are studying Ilo and find it extremely easy to learn.

By the time the new big plant of CKAC has been installed, everybody connected with the studio expects to be able to talk Ilo, and then this musical "tongue" will be on the air regularly.

Heretofore CKAC has found bi-lingualism adequate for its needs, but now that constantly increasing numbers of radio enthusiasts are clamoring for Ilo—"Well, not to advance is to recede," according to J. N. C., "and in Ilo all fans have a new standard! There is no way possible for us to satisfy everybody. All non-English and French fans, within our range, advocate Ilo, because it is the only known auxiliary language possessing complete radio, scientific and business vocabularies."

Mr. Cartier points out that CKAC serves a big Italian colony, a Greek village, a miniature Vaterland, a tiny Chinese town, a large Jewish settlement and several other small colonies, whose inhabitants speak Polish, Roumanian, Russian, Galician, Ukranian, Dutch, Swedish, Norse and twenty other languages, besides the two big majority French and English-speaking nationalities.

Because they do not know French or English, foreigners are sore and irritated in spirit and constantly chafing under the restraint of language barriers.

Eiffel Tower on Short Wave

The Eiffel Tower is now calling America on the short-wave telegraph set which they have recently installed at this big station. The Tower commander furnishes a monthly schedule of transmissions.

Transmissions take place every Monday, Tuesday, Friday and Saturday. Transmission will be on 25 meters.

The transmissions will take place at intervals as follows, according to the following table:

5:00-5:10	A. M.—	f	f	f	f
5:15-5:25	A. M.—	h	h	h	h
5:30-5:40	A. M.—	f	f	f	f
5:45-6:00	A. M.—	h	h	h	h
3:00-3:15	P. M.—	f	f	f	f
3:20-3:35	P. M.—	h	h	h	h
9:00-9:15	P. M.—	f	f	f	f
9:30-9:35	P. M.—	h	h	h	h

These times are Greenwich mean time, which is five hours earlier than Eastern standard time in the United States. Local times, daylight saving time, etc., may be computed from the relation of these times to Eastern standard time.

The text which is being sent by the Tower is simply: "v. v. v. de FL—FL—115 metres—emission f f f (or h h h)." This text, of course, in code is being transmitted very slowly, just as above; not, it must be remembered, in English.

The commandant of the Tower, Captain Bergeron, has asked all American amateurs who pick him up to please notify him of the relative intensity of the "fff" and "hhh" signals, as well as of the atmospheric conditions under which the signals were heard.

To simplify the notices which are coming in in many different languages, Captain Bergeron has devised the following code to be used by hearers reporting to him:

R1—Signals unreadable.
R2—Readable with great difficulty.
R3—Weak but readable.
R4—Readable.
R5—Comfortably readable.
R6—Readable quite strong.
R7—Signals strong.
R8—Signals too strong.
R9—Loud speaker.

British Plan Radiophone Plant

Following a demonstration by the officials of the American Telephone and Telegraph Company and the Radio Corporation of America, by which radio telephone speech was transmitted for two hours from New York to London, the British post-office appointed a committee to investigate trans-Atlantic telephony. This committee has recently recommended that the British post-office establish a 200 k. w. radio telephone plant at their new radio station at Rugby, England.

The committee recommends that this plant be of a type similar to that which has been used by the American Telephone and Telegraph Company and the Radio Corporation of America in the experiments which they have been carrying on for the last eighteen months in transmitting speech across the Atlantic.

If this work is carried out, it is expected that under favorable atmospheric conditions during the winter months, it will be possible to connect telephone subscribers in the United States to telephone subscribers in London, and in this way permit them to talk to each other as they do over ordinary telephone circuits. In doing this the subscribers at each end would be connected to their respective radio stations by the wire telephone lines. Atmospheric conditions, however, vary tremendously from winter to summer and during the different hours

(Continued on next page)

THE CANADIAN CASTLE OF JAZZ

American Radio fans who tune in on CKCH at Ottawa, Canada, and roll up the rugs for the peppy dance programs this station broadcasts, will be interested to know where the alluring music originates. Above is shown the "Chateau Lanier" Hotel, near Ottawa, which is connected with CKCH's studio. Popular programs from the Chateau pleasing to Americans and Canadians alike are broadcast Wednesday and Saturday nights on a 435-meter wave length.

of each day.

To determine the effect of such atmospheric changes, the engineers of the American Telephone and Telegraph Company have been transmitting speech weekly from America to England, measuring static interference and the strength of signals received from a number of British telegraph stations. The British postoffice has been carrying out careful measurements of the energy which they receive under various conditions from the telephone transmitting station in America, and also from certain telegraph stations.

The tests which will be possible when the British transmitting station is completed will form another important step in the work which has been carried on for many years in the development of radio telephony across the Atlantic Ocean. The first successful telephone transmission across the Atlantic was in 1915, when engineers succeeded in talking by radio telephone from the United States Naval Station at Arlington, Virginia, across the Atlantic to Paris, while the same messages were heard 5,000 miles to the westward at Honolulu.

Amateur Arrested for "Talking" to U. S.; Vindicated

The decision that it is not a serious offense against law and order for an experimental radio amateur of Holland to communicate with amateurs in this country has done much to vindicate the standing of amateurs in the Netherlands, according to a report received by the American experimenters.

Soon after a prominent French telegraph amateur was decorated with a gold medal for the skill with which he communciated across the Atlantic Ocean on short wave lengths, amateurs in Holland were regarded as something equivalent to the boll weevil. The authorities were inclined to classify them as a menace to their community.

The science of private radio communication among the youths of the country had kept abreast of progress much better than the laws, with the inevitable result that H. J. Jesse, Jr., prominent radio experimenter at Leiden, was made the defendant that the courts might decide whether it was lawful for a citizen to transmit.

It was charged that Jesse's telegraph and telephone station was not intended for public communication and that messages had been exchanged "without authority having been obtained from the minister of Waterstaat." He had in fact taken part in transatlantic radio tests and communicated with amateurs in the United States as far west as Nebraska.

The attorney for the defense pointed out that regular telegraphic communication in competition with commercial traffic was not intended and that the case was in the class with work concerning laboratories. The clerk of the open ministry congratulated the defendant for having communicated with a station in America. It was shown the defendant had not transgressed and the case was dismissed.

HE WINS THE BROWN DERBY Photo from Intl.

And he isn't ashamed of it, either. F. H. Schnell, traffic manager for the American Radio Relay League, is shown wearing the brown derby awarded by Kenneth B. Warner to the first American amateur to establish two-way communication with a European operator. Mr. Schnell swept aside all derby opposition when he conversed with French 8AB.

Broadcasting in South Africa Soon

Although not actually granted, the Government has finally definitely promised a broadcasting license to the Associated Scientific and Technical Societies, Johannesburg, for a broadcasting station to be installed in that city, Consul G. K. Donald reports. The reason for the delay has been an objection lodged by the Johannesburg municipality on the ground that the city was the proper authority to exercise broadcasting rights. The objection has now been overruled. When the license is issued, it will be only a matter of a few days before broadcasting is commenced.

It is announced that the new station will be installed on the top of the Stuttaford Building, with a broadcasting studio located on the third floor in the same premises. The wave length has not yet been definitely settled upon, but it will be between 350 and 450 meters. A 500-W. transmitting set will be used.

The Associated Societies' license gives them an area for the collection of fees from listeners extending 100 miles in all directions from Johannesburg and it is expected that the station will be supported by the fees paid in by persons owning receiving sets.

The program for broadcasting includes, in addition to musical entertainments, talks of interest to women, market reports, local news and a children's hour.

Application has been made to the Paraguay Chamber of Deputies by Messrs. Eduardo Rojas & Compania of Asuncion for a concession giving this company exclusive rights to sell radio telephone equipment in Paraguay for five years. It is said, Consul D. A. Wilson reports, that Mr. Rojas has already obtained the necessary equipment for broadcasting and will place it in operation within six months if the concession should be granted.

"Big Things Are Coming for Radio on the Farm"

By GEN. JAMES G. HARBORD

RADIO'S greatest opportunity lies in its usefulness to the farm. I believe that radio broadcasting is destined to become a greater boon to the farm than to the city home. It can be made a thing of greater benefit and more practical use to the thirty-nine millions of you who live on farms than to the rest of us who live in cities. And this very soon.

Those of us who are trying to direct this gigantic new industry that has sprung up overnight have been thinking about the farmer's problems and his needs—about how radio can be made to serve him. We have just completed some nation-wide inquiries on the subject of how radio can help the farmers. We have asked questions of thousands of farmers, school-teachers, agricultural professors, farm paper editors, farm agents, Grange officials, country editors and bankers.

ORDINARY common sense tells me what a blessing radio can be to the farm; but the unanimity of the evidence which our national inquiry brought us was amazing.

Consider for a moment the amazing growth of the radio broadcasting industry as a whole.

We point to the automobile industry as having experienced an amazingly rapid growth. In about twenty-five years the motor has come into such general use that there are now 14,000,000 automobiles in the country, or two for every three homes in the country. But radio broadcasting is only two years old and already there is one radio set to every seven homes!

We have been riding in auomobiles for so long that we have forgotten, almost, the day of the horse-drawn carriage, while it was only day before yesterday, one might say, that we learned we could have an inexpensive radio telephone in our homes. Yet as against 4,000,000 cars made last year for us, we bought and constructed 2,000,000 radio sets.

The phonograph had a startlingly abrupt leap into popularity. The Department of Commerce estimates that we have spent a little less than $150,000,000 in a year for phonographs and records. We estimate that "radio fans" spent $150,000,000 last year for sets and parts.

Of the 3,000,000 radio sets now being used in the United States we estimate that only about 150,000 are on the farm. Although farmers constitute a third of the population, they are as yet using only one twentieth of all the radio sets in existence in America. There is only about one set to each forty farm homes.

YOU will soon sit in that familiar living-room in the old farmhouse and hear the President and others speak, enjoy Grand Opera as thoroughly as the thirty-two hundred who actually have found seats in the Metropolitan Opera House in New York. Paul Whiteman and Paul Specht, the jazz kings, have come to you already as stars of the phonograph record; but you may pluck their syncopations from the air tonight, and on many another night if you wish.

The nearest agricultural college, the one that knows most about your own peculiar local problems, will be brought into your little sitting-room of an evening to help guide you in tomorrow's farm work. The general educational and entertainment lectures of the Chautauqua type need no longer wait upon Summertime and the big tent.

If you live in Nebraska and have a load of hogs to ship to market, you can know the quotations up to the last minute on the Chicago market—by radio. The newspaper will not get these quotations to you until many hours later. This of course is a fact of the present, and no forecast of radio future.

Photo from Fotogram

YOUNGEST BROADCASTER

That's the distinction enjoyed by little Harriett Carman, daughter of Harry H. Carman, at 2 E L. She is only 4 years old, but she's on the air frequently and is rapidly becoming known to radio fans all over the country. The picture shows her at her father's broadcasting apparatus at Freeport, L. I.

Soon we shall be able to render great service to agriculture by broadcasting weather warnings that have a bearing on the care and shipment of crops and farm stock. In periods of epidemics, such as hoof-and-mouth disease, radio will deliver instant advice on prevention and treatment even to the most remote localities. Radio will tell you how to fight insect pests that are devastating your crops.

The radio telephone also will be able to broadcast calls for farm help for districts in which labor shortage exists. If, because of a sudden change in weather, crops are spoiling in Kansas while men seek jobs in Nebraska, a veritable labor army could be started for the Sunflower State overnight.

WE WILL try to make radio give you just the kind of service you need—at the time when you need it most.

Wireless can help link up government services direct with the farm. It will become the servant of the various farmer co-operative movements. In one state where there are two hundred Grange halls arrangements are being made to place receiving sets in each hall. Someone has pointed out to us that by use of radio broadcasting Farm Bureaus could get their information and proposed policies into the hands of individual farmers *"with the speed of light."* Grain elevators and live-stock shipping associations can get market information instantaneously by wireless. That is almost a literal use of the word instantaneous.

The spread of advanced farming methods through the teaching of agricultural colleges has added hundreds of millions to farm productivity, and yet only about 150,000 students are enrolled at these colleges at any given time. Faculties of agricultural colleges are aroused to the tremendous magnification of teaching opportunity which broadcasting gives. One has suggested that the farmer be given a wave length all his own. This sort of a teaching program is being worked out: Illustrations and charts and textbooks to be sent by mail, instruction and guidance regarding the studies to be by radio lectures—a great radio extension university, in which hundreds of thousands will be enrolled and work at home, to travel to their alma mater only on completion of the courses, when they go to receive a diploma.

Personally I believe that radio development is going to continue at such a rapid pace that in a period of three to five years it will be possible for one man to speak to 50,000,000 persons in the United States, and to many millions in Canada, South America, and Europe, if stations there relay his voice.

We believe that there will come to be perhaps three of four great super-broadcasting stations. These then can broadcast identical programs by retransmission from one station to another. With such technical resources at their command, consider what wonderful programs such a national entertainment institution could provide.

I like to visualize what radio means by thinking of the boys around the grub wagon at round-up time on some far

(Continued on page 48)

Only a Short Time Left to Get the Best Hookup Book Ever Printed!

The profound technical problems to be encountered in the study of Radio are all very interesting to the expert, but the great majority of "fans" are vitally concerned in the building of simple sets that really will work and produce effective results.

To supply this demand for practical, simple and efficient sets, RADIO AGE compiled THE RADIO AGE ANNUAL for 1924 in the belief that it contains more real help and meaty material than any other book on this subject ever published.

THOUSANDS have been sold at $1 each since they were first offered to fans early this year. The supply is rapidly becoming exhausted, so we are making this last appeal to the fans to order their ANNUAL now if they have not already done so.

This Book Is Endorsed by Expert and Novice Alike

Cover View of 120-Page Annual.

Full of Hookups That Are Guaranteed to Work!

The RADIO AGE ANNUAL for 1924 is chock full of real radio ideas. From the humble $6 crystal receiver to the great engineering problems involved in the Grimes Inverse, Neutrodyne and Super-Heterodyne sets, the fan is taken by easy and successive stages through the various steps in radio construction.

The principal articles are illustrated with the well-known RADIO AGE isometric drawings, reputed by countless experts as the clearest construction diagrams ever put on the market.

The construction of every standard set and essential accessories is described in detail in the ANNUAL. Each tuner and each accessory was built in the RADIO AGE laboratories and tested and proved before it was awarded space in the ANNUAL.

You cannot afford to be without this wonderful radio "guide book." Send your dollar today for this gold-mine of radio ideas.

here!

This Coupon, Pinned to a Dollar Bill, Will Bring the ANNUAL to You by Return Mail!

(If by Check, Add 5c for Exchange.)

RADIO AGE, Inc., 500 N. Dearborn St., Chicago, Ill.

Gentlemen: Attached find One Dollar ($1) for which kindly forward me by return mail one copy of RADIO AGE ANNUAL FOR 1924. If not satisfied with it I will return it to you within three days and you will refund my money.

Name.....

Address.....

City.....State.....

RADIOTORIALS

AROUND the world by radio!

It sounds impossible, and yet scientists are talking about it without cracking a smile. In fact, they are devoting the best part of their lives to determining just how and when radio will be sufficiently harnessed and organized to allow Mother Earth to be the universal playground of the ether waves.

Heretofore radio transmission of 4,000 miles was considered miraculous and the height of radio development. Devotees of the science settled back with the air of a person who has seen all there is to see and expects to view no more. But no sooner was this "last step" announced than the next step was under way.

Readers of RADIO AGE who have been keeping themselves informed on latest developments will need no explaining as to the real situation. They know efforts are being made to get every big country in the world to become a part of a great chain of short wave radio stations whose sole duty will be to relay programs around the world on special, pre-arranged wave lengths.

The United States already has the beginning of such a "radio chain." Powerful stations are well sprinkled throughout the country so that with a few weeks' preparation, America's part in the world-wide transmitting program could easily be taken care of. A few other nations, including Great Britain, France, Germany, South America and Canada, have one or two giant stations, but they are not yet fully developed.

All that remains is the final word which would set all radio forces in action to complete this international program of radio broadcasting.

The answer lies in an international radio conference. Radio as an industry and as a science has far outgrown the limitations originally placed upon it. It is too big to be controlled as each nation sees fit. There must be international radio co-operation or radio will stand still just when it should forge ahead into a new realm of magic accomplishments.

The United States has taken the lead in peace and armament conferences. Why not in radio? This country has developed radio more than any other, and has shown the most liberal attitude concerning the use of receiving sets by the general public.

Then why should not America assume radio leadership by calling this radio conference? Secretary of Commerce Hoover has shown the right spirit by calling a conference of those interested in radio *in this country*; but he should look farther and invite foreign nations to share in the long strides America is taking in the once "infant industry."

If it can obtain a willing and influential listener among the government officials interested in radio, or among prominent radio manufacturers, RADIO AGE will be so bold as to offer a tentative constructive program for such an international radio conference. This proposal should be especially welcome at this time, because of its proximity to the Radio World's Fairs in New York and Chicago. Correspondence from readers is urgently invited.

Every broadcasting station should be interested, especially in view of the fact that the government has begun to weed out "dead wood" among the broadcasters. Eighty-two stations were shut down last month alone. Is this not proof enough that only those who produce the best service to the fans will survive in the future?

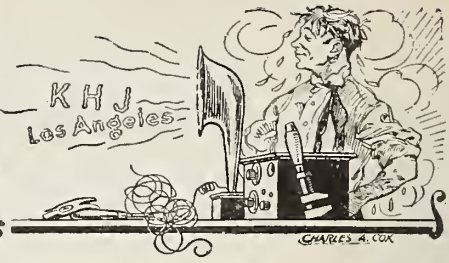
IS THE American Society of Composers, Authors and Publishers weakening? We have heard several broadcasts of popular copyrighted music recently from stations who do not pay levies to the Society. These stations are proceeding on the theory that one court decision against the Society is enough to throw out its contention that it is a crime to broadcast copyrighted selections over the ether without a permit. As many fans will remember, an Ohio Supreme Court judge ruled broadcasting is not a public performance for profit and therefore does not come under the jurisdiction of the copyright laws. We are elated to hear that the Society is at last realizing the futility of its fight against the broadcasters and the listening public. Our only hope is that the broadcasters will not decide they can get along without the Society's compositions and refuse to render them altogether; for then the Society will have lost the greatest agency it ever had for the free popularization of timely tunes. If nothing else, the war between the broadcasters and the music publishers has resulted in the birth of a new coterie of music writers whose work is becoming more popular than the so-called popular copyrighted brand.

ONE BIG broadcasting station reports that there has been a decided trend toward increasing classical music in recent programs. Asked why, he reports that the demand came from the public itself, who, contrary to common belief, was fed up on jazz and wanted something soft and soothing. Perhaps we can take this as an indication that radio is becoming a barometer of the national mind. If so, are we becoming more serious and even-minded, and getting over the flapper-and-sheik age that preceded radio's entry into the scheme of human events? Maybe so. Watch radio programs and judge for yourself.

GENE McDONALD, president of the Zenith Radio Corporation of Chicago, has a fine idea. He sold station WJAZ because he believed it interfered too much with local broadcasting, located as it was in the heart of a big Chicago residential section. Mr. McDonald now proposes to find a location a hundred miles or so from the city, where he can build an isolated broadcasting station which would not interfere with reception of other stations any more than reasonably possible. The studio would be located in the city, connected with the station by telephone. If this country had more liberal-minded men like Mr. McDonald, the ether wouldn't be so clogged with unnecessary wave lengths and those stations which had to exist wouldn't do so at the expense of exasperated neighbors. Mr. McDonald's experiment, if successful, ought to open a new era in broadcasting.

RADIO MOVIES! Will wonders never cease? In this issue you will read how radio motion pictures have become an accepted fact in experiments in Washington, D. C., and it is now only a matter of time before the fan may equip himself with the proper apparatus. Telephone pictures first, then radio pictures; now radio movies. We refuse to predict the climax of it all.

Pick-ups and Hook-ups by our Readers



The material appearing under the title "Pickups and Hookups by Our Readers" in RADIO AGE, is contributed by our readers. It is a department wherein our readers exchange views on various circuits and the construction and operation thereof. Many times our readers disagree on technical points, and it should be understood that RADIO AGE is not responsible for the views presented herein by contributors, but publishes the letters and drawings merely as a means of permitting the fans to know what the other fellow is doing and thinking.

WE ARE quite sure that many of our new readers, in scanning over the July issue of RADIO AGE, will wonder just what the Pickups by Readers section of this magazine is, how to contribute and what our purpose is. At the time we learned that RADIO TOPICS was to be absorbed by RADIO AGE, our July copy had all gone forward to the printer, and we therefore lost our chance to welcome that group of readers who formerly used to refer to RADIO TOPICS for all their radio news and information. At any rate, though we are a little late, we want to extend to these new friends our heartiest welcome and assurance that their contributions are as welcome as any others. We know that they will have a different perspective of this department, and may have some constructive criticisms, too, to offer.

Briefly, the Pickups Pages are a group of pages devoted to the contributions of all our readers in general. In this department, fans avail themselves of the chance to compare results, circuits and information, and contribute anything of interest to the radio world as a whole. Under the direction of the Pickups Editor, letters, lists, circuits, challenges and other interesting matter is published. You can feel the wave of good fellowship that this cold type and paper radiates as you read over the varied items of interest.

Contributions to the department are always welcome. Any items of interest with regard to lists of stations, results, information and other items are solicited. Information with regard to experiences with different types of receivers is especially desirable because it shows the other fellow just what you have done in cases which are much like the ones he may be experiencing.

Contributions should be neatly executed and, if possible, written on a typewriter; or if not, should be neatly done in pen and ink. Pencil contributions may look all right when you've just finished writing them, but you should try to read them after they have been handled a few times.

However, all we expect is that you make them as neat as possible, because a neat letter always has twice as much chance of publication as one that is difficult to read and poorly executed.

Lists of stations heard containing trans-Pacific or trans-Atlantic receptions should preferably be confirmed. Your contribution always is twice as convincing if you can say, "the reception was confirmed." Incidentally, if you are contributing a circuit or other matter of technical nature it is a wise plan to omit no details; too many of our contributors have been swamped with questions. Witness the letter of M. C. Williams, a contributor to the June issue, in the department this month. *He says he got 1,180 letters since that time.* Make your descriptions as complete as possib'e.

The purpose of the Pickups Pages I am sure can be gleaned from the contributions that follow. All in all, we have built up a hearty, good-natured following of readers, and we have all kinds of fun in this department.

We're glad to meet you. We hope you'll like our department, and we hope to include some of your contributions in the next month's department.

THE PICKUPS EDITOR.

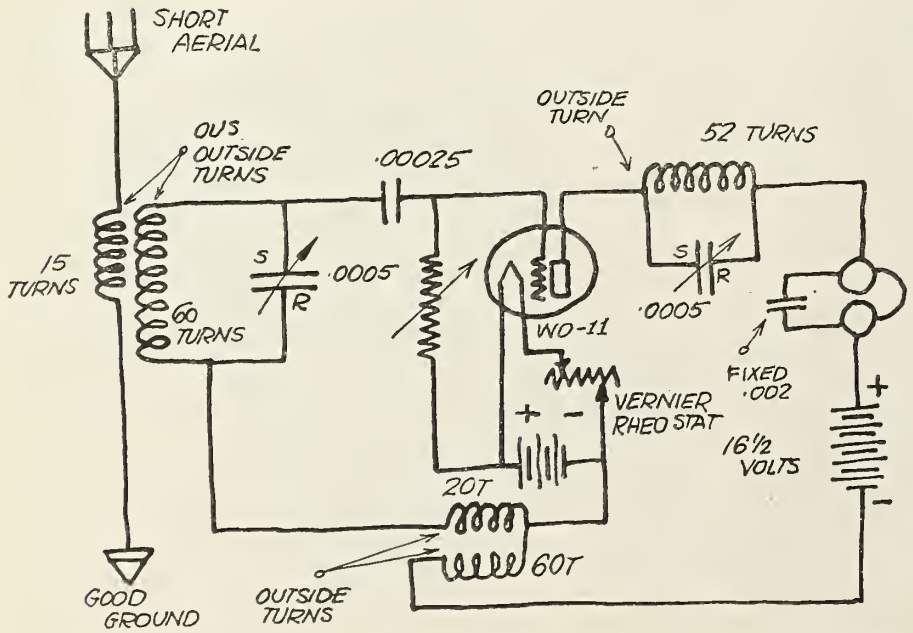


Figure 1. The diagram of the Baby Heterodyne receiver constructed with spiderweb coils as it was submitted to us by Mr Lueven of Los Angeles, California.

The first of our contributions this month is a gathering of additional material on the Superdyne by M. C. Williams, who asks help because he seems to be overwhelmed by mail. We're always willing to help our contributors out, so here goes:

RADIO AGE,
Gentlemen:

Due to numerous letters I am receiving in the daily mails asking for technical data relative to the *Superdyne* receiver, as published in the RADIO AGE for June, I suggest you print the following additional compiled technical data which is requested by the majority:

(A) It has been found that a five-tube Superdyne using one stage radio frequency, detector, one stage audio transformer coupled frequency and the push and pull (two-tube) stage, gives all around better results as to clarity, about the same range, and affords a saving in both "A" and "B" batteries. Also not much difference in volume.

(B) The Superdyne ranks next to the Superheterodyne. Ultradyne and other multi-tube circuits, in the order

other multi-tube circuits, in the order named, possibly next to the Super-Het, according to number of tubes, to volume and clarity of tone.

(C) The small fixed condensers as shown in the June RADIO AGE may be done away with, connected as they are across the primaries of the audio transformers, for they are seldom needed.

(D) An 11-plate condenser connected in series with antennae lead seems to meet all wave length problems.

(E) A good grade variable grid leak should be used and is very essential to tone.

(F) The following arrangement of parts in a 7x26-inch cabinet has proven to be the most efficient lay-out so far:

(1) A .00055 (De Forest) condenser connected at extreme left end of panel.

(2) Beneath this condenser the variable grid leak is mounted on panel.

(3) Directly behind this condenser place the radio frequency and detector sockets on back edge of baseboard.

(4) To the right of the condenser with proper clearance mount the special Superdyne coupler to both baseboard and panel.

(5) To the right of this special coupler mount the other .00055 condenser on panel.

(6) Mount the plate reactance coil directly back of the second condenser. De Forest condensers have binding posts at rear which are long enough to mount this coil snugly. After this coil is mounted, it will be found that it all will barely fit in cabinet.

(7) To the right of the plate reactance coil place all the audio sockets in line to nearly end of baseboard.

(8) Install audio transformers between the line of audio transformers and panel. Be sure to slightly turn one transformer or mount at right angles if enough room is available.

(9) At the extreme end (right) of baseboard install the push and pull transformers running line from panel to back edge of baseboard.

(10) Install jacks, rheostats and filament switch to the right of the three large dials on panel. Voltmeter is desirable.

(11) A small Bakelite sub-panel is connected by right angle brackets to top front edge of panel, far enough down, however, to allow binding posts to pass into cabinet. The following binding posts are mounted on this panel in the order named: Aerial, Ground, B—, B+ Det., B+, A—, A+, C—, C+. However, better results are obtained by having a separate B battery for the push and pull stage, so separate binding posts will have to be added to the sub-panel in case this is desired.

(12) A 1-henry choke coil and a 1-MFD. fixed condenser shunted across the aerial and ground leads will tone down static considerably and will nearly cut out AC hum and other foreign battery interference. This may be added and wired so that it may be cut out with a neat filament switch installed on the panel.

(13) A variable grid-condenser (grid-denser) is also very essential and is certainly worth installing in place of the .00025 fixed grid condenser.

(14) Vernier or micrometer adjusted condensers are not needed but a micrometer adjustment on the special coupler is a great help. Any of the micrometer adjusted dials on the market will serve the purpose.

(15) It takes patience and time to learn the technique in tuning the Superdyne, but the results obtained are surely worth the time spent.

I will be glad to answer any of the DT's who desire any additional information and who are actually contemplating on building the set.

Superdyne Supplement Experimental

The following information furnished for the convenience of DT's who are experimenting on my hookup of the *Superdyne* shown in June RADIO AGE and who have swamped me wtih mail, having *received eleven hundred and eighty* letters so far.

1. The by-pass condensers may be .001 or .002 as the case may require. May be done away with on transformers.

2. Audio transformers need not be as high a ratio as shown; in fact, a 6 to 1 in first stage and a 4 to 1 in second will be better.

3. A fixed condenser suitable to your present antenna placed in series in aerial lead is better than a variable. This must be arrived at by trial.

4. It is not necessary to have rheostats for each tube, but they help to get the best there is in each tube, for the characteristics of tubes vary. One good rheostat for detector and one for radio frequency are essential and one for the two audio tubes and one for P. & P. will work wonders and save money for the builder.

5. For selectivity cut down your aerial to about sixty feet with single wire, well insulated.

6. When you heard a noise like rushing wind, your set is in oscillation and then is the time to adjust the feed-back (rotor) and bring in quiet the music or speech.

7. A 1-henry choke coil (iron coil) and a 1-MFD. fixed, cut directly across the ground and aerial binding posts works wonders in cutting out power hum and foreign battery noises.

8. It is not necessary to use the P. & P. at all if not desired; it only helps to cut down distortion and produce volume.

9. Amplex Instrument Laboratories, 57 Dey Street, New York City, put out a kit complete with all parts with tested instruments which are wonderful and cost only $30.75, which includes a drilled panel with baseboard.

STATIC PUNCTURING CONTEST

CAN old man static stop you or can you stop old man static? We offer the following prizes to DTs for the five best records submitted during the month of August. The contest is open to any reader of RADIO AGE, and any type of set. The Pickups Editor reserves the right to pick the winners.

We will be especially interested in lists submitted by persons making their receptions on portable receivers.

The baseball season is open—who will be the ones to sock old static for a home run? Wot sa, DTs?

PRIZES for August

A year's subscription to RADIO AGE for the first best list submitted showing receptions made during the month of August.

A year's subscription to RADIO AGE for the second best list submitted showing receptions made during the month of August.

For the third, fourth and fifth best lists, we will award a copy of the RADIO AGE ANNUAL to the contributor of the winning list.

If any transcontinental or transatlantic reception is accomplished, confirmation of such reception is necessary.

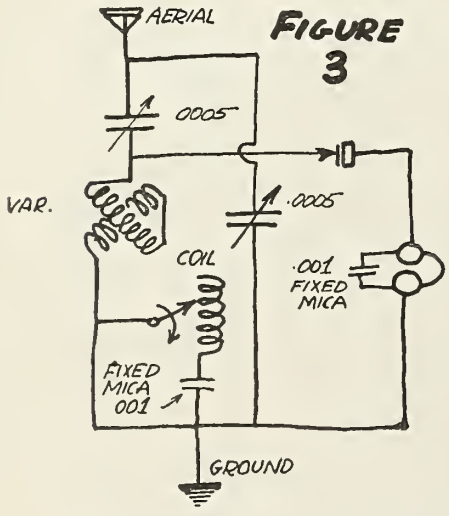
10. Do not use taps unless absolutely necessary, as these ends afford a great loss in sensitiveness.

11. In case two wires are used in aerial, transposition should be used; i. e., in the center of the wires disconnect and insert strain insulators and change left wire to right and right to left and you will be surprised how this will help where you are located near power lines.

12. Any of the Superdyne coils advertised in RADIO AGE are tested and O. K.

MARVIN C. WILLIAMS.
Department of Communications,
Air Service Technical School,
Box 353, Rantoul, Ill.

Our hat is off to Mr. Williams. If I could, I would like to shake hands with him. If every radio man in the game were as generous with information, and information on a circuit that he has become acquainted with as he is, what a wonderful radio world this would be! Now, if some fellow would only give a similar report of experiments and experiences with a super-het, we would consider him a regular radio fan at heart. Remember, all the information you may glean from your experiments is of little use if you hoard it. This game progresses only when we let others know of what progress we have made. Radio free-givers like Mr. Williams, Mr. Gannon, Mr. Baumgardner, Mr. Glass and others who have given us their experience with circuits are the real fellows who further the progress of the art. The world loves a cheerful giver, and although you may not be an engineer, when you contribute a gathering of information as did Mr. Williams and the others whose work has been offered in the Pick-ups Pages, you spell GENEROSITY with capital letters.



A diagram showing the connections of the crystal receiver which has done exceptionally good work for one of our Dial Twisters. The coil is a 40 turn inductance wound on a 3½ inch tube tapped every fifth turn. It is wound with No. 20 DSC wire.

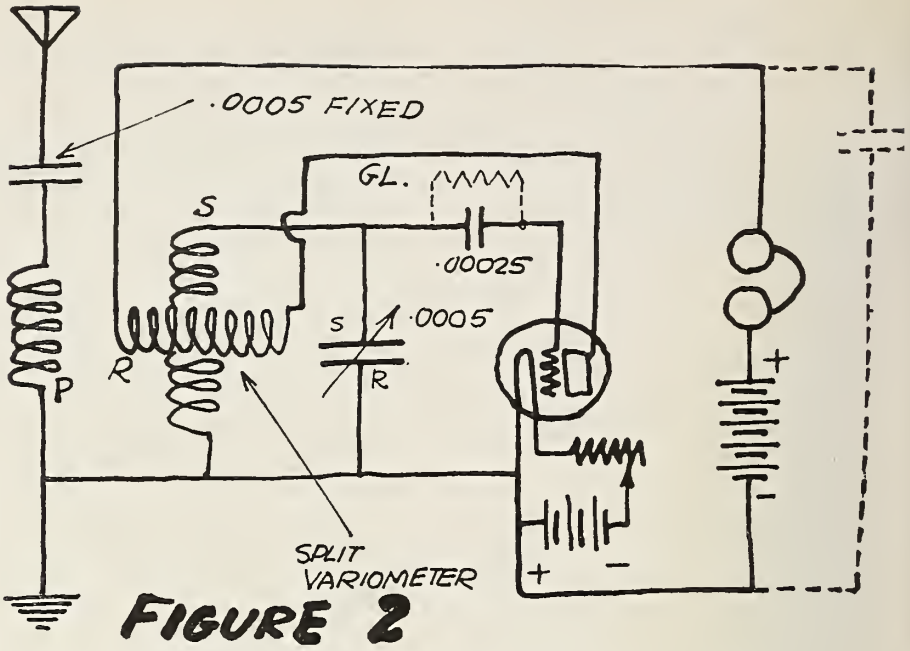


FIGURE 2

An improvised low loss tuner suggested by one of our readers.

RADIO AGE,
Gentlemen:

I notice that M. R. C. of Los Angeles has built one of your Baby Heterodyne receivers without success, in scanning over the Trouble-shooter section of RADIO AGE. In answering this letter of M. R. C.'s you first state that WD11 or WD12 tubes will not work efficiently. Now, if you will be so kind as to inform M. R. C. that I, too, have built your Baby Heterodyne around a WD12 tube with great results and that I live in Los Angeles, at 1536 East 40th Street, I will show him how he can get more volume from this hookup than 50 per cent of the neutrodyne owners of Southern California.

I have done quite a bit of experimenting on this set and I have it so that I now can take in Oakland every night they are on the air. I have heard KGW at Portland, Ore.; I get KPO repeatedly and I can tune out local with a variation of two degrees on my tuning condenser. I hear Oakland as loud as local. This is done in Southern California, Los Angeles, the worst place in the United States for getting distance on any set. And during Summer, too.

Let me say that the Baby Heterodyne hookup is the best little single tube hookup going.

For those who want to get results from this hookup, using WD12 or WD11 tubes, I am writing these few hints.

The antenna should be only one wire, not over 50 feet long. And the antenna coils should only be 15 turns; no more, no less. The tuning coil should be 60 turns, which if used with a *good* 23-plate condenser will tune very sharply. Both these coils, which are primary and secondary, are wound on spider web forms of 15 slots each. The antenna connection is made on the outside turn of the spider web primary. The turn nearest to the outside of the coil on the secondary is connected to the grid. Coils M and N are wound also on spider web forms of 15 slots. Coil M has 20 turns, and M, 60 turns. The inside turns of both coils are connected together, and then to the negative side of the A battery. The outside turn of coil N runs to the negative B battery, putting the phones nearer to the plate of the tube. The diagram shown in Figure 1 illustrates what I mean.

Now as to mounting these coils, it is important that it be done correctly or the selectivity of the set will be lost. Drill holes in the center of each form. Place a 1½-inch brass screw through the form P and a nut is run on it. Coil S is then mounted on the other end of the screw, taking care that both coils are placed with the winding running in the same direction—preferably to the right. The two coils constitute the tuner, and are mounted on the end of the board, in a horizontal position. It is advisable to use a Bakelite mounting board to fasten the apparatus.

Coils M and N are mounted in the same manner, but when placed on the board I set them to turn in the opposite direction (say to the left), and are mounted on the extreme end from the coupler. Inductance L is 52 turns, which I found tunes well with the WD12 tube and 23-plate condenser.

Incidentally, the outside turns of all the honeycomb or spider web coils should be connected to the radio frequency paths; in other words, the plate and grid circuits, while the inside terminals should go to the low

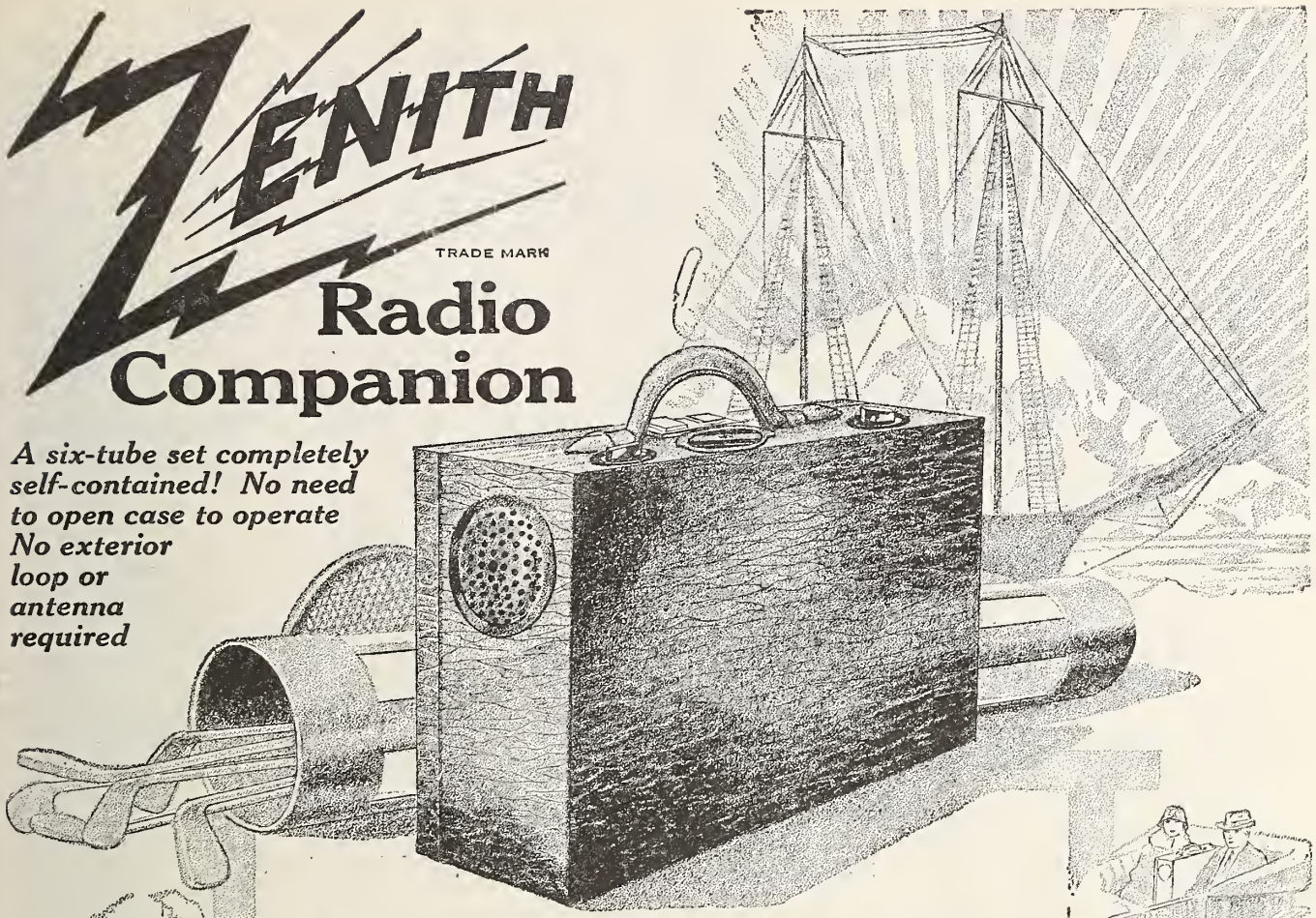
(Continued on page 42)

ZENITH

TRADE MARK

Radio Companion

A six-tube set completely self-contained! No need to open case to operate No exterior loop or antenna required



Listening, with the keenest pleasure, to music and voices in the cities they have left behind!

Lively orchestras entertain these boys, miles and miles from civilization.

Receiving the latest market reports, the latest news developments, with the aid of the Zenith Radio Companion.

Zenith — MacMillan's Choice

Encased in a Light Traveling Bag!

Here's a six-tube radio set that's entirely self-contained—tubes, "A" batteries, "B" batteries, loud speaker and loop antenna complete, and it's a ***Zenith!***

Packed into a small, beautifully finished traveling case—much smaller than the average suitcase—this new Zenith is the most compact set ever made giving clarity, quality, volume and distance.

Do you see those two little buttons close to the handle? Those are the controls. In order to operate the new Zenith Radio Companion you simply turn the controls to bring in the station you want—then for maximum volume you swing the case so that the loop is facing that particular station. You will be astonished at the clearness with which the music and the voices come through—and in what volume!

Think what it would mean to you to be able to take one of these new Zeniths with you on your travels and outings. A real radio set—the exclusive choice of Donald B. MacMillan for his Arctic expedition—yet so compact that it takes up no more space than a light traveling bag!

Think of the fun you could have with this set—the dance music you could listen to on moonlit nights—the orchestras that would play for you as you and your pals gathered round the camp fire—the companionship it could give you on your motor parties—at the bathing beach. Picture the enjoyment it could bring your guests at the house-party or the week-end gathering.

Again, think how such a set would while away a lonesome evening in that dreary out-of-town hotel—what a god-send it would be to that invalid mother—to that dear relative or friend who must spend weeks and months in the hospital!

But if you have already been initiated into the wonders of the Zenith, you don't need be told the extraordinary use you could get from this new model or the fun it could give you.

Just the knowledge that you could pick up this beautifully finished case—even as you would pick up your hand bag—and take it with you across city, country, lakes, mountains, and ***still*** turn those two controls and be able to listen at a moment's notice to the world you have left behind—that thought alone should be enough to suggest the infinite delights provided by this new Zenith Radio Companion

You will want to know more of this remarkable set—so light and compact, so easy to operate, so wonderfully convenient. You will want to see it for yourself, at the very earliest moment. No earphones, you understand. No outside antenna. Yet clarity, volume, quality, distance! A real Zenith, packed into a traveling case!

Your name and address on the coupon, and the coupon placed in the mail, will bring you full particulars.

The height of luxury—motoring to music!

When three is company at the bathing beach.

A constant source of entertainment and delight to the invalid.

Zenith Radio Corporation

McCormick Building
Chicago, Illinois

ZENITH RADIO CORPORATION,
Dept.4-F 328 S. Michigan Ave., Chicago, Ill.

Gentlemen:

Please send me illustrated literature on Zenith Radio, including full particulars of the new Zenith Radio Companion.

Name.....

Address.....

.....

Pickups
By Our Readers

(Continued from page 40)

voltage or battery connections common to the ground.

I use a Bradleyleak, connecting it to the grid of the tube and the positive filament as shown. The Bradleystat is connected in the negative lead of the filament instead of the positive as was originally specified. Dials of the friction or gear type were used and not separate plate type condensers. This is very necessary for sharp tuning. A .002 fixed mica condenser across the phones helps to clear up noises, and makes the regenerative action more stable.

A mounting board of Bakelite is used, raised sufficiently on the back of the main panel to permit the coils to be placed underneath and the tube sockets and controls to be placed on top. On my set I put the condensers on each end, and the grid leak between them.

I soldered all connections, using bus bar wire, lugs and spaghetti. I wiped every joint of soldering paste and used the paste only very sparingly.

Before placing the set in the cabinet, be sure that all soldered joints are clean of foreign matter. Dust off everything carefully, and clean the plates of the condensers with a bent pipe cleaner or a vacuum cleaner.

I find that a tapped 22½-volt B battery is a necessity to get a clear, audible signal. I found that around 16½ volts the WD12 tube responded best. Also set the grid leak by turning the knob all out and turning it in until good clear signal is heard. The higher you make the grid leak resistance without making it scratchy, the louder the signal will be.

I hope that this will be of interest to some of your Baby Heterodyne fans. Very truly yours,

A. F. VAN LEUVEN.

1536 East Fortieth Street,
Los Angeles, Cal.

Mr. Van Leuven wants to know if he can't make his Baby Het into a Super by adding another detector tube and an oscillator. We'll almost bet you could do it and still make it work, but the only trouble is that when you do that, you've got to have an intermediate amplifier, and then your set runs into tubes—and $$$$$. However, information of that nature is in the RADIO AGE ANNUAL, under the heading of the "Junior Heterodyne." You might look it up.

Now here's something that looks interesting:

RADIO AGE,
Gentlemen:

In your excellent magazine for May there appeared an article on "Aperiodic Antenna Coupling." I have been using an aperiodic coupler with which I have had good success, so am passing it on for the boys to fool with. As seen in the drawing, it is an exact duplicate of the Low Loss Tuner which has appeared of late. It is very selective and has the advantage of only two controls.

The primary consists of fifteen turns of No. 18 D. C. C. wound on wooden pegs directly on the side of the variometer, which should be of the wooden variety, having fifty turns on both stator and rotor. For the secondary I used the stator and the rotor is used for the tickler. A .0005 fixed condenser in the antenna lead makes the tuner more selective.

The drawing (Figure 2), I think, is self-explanatory. For those who want a set that will "do its stuff" and is portable, lash this up.

Yours truly,

E. M. ABBOTT.

R. No. 1, Box 152,
Petaluma, Calif.

Now look what we dug out of the mail bag for the crystal fans:

RADIO AGE,
Gentlemen:

Enclosed you will find a list of stations received during the month of June. This is a crystal set of my own make, and with which I have had exceptional results with in freak receptions.

If I had a camera, I'd like to drop you a few photos of the set, of which I am quite proud. The diagram of the circuit is enclosed. I hope that it will be of some use to those bugs who can't afford a tube receiver. (Diagram is shown in Figure 3.)

I have a card and letter of confirmation from most of these stations while others just sent a pamphlet and a card confirming the receptions.

This ought to win a prize on the DT list. Very truly yours,

JAMES A. BENNETT.

Chester, Pa.

Calls Heard by James A. Bennett, 2733 W. Third Street, Chester, Pa.

WGY, WEAF, WBAP, WBZ, WMAQ, WHAV, WHAZ, WWJ, KDKA, PWX, 9XAE, 2XI, 2XAP, 2CDC, WOO, WIP, WFI, WDAR, WWAD, WCAU, WIAD.

This seems to be another little "Long Distance Crystal set." Mr. Bennett has the dope, all right—you've got to know HOW to make 'em to do a thousand miles or more. Good stuff!

RADIO AGE.
Gentlemen:

In your issue for June, 1924, I see a radio fan from Halifax, N. S., sent in his list of stations heard. I refer to H. K. Hatheway, as I reside just across the harbor from him, and am naturally interested in any news from Halifax pertaining to radio.

(Continued on page 52)

Have You Placed Your Entry in the Popularity Contest?

As announced in a page advertisement in this and in the July issue, RADIO AGE is conducting a RADIO FAVORITE POPULARITY CONTEST to determine the most popular personage in the radio world.

This contest is open to all readers of RADIO AGE, and each coupon clipped from this magazine is good for one vote. First tabulation of results will appear in the September issue.

If you have not already voted for your favorite announcer, entertainer, or other radio figure, clip the coupon in this issue and get your friends to do the same.

Get a Job Like These

Earn $3500 to $10,000 a Year

in the Big Pay Field of ELECTRICITY

20 Years Old—Makes Almost $500 a Month

Harold Hastings of Somers, Mass., says: "The profit on my electrical business amounts to $475.00 a month. My success is due entirely to your instruction. You make your men just what you say—Electrical Experts. No man will ever make a mistake enrolling for your course."

Dickerson Gets $7500 a Year

"I earned $30 a week when I started with you—$50 a week when half through your course. Now I clean up at the rate of $7500 a year. Thank you a thousand times for what you did for me. Electricity pays big on the farm." Herbert M. Dickerson, Warrentown, Va.

$20.00 a Day for Schreck

"Use my name as a reference and depend on me as a booster. The biggest thing I ever did was answer your advertisement. I am averaging better than $500 a month from my own business now. I used to make $18.00 a week." A. Schreck, Phoenix, Ariz.

Pence Earns $9000 a Year

W. E. Pence, Chehalis, Wash., says: "Your course put me where I am today, Mr. Cooke—making $750 a month doing automobile electrical work—think of it—$9000 a year. Besides that I am my own boss. My wife joins me in thanking you for what you did for us."

$30 to $50 a Day for J. R. Morgan

"When I started on your course I was a carpenter's helper, earning around $5.00 a day. Now I make from $30 to $50 a day and am busy all the time. Use this letter if you want to—I stand behind it." J. R. Morgan, Delaware, Ohio.

Spare Time Work Pays Stewart $100 a Month

"Your course has already obtained a substantial increase in pay for me and made it possible for me to make at least $100 a month in spare time work. You can shout this at the weak fellows who haven't made up their minds to do something yet." Earl Stewart, Corona, Calif.

It's your own fault if you don't earn more. Blame yourself if you stick to your small pay job when I have made it so easy for you to earn $3500 to $10,000 a year as an electrical expert. **Electrical Experts** are badly needed. Thousands of men must be trained at once. One billion dollars a year is being spent for electrical expansion and everything is ready but the men. Will you answer the call of this big pay field? Will you get ready now for the big job I will help you get? The biggest money of your life is waiting for you.

I Will Train You at Home

I will train you just like I trained the six men whose pictures you see here. Just like I have trained thousands of other men—ordinary, everyday sort of fellows—pulling them out of the depths of starvation wages into jobs that pay $12.00 to $30.00 a day. Electricity offers you more opportunities—bigger opportunities—than any other line and with my easily learned, spare time course, I can fit you for one of the biggest jobs in a few short months' time.

Quick and Easy to Learn

Don't let any doubt about your being able to do what these other men have done rob you of your just success. Pence and Morgan and these other fellows didn't have a thing on you when they started. You can easily duplicate their success. Age, lack of experience or lack of education makes no difference. Start just as you are and I will guarantee the result with a **signed money back guarantee bond.** If you are not 100% satisfied with my course it won't cost you a cent.

Free—Electrical Working Outfit and Tools

In addition to giving my students free employment service and free consultation service, I give them also a complete working outfit. This includes tools, measuring instruments, material and a real electric motor—the finest beginners' outfit ever gotten together. You do practical work right from the start. After the first few lessons it enables you to make extra money every week doing odd electrical jobs in your spare time. Some students make as high as $25 to $35 a week in spare time work while learning. This outfit is all FREE.

Mail Coupon for FREE BOOK—
The Vital Facts of the Electrical Industry

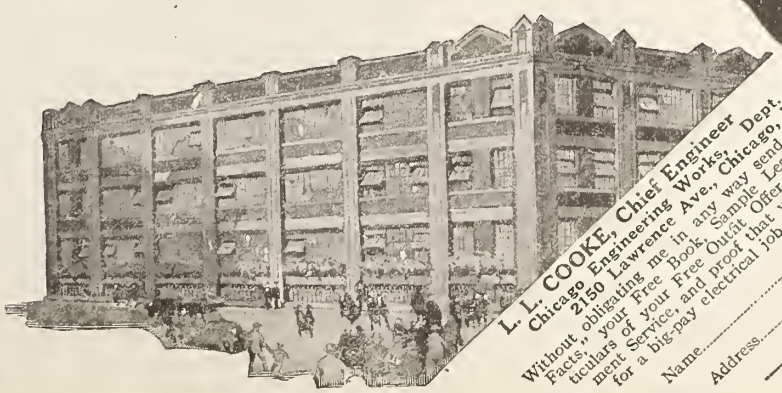
The coupon below will bring you my big free electrical book—over 100 interesting pictures. The real dope about your opportunities in electricity—positive proof that you, too, can earn $3500 to $10,000 a year. Send for it now. Along with the book I will send you a sample lesson, a credit check allowing you a $45.50 reduction, my guarantee bond and particulars of the most wonderful pay-raising course in the world. Send the coupon now—this very second may be the turning point in your life. Send it while the desire for a better job and more money is upon you, to

L. L. COOKE, *Chief Engineer*

Chicago Engineering Works

DEPT. 82-B **2150 Lawrence Ave., Chicago**

The Cooke Trained Man is the Big Pay Man



L. L. COOKE, Chief Engineer, Dept. 82-B
Chicago Engineering Works, 2150 Lawrence Ave., Chicago, Ill.
Without obligating me in any way send me the "Vital Facts," your Free Book, Sample Lessons and particulars of your Free Outfit Offer, Free Employment Service, and proof that you can fit me for a big-pay electrical job.

Name.....

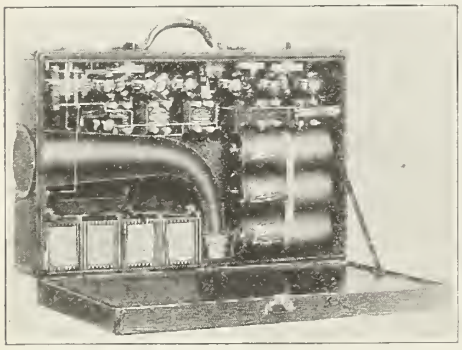
Address.....

WITH THE MANUFACTURERS

The New Zenith Super-Portable

The new Zenith Super-Portable is a six-tube radio set complete with tubes, "A" batteries, "B" batteries, loud speaker and loop antenna, entirely self-contained. It is fitted into a small traveling case—giving clarity, quality, volume and distance.

In the case are included all the essentials of an efficient six-tube receiver employing three stages of transformer-coupled radio frequency, a detector, and two stages of audio frequency. The set is dry-cell operated. A loop antenna is per-



manently mounted inside the case, and the three controls—(1) A rheostat for regulating the battery current; (2) Tuning control for selecting stations; (3) Volume control—are mounted close to the handle in three recessed dials.

The Zenith Super-Portable weighs only twenty-four pounds and may be carried about like an ordinary small suitcase. No external aerial is required for operating the Zenith Super-Portable, nor is it necessary to open the case. The set is operated by means of two controls, both on top of the case. Having tuned in the station you want, volume can be further regulated by swinging the case so that the loop is pointed in the direction of the station broadcasting. A station may be tuned and the Super-Portable placed in full operation while it is being carried down the street, in an automobile or otherwise transported.

An extremely sensitive and distortionless loud speaker is mounted inside the cabinet with a shielded orifice through which the spoken word or music is clearly heard. Neither head phone nor external loud speaker is therefore necessary. The same principles that have made the Zenith models 3R and 4R so highly selective—permitting the tuning out of powerful local broadcasting stations close to the receiver and at the same time tuning in distant stations—have been utilized in the new Super-Portable. Special attention has been given to low-loss design and distortionless amplification. Reception of distant stations may be accomplished in full phonographic volume with the Super-Portable without any external equipment.

In creating the new Zenith Super-Portable its designers had high standards to live up to. For it was a Zenith set which Donald B. MacMillan, world-famous Arctic explorer, chose exclusively for his expedition to the North Pole; it was a Zenith with which Miss Florence MacDonald, a passenger on the trans-Atlantic liner Berengaria, established a new long-distance record over land and water, tuning in station WDAP, Drake Hotel, on the fifth day out—a distance of 3,463 miles. With these records in mind, the designers of the new Zenith Super-Portable undertook to create a set which would live up to the Zenith name in every particular, and yet would be contained in a small traveling case.

New Trirdyn 3 R 3 Receiver

The rapidly increasing popularity of tuned radio frequency in receiving sets is clearly indicative of its extreme efficiency. The Crosley Radio Corporation has used tuned radio frequency for the past two years, notwithstanding the great amount of publicity already given to tuned radio frequency of the transformer type. It is gratifying to know that so many large and influential manufacturers are turning to tuned radio frequency amplification in the design of the new receivers.

The newest addition to the Crosley line is the Trirdyn 3 R 3, announced on the third anniversary of the corporation. The Trirdyn, having passed through a thorough test from every angle and after practical use by people in various parts of the United States, was deemed ready to be distributed to the public. Laboratory tests are not always as practical as those given a receiver under the different circumstances encountered in actual operation and the reports received bore out the excellent tests of the designers. A year has been given to perfecting this receiver.

Four important principles are accomplished in receiver design in the Trirdyn: Tuned radio frequency amplification with the first tube; Armstrong regenerative detector action with the second tube; reflex amplification by employing the first, or radio frequency tube as an audio amplifier and one-stage of audio frequency with the third tube. These factors combined in the particular arrangement of this receiver, give high signal strength.

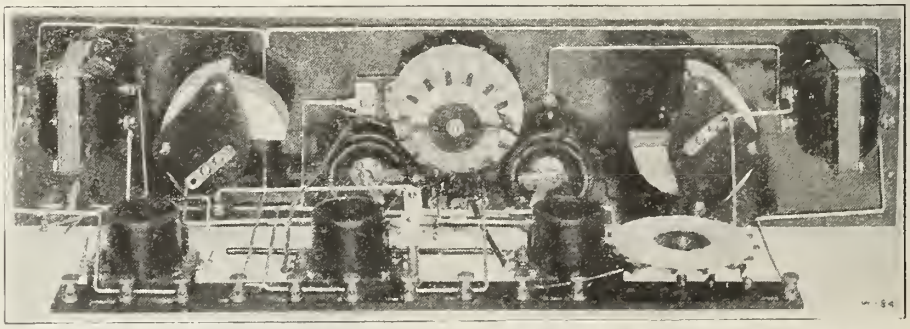
The Trirdyn will not radiate when receiving broadcasting stations' signals, due to the fact that the antenna is very loosely coupled to the secondary circuit and a non-oscillating radio-frequency amplifier is employed before the regenerative detector, as a barrier to prevent oscillations generated by the detector upon reaching the antenna.

The primary or antenna circuit of this set is aperiodic or untuned, making it possible to calibrate the secondary circuit and the tuned radio frequency amplifier in terms of wave length, thereby enabling the receiver to be accurately adjusted to the signals of any broadcasting station from a calibration table or curve sheet.

The set is selective because it employs tuned radio frequency, loose-coupled antenna and a tuned secondary. The operation of the Trirdyn is very simple and will give excellent results with any good antenna. It also operates well with a small indoor antenna.

It requires a detector and two amplifier tubes of standard type. Good results are obtained when UV 199 tubes are employed, but the volume will be greater with 6-volt tubes. The amplifier circuit employs 90 volts of "B" battery. A "C" battery may be employed if desired. The Trirdyn is enclosed in a beautiful solid mahogany cabinet.

(Continued on page 64)



The back panel view of the new Crosley Trirdyn 3R3 receiver. Note the symmetrical arrangement of the apparatus, designed to make possible short leads and yet preserve the front panel appearance of the set. The open work style of mounting, and the method used to keep the tubes away from the controls on the panel insure extreme stability.

RADIO FANS—YOU NEED THIS!

$5.00 VALUE

WEBSTER'S New Modern DICTIONARY

1924 Radio Edition

And One Year's Subscription to RADIO AGE

$3.75 POSTPAID

Both for Only

1,228 Pages
Size, 5¼x7½ inches.
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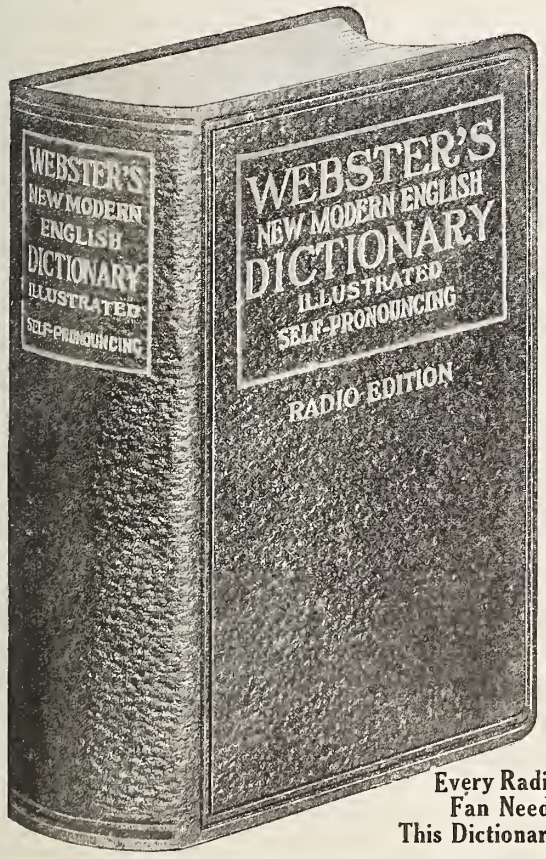

Every Radio Fan Needs This Dictionary

Every teacher, student, reader, writer and author will find this splendid word-book exceedingly helpful in the preparation of their work. It is a recognized, authoritative guide containing practically every word in the English language in daily use and in addition hundreds of new words brought into use by the recent World War, political upheavals, recent investigations in arts, science, and modern industrial activities never before found in any dictionary. Bold black face type, easily readable and words clearly and concisely defined.

New 1924 *Special Radio Edition*

A special supplementary vocabulary consisting of over one thousand (1,000) radio and wireless terms are herein concisely and authentically defined. This popular edition is invaluable to "Radio Fans."

Order Now!

This is your opportunity to secure this handsomely bound, strictly modern and up-to-date dictionary—with a year's subscription to RADIO AGE, the finest and most authoritative radio publication on the market. The cost of the dictionary alone is $2.50, and the subscription price of RADIO AGE is $2.50 a year, postpaid. But if you take advantage of this offer at once and clip the coupon below, you can purchase both of these wonderful bargains, with a total value of $5.00, at our special price of

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Note these features—

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- Automobile Terms.
- Aviation Terms.
- Commercial and Legal Terms.
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- Common Abbreviations.
- Christian Names of Men and Women.

USE THIS COUPON

RADIO AGE,

510 N. Dearborn St., Chicago, Ill.

Gentlemen:—Enclosed find $3.75 in cash or equivalent, for which send me one copy of your Webster's New Modern English Dictionary, Radio edition, postpaid, and Radio Age for one year.

Name.....

Address.....

City..... State.....

New and Novel Radio Patents

Selective Tuning Possible by New Vario-Coupler

NEARLY perfect zero coupling in radio-frequency amplification is claimed for a vario-coupler designed by Alfred Crossley of the Bureau of Engineering, United States Navy Department, for which invention a patent has just been issued.

Selective tuning is the practical accomplishment of this new coupling device. Novices and amateurs are earnestly seeking in these days to attain this end, especially since local broadcasting stations are creating interference with respect to long-distance reception.

The newly designed vario-coupler, according to claims, provides large electro-magnetic coupling with a minimum electrostatic coupling. That is to say, in many of the radio-frequency amplifying receiving sets in use today, the passage of electrostatic energy from one circuit to another has a tendency of annulling the tuning effects and thereby making difficult fine adjustments of the circuits.

This vario-coupler serves the highly desirable purpose of bucking out the electrostatic energy and employing the electro-magnetic energy, which alone is useful in the reception of radio communication.

Structurally, this tuning device includes a rotor and stator forming the primary and secondary windings, which connect to the coupled electric circuits. The stator takes the form of a tube or cylinder and its windings are in the interest of the least dielectric loss. The rotor, on the other hand, is in the shape of a disc mechanically mounted in a plane passing through the diameter of the stator and at right angles to the axis thereof. The rotor, like the wheel of a wagon, contains a hub with spokes.

The windings of wires on this rotor, or revolving portion of the vario-coupler, resemble a spider web, the turns of wire being threaded upon the spokes and spirally built up to occupy the length of the latter.

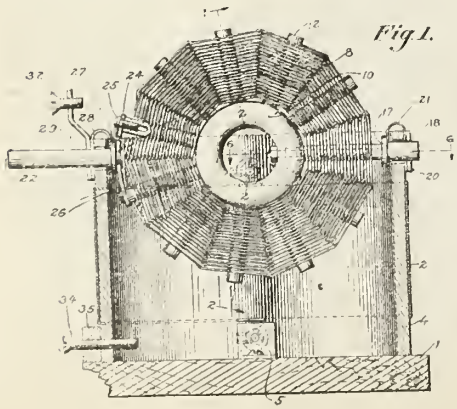


Fig 1.

Photo from Fotograms

GIRLS BECOMING RADIO EXPERTS

Gone are the days when one had to be a man to understand the intricacies of radio apparatus. Now girls are employed extensively in the big radio manufacturing plants to make and assemble radio sets. Two interested girl workers are shown above assembling vernier wheels on clarifier panels in the Grebe Mfg. Plant, Richmond Hill, L. I. Their positions were won only after long study of the principles and practice of Radio.

In practice, when this vario-coupler is used in the tuning circuit before a radio-frequency vacuum-tube amplifier, the stator or primary winding is connected in the antenna ground system while the rotor or secondary winding is identified with the input circuit of the first stage of the radio-frequency vacuum-tube amplification. The greatest degree of electro-magnetic coupling is accomplished when the flat area of the rotor is in a position parallel with the direction of the turn of the windings of wire upon the stator; whereas, zero coupling takes place when the flat area of the rotor is approximately at right angles with the direction of the turns of wire upon the stator.

The Crossley vario-coupler should be useful in exact tuning of radio-receiving sets when operating over a band of wave lengths of narrow margins. And with approximately 500 broadcasting stations in operation, this condition exists at all times. This is accomplished, in part, by the elimination of electrostatic energy and the maximum building up of the electro-magnetic field.

The papers granted by the Patent Office accede to these claims: A vario-coupler having a large electro-magnetic coupling with minimum electrostatic coupling; an instrument attaining a more perfect zero coupling than found in any vario-coupler yet introduced; and a device which may be connected in a circuit and arranged to secure extremely selective tuning of the circuits.

"Great Things Are Coming for Radio On the Farm"

(Continued from page 35)

Western ranch. In the old days they could cuss the cook and play cards. Now they can carry a radio outfit on the wagon, and pluck out of the night voices of many distant cities, while in a mean room in some city slum the owner of a fifteen-dollar set may hear John McCormack, Mary Garden, Chaliapin. Neither the cowboys on the plains nor the victim of city poverty need any longer be isolated.

It seems probable, judging by experiments already made, that, in the course of four or five years of research, engineers will have perfected methods of rapid, accurate, and detailed transmission of photographs by wireless. They will then work on the more difficult problems of reproducing at a distance moving pictures of moving bodies.

You will sit before your radio set out there on the farm and hear the Presidential address while you watch his gestures and the crowds about him. Opera and drama in a distant city you will both see and hear. You may have almost ringside seats at the world championship match, and thrill to the swat of the "Babe" Ruth of that day—all in your own sitting-room. This will never be a complete substitute for seeing and hearing the opera and the play or the great political or sporting event—but then indeed will the farm cease to be "isolated."

*Courtesy *Farm and Fireside*.

A New Service to Aid the Radio Public In Buying Efficient Sets and Parts

By EDMUND H. EITEL

Vice-President, Pfanstiehl Radio Co.

SERVICE? What is it? Perhaps we had better ask, "What *isn't* it?" If the vacuum tube is the "heart of the receiving set," service is the heart of the radio industry. A receiver is not a few pounds of wood, metal, and rubber, which are worth intrinsically very little, but it is the most marvelous service that science has yet contributed to civilization, a service which annihilates space and time and the ordinary considerations of economics.

And so, from the manufacturer to the public, we deal not so much in radio materials as in radio service. It is just as important for the public to recognize this, as for the man who wholesales or retails radio, in order that the merchandising of radio may be placed on a more dependable basis and those merchants eliminated who sell apparatus which will not work properly.

Let us illustrate with what service *is not*. A certain manufacturer, who is noted for doing his utmost to make products of the best design and workmanship, recently discussed his line with a small New York dealer who said, "I believe your goods are the best and I know how well they are made. That's just why I don't carry them. You see, when I sell the junk I now carry, the customer usually brings his set in and gives me a chance to make a profit repairing it."

That dealer will not be permanently in the radio industry. Fortunately, there are few merchants who talk in this way and who know and care so little about service. To eliminate such menaces to the health of radio, we need more intelligent buying on the part of the public, and this leads us to the question of where service begins.

There is apt to be a vicious circle started when dealers sell without conscience, and the public will buy anything. Weak manufacturers will be tempted to furnish junk and the newspapers to print hookups to serve. The public, *while* uneducated, is duped.

We have had some experiences of this kind in the first few years of radio and we see now that to begin with the public must be well trained in the fundamental principles of radio by the radio journals. The manufacturer must build with foresight for the future; must not "fall" for the temptation to sell even fads. The wholesalers must think first of all not what will sell today, but what reputation is he building? And the dealer the same. The dealer, like the journal, can render an invaluable service by helping educate the public in the fundamental principles of good buying; and grateful customers will pay him in the long run.

No other industry has ever before placed such a difficult technical problem in the hands of the public. RADIO AGE offers a solution of this problem in a series of Service articles on buying and selling radio. These discussions will not deal with the theoretical requirements of voltage, capacity, etc., which are covered in the usual diagrams and articles, but with a side of the subject which has been neglected; namely, the practical points one needs in selecting apparatus. What you want to know chiefly is how to buy apparatus which *will work* and work most efficiently.

Too Many Radio Fans Are Duped By Failing to Do Buying Wisely; Radio Age to Tell How

The group with whom I am identified received some curious advice when it proposed to make sets. We were warned by a manufacturer of parts to leave sets alone. The trouble with making sets, he said, lay in there being so much junk in radio apparatus that you had the greatest difficulty in building a set which would work. If you sold parts, he said, you were relieved of the responsibility of making the set perform.

In the course of many experiences we have often laughed over this advice. After the manufacturer designs his apparatus, he reviews the materials and parts available, tests them, and makes his selections. Next he buys a very great number of the units selected and learns how many hundred different ways they can fail to work. Occasionally, despite all the manufacturers' foresight and final testing, the customer gets into difficulties. And so, the manufacturers' knowledge is widened into a new field of troubles, due for the most part to the customer's unfamiliarity with the technical side of the apparatus. This results ultimately in simplification of design.

RADIO AGE has asked me to set down points of practical, as contrasted with theoretical, experience on data sheets in the form of buyer's guide or service. During the coming radio season, we shall hear less of so-called "new" hookups and more about improving the efficiency of those circuits which have demonstrated their superiority. For this development of interest such data will be timely.

Since the data on these sheets will aid those who buy as well as to those readers who sell radio, they will be called a "Buyers' and Sellers' Service." They will supplement and be convenient to bind with Mr. Rathbun's technical data sheets.

The First of the Buyers' and Sellers' Service Sheets Will Be Found on Page 50.

HOW DID THEY GET THAT WAY?

What did the radio announcers and entertainers do before they were brought into the limelight by the sudden advent of radio popularity?

Some were unknown completely. Others were struggling along at some kindred occupation, such as theatricals or public speaking. Overnight they became familiar—by voice and name, though not by sight—to millions of radio listeners.

The story of how many studio favorites rose to fame and how they did it ought to prove of interest to every RADIO AGE reader. The first of an interesting series on this subject begins in this issue and will be continued in the September RADIO AGE. Order your copy from your news-dealer in advance to insure getting this All-Star number.

Sonora Phonograph Co. Produces Radio Speaker

The Sonora Phonograph Company has recently produced a Radio Speaker which is a radical departure from the established type of upright horn loud speaker, and which bears evidence of becoming exceedingly popular with radio enthusiasts.

The Sonora Radio Speaker differs from those now on the market in two major characteristics; its horn is concealed in a mahogany cabinet, following present day practice, and it embodies the most advanced theories of tone production as developed by this successful phonograph company's engineers.

Incorporated in this Radio Speaker is the famous Sonora tone passage, consisting of a highly developed, correctly proportioned all-brass tone arm and the Sonora all-wood, laminated horn. It is the product of years of thought and experiment pursued in the interest of high quality sound reproduction. When it is realized that the principle of sound reproduction applied to the phonograph holds true in radio, then the significance of this latest addition to radio reproduction will be appreciated.

One of its chief bids for popularity is its small size. It measures only 16½ inches long, 9½ inches high and 9½ inches deep. Combined in this small space is the large, full tone passage, representing skillful engineering design. It is equipped with a generous length of cord and connections for use with any good receiving set.

BUYERS' AND SELLERS' SERVICE SHEETS

ON BUYING IN GENERAL (No. 1-A-24)

The first principle of good buying, of course, is to know exactly what you want and why you want it. Then in looking over the sources of supply you can select more surely from the mass of stuff offered you the thing in the market which most nearly meets your demands. You should know more about the subject if possible than the salesman who waits on you, for he is very apt to know only one line well or be stimulated by his employer to sell a special line.

Assuming that you correctly know what you need from the theoretical point of view—say a 30-ohm rheostat or a .00025 mfd. condenser—first of all, how are you going to get exactly what you ask for?

Unless you have expensive testing instruments, you are going to have to depend on somebody's **word**. Whose word shall it be?

Somebody, of course, whose word is good. That is, someone who is honest and also knows what he is talking about. Isn't this someone who recognizes that he is selling service? Such a man, if he failed to deliver you an article which **worked** properly, would replace it.

1. Buy, therefore, of a reliable merchant.

Radio is so new an industry that there are many concerns which have made a fine reputation in the mechanical field, and yet have not made good in radio. You cannot judge the merchant by size alone, for very often the new and smaller firms are the best and know most about radio. The test to make is, will the concern replace the article if it proves inferior?

The next point is, buy goods with a reputation. If I say, "with good will," you will agree at once, but if I say "well advertised" you may not. Some people distrust advertising because they do not understand exactly what considerations make a firm advertise. .

If it were not for "quality" goods, as contrasted with "goods at a price," there would be little advertising. There would be little use to advertise. If a head-set were only a "head-set," for example, and all head-sets were considered of equal value, just as so many grains of wheat, price would determine sales. Manufacturers would sell to the trade on a price basis and you would buy the **cheapest** head-set, and that is all there would be to it.

The moment the radio manufacturer introduces some improvement in an article, he must find a way to let you know that you can get superior service with that article. Design and excellence necessitate his advertising. This is because well-designed, well-made goods cost more to make than poor goods. The buyer must be educated by advertisements so that he will know how much better service he can get from quality goods; in other words that they are worth the extra money he must pay. And the law of service in business is inexorable. As Lincoln said, "You can fool some of the people all of the time and all of the people some of the time, but you can't fool all of the people all of the time." The manufacturer whose goods fail to live up to his advertisements is soon found out and deserted. And the sooner the public knows the fundamental principles well, the quicker will such manufacturers be found out.

Furthermore, advertising to a certain extent gives the buyer this protection: To misrepresent in a publication which goes through the mails is to commit the very serious offense of "using the mails to defraud." Every advertiser has to make good advertised claims. You can hold him to it.

2. Therefore, buy goods with a reputation.

When you find well-tried and established reputation you may bank on it.

3. Don't try to get something for nothing. You won't. Don't be penny-wise, pound foolish. For suppose you save a dollar on a condenser and get an inferior instrument which destroys the value of a set on which you have spent twenty dollars! The chain is no stronger than its weakest link.

Next, assuming you know the technical requirements of the apparatus you are buying, you should know the practical points. The manufacturer soon learns that these, after all, constitute the most vital requirements.

For example, a certain factory laid down a splendid set of technical specifications for jacks and instituted a careful inspection of goods received. Despite all this, one practical consideration was neglected which might have brought "tragic" consequences to some young radio fan had he been the victim. A set passed the factory tester, who "plugged in" successfully. But when the customer "plugged in" he burned out all his tubes!

The jack arm was slightly misshaped. The factory plug was standard, but the customer's plug was undersized. The latter, being loose, came into contact with the arm, sending the B-battery current into the filaments.

That is an example of how important the practical considerations of buying may be.

The next four service sheets will have to do with vacuum tubes, sockets, jacks and plugs.

COMPILED BY
EDMUND H. EITEL

BUYERS' AND SELLERS' SERVICE SHEETS

TUBES (No. 2-A-24)

More than of any other radio item, from a commercial point of view, the most interesting things might be said about tubes. And yet fewer practical points of advice can be given here than anywhere else. Tubes are the best example of the above general principles of radio buying outlined in the first Buyers' and Sellers' Service Sheets.

If you are a fan, you can, of course, insist on one thing when making a purchase. You can see the filament tested; or if buying by mail, have a certified report upon this test. And you should immediately check it.

If the tube is transparent, you also can observe whether the grid, plate, and filament are separated and are in alignment. If a radio set happened to be in operation in the store and you have a lot of nerve or know the dealer well, you may have the tube tested under receiving conditions. Or if you are a manufacturer or engineer, you may test your tubes with proper instruments for filament emission, etc. But what is the fan to do under the usual conditions of purchase to make certain that he is securing a good tube?

Right here is where difficulties arising "on both sides of the counter," so to speak, make it well to examine points of view of tube manufacturer, jobber, dealer and public. The facts are they each want to be protected from the other.

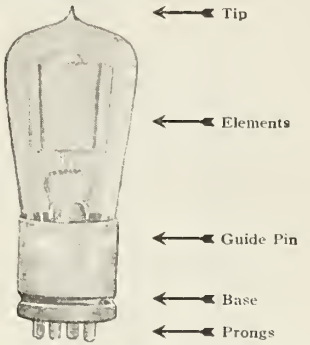
If a tube receives an overvoltage, it will have the electrons boiled off the filament and become low in electronic emission. Since the ultimate purchaser, or user, may cause this damage, the manufacturer will not officially "make good" such tubes, although occasionally he may be persuaded to replace them. If a fan damages a tube in this manner, he should light the filament at rated voltage for ten to twenty minutes (sometimes longer) with plate voltage off and thus drive the thorium from the inside of the filament to the surface, thus restoring the high rate of electronic emission. This applies to the tubes using thoriated filaments or to most of the new and better tubes; and the buyer can at least ascertain whether the tube he is purchasing can be restored in such a manner if accidentally given an overvoltage.

The fan has only one source of protection, however, against spending his money for a poor tube; he must buy a tube made by one of the reputable tube manufacturers, and buy it through reliable merchants, whose connections with the tube manufacturer are through a reliable wholesaler. Under these conditions, and also provided he will test his tube at once and report if it proves inferior, he has an excellent chance of securing a replacement. The reputable tube manufacturers guarantee their tubes against faulty manufacture, although not specifically against low electron emission.

Various tube patents are now expiring and several other large and reliable radio manufacturers will begin the making of tubes. It would seem the part of wisdom for the present tube manufacturers to establish a reputation for liberal replacement. There is every indication of a tube shortage for the coming season. Those who can afford to do so will do well to buy their tubes early.

VACUUM TUBES

1. Buy only reliable and reputable brands.
2. Buy only through reliable dealer whose connections are through reliable wholesaler.
3. See that tube filament is tested in your presence, or certified, if you buy by mail.
4. Examine elements, if tube is transparent, to make sure they are not touching, loose, or out of line.
5. See that tube base or insulating plate is clean and free from dealer's pencil marks; also see that prongs are clean.
6. Examine the tip where tube is sealed off. If this is broken, air may enter the tube and the vacuum be lost, or impaired, even though the filament may burn.
7. Microphonic tubes: About 2 per cent of most tubes and all U. V. 199 or C. 299 tubes and W. D., or C, 11 and 12, will sing if the set is jarred. This cannot be helped in the case of the tubes named above, but in the large sizes of tubes it is a defect due to poorly attached connections. The large manufacturers will not officially replace such tubes, but the best dealers and wholesalers usually can secure a replacement.



8. Tube noises: Determine if your tube is noisy by comparative tests. High vacuum means uniform characteristics and quiet operation.
9. Remade tubes: The end of the useful life of a vacuum tube is indicated by a decrease in electron emission and increase in filament voltage required for satisfactory operation. Repaired tubes, if the filament is old, are likely to be short-lived.

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RADIO AGE

COMPILED BY
EDMUND H. EITEL

American Boy Important Factor in Summertime Radio

The American boy, with his wonderful adaptation to electrical and mechanical development, continues to be a factor both in the progress of the radio art and in the Summertime demand for radio apparatus, according to reports received by the Radio Section of the Associated Manufacturers of Electrical Supplies.

He is supplementing his Winter book-studies with practical work at home, in camp or at the seashore. Pierre Boucheron, chairman of a committee now compiling statistics on the subject, declares the outstanding fact already developed is that no other scientific achievement in recent history has so captured the imagination of millions of American boys as radio has done.

"In this case, at least," Mr. Boucheron adds, "it stands thoroughly proved that the American boy is father to the radio man."

Radio has created a new type of electrical experimenter with the result, as Mr. Boucheron points out, that many of the noteworthy developments in the art have been brought about by comparatively young men.

"Boys of today are astonishing their elders with glib references to such recondite subjects as electrons, ether waves and radio frequency amplification," Mr. Boucheron continues. "These boys understand the fundamentals of electrical theory and practice and the complex changes undergone by electrical impulses in a radio circuit.

"Radio this Summer has taken the American boy off the street corner and placed him in his home-made laboratory. Instead of lurid novels, he now reads the authoritative radio magazines.

"Radio is teaching the boy a greater appreciation of music than he could possibly have attained from painful 'music lessons' or lectures on the subject. It has given him a more graphic knowledge of current events. Radio Sunday sermons bring the teachings of religion home to him.

"But the gain is not all one-sided. The youth of the nation perhaps have done as much for radio as the art has done for them. For the fact remains that it was the boy who first 'sold' the idea of radio to the entire family. It is the boy who keeps the older folks informed of developments in the radio art; it is the boy who determines very largely the type and character of radio equipment which the family shall buy; and it is the boy who this Summer is making radio a year-round necessity rather than a seasonal luxury."

"THE TROUBLESHOOTER"

Due to unexpected changes in makeup of this issue of RADIO AGE, the "Troubleshooter Section" for fans is omitted. Watch September RADIO AGE for an extraordinarily big section answering all the latest technical queries.

The Second of RADIO AGE'S Articles on Tube Efficiency Will Appear Next Month

Pickups
By Our Readers

(*Continued from page 42*)

Instead of the honeycomb set used by him, I am using the old-fashioned, much-abused single circuit, and although I must have caused interference at first, now I can consistently tune in stations by setting the dials. The tickler coil is set at zero first, then the condenser is set for the proper wave length, then I reset the tickler dial, and no squeals are heard either in my phones or in the neighbor's. It is just as easy to do it right as wrong if one keeps a log.

Below are the stations I have consistently heard up until the end of April, when I ceased listening in. All these on two small peanut tubes:

WCAR (once an entire program), KFKX, WRAN, WCAL, WSB, WDAP, WLW, WNAP, WWI, WCAD, WRC, WSAX, KDKA, WGR, WMAK, WCAP, WHAM, WFI, WIP, WOO, WDAR, WOAX, WOR, WGY, WBZ, WEAF, WHN, WJZ, WMAF, WHAZ, WJAR, WNAC, WGI, CHCX, CHYC, CHXC.

I want to thank both yourself and Mr. Kennedy for the suggestion of grid leaks across the secondary of the transformers, as I am sometimes bothered with shrillness of tone.

Thanking you again for many valuable hints I have received in your wonderful magazine, I am,

Yours very truly,
J. T. CREELMAN.

198 Windmill Road,
Dartmouth, N. S., Canada.

RADIO AGE,
Gentlemen:

I am fifteen years old and I believe that I ought to be admitted to your Loyal Order of Dial Twisters. I am a regular reader of your magazine and I like your technical articles. As to my opinion of your little magazine I think it the best of its kind. I am enclosing my list of stations heard since about January.

KFI, KHJ, KGO, KPO, KLZ, KFAE, KYW, KFLZ, KFNF, KFKB, KOP, KFOY, KSD, KFIX, KFKX, KGW, KFGL, KDKA, KQV, KFFZ, KFOP, KFIZ, CYB, CYL, CHYB, CKCH, CFCA, CFCN, CKCK, CKAC, WMAV, WSY, WEAP, WKAN, WABE, WCAP, WEAS, WMU, WRC, WSB, WEBH, WGN, WAAF, WDAP, WMAQ, WPAD, WTAS, WTAN, WRM, WCBD, WLS, WWAE, WOAG, WQJ, WJAK, WSAL, WOJ, WJAS, WDAX, WOC, WHAA, WHAC, WHO, WOAK, WHAS, WAAB, WKC, WSAR, WBZ, WGI, WDAS, WCX, WWJ, WOAP, WWAO, WCAL, WFAN, WRAH, WLAG, WBAH, WAAH, WOS, WDAF, WHB, WCK, WMAJ, WEB, WOO, WOAW, WIAW, WAAW, WOR, WHAR, WGR, WCAD, WMAK, WEAF, WJX, WJS, WJZ, WHN, WSAP, WGY, WHAZ, WHAM, WAAD, WLW, WSAI, WPAL, WBAV, WOAC, WABT, WGAF, WLAL, WNAD, WOAV, WCAU, WOAR, WFI, WIP, WOO, WJAS, WJAI, WPAB, WCAM, WIAD, WJAR, WSAD, WMC, WNAV, WFAA, WBAP, WIAC, WEAY, WFAH, WCAR, WOAI, WJAD, NAA, WPAH, WCAY, WIAO, WAAK, WHAD, WOAY, WHA, WRAL, WLAY, WKAQ, PWX, 6KW.

These stations were all heard more than once and can all be verified.

I use a three-tube single circuit set. Most of the above stations come in on the loud speaker. It is not at all uncommon to hear KGO on the loud speaker.

Hoping to find my name with the Dial Twisters,

I am,
RALPH RIPSOM.

544 20th Street,
Milwaukee, Wis.

RADIO AGE,
Gentlemen:

After reading some of the records hung up by "Dial Twisters," I decided to construct a reflex set, which proved inefficient. Then I monkeyed on a one-tube hookup of my own, which has proved a "wow." Below are a list of stations bagged by my set.

KDKA, WTAM, WWAE, WBZ, CJCG, WCAP, WCAM, WGY, WCAE, WSB, WIP, WDAR, WEAF, WAID, WJZ, WJY, WMAJ, WGR, CKY, CFCF, WNAC, WJAR, WRL, KYW, WDAF, WOAW, KGO, KFI, WMAQ, WDAP, WBAV, WSAI, WPAB, WJAN, WRC, WMU, WDM, WHAZ, WJH, WIAY, WCBD, WHN, WHAR, WHB, WOR, WLW, WFI, KSD, NAA, KQV, PWX, WGI, WHAM, WHAS, KFGZ, WBAP, KFKX, 6KW, WOO, CFAC, WWJ, WCAL, WGL, CFCA, WRAM, KFKB, WIAG, WFAA, WCAJ, WHAA, KFAF, WABQ, WBBG, WGR, WGN, WTAR, WOC, WOS, WAAM, WCX, WBT, WRAZ, WMAK, WGAN.

On the first night I tuned in forty-one stations. Altogether I have tuned in eighty-four stations, the farthest being KGO, California, about 2,500 miles from here. Will be pleased to give information regarding my set.

Yours very truly,
JOHN F. MULLIKIN.

128 Bates Street, N. W.,
Washington, D. C.

P. S.—Do not think hearing the coast was a freak, for the following day I picked up KFI and held it for half an hour.

RADIO AGE,
Gentlemen:

About two weeks ago I got the bug. A friend of mine let me have some magazines. Among these I found the RADIO AGE for January. I followed the instructions and built the Rosenbloom circuit. Last Monday I was ready to try the set, and the first station I heard was KFI of Los Angeles, Calif.!

In six days I have heard sixty-seven stations, many of them being over 1,000 miles away. Saturday night from 7:30 to 1:00 o'clock the following stations were heard:

Calls Heard by Jewell A. Goddard, Farmland, Ind.

WBS, WMAQ, KYW, WRC, KSD, WGY, KPO, KGW, KDKA, WLS, WGN, WFAA, WOC, PWX, WDAF, KFI, CKAC, WEAF and WOAW.

They were all heard very clearly. If I had a transmitting set, I'd give three cheers for the RADIO AGE and add, long may it live.

Yours very truly,
JEWELL A. GODDARD.

(Continued on page 55)

RADIO AGE ANNOUNCES:

The most unusual radio innovation for fans ever published. Original—helpful—authentic. In September RADIO AGE—on the stands about August 25. Don't miss this all-star issue!

BATTERIES (DD-1-5)
PRIMARY BATTERIES

GENERAL PRINCIPLES. When two different metals are placed in contact with one another, or when these metals are placed mutually in contact with certain solutions, an electromotive force (voltage) is generated. The value of this voltage depends upon the kind of metals used, the nature of the solution, character of the contact surfaces, etc. The dry contact voltage between two metals in air is quite low, but when the metals are immersed in a suitable fluid which is capable of attacking and dissolving at least one of the metals, the voltage may range from 0.5 to 3.0 volts per pair. The two metals are known as the "ELECTRODES" or plates while the solution is called the "ELECTROLYTE."

Each pair of metal electrodes with its electrolyte and container is called a "CELL," while a group of such cells electrically connected together is a "BATTERY." Any number of unit cells can be connected together to obtain greater voltages or greater currents in amperes than the voltages or currents of a single cell.

Electrical energy is produced within the cell by the chemical reduction of one of the electrodes and the electrolyte, the reducable elements being the fuel from which the electrical energy is obtained. The electrolyte, which is alkaline or acidnous by nature, combines with the electrode to form metallic salts while the electrolyte in turn is neutralized by the metal. This is very similar to the chemical process of combustion in which heat energy is liberated by the combination of the oxygen of the air with the carbon of coal, the final product being carbon dioxide. When the electrode is completely consumed and the electrolyte is neutralized, the chemical action ceases and the production of current also ceases. A cell of this sort is called a "PRIMARY CELL" and is one in which the elements must be replaced physically and in which the elements cannot practically be renewed by the electrical process known as "Charging."

Both electrodes form the "poles" of the battery, one electrode being the positive pole while the other is the negative. When the ends projecting above the electrolyte are connected together, an electric current will flow from the positive pole to the negative pole at the outer ends and will return through the electrolyte from the negative to positive electrode. Thus, the electrode really has two polarities, one external and one internal, but for convenience it is the practice to consider only the outer poles above the level of the electrolyte where the current flows from the positive to negative. With proper materials, the chemical action continues as long as the external circuit is closed and will cease when the circuit is opened. With impure materials there will always be some wastage due to small currents set up within the electrodes which will continue regardless of whether the external circuit is open or closed. These wasteful currents are known as "local currents."

It should be noted that the electrolyte solution forms a part of the electrical return circuit and that the current flows through the electrolyte in the reverse direction to that in the external circuit. This "internal circuit" results in the production of hydrogen gas bubbles at the positive pole and oxygen bubbles at the negative pole, or just the reverse of the case in the electrolytic cell. The bubbles of gas are due to the decomposition of the water in the electrolyte, and are produced in the proportion of two parts of hydrogen to one part of oxygen. The escape of these gases from the cell means that the electrolyte will gradually lose weight during the discharge as well as suffering decomposition in regard to the acid or alkaline elements.

BATTERIES (DD-80-5)
PLATE OR "B" BATTERIES

THE "B" BATTERY. The "Plate Battery," also commonly known as the "B" battery, is used in the receiving circuit for the purpose of maintaining a positive potential on the plate of the tube. For the ordinary regenerative circuit it is common practice to apply from 16 to 22.5 volts on the detector tube, but in radio or audio amplifying circuits or in super-regenerative circuits from 45 to 100 volts may be applied to the plate or even greater voltages in certain limited cases. While the voltage of the "B" battery is comparatively high, the current demand on the battery is very low, being only in the nature of a few thousandths of an ampere for a single tube. The demand is increased in proportion to the number of tubes used, since the plates are all connected in parallel across the "B" battery, so that a six or eight-tube set consitutes quite a pull on the battery and rapidly exhausts it.

Plate batteries are supplied both in dry cell and in storage cell types, the former having the advantage of low first cost and simplicity while the latter costs more in the beginning but effects a saving in the long run particularly if more than three tubes are used. When a dry cell "B" battery is exhausted it must be thrown away, but the storage cell type can be recharged indefinitely be means of simple charging apparatus, and in addition maintains a more nearly constant voltage throughout its charge. However, the dry cell battery is the most convenient for the average amateur and for small and medium size sets is used more extensively than the storage type.

Both types of battery are built up into blocks having a number of small cells connected in series. The unit block of dry cells develops a total of 22.5 volts with 15 cells in series. The unit block of the storage type develops 24 volts with 12 cells in series. The "plain" block has only two connection posts giving the total voltage, but for use with gas filled detector tubes which are quite critical to the plate voltage, we should use the "tapped" type in which intermediate connections between cells give intermediate voltages of 16.5, 18, 19.5, 21 and 22.5 volts. (Dry cell type.) The tapped battery costs a little more than the plain but is better.

For higher voltages two or more blocks can be connected in series. Thus, with dry cell batteries we can obtain 45 volts, 67.5 volts, 90 volts and 112.5 volts by connecting two, three, four or five blocks in series. For convenience in making connections to sets having amplifying stages, the dry cell "B's" can also be obtained in single blocks giving a total of 45 volts. Such blocks cost less than two 22.5 blocks connected in series and are much simpler to connect. While 90-volt blocks can be obtained they are not so often stocked by the dealer. Storage batteries can be obtained in units of 24 or 48 volts and contain respectively 12 and 24 cells each.

The life of a "B" battery depends upon several factors. It is shorter when a number of tubes are used than with only a single detector. For a given number of tubes, the life is longer when the audio stage tubes are "biased" with a negative charge to the grid since under these conditions less current is drawn from the battery. Again, the life of the battery in hours depends upon the plate voltage used, less current being drawn with low voltages than at voltages of from 67 to 90 volts. While high plate voltages are necessary for maximum amplification, yet there is much waste and expense incurred if the plate voltage is unnecessarily high. When voltages higher than 45 volts are used, the grids of the tubes should be biased by a "C" battery.

Pickups
By Our Readers

(*Continued from page* 53)

Farmland, Ind.

P. S.—Your Rosenbloom is a wonder. From now on, I am going to be counting the days until the RADIO AGE is on sale at the news stands again.

Looks like the Rosenbloom is stepping out to the front. That certainly is some record, if you ask us.

RADIO AGE,
Gentlemen:

For some time I have read the Pickups Pages of your magazine. It is but recently that I think that I have a good enough list to become a member of the Dial Twisters.

I am 14 years old, and have had my set about four months. The most distant station I have heard is WKAQ at San Juan, which is about 3,300 miles from Los Angeles by air line. The following stations have confirmed my reception of their programs:

KDKA, KFI, KHJ, KSD, KGO, WFI, WGY, PWX, WKAQ, KLZ, KOB, KGW, WHO, WCBD, CKY, WMC, WHYC, KPO, KFNF, WTAM, KLX, WLAG, WHAS, KFKX, KFOA, CKAC, WJZ, WJY, CAL, WDAH, WHB, WRC.

The following have been received, but have not been confirmed.

KGU, WLW, WSAI, KYW, WJAZ, WDAP, CFCN, CFAC, CHYB, KFNC, WBAV, WEAO, KFAF, KFSG, KNX, KFON, WCX, WFAA, KOP, WOC, WBAP, KFKA, KDAS, CFCH, WDAF, KJS, CYB, WBAH, CYL, WKAN, WOR, WEAF, KLS, WAAW, KGG, KFEC, KGN, KFAD, KFAE, KQU, WCAE, KUO, KDYM, KDYL, KZN, KFBK, KWG, KHQ, KFHJ, KFAW, KDPT, WBZ, KFFR, WSY, CFCA, CFCQ and WCAP.

I hope that list lets me in.

Sincerely yours,
HAMPTON MACOMBER.
843 Third Avenue,
Los Angeles, Calif.

RADIO AGE,
Gentlemen:

The other day I bought my first copy of your magazine and I thought "what a little magazine for two bits!" When I looked over its contents, I changed my mind. It certainly is full of good stuff from cover to cover.

I have been doing a little experimenting in building, and I have contrived to devise a little hookup of my own which is a real DX-getter. Here is my log for Saturday, May 24:

KGO, PWX, KPO, KHJ, WOR, WDAR, WSB, WFAA, WBBR, KLS (or X; I wasn't sure on account of heavy static), KDKA, WLS, WMC, WOC, WCAE, KFNF, WGN, WDAJ, and about five others whose calls were weak due to the terrific

(*Concluded on page 57*)

BATTERIES (DD-1-9)
PRIMARY BATTERIES

VOLTAGE AND CURRENT. The voltage of a primary cell is determined by the nature of the electrodes and electrolyte, and is independent of the size of the battery. Thus, with any given combination of electrodes and electrolyte, the voltage remains constant regardless of the size. When a higher voltage is required than is produced by a single cell, a number of cells can be connected up in "series" to form a high voltage battery. This will be explained later.

Current flow in amperes depends upon both the voltage of the cell and upon the resistance of the internal circuit. If the internal resistance of the electrolyte is high, then it is evident that the flow of current will be small. This is determined by Ohm's law. Since the internal resistance is largely determined by the area of the plates, the current capacity of a cell in amperes is roughly in proportion to the size of the plates or the size of the battery, all other conditions remaining constant. For this reason, the area of the plates is made as great as possible so that the maximum current flow can be obtained.

Some electrolytes have a higher specific resistance than others, hence with equal plate areas one type of cell with a given electrolyte will produce less current with a given plate area than another. Dilute sulphuric acid and caustic soda solutions have a very low resistance, hence the current flow in such cells will be greater than where the high resistance copper sulphate solutions are used. A second consideration is the spacing of the electrodes. The farther they are spaced apart, the higher will be the resistance.

The current flow can be determined as follows by Ohm's law when the internal resistance (r) in ohms is known. Let (E) be the voltage of the battery, and (I) be the current in amperes, then:

$$I = \frac{E}{r}$$

This assumes that the resistance of the external circuit is zero. For example, let the internal resistance of a cell be 0.05 ohm. Then the current flow with a potential of 1.0 volt will be:

$$I = \frac{E}{r} = \frac{1.00}{0.05} = 20 \text{ amperes}$$

If a greater current than 20 amperes is desired, then we must connect two or more of the cells in "parallel" or "multiple" to form a battery. After the cell has been in operation for some time, and polarization has set in, then the hydrogen film will increase the resistance and the current will fall off gradually.

Under practical working conditions the total opposition offered to the flow of current, or the total resistance, is equal to the sum of the resistance of the external circuit and the internal resistance of the battery cell. Thus, if (R) is the resistance of the external circuit, then the total resistance will be: (R+r), and the current flow under these conditions will be:

$$I = \frac{E}{(R+r)}$$

The resistance of a cell can only be determined accurately by test on each individual cell, and it is impossible to make estimates that will hold true under all conditions.

Owing to the internal resistance, there is a drop of voltage across the battery terminals when the flow of current is increased. The greater the amperage, the lower will be the terminal voltage. If (e) is the drop in voltage due to a flow of (I) amperes, then X

$$e = I \times r$$

COMPILED BY I. B. RATHBUN

INDUCTANCES (F-18-20)
SPIDERWEB COIL CALCULATIONS

PFANSTIEHL COILS. The Pfanstiehl spiderweb coils, known to the trade as "Pure Inductances," are spiderweb coils of the self-supporting type without supporting forms or spiders. The elimination of fiber or wood supports eliminates the dielectric losses common to coils built up on such form, and in addition the Pfanstiehl coils give a more concentrated magnetic field with reduced possibility of trouble causing stray fields within the set. In many circuits, a widely dispersed magnetic field introduces interferences that lead to noise and reduced power of reception and in this respect the self-supporting type coils are far superior to the homemade variety wound on wood spiders or fiber discs.

They are wound on a 2.25 mandrel which leaves an opening of the same diameter in the center of the coil. The wire is double silk insulated and the whole structure is then stiffened by the use of a special non-capacity cement. It is said that distributed capacity of the winding is so small that it cannot be measured by ordinary laboratory methods, hence the expression "Pure Inductance." The absence of distributed capacity is productive of sharp tuning and avoids the losses that take place in coils less carefully constructed.

The following table gives the wave lengths in meters of the straight untapped inductances, and is based on the use of a variable condenser shunted across the coil which has a maximum capacity of 0.0005 m. f., or equivalent to the common 23 plate type. For minimum readings, the condenser is set at its lowest possible capacity, probably in the neighborhood of 0.00003 to 0.00004 m. f. The maximum wave length is attained with the condenser "full in" with the maximum capacity of 0.0005 m. f.

PFANSTIEHL UNTAPPED PURE INDUCTANCE COILS

TYPE NO.	No. OF TURNS	WAVE LENGTHS IN METERS MAXIMUM	MINIMUM
P-201	25	340	Less than 100
P-202	35	470	125
P-203	50	650	170
P-204	75	960	220
P-205	100	1300	300
P-206	150	1980	470

Such inductances can be used wherever inductances are necessary in a circuit, for tuning, chokes, R. F. transformers and couplers, plate and grid inductances, etc.

For the conventional primary inductance used in tuning, a special type known as P-225 is made. This is a tapped coil having a total of 86 turns, and will cover a band of wave lengths ranging from 150 meters to 700 meters when used IN SERIES with a 0.0004 m. f. variable condenser. The coil has four taps taken off at the proper points in the winding to cover the various wave lengths with plenty of overlap between points so that a continuous field can be covered within the range of the coil.

COMPILED BY J. B. RATHBUN

Pickups
By Our Readers

(Continued from page 55)

static abated, and I got KGO like a local station.

I am willing to pass this circuit on to any brother radio fan who desires it if he will only write for it.

There is another set here in town I made and the owner thinks it great. I had a crowd May 30 and 31 up at my house just to look over this little wonder.

Those Dial Twister buttons are the thing—I'm sure I would be proud to wear one.

Yours for better radio,
WILLIAM WEIGHTMAN.
P. O. Box 288,
Middletown, Ind.

RADIO AGE,
Gentlemen:

I built one of your Low Loss Tuners, and I must report the wonderful results I have had with it. I have built several hookups since I first built my Low Loss set, to compare it with for results, and I pick it as "the berries" of the lot. I have one step of audio frequency and work all the strong stations within 500 miles on the loud speaker. The night before last I had station WBAP of Fort Worth, Texas, at 10:15 P. M. louder than in the Winter time. Fine for this time of the year.

All the big sets about here can bag no distance at all.

I have tried out a great many grid leaks, but have tried nothing higher than 3 megohms. I wonder what the results would be in trying something higher?

I certainly want to recommend your RADIO AGE, and want to thank you for printing the description of the Low Loss Tuner. I have convinced several fellows around here to the extent of building one for themselves.

Yours very truly,
NORMAN E. RINGLER.
134 King Street,
Guelph, Ont., Can.

Low Loss Tuners—that's the little set in the March, 1924, issue. What this fellow says for it is enough to make anyone throw their super-iodine receiver out the window.

The letter you last read was the concluding contribution to the July Pickups Pages of RADIO AGE. In signing off we wish to say that the supply of buttons for the contributions has been entirely exhausted and as soon as a new supply can be made we will again be shooting them out to those fellows whose letters could not be printed, due to lack of space. In the meantime let's all get ready for a big rush of things in the September issue and here's hoping to see some keen records hung up.

This is the Pickups Pages of RADIO AGE magazine signing off until the September, 1924, issue. (Now—watch this—we're going to sign off like WQJ, Chicago.)

Don't go away,
This much we have to say:
We'll be back, just twice as strong,
Some fine September day—
Letters, Circuits, Everything.
With diagrams complex,
We're going to help most everyone
To get the best DX.
It only costs you two bits
To tune in on our wave;
You can be in Troy or Fargo
And a connection can be made.
We'll have stuff from California,
We'll have stuff from New York, too;
From Portland down to Cuba
You'll hear us calling you;
We'll have the finest line of radio
In our next month's Pickups Page;
You can tune in strong,
You can't go wrong
With a copy of RADIO AGE.

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers and broadcasters.

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh	326
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270
KDPT	Southern Electrical Co.	San Diego, Calif.	244
KDYL	Telegram Publishing Co.	Salt Lake City, Utah	360
KDYM	Savoy Theatre	San Diego, Calif.	244
KDYQ	Oregon Institute of Technology	Portland, Oreg.	360
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZE	Rhodes Department Store	Seattle, Wash.	270
KDZI	Electric Supply Co.	Wenatchee, Wash.	360
KDZR	Bellingham Publishing Co.	Bellingham, Wash.	261
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	360
KFAE	State College of Washington	Pullman, Wash.	330
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif.	280
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280
KFAY	W. J. Virgin	Medford, Oreg.	283
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Azbill	San Diego, Calif.	278
KFBE	Reuben H. Horn	San Luis Obispo, Calif.	242
KFBG	First Presbyterian Church	Tacoma, Wash.	360
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and the Chronicle News	Trinidad, Colo.	360
KFBU	The Cathedral (Bishop N. S. Thomas)	Laramie, Wyo.	283
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFCF	Frank A. Moore	Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)	Billings, Mont.	360
KFCP	Ralph W. Flygare	Ogden, Utah	360
KFCV	Fred Mahaffey, Jr.	Houston, Texas	360
KFCZ	Omaha Central High School	Omaha, Nebr.	258
KFDD	St. Michaels Cathedral	Boise, Idaho	252
KFDH	University of Arizona	Tuscon, Ariz.	368
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	360
KFDR	Bullocks' Hardware & Sporting Goods (Rob. G. Bullock)	York, Nebr.	360
KFDX	First Baptist Church	Shreveport, La.	360
KFDY	South Dakota State College of Agriculture and Mechanics Arts	Brookings, S. Dak.	360
KFDZ	Harry O. Iverson	Minneapolis Minn.	231
KFEC	Meier & Frank Co.	Portland, Oreg.	360
KFEL	Winner Radio Corp.	Denver, Colo.	254
KFEQ	J. L. Scroggin	Oak, Nebr.	360
KFER	Auto Electric Service Co.	Fort Dodge, Iowa	231
KFEV	Radio Electric Shop	Douglas, Wyo.	261
KFEX	Augsburg Seminary	Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining and Concentrating Co.	Kellogg, Idaho	360
KFEZ	Asso. Engr. Societies of St. Louis	St. Louis, Mo.	248
KFFB	Jenkins Furniture Co.	Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.	Pendleton, Oreg.	360
KFFP	First Baptist Church	Moberly, Mo.	266
KFFR	Nevada State Journal (Jim Kirk)	Sparks, Nev.	226
KFFX	McGraw Co.	Omaha, Nebr.	278
KFFY	Pincus & Murphy	Alexandria, La.	275
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	273
KFGL	Arlington Garage	Arlington, Oreg.	234
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFGX	First Presbyterian Church	Orange, Tex.	250
KFGZ	Emmanuel Missionary College	Berrien Springs, Mich.	268
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHD	Utz Electric Shop Co.	St. Joseph, Mo.	226
KFHH	Ambrose A. McCue	Neah Bay, Wash.	283
KFHJ	Fallon & Co.	Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.	Seattle, Wash.	270
KFI	Earle C. Anthony (Inc.)	Los Angeles, Calif.	469
KFID	Ross Arbuckle's Garage	Iola, Kans.	246
KFIF	Benson Polytechnic Institute	Portland, Oregon	360
KFIL	Windisch Electric Farm Equipment Co.	Louisburg, Kans.	234
KFIO	North Central High School	Spokane, Wash.	252
KFIQ	Yakima Valley Radio Broadcasting Association	Yakima, Wash.	224
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIV	V. H. Broyles	Pittsburg, Kans.	240
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huelsman	Fon Du Lac, Wis.	273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	Seattle Post Intelligencer	Seattle, Wash.	233
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	252
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg.	252
KFJK	Delano Radio and Electric Co.	Bristow, Okla.	233
KFJL	Hardsacg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	229
KFJQ	Valley Radio, Div. of Elec. Constr. Co.	Grand Forks, N. D.	280
KFJR	Ashley C. Dixon & Son	Stevensville, Mont. (near)	258
KFJX	Iowa State Teachers' College	Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	248
KFJZ	Texas National Guard, One hundred and twelfth Cavalry	Fort Worth, Texas	254
KFKA	Colorado State Teachers College	Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association	Milford, Kans.	286
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark.	224
KFKV	F. F. Gray	Butte, Mont.	283
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	286
KFKZ	Nassour Bros. Radio Co.	Colorado Springs, Colo.	234
KFLA	Abner R. Willson	Butte, Mont.	283
KFLB	Signal Electric Manufacturing Co.	Menominee, Mich.	248
KFLD	Paul E. Greenlaw	Franklinton, La.	234
KFLE	National Educational Service	Denver, Colo.	268
KFLQ	Bizzell Radio Shop	Little Rock, Ark.	261
KFLU	Rio Grande Radio Supply House	San Benito, Texas	236
KFLV	Rev. A. T. Frykman	Rockford, Ill.	229
KFLX	George Roy Clough	Galveston, Tex.	240
KFLY	Fargo Radio Supply Co.	Fargo, N. Dak.	231
KFLZ	Atlantic Automobile Co.	Atlantic, Ia.	273
KFMQ	University of Arkansas	Fayetteville, Ark.	263
KFMR	Morningside College	Sioux City, Iowa	261
KFMT	Dr. George W. Young	Minneapolis, Minn.	231
KFMW	M. G. Sateren	Houghton, Mich.	266
KFMX	Carleton College	Northfield, Minn.	283
KFNF	Henry Field Seed Co.	Shenandoah, Iowa	266
KFNG	Wooten's Radio Shop	Coldwater, Miss.	254
KFNJ	Warrenshurg Electric Shop	Warrensburg, Mo.	234
KFNL	Radio Broadcast Ass'n.	Paso Robles, Calif.	240
KFNV	L. A. Drake Battery and Radio Supply Shop	Santa Rosa, Calif.	234
KFNX	Peabody Radio Service	Peabody, Kansas	240
KFNY	Montana Phonograph Co.	Helena, Montana	261
KFNZ	Royal Radio Company	Burlingame, Calif.	231
KFOC	First Christian Church	Whittier, Calif.	236
KFOD	Vern Peters	Wallace, Idaho	224
KFOJ	Moberly High School Radio Club	Moberly, Missouri	246
KFOL	Leslie M. Schafbush	Marengo, Iowa	234
KFON	Echophone Radio Shop	Long Beach, Calif.	234
KFOO	Latter Day Saints University	Salt Lake City, Utah	261
KFOQ	Ora William Chancellor	Galveston, Texas	240
KFOR	David City Tire & Electric Co.	David City, Nebraska	226
KFOT	College Hill Radio Club	Wichita, Kansas	231
KFOU	Hommel Mfg. Co.	Richmond, Calif.	254
KFOX	Board of Education, Technical High School	Omaha, Nebraska	248
KFOY	Beacon Radio Service	St. Paul, Minn.	226
KFOZ	Leon Hudson Real Estate Co.	Fort Smith, Ark.	233
KFPB	Edwin J. Brown	Seattle, Wash.	224
KFPG	Garretson and Dennis	Los Angeles, Calif.	238
KFPH	Harold Chas. Mailander	Salt Lake City, Utah	242
KFPL	C. C. Baxter	Dublin, Texas	242
KFPM	The New Furniture Co.	Greenville, Texas	242
KFPN	Missouri National Guard	Jefferson City, Mo.	242
KFPP	G. & G. Radio & Electric Shop	Olympia, Washington	236
KFPQ	Clifford M. Esler	Denison, Texas	231
KFPR	Los Angeles Co. Forestry Dept.	Los Angeles, Calif.	231
KFPS	Carter A. Ross Motor Service Co.	Casper, Wyo.	242
KFPV	Heintz & Kohlnoos, Inc.	San Francisco, Calif.	236
KFPW	St. Johns M. E. Church, S.	Carterville, Mo.	268
KFPY	Symons Investment Co.	Spokane, Wash.	283
KFPX	First Presbyterian Church	Pine Bluff, Ark.	242
KFQA	The Principia	St. Louis, Mo.	261
KFQB	The Searchlight Publishing Co	Fort Worth, Tex.	254
KFQC	Kidd Brothers Radio Shop	Taft, Calif.	227
KFQD	Chovin Supply Co.	Anchorage, Alaska	280
KFQE	Dickenson-Henry Radio Laboratories	Colorado Springs, Colo.	224
KFQG	Southern Calif. Radio Ass'n	Los Angeles, Calif.	226
KFQH	Albert Sherman	Hillsbourgh, Cal.	231
KFQR	Walter LaFayette Ellis	Oklahoma City, Okla.	250
KFQI	The Thos. H. Ince Corp.	Culver City, Calif.	234
KFSG	Angelus Temple	Los Angeles, Calif.	278
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service	Portland, Oreg.	360
KGO	General Electric Co.	Oakland, Calif.	312
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach	360
KGW	Portland Morning Oregonian	Portland, Oreg.	492
KGY	St. Martins College (Reb. Sebastian Ruth)	Lacy, Wash.	258
KHJ	Times-Mirror Co.	Los Angeles, Calif.	395
KHQ	Louis Wasmer	Seattle, Wash.	360
KJQ	C. O. Gould	Stockton, Calif.	360
KJR	Northwest Radio Service Co.	Seattle, Wash.	270
KJS	Bible Institute of Los Angeles	Los Angeles, Calif.	360
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	360
KLX	Tribune Publishing Co.	Oakland, Calif.	509
KLZ	Reynolds Radio Co.	Denver, Colo.	283
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif.	273
KMO	Love Electric Co.	Tacoma, Wash.	360
KNT	Grays Harbor Radio Co. (Walter Hemrich)	Aberdeen, Wash.	263
KNX	Electric Lighting Supply Co.	Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture & Mechanic Arts	State College, N. Mex.	360
KOP	Detroit Police Department	Detroit, Mich.	286
KPO	Hale Bros.	San Francisco, Calif.	423
KQP	Apple City Radio Club	Hood River, Oreg.	360
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	360
KQW	Charles D. Herrold	San Jose, Calif.	360
KRE	V C Battery & Electric Co.	Berkeley, Calif.	278
KSD	Post Dispatch (Pulitzer Pub. Co.)	St. Louis, Mo.	546
KTW	First Presbyterian Church	Seattle, Wash.	360
KUO	Examiner Printing Co.	San Francisco, Calif.	360
KUY	Coast Radio Co.	El Monte, Calif.	256
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	360
KYQ	Electric Shop	Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	536
KZM	Preston D. Allen	Oakland, Calif.	360
KZN	Cope and Johnson Co.	Salt Lake City, Utah	268
WAAB	Valdemar Jensen	New Orleans, La.	268
WAAC	Tulane University	New Orleans, La.	360
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	286
WAAK	Gimbel Brothers	Milwaukee, Wis.	280
WAAM	I. R. Nelson Co.	Newark, N. J.	263
WAAN	University of Missouri	Columbia, Mo.	254
WAAW	Omaha Grain Exchange	Omaha, Nebr.	360
WABB	Harrisburg Sporting Goods Co.	Harrisburg, Pa.	266
WABD	Parker High School	Dayton, Ohio	283
WABE	Young Men's Christian Association	Washington, D. C.	283
WABG	Arnold Edwards Piano Co.	Jacksonville, Fla.	248
WABH	Lake Shore Tire Co.	Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co.	Bangor, Me.	240
WABL	Connecticut Agricultural College	Storrs, Conn.	283
WABM	F. E. Doherty Automotive and Radio Equipment Co.	Saginaw, Mich.	254
WABO	Lake Avenue Baptist Church	Rochester. N. Y.	252
WABP	Robert F. Weinig	Dover, Ohio	266
WABQ	Haverford College, Radio Club	Haverford, Pa.	261
WABR	Scott High School, N. W. B. Foley	Toledo, Ohio	270
WABT	Holiday-Hal', Radio Engineers	Washington, Pa.	252
WABU	Victor Talking Machine Co.	Camden, N. J.	226
WABW	College of Wooster	Wooster, Ohio	234
WABX	Henry B. Joy	Mt. Clemens, Mich.	270
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	263
WBAA	Purdue University	West Lafayette, Ind.	360
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAN	Wireless Phone Corp.	Paterson, N. J.	344
WBAO	James Millikin University	Decatur, Ill.	360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex.	476
WBAY	Erner & Hopkins Co.	Columbus, Ohio	390
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.	New York, N. Y.	492
WBBA	Newark Radio Laboratories	Newark, Ohio	240
WBBD	Barbey Battery Service	Reading, Pa.	234
WBBE	Alfred R. Marcy	Syracuse, N. Y.	246
WBBG	Irving Vermilya	Mattapoisett, Mass.	240
WBBH	J. Irving Bell	Port Huron, Mich.	246
WBBJ	Neal Electric Co., P. E. Neal	West Palm Beach, Fla.	258
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	283
WBBM	Frank Atlass Produce Co.	Lincoln, Ill.	225
WBBN	Blake, A. B.	Wilmington, N. C.	275
WBBR	Peoples Pulpit Asso.	Rossville, N. Y.	244

CLASSIFIED ADVERTISEMENTS

Ten cents per word per insertion, in advance. Name and address must be counted. Each initial counts as one word. Copy must be received by the 10th of month for succeeding month's issue.

RADIO CIRCUITS

SPECIAL FOR AUGUST
The Reinartz Radio Booklet, by Frank D. Pearne, fully illustrated, and RADIO AGE, for $2.50. Price of booklet alone is 50c. Send check, currency or money order to RADIO AGE, 500 N. Dearborn Street, Chicago.

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WHOLESALE PRICES ON STANDARD RECEIVERS, 25% discount; list for stamp. LIVE PROPOSITION to DEALERS. Thomas Radio Co., 111a Dix St., Muncie, Ind.

RADIO BATTERIES

Super Radio A and B Circuit Batteries, which bring in long distance reception. Sold for cash or on payment plan. Write for prices and details. Radio Battery Corporation, 501-B Industrial Bank Bldg., Flint, Mich.

MISCELLANEOUS

158 GENUINE Foreign Stamps. Mexico War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc., only 5c. Finest approval sheets 50 to 60%. Agents Wanted. Big 72-p. Lists Free. We Buy Stamps. Established 20 Years. Hussman Stamp Co., Dept. 152, St. Louis, Mo.

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Radio Geniuses to Be at 'World's Fair'

The first Radio World's Fair, to be held in Madison Square Garden and the 69th Regiment Armory, New York City, Sept. 22nd to 28th, is attracting the serious attention of the radio geniuses of the world and scores of them are preparing to introduce their latest inventions at the coming exposition.

Managers U. J. Herrmann and James F. Kerr have been compelled to enlarge the "New Inventions Section" to a size which will allow the exposition of one hundred devices. Among the noteworthy American discoveries to be shown will be at least three different instruments designed for the purpose of radiocasting "photographs in motion." Europe will also be well represented in this department. Several Continental inventors will display new inventions of a most unusual character.

Half a dozen recognized wireless engineers are now busily engaged trying to perfect systems for broadcasting pictures and it is hoped the world's first program of "Radio Motion Pictures" will be broadcast on the opening night of the exposition.

Sixty nationally known manufacturers of the United States will have de luxe exhibits at the big fair and England, France, Belgium, Italy, Switzerland and Austria will have proper representation in the "Foreign Section." Exhibition booths of elaborate construction will fill both big buildings to which there will be but one admission charge.

The most attractive feature programs imaginable will be staged every afternoon and evening, which will include a series of almost unbelievable overseas tests in which Miss Edith Bennett, the famous young American concert star, will participate. Miss Bennett is well known to the radio enthusiasts of every land because of her now historical trans-Atlantic recital last year, which was heard by millions of people in a hundred or more countries.

The International Amateur Builders' Contest is assuming such huge proportions that the show management expects this feature alone to fill the entire basement of Madison Square Garden.

WorkRite Opens Los Angeles Branch

To take care of the tremendous demand for WorkRite radio sets on the Pacific Coast, the WorkRite Manufacturing Company of Cleveland have recently opened a branch in Los Angeles, where they will manufacture WorkRite five-tube super-neutrodyne sets.

This Pacific Coast factory is under the direction of Emmet R. Patterson, who is well known to the Western trade.

With the establishment of this Pacific Coast factory branch, the WorkRite company have also opened a Western sales office in Los Angeles, at 239 Los Angeles street. This branch of the business is managed by J. A. Hymer, sales manager.

Mr. Hyman has just completed a trip over the entire Western territory and writes that the Los Angeles factory will be hard pressed to meet the demand for Work-Rite sets during the coming season.

YOUR SUBSCRIPTION

—should be renewed as soon as it expires, so you won't miss a single issue of RADIO AGE. Order your September copy in advance if you buy from a news-stand, or you may miss the all-star September issue with the new Radio Technical Feature originated by RADIO AGE.

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

WBBT	Lloyd Brothers	Philadelphia, Pa. 234
WBBU	Jenks Motor Sales Co.	Monmouth, Ill. 224
WBBV	Johnstown Radio Co.	Johnstown, Pa. 248
WBBW	Ruffner Junior High School	Norfolk, Va. 222
WBBY	Washington Light Infantry, Co. "B" 118th Inf.	Charleston, S. C. 268
WBBZ	Noble B. Watson	Indianapolis, Ind. 227
WBL	T & H Radio Co.	Anthony, Kans. 254
WBR	Pennsylvania State Police	Butler, Pa. 286
WBS	D. W. May, Inc.	Newark, N. J. 360
WBT	Southern Radio Corp.	Charlotte, N. C. 360
WBZ	Westinghouse Elec. & Mfg. Co.	Springfield, Mass. 337
WCAD	St. Lawrence University	Canton, N. Y. 280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa. 462
WCAG	Clyde R. Randall	New Orleans, La. 268
WCAH	Entrekin Electric Co.	Columbus, Ohio 286
WCAJ	Nebraska Wesleyan University	University Place, Nebr. 360
WCAK	Alfred P. Daniel	Houston, Texas 263
WCAL	St. Olaf College	Northfield, Minn. 360
WCAO	Sanders & Stayman Co.	Baltimore, Md. 360
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C. 469
WCAR	Alamo Radio Electric Co.	San Antonio, Tex. 360
WCAT	South Dakota State School of Mines	Rapid City, S. Dak. 240
WCAU	Durham & Co.	Philadelphia, Pa. 286
WCAV	J. C. Dice Electric Co.	Little Rock, Ark. 360
WCAX	University of Vermont	Burlington, Vt. 360
WCAZ	Carthage College	Carthage, Ill. 246
WCBA	Charles W. Heimbach	Allentown, Pa. 280
WCBC	University of Michigan	Ann Arbor, Mich. 280
WCBD	Wilbur G. Voliva	Zion, Ill. 345
WCBE	Uhalt Radio Co.	New Orleans, La. 263
WCBF	Paul J. Miller	Pittsburgh, Pa. 236
WCBG	Howard S. Williams (Portable)	Pascagoula, Miss. 236
WCBI	Nicoll, Duncan & Rush	Bemis, Tennessee 226
WCBJ	J. C. Maus	Jennings, Louisiana 244
WCBK	E. Richard Hall	St. Petersburg, Fla. 266
WCBL	Northern Radio Mfg. Co.	Houlton, Me. 280
WCBM	Charles Swarz	Baltimore Md. 229
WCBN	James P. Boland	Ft. Benj. Harrison, Ind. 266
WCBO	The Radio Shop, Inc.	Memphis, Tenn. 250
WCBQ	First Baptist Church	Nashville, Tenn. 236
WCBR	University of Mississippi	near Oxford, Miss. 242
WCBR	Charles H. Meester (Portable Station)	Providence, R. I. 246
WCBT	Clark University, Collegiate Dept.	Worcester, Mass. 238
WCBU	Arnold Wireless Supply Co.	Arnold, Pa. 254
WCBV	Tullahoma Radio Club	Tullahoma, Tenn. 252
WCRW	George P. Rankin, Jr., and Maitland Soloman	Macon, Ga. 226
WCBX	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J. 233
WCBY	The Forks Electrical Shop	Buck Hill Falls, Pa. 268
WCBZ	Coppotelli Bros. Music House	Chicago Heights, Ill. 248
WCK	Stix, Baer & Fuller Dry Goods Co.	St. Louis, Mo. 360
WCX	Detroit Free Press	Detroit, Mich. 517
WDAE	Tampa Daily Times	Tampa, Fla. 360
WDAF	Kansas City Star	Kansas City, Mo. 411
WDAG	J. Laurence Martin	Amarillo, Tex. 263
WDAH	Trinity Methodist Church (South)	El Paso, Tex. 268
WDAK	The Courant	Hartford, Conn. 261
WDAR	Lit Brothers	Philadelphia, Pa. 395
WDAS	Samuel A. Waite	Worcester, Mass. 360
WDAU	Slocum Kilburn	New Bedford, Mass. 360
WDAY	Radio Equipment Corp.	Fargo, N. Dak. 244
WDBA	Fred Ray	Columbus, Ga. 236
WDBB	A. H. White & Co., Inc.	Taunton, Mass. 229
WDBC	Kirk, Johnson & Co.	Lancaster, Pa. 258
WDBD	Herman Edwin Burns	Martinsburg, W. Va. 268
WDBE	Gilham-Schoen Electric Co.	Atlanta, Ga. 252
WDBF	Rohert G. Phillips	Youngstown, Ohio 246
WDBH	C. T. Scherer Co.	Worcester, Mass. 268
WDBI	Radio Specialty Co.	St. Petersburg, Fla. 226
WDBJ	Richardson Wayland Electric Corp.	Roanoke, Va. 229
WDBK	M. F. Broz Radio Co.	Cleveland, Ohio 248
WDBL	Wisc. Dept. of Markets	Stevens Point, Wisc. 278
WDBN	Electric Light & Power Co.	Rangor, Me. 252
WDBO	Rollins College, Inc.	Winter Park, Fla. 240
WDBP	Superior State Normal School	Superior, Wis. 261
WDBQ	Morton Radio Supply Co.	Salem, N. J. 234
WDBR	Tremont Temple Baptist Church	Boston, Mass. 256
WDBS	S. M. K. Radio Corp.	Dayton, Ohio 283
WDBT	Taylor's Book Store	Hattlesburg, Miss. 236
WDBU	Somerset Radio Co.	Skowhegan, Maine 258
WDBV	The Quimby Enterprises, The Strand Theatre	Fort Wayne, Ind. 258
WDM	Church of the Covenant	Washington, D. C. 234
WDZ	James L. Bush	Tuscola, Ill. Star Store Bldg. 278
WEAA	F. D. Fallain	Flint, Mich. 280
WEAF	American Telephone & Telegraph Co.	New York, N. Y. 492
WEAH	Wichita Board of Trade	Wichita, Kans. 244
WEAI	Cornell University	Ithaca, N. Y. 286
WEAJ	University of South Dakota	Vermillon, S. Dak. 283
WEAM	Borough of North Plainfield (W. Gibson Buttfield)	North Plainfield, N. J. 252
WEAN	Shepard Co.	Providence, R. I. 273
WEAO	Ohio State University	Columbus, Ohio 360
WEAP	Mobile Radio Co.	Mobile, Ala. 360
WEAR	The Evening News Publishing Co.	Baltimore, Md. 261
WEAU	Davidson Bros. Co.	Sioux City, Iowa 360
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Texas 360
WEB	Benwood Co.	St. Louis, Mo. 273
WEBC	Walter Cecil Bridges	Superior, Wis. 242
WEBD	Electrical Equipment and Service Co.	Anderson, Ind. 246
WEBH	Zenith-Edgewater Beach Broadcasting Station	Chicago, Ill. 370
WEV	Hurlburt-Still Electrical Co.	Houston, Texas 360
WEW	St. Louis University	St. Louis, Mo. 261
WFAA	Dallas News & Dallas Journal	Dallas, Texas 476
WFAB	Carl F. Woese	Syracuse, N. Y. 234
WFAH	Electric Supply Co.	Port Arthur, Texas 236
WFAM	Times Publishing Co.	St. Cloud, Minn. 360
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn. 360
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr. 275
WFBW	Ainsworth-Gates Radio Co.	Cincinnati, Ohio 309
WFI	Strawbridge & Clothier	Philadelphia, Pa. 395
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa. 248
WGAN	Cecil E. Lloyd	Pensacola, Fla. 360
WGAQ	Glenwood Radio Corp. (W. G. Patterson)	Shreveport, La. 252
WGAW	Ernest C. Albright	Altoona, Pa. 261
WGAZ	South Bend Tribune	South Bend, Ind. 360
WGI	American Radio & Research Corp.	Medford Hillside, Mass. 360
WGL	Thomas F. I. Howlett	Philadelphia, Pa. 360
WGN	Chicago Tribune Broadcasting Station	Chicago, Ill. 360
WGR	Federal Telephone & Telegraph Co.	Buffalo, N. Y. 319
WGY	General Electric Co.	Schenectady, N. Y. 380
WHA	University of Wisconsin	Madison, Wis. 360
WHAA	State University of Iowa	Iowa City, Iowa 484
WHAD	Marquette University	Milwaukee, Wis. 280
WHAG	University of Cincinnati	Cincinnati, Ohio 222
WHAH	Hafer Supply Co.	Joplin, Mo. 283
WHAK	Roberts Hardware Co.	Clarksburg, W. Va. 258
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y. 283
WHAP	Otta & Kuhns	Decatur, Ill. 360
WHAR	Paramount Radio & Electric Co. (W. H. A. Pulus)	Atlantic City, N. J. 231
WHAS	Courier-Journal & Louisville Times	Louisville, Ky. 400
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del. 360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y. 380
WHB	Sweeney School Co.	Kansas City, Mo. 411
WHK	Radiovox Co. (Warren R. Cox)	Cleveland, Ohio 360
WHN	George Schuhel	New York, N. Y. 360
WHO	Bankers Life Company	Des Moines, Iowa 526
WIAB	Joslyn Automobile Co.	Rockford, Ill. 252
WIAC	Galveston Tribune	Galveston, Texas 360
WIAD	Howard R. Miller	Philadelphia, Pa. 254
WIAH	Continental Radio & Mfg. Co.	Newton, Iowa 258
WIAK	Journal-Stockman Co.	Omaha, Nebr. 278
WIAO	School of Engineering of Milwaukee	Milwaukee, Wis. 246
WIAQ	Chronicle Publishing Co.	Marion, Ind. 226
WIAS	Home Electric Co.	Burlington, Iowa 283
WIAT	Leon T. Noel	Tarkio, Mo. 360
WIAU	American Trust & Savings Bank	Le Mars, Iowa 360
WIAY	Woodward & Lothrop	Washington, D. C. 273
WIK	K. & L. Electric Co. (Herbert F. Kelso and Hunter J. Lohman)	McKeesport, Pa. 234
WIL	Continental Electric Supply Co.	Washington, D. C. 360
WIP	Gimbel Brothers	Philadelphia, Pa. 509
WJAB	American Electric Co.	Lincoln, Neb. 229
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas 360
WJAG	Norfolk Daily News	Norfolk, Nebr. 283
WJAK	Clifford L. White	Greentown, Ind. 254
WJAM	D. M. Perham	Cedar Rapids, Iowa 268
WJAN	Peoria Star	Peoria, Ill. 280
WJAQ	Capper Publications	Topeka, Kans. 360
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I. 360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa. 250
WJAX	Union Trust Co.	Cleveland, Ohio 390
WJAZ	Chicago Radio Laboratory	Chicago, Ill. 448
WJD	Richard H. Howe	Granville, Ohio 229
WJY	R. C. A.	New York, N. Y. 405
WJZ	R. C. A.	New York, N. Y. 455
WKAA	H. F. Paar	Cedar Rapids, Iowa 268
WKAD	Chas. Looff (Crescent Park)	East Providence, R. I. 240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Texas 360
WKAN	United Battery Service Co.	Montgomery, Ala. 226
WKAP	Dutee W. Flint	Cranston, R. I. 360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R. 360
WKAR	Michigan Agriculture College	East Lansing, Mich. 280
WKAS	L. E. Lines Music Co.	Springfield, Mo. 360
WKAV	Laconia Radio Club	Laconia, N. H. 254
WKY	WKY Radio Shop	Oklahoma, Okla. 360
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn. 417
WLAH	Samuel Woodworth	Syracuse, N. Y. 234
WLAL	Naylor Electrical Co.	Tulsa, Okla. 360
WLAP	W. V. Jordon	Louisville, Ky. 360
WLAQ	Arthur E. Shilling	Kalamazoo, Mich. 283
WLAV	Electric Shop	Pensacola, Fla. 254
WLAW	Police Dept., City of New York	New York, N. Y. 360
WLAX	Putnam Electric Co. (Greencastle Community Broadcasting Station)	Greencastle, Ind. 231
WLB	University of Minnesota	Minneapolis, Minn. 360
WLS	Sears, Roebuck and Co.	Chicago, Ill. 345
WLW	Crosley Manufacturing Co.	Cincinnati, Ohio 309
WMAC	J. Edw. Page (Olive B. Meredith)	Cazenovia, N. Y. 261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass. 360
WMAH	General Supply Co.	Lincoln, Nebr. 254
WMAK	Norton Laboratories	Lockport, N. Y. 273
WMAL	Trenton Hardware Co.	Trenton, N. J. 256
WMAN	First Baptist Church	Columbus, Ohio 286
WMAP	Utility Battery Service	Easton, Pa. 246
WMAQ	Chicago Daily News	Chicago, Ill. 448
WMAV	Alabama Polytechnic Institute	Auburn, Ala. 250
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo. 280
WMAZ	Mercer University	Macon, Ga. 261
WMC	"Commercial Appeal" (Commercial Publishing Co.)	Memphis, Tenn. 500
WMH	Precision Equipment Co.	Cincinnati, Ohio 248
WMU	Doubleday-Hill Electric Co.	Washington, D. C. 261
WNAC	Shepard Stores	Boston, Mass. 278
WNAD	University of Oklahoma	Norman, Okla. 360
WNAL	R. J. Rockwell	Omaha, Nebr. 242
WNAM	Ideal Apparatus Co.	Evansville, Ind. 360
WNAP	Wittenberg College	Springfield, Ohio 231
WNAR	C. C. Rhodes	Butler, Mo. 231
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa. 360
WNAW	Peninsular Radio Club (Henry Kunzmann)	Fort Monroe, Va. 360
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak. 244
WOAA	Dr. Walter Hardy	Ardmore, Okla. 360
WOAC	Maus Radio Co.	Lima, Ohio 266
WOAD	Friday Battery & Electric Corp.	Sigourney, Iowa 360
WOAE	Midland College	Fremont, Nebr. 280
WOAF	Tyler Commercial College	Tyler, Texas 360
WOAG	Apollo Theater (Belvedere Amusement Co.)	Belvedere, Ill. 224
WOAH	Palmetto Radio Corp.	Charleston, S. C. 360
WOAI	Southern Equipment Co.	San Antonio, Texas 385
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn. 360
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind. 360
WOAQ	Portsmouth Kiwanis Club	Portsmouth, Va. 360
WOAT	Boyd M. Hamp	Wilmington, Del. 360
WOAV	Pennsylvania National Guard, 2d Battalion, 112th Infantry	Erie, Pa. 242
WOAW	Woodmen of the World	Omaha, Nebr. 526
WOAX	Franklyn J. Wolff	Trenton, N. J. 240
WOC	Palmer School of Chiropractic	Davenport, Iowa 484
WOI	Iowa State College	Ames, Iowa 360
WOO	John Wanamaker	Philadelphia, Pa. 509
WOQ	Western Radio Co.	Kansas City, Mo. 360
WOR	L. Bamberger & Co.	Newark, N. J. 405
WOS	Missouri State Marketing Bureau	Jefferson City, Mo. 441
WPAB	Pennsylvania State College	State College, Pa. 283
WPAC	Donaldson Radio Co.	Okmulgee, Okla. 360
WPAJ	Doolittle Radio Corp.	New Haven, Conn. 268
WPAK	North Dakota Agricultural College	Agricultural College, N. Dak. 283
WPAL	Superior Radio & Telephone Equipment Co.	Columbus, Ohio 286
WPAM	Auerbach & Guettel	Topeka, Kans. 360
WPAP	Theodore D. Phillips	Winchester, Ky. 360
WPAR	Ward Battery and Radio Co.	Beloit, Kans. 236
WPAU	Concordia College	Moorhead, Minn. 286
WPAZ	John R. Koch (Dr.)	Charleston, W. Va. 273
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa. 360
WQAC	E. B. Gish	Amarillo, Texas 234
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt. 275
WQAF	Sandusky Register	Sandusky, Ohio 240
WQAL	Coles County Telephone & Telegraph Co.	Mattoon, Ill. 258
WQAN	Scranton Times	Scranton, Pa. 280
WQAO	Calvary Baptist Church	New York, N. Y. 360
WQAQ	Abilene Daily Reporter (West Texas Radio Co.)	Abilene, Texas 360
WQAS	Prince-Walter Co.	Lowell, Mass. 266
WQAX	Radio Equipment Co.	Peoria, Ill. 360
WQJ	Calumet Baking Powder—Rainhow Gardens Station	Chicago, Ill. 448
WRAF	The Radio Club (Inc.)	Laporte, Ind. 224
WRAL	Northern States Power Co.	St. Croix Falls, Wis. 248
WRAM	Lombard College	Galesburg, Ill. 244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa 236
WRAO	Radio Service Co.	St. Louis Mo. 360
WRAV	Antioch College	Yellow Springs, Ohio 242
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa. 238
WRAX	Flaxon's Garage	Gloucester City, N. J. 268
WRBC	Imanuel Lutheran Church	Valparaiso, Ind. 278
WRC	Radio Corporation of America	Washington, D. C. 469
WRH	Chicago Herald & Examiner	Chicago, Ill. 536
WRK	Doron Bros. Electric Co.	Hamilton, Ohio 360
WRL	Union College	Schenectady, N. Y. 360
WRM	University of Illinois	Urbana, Ill. 360
WRR	City of Dallas (police and fire signal department)	Dallas, Texas 360
WRW	Tarrytown Radio Research Laboratory (Koenig Bros.)	Tarrytown, N. Y. 273
WSAB	Southeast Missouri State Teachers College	Cape Girardeau, Mo. 360
WSAC	Clemson Agricultural College	Clemson College, S. C. 360
WSAD	J. A. Foster Co.	Providence, R. I. 261
WSAI	United States Playing Cards Co.	Cincinnati, Ohio 309
WSAJ	Grove City College	Grove City, Pa. 259
WSAN	Allentown Radio Club	Allentown, Pa. 229
WSAP	Seventh Day Adventist Church	New York, N. Y. 263
WSAR	Dougnty & Welch Electrical Co.	Fall River, Mass. 254

Breaking Into Radio Without a Diagram

(Continued from page 12)

electric light current, but permits radio currents to pass unimpeded.

With your "aerial" connected, turn on the rheostat again and proceed to "tune in." Vary the condenser over its range as before and follow up with variometer, trying to avoid actual oscillation. You should look up the broadcasting hours of the nearby stations beforehand to be sure there is something "on the air." A whistle is a sign that your tube is oscillating, and the variometer setting should be changed until it stops. By this time you will have tuned in a station or two and will have a better understanding of the relationship between condenser and variometer. Always think of the condenser as the "tuner," or the device which selects the station you wish to hear. The variometer is the "volume" control, for it determines the sensitiveness of your set. A loud howl may result if the variometer if turned too far.

The "Circuits"

During the wiring, you noticed that several "circuits" were referred to. The current set up in the phone or lighting wires by the wave from the broadcasting station passes through the condenser "1" and thence through the primary coil "2," to the earth at "G." As these radio currents fluctuate in coil "2" in accordance with the voice or music from the station, there is a magnetic field spreading out and then collapsing back again in the space around that coil just as there is a magnetic field (though steady) surrounding the ordinary horse-shoe magnet. As a matter of fact, current set up by a great many broadcasting stations is passing through coil "2" at the same time. It is the function of the secondary circuit with coil "3" and variable condenser "4" to pick out which station is desired. If the station is sending on 300 meters, not very much of the capacity of condenser "4" will be required, but if the wave length is longer, say 500 meters, more of the capacity is necessary and the plates must be moved further in, perhaps as shown in *Fig. 2*. The magnetic field from coil "2" sets up current in coil "3" once the latter has been "tuned" to the right wave length by the condenser. Then through the tube and the variometer, the energy is very greatly amplified. It is really not the actual energy which comes in on the aerial which actuates the magnets in your telephone receivers, but the current from the "B" battery. The tube is a valve through which a slight impulse from the broadcasting station causes a great variation of the "B" battery current in the telephones.

It is a good plan to fasten a stiff wire as a pointer for the dial of the condenser. It may be attached to one of the mounting screws and allowed to project past the rim at some convenient point. Then the dial should be set to read "100" when the movable plates are all the way enmeshed between the fixed plates, and there the capacity is a maximum.

As your radio knowledge grows there are other combinations you will like to try, but for a simple and easily comprehended "starter" in radio reception, the board layout is unbeatable. *Fig. 2* gives the final appearance, and the set is a simple and sure receiver that will in most locations not only respond to local stations, but will at times bring in plenty of distance for you. With the phone line or with an outside aerial, "DX" stations are easily heard with this regenerative arrangement, and for sharp tuning and for volume, even though your aerial is small, or if you use the lighting circuit or bell wiring, you'll be pleased with your first plunge into the most fascinating game of them all.

No Radio Conference This Summer

[By Washington Radio News Service]

Just before Secretary Hoover left the city last week for a two-month vacation it became known that he would not call the third radio conference before September.

KEEPING UP-TO-DATE

For the latest radio inventions RADIO AGE readers should keep a close watch on the "New and Novel Radio Patents" department beginning in this issue. Up-to-date every month.

Corrected List of U. S., Cuban and Canadian Broadcasting Stations

WSAU	Camp Marienfeld	Chesham, N. H.	229
WSAX	Chicago Radio Laboratory	Chicago, Ill.	268
WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	233
WSAZ	Chas. Electric Shop	Pomeroy, Ohio	258
WSB	Atlanta Journal	Atlanta, Ga.	429
WSL	J. & M. Electric Co.	Utica, N. Y.	273
WSY	Alabama Power Co.	Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAF	Louis J. Gallo	New Orleans, La.	242
WTAG	Kern Music Co.	Providence, R. I.	258
WTAH	Carmen Ferro	Belvedere, Ill.	236
WTAJ	The Radio Shop	Portland, Me.	230
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gordon & Son	Osseo, Wis.	220
WTAR	Reliance Electric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	275
WTAT	Edison Electric Illuminating Co.	Boston, Mass. (portable)	244
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	360
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	242
WTAW	Agricultural & Mechanical College of Texas	College Station, Tex.	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAY	Oak Leaves Broadcasting Station	Oak Park, Ill.	283
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTG	Kansas State Agricultural College	Manhattan, Kans.	273
WWAB	Hoenig, Swern & Co. (John Rasmussen)	Trenton, N. J.	220
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	Alamo Dance Hall, L. J. Crowley	Joliet, Ill.	227
WWAO	Michigan College of Mines	Houghton, Mich.	244
WWI	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	517
WWL	Loyola University	New Orleans, La.	260
WYAM	Electrical Equipment Co.	Miami, Fla.	283
WYAW	Catholic University	Washington, D. C.	236

Canadian Stations

CFAC	Calgary Herald	Calgary, Alberta	430
CFCA	Star Pub. & Prtg. Co.	Toronto, Ontario	400
CFCF	Marconi Wireless Teleg. Co. of Canada	Montreal, Quebec	440
CFCH	Abitibi Power & Paper Co.	Iroquois Falls, Ont.	400
CFCJ	La Cie de L'Evenement	Quebec, Quebec	410
CFCK	Radio Supply Co.	Edmonton, Alberta	410
CFCL	Centennial Methodist Church	Victoria, British Col.	400
CFCN	W. W. Grant Radio (Ltd.)	Calgary, Alberta	440
CFCQ	Radio Specialties (Ltd.)	Vancouver, B. C.	450
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCW	The Radio Shop	London, Ont	420
CFDC	Sparks Co.	Nanaimo, B. C.	430
CFQC	The Electric Shop (Ltd.)	Saskatoon, Saskatchewan	400
CFRC	Queens University	Kingston, Ontario	450
CFUC	University of Montreal	Montreal, Quebec	400
CHAC	Radio Engineers	Halifax, Nova Scotia	400
CHBC	Albertan Publishing Co.	Calgary, Alberta	410
CHCB	Marconi Company	Toronto, Ont.	410
CHCD	Canadian Wireless & Elec. Co.	Quebec, Quebec	410
CHCE	Western Canada Radio Sup. (Ltd.)	Victoria, B. C.	400
CHCL	Vancouver Merchants Exchange	Vancouver, B. C.	440
CHCM	Riley & McCormack	Calgary, Alberta	415
CHCS	The Hamilton Spectator	Hamilton, Ont.	420
CHYC	Northern Electric Co.	Montreal, Quebec	410
CJCA	Edmonton Journal	Edmonton, Alberta	450
CJGC	London Free Press Prtg. Co.	London, Ont.	430
CJCD	T. Eaton Co.	Toronto, Ont.	410
CJCE	Sprott-Shaw Radio Co.	Vancouver, B. C.	420
CJCI	Maritime Radio Corp.	St. John, New Brunswick	400
CJCM	J. L. Phillipe	Monti Joli, Quebec	430
CJCN	Simons Agnew & Co.	Toronto, Ont.	410
CJSC	Evening Telegram	Toronto, Ont.	430
CKAC	La Presse Pub. Co.	Montreal, Quebec	430
CKCD	Vancouver Daily Province	Vancouver, B. C.	410
CKCE	Canadian Independ. Telephone Co.	Toronto, Ont.	450
CKCH	Canadian National Railways	Ottawa, Ont.	435
CKCK	Leader Pub. Co.	Regina, Saskatchewan	420
CKCO	Ottawa Radio Association	Ottawa, Ont.	440
CKCX	P. Burns & Co.	Calgary, Alberta	445
CKLC	Wilkinson Electric Company	Calgary, Alberta	400
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	410
CKY	Manitoba Telephone System	Winnipeg, Manitoba	450

Cuban Stations

PWX	Cuban Telephone Co.	Habana	400
2DW	Pedro Zayas	Habana	300
2AB	Alberto S. de Bustamante	Habana	240
20K	Mario Garcia Velez	Habana	360
2BY	Frederick W. Borton	Habana	260
2CX	Frederick W. Borton	Habana	320
2EV	Westinghouse Elec. Co.	Habana	220
2TW	Roberto E. Ramires	Habana	230
2HC	Heraldo de Cuba	Habana	275
2LC	Luis Casas	Habana	250
2KD	E. Sanchez de Fuentes	Habana	350
2MN	Fausto Simon	Habana	270
2MG	Manuel G. Salas	Habana	280
2JD	Raul Perez Falcon	Habana	150
2KC	Alvara Daza	Habana	200
2HS	Julio Power	Habana	180
2OL	Oscar Collado	Habana	290
2WW	Amadeo Saenz	Habana	210
5EV	Leopoldo V. Figueroa	Colon	360
6KW	Frank H. Jones	Tuinucu	340
6KJ	Frank H. Jones	Tuinucu	275
6CX	Antonio T. Figueroa	Cienfiegos	170
6DW	Eduardo Terry	Cienfiegos	225
6BY	Jose Ganduxe	Cienfuegos	300
6AZ	Valentin Ullivarri	Cienfuegos	200
6EV	Josefa Alverax	Caibarien	225
8AZ	Alfreda Brocks	Stgo de Cuba	240
8BY	Alberto Ravelo	Stgo. de Cuba	250
8FU	Andres Vinnet	Stgo. de Cuba	225
8DW	Pedro C. Anduz	Stego. de Cuba	275
8EV	Eduardo Mateos	Stego. de Cuba	180

Status of Broadcasting Stations Falling Off

A survey and house cleaning of broadcasting stations, completed by the Department of Commerce on July 1, eliminated a lot of "dead wood" stations, reducing the total number of broadcasters to 534, thirty-nine less than on July 1, last year, and fifty-five less than on June 1 this year.

Fans should not be alarmed, however, for fear that this popular practice is about to die out. Many of the stations eliminated simply failed to renew their licenses, and some will again apply for permission to broadcast it is believed. Of the stations which dropped out, 53 were in Class A, and 29 in Class C. No Class B stations quit the air, and there are today 54 such, an increase of 12 over the number on June 1. There are also 377 Class A stations; 101, C, and 2 in the experimental Class D, still operating. Nevertheless, the peak of broadcasting, on May 1, 1923, totaled 592 stations and may never again be attained, although the total was only 3 below par, so to speak, on June 1, 1924, when 589 were on the air.

The eighty-two stations which were dropped from the Department of Commerce active list for various reasons are as follows:

CALL	STATION
KDYX	Star Bulletin Pub. Co., Honolulu, T. H.
KDZQ	Nichols Academy of Dancing, Denver, Col.
KFAF	Western Radio Corp., Denver, Col.
KFAJ	University of Colorado, Boulder, Col.
KFCY	Western Union College, LeMars, Iowa.
KFDA	Adler's Music Store, Baker, Oregon.
KFFQ	Marksheffel Motor Co., Col. Springs, Col.
KFFV	Graceland College, Lamoni, Iowa.
KFGV	Heidbreder Radio Supply Co., Utica, Neb.
KFHX	Nelson, Robert W., Hutchinson, Kansas.
KFJV	Warren, Thomas H., Dexter, Iowa.
KFLH	Erickson Radio Co., Inc., Salt Lake City, Utah.
KFLP	Everette M. Foster, Cedar Rapids, Iowa.
KFMS	Freimuth Dept. Store, Duluth, Minn.
KFMY	Boy Scouts of America, Long Beach, Cal.
KFNH	State Teachers College, Springfield, Mo.
KFOV	Davis Electrical Corp., Sioux City, Iowa.
WABA	Lake Forest University, Lake Forest, Ill.
WABN	Ott Radio Inc., La Crosse, Wis.
WBBF	Georgia School of Technology, Atlanta, Ga.
WBBO	Mich. Limestone & Chemical Co., Rogers, Mich.
WCAS	Dunwoody Industrial Institute, Minneapolis, Minn.
WFAJ	Hi Grade Wireless Inst. Co., Asheville, N. C.
WFAQ	Missouri Wesleyan College and Cameron Radio Co., Cameron, Mo.
WFAT	Columbus College, Sioux Falls, S. Dak.
WIAI	Heers Stores Co., Springfield, Mo.
WIAJ	Fox River Valley Radio Supply Co., Neenah, Wis.
WJAT	Kelley-Vawter Jewelry Co., Marshall, Mo.
WKAY	Brenau College, Gainesville, Ga.
WLAK	Vermont Farm Machine Corp., Bellows Falls, Vt.
WMAJ	Drovers Telegram Co., Kansas City, Mo.
WNAQ	Charleston Radio Elect. Co., Charleston, S. C.
WOAR	Lundskow, Henry P., Kenosha, Wis.
WQAW	Catholic University of America, Washington, D. C.
WSAG	Davis, Loren V., St. Petersburgh, Fla.
WSAW	John L. Long, Jr., Canandaigua, N. Y.
WWAF	Galvin Radio Supply Co., Camden, N. J.
KFAN	Electric Shop, Moscow, Idaho.
KFAU	Independent School Dist. of Boise City, Boise, Idaho.
KFDO	Cutting, H. E., Bozeman, Mont.
KFDV	Gilbrech and Stinson, Fayetteville, Ark.
KFHB	A. S. Kolstad, The Rialto Theatre, Hood River, Ore.
KFHF	Central Christian Church, Shreveport, La.
KFFO	Smith, Dr. E. H., Hillsboro, Ore.
KFFZ	Al. G. Barnes Amusement Co., Dallas, Texas.
KFLR	University of New Mexico, Albuquerque, N. M.
KFLW	Missoula Electric Supply Co., Missoula, Mont.
KFMU	Stevens Brothers, San Marcos, Texas.
KFMZ	Roswell Broadcasting Club, Roswell, N. M.
KFNC	Alonzo Monk, Jr., Corsicana, Texas.
KFOF	Rohrer Electric Co., Marshfield, Oregon.
KFOH	The Radio Bungalow, Portland, Oregon.
KFOP	Willson Construction Co., Dallas, Texas.
KGN	Northwestern Radio Mfg. Co., Portland, Ore.
KZV	Wenatchee Battery and Motor Co., Wenatchee, Wash.
WABS	Essex Mfg. Co., Newark, N. J.
WABV	DeWitt, John H., Jr., Nashville, Tenn.
WBBQ	Frank Crook, Pawtucket, R. I.
WBBS	First Baptist Church, New Orleans, La.
WCAM	Villanova College, Villanova, Pa.
WCM	University of Texas, Austin, Texas.
WDAO	Automotive Electric Co., Dallas, Texas.
WFAF	Spratley, Henry C., Poughkeepsie, N. Y.
WGV	Interstate Electric Co., New Orleans, La.
WHAB	Thompson, Clark W., Galveston, Texas.
WIAF	De Cortin, Gustav A., New Orleans, La.
WJX	De Forest Radio Telephone & Telegraph Co., New York City.
WLAJ	Waco Electrical Supply Co., Waco, Tex.
WMAB	Radio Supply Co., Oklahoma City, Okla.
WNAN	Syracuse Radio Telephone Co., Syracuse, N. Y.
WNAS	Texas Radio Corporation, Austin, Texas.
WNAV	Peoples Tel. & Tel. Co., Knoxville, Tenn.
WNJ	Shotton Radio Mfg. Co., Inc., The, Albany, N. Y.
WOAP	Kalamazoo College, Kalamazoo, Mich.
WOK	Pine Bluff Company, The, Pine Bluff, Ark.
WPAT	Saint Patricks Cathedral, El Paso, Texas.
WQAD	Whitall Electric Co., Waterbury, Conn.
WRAA	Rice Institute, Houston, Texas.
WRAH	Read, Stanley N., Providence, R. I.
WRAY	Radio Sales Corp., Scranton, Pa.
WSAT	Donohoo Ware Co., Plainview, Texas.
WWAC	Sanger Bros., Waco, Texas.

Department of RADIO ENGINEERING

Radio Age Institute

Look for the Approval Seal

The above approval seal will be furnished free of charge by RADIO AGE, and any article bearing this seal has been approved by the Institute Laboratory.

We will be pleased to receive and test any materials that are offered on the market and give them our endorsement where they meet all Institute tests. Send materials to RADIO AGE INSTITUTE, 500 N. Dearborn St., Chicago.

Radio sets and equipment sent to the RADIO AGE INSTITUTE since its inception last month are now being tested in our laboratories. This apparatus includes sets from amateur radio builders as well as the perfected inventions of well known manufacturers.

All will be tested, and, if meeting RADIO AGE INSTITUTE requirements, will be given the official approval seal reproduced above and sent back to the maker.

This service is absolutely free, and RADIO AGE wishes it understood a test by its INSTITUTE does not incur any obligations on the part of the maker, whether he be amateur or manufacturer.

Results of the first tests will be announced in the September RADIO AGE, with illustrations.

With the Radio Manufacturers

(*Continued from page 44*)

Prest-O-Lite Announces New Radio "B" Battery

A radio "B" battery with many new features has just been announced by the Prest-O-Lite Co., Inc., from their factory at Speedway, Indianapolis, Ind. It will

be known as the Prest-O-Lite Super-Service Radio "B" Battery and will be supplied in 24 and 48-volt sizes in 4,500 and 2,500 M. A. H. capacities for each. It is designed not only to produce dependable continuous service but to harmonize in appearance with the finest furniture and radio sets.

It is generously proportioned and ruggedly built to insure trouble-free operation and uniform voltage without the disturbances-causing reception faults frequently attributed to other sources.

The cells are kept correctly spaced and are protected from breakage by spacing panels at both top and bottom. The semi-hard rubber cell covers lock securely around the jars and plate lugs, preventing seepage. The inside of the case is coated with an acid-proof preparation and as a further precaution the cell jars rest on a thick shock-absorbing pad containing an acid absorbing and neutralizing compound. It is claimed that the entire contents of a cell could be suddenly spilled into the case, yet all the acid solution would be absorbed and neutralized without the slightest danger of its soaking through and damaging the furniture.

Another feature of the design to which particular attention has been given is the cell connectors. Great precautions have been made against short circuiting.

This raised position of the cell connectors makes it easy to keep the top of the cells dusted and looking spick and span. It is to be noticed that the positive and negative terminals are large enough to allow easy ample gripping of connection clips.

"Kodel" Portable Like a Camera

In the early day of the automobile, the car owner used to place his machine in the garage long before the first snow fall, there to let it remain until the coming of Spring. It was thought that an automobile was of no use, and impracticable to operate, during the Winter months.

For some time the radio operator has held to an equally foolish view of Summer receiving conditions. The use of radio during the Summer months was thought to be impracticable and impossible.

Winter driving was not exactly a pleasure before the windproof top and the closed body became standard equipment. Neither has the use of a radio set with its cumbersome storage battery, bulky size, and the need for a suspended aerial, been much of a success as a portable proposition for Summer use.

All of these disadvantages have been overcome in the design of a new and novel receiving set that fits a neat leather covered carrying case of practically the same size and general appearance of a camera. You can now take your radio set with you wherever you go without the incoveniences formerly attached to portable radio sets.

The "Kodel," as this new receiving set is called, is entirely self contained. "A" and "B" batteries, head phones, vacuum tube, and a fifteen-foot aerial and ground wire are accommodated within the small case which measures only 5¾x4½x8 inches over all, and weighs but 4¾ pounds complete with all accessories.

The "Kodel" requires no loop or aerial for its successful operation. A single connection to water pipe or other ground is all that is required. Where a ground is not available, stations from 50 to 100 miles away can be heard with surprising clearness by merely throwing the fifteen-foot ground and aerial wires on the floor.

So sensitive is this set that, under favorable conditions, Havana, Cuba, New York City and Jefferson City, Mo., have been clearly heard in Cincinnati by using ground connections only. Pittsburgh, Schenectady and other high power stations are picked up regularly in the same manner. With outside aerial, the set is claimed to have, under favorable conditions, truthfully a range of from coast to coast.

Big Production Increase Planned by Pacent

The Pacent Electric Company, Inc., of 22 Park Place, New York, manufacturer of the well known Pacent Radio Essentials, announces the opening of its enlarged factory, laboratories and engineering department at 91 Seventh Avenue, New York City.

The Popularity of Pacent Radio Essentials reached a point last season where the old Pacent factory on 38th Street was unable to cope with the increase in production that was necessary. The new factory is believed to provide for future service that is more consistent with the quality of their products.

The Pacent Company lay great stress upon the careful inspection and testing of their apparatus before it leaves the factory. In their new factory the testing department has been considerably enlarged and improved in every way. For the use of this department a number of unique testing instruments have been constructed.

In one corner of the factory there is a model room. In this room may be found practically every kind of radio apparatus ever designed. It is used by Mr. Pacent and his engineers for their experimental work, and in this room are being developened many new Pacent Essentials that will make their appearance during the coming season.

A completely equipped laboratory is maintained for the purpose of making special tools, jigs, etc., necessary to the manufacture of Pacent Essentials. This laboratory functions in close co-operation with the drafting department.

A Manufacturers' Exposition

WHICH WILL BE ATTENDED BY THE PRINCIPAL RADIO JOBBERS AND DEALERS OF THE UNIVERSE

De Luxe Exhibits By Nationally Known American Manufacturers

Representive Displays By The Famous Manufacturers Of

ENGLAND ❦ FRANCE ❦ BELGIUM
ITALY ❦ SWITZERLAND & AUSTRIA

Direction of

U. J. Herrmann and James F. Kerr

Business Office
Prince George Hotel,
New York City.

Look for the
RADIO AGE
Booth—No. 1
in Section L.

Listen in on W.L.W.

Still Better

New Crosley Radio Receivers

PROVING that Crosley Radio Receivers have made Satisfied Customers, The Crosley Radio Corporation sold more receiving sets last year than any other manufacturer in the world.

The new Crosley line illustrated here is still better as shown by laboratory tests and by reports from users of performances under all weather conditions.

Listen in on a Crosley—compare it with other receivers—then you will choose a Crosley!

CROSLEY 50, a new one tube Armstrong Regenerative Receiver. We believe this to be the most efficient one tube receiver ever put on the market.....***Price, $14.50***
Crosley 50-A, two tube amplifier may be added at..... ***18.00***

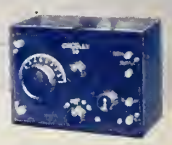
CROSLEY 51, two tube regenerative receiver, the biggest selling radio receiver in the world. Gives loud speaker volume on local and distant stations under average conditions.....***Price, $18.50***
Crosley 51-A, one tube amplifier may be added at..... ***14.00***

CROSLEY 52, a new three tube Armstrong Regenerative Receiver. Provides loud speaker volume on distant stations under practically all conditions.....***Price, $30.00***

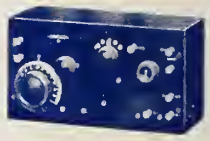
CROSLEY 51-P, this is our new portable set. It is the Crosley Model 51, two tube receiver mounted in a leatherette covered carrying case, battery space and all self-contained.....***Price, $25.00***

CROSLEY TRIRDYN 3R3, this three tube receiver gives the efficiency and volume of five tubes. We believe it is the most efficient receiver on the market at any price for bringing in long distance stations.....***Price, $65.00***

CROSLEY TRIRDYN 3R3 SPECIAL, the same as the Trirdyn 3R3, except cabinet is larger to contain "A" and "B" dry cell batteries and accessories. A beautiful set to match the highest grade of furniture.....***Price, $75.00***

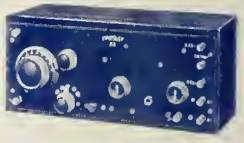


Crosley 50 $14.50



Crosley 51 $18.50

Crosley 51-P $25.00



Crosley 52 $30.00

Crosley Trirdyn 3R3 $65.00 and below
Trirdyn Special $75.00

CROSLEY

Better-Cost Less Radio Products

MAIL THIS COUPON TODAY.

The Crosley Radio Corporation,
863 Alfred Street, Cincinnati, O.

Gentlemen:—Please mail me free of charge your complete catalog of Crosley instruments and parts together with booklet entitled "The Simplicity of Radio."

Name.....

Address.....

All Crosley Regenerative Receivers licensed under Armstrong U. S. Patent 1,113,149

THE CROSLEY RADIO CORPORATION

863 ALFRED STREET — Powel Crosley, Jr., President — CINCINNATI, OHIO

The Crosley Radio Corporation owns and operates broadcasting station WLW

SEPTEMBER 1924

RADIO AGE

The Magazine of the Hour

WITH WHICH IS COMBINED

Radio Topics

Price 25 Cents

In This Issue

REAL BLUEPRINTS

of Baby Heterodyne II and an Aperiodic Variometer Set

Accurate Isometric and Circuit Diagrams

Latest Hookups and Studio-Land Features

Let Our Hook-ups Be Your Guide

MANHATTAN
ELECTRICAL SUPPLY CO., INC.,

MAKERS OF THE FAMOUS

"The Loud Speaker with Concert Modulator"

The Manhattan Loud Speaker with the "concert modulator" gives real tone quality.

MANHATTAN

LOUD SPEAKER

AND

RED SEAL
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ATTACHMENT

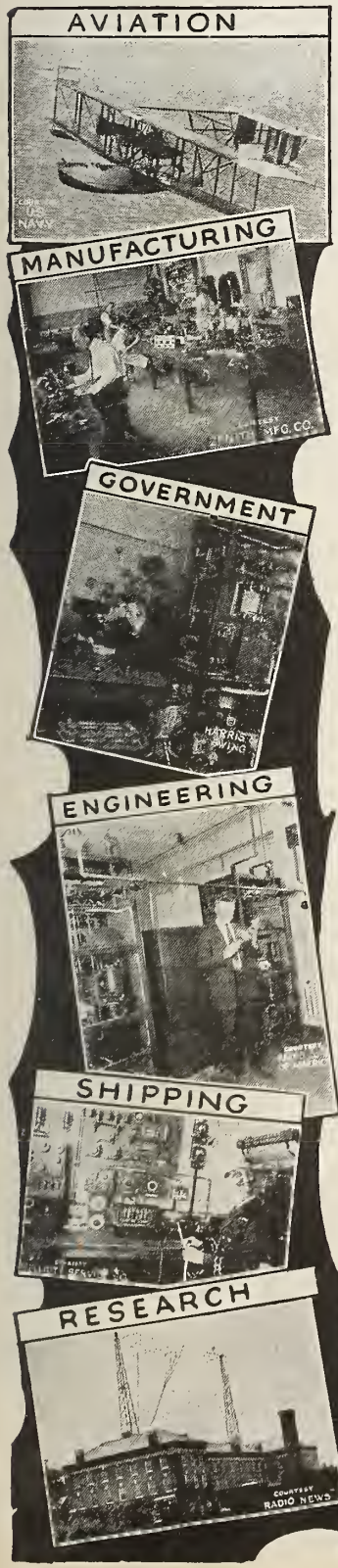
Oldest and Largest Distributors of

Radio Corporation of America
WORLD WIDE WIRELESS

114 SO. WELLS ST., CHICAGO

NEW YORK ST. LOUIS SAN FRANCISCO

National Radio Institute Graduates Are "Cashing In" On These Wonderful Opportunities!



Austin Riu, one of our graduates, is now an operator of broadcasting station PWX of Havana, Cuba, and earns $250 a month. Merle Wetzel, of Chicago Heights, Ill., another graduate, advanced from lineman to Radio Engineer, increasing his salary about 100 per cent. *even while taking his training*! Emmett Welch of Peculiar, Mo., right after graduating started in Radio, earning $300 a month and expenses as a radio salesman. William West of St. Louis is earning big money as a radio correspondent.

Not a week goes by without our receiving urgent calls for our graduates. "We need the services of a competent Radio Engineer" writes a prominent radio firm, "Would appreciate your recommending any person who could fill position." "We want men with executive ability as well as radio knowledge to become our local managers" writes another firm. "We will require the services of several resident demonstrators"—these are just indications of the great variety of opportunities open to our graduates!

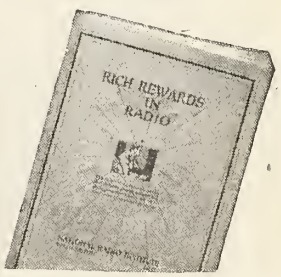
More Money for YOU in Radio

Are you "cashing in" on your Radio Knowledge? If you're not, you are passing up the best bet that has ever come your way. It's entirely up to you. There's nothing impossible in Radio for the man who has nerve enough to try. In a few months at home, you can easily become a *recognized radio expert*—and to these radio specialists, Radio offers remarkable salaries, easy fascinating work, short hours—and a wonderful future!

Earn $2400 to $10,000 a Year

You can earn bigger pay than you probably ever dreamed possible. Only don't let yourself stay in a rut. Sit up—look up—make up your mind that if others can make big money and big successes in Radio, so can you. The National Radio Institute has a sound practical radio course that defies comparison. It has a record of successful graduates that is unquestionable evidence of its ability to qualify you quickly for a big money position in Radio.

THIS FREE BOOK Points The Way To Your Success.



Our Free Book "Rich Rewards in Radio" tells all about the amazing opportunities Radio offers *you*, and describes how you can become a recognized radio expert at home in an astonishingly short time. Now—while your ambition is warm—mail the coupon for this big-money Free Book!

National Radio Institute, Dept. 53JA, Washington, D. C.

National Radio Institute, Dept. 53JA
Washington, D. C.

Without obligation send me your book, "*Rich Rewards in Radio*," which tells all about the opportunities in Radio, how spare time study at home will qualify me quickly as a Certified Radiotrician so I can get one of these splendid positions, and how your Employment Service helps me to secure a big pay position.

Name..... Age.....
Please write plainly.

Street.....

City..... State.....

RADIO AGE

The Magazine of the Hour
Established March, 1922
WITH WHICH IS COMBINED
Radio Topics

Volume 3 *September, 1924* *Number 9*

CONTENTS

Radio Age is published monthly by
RADIO AGE, Inc.
Member: Audit Bureau of Circulations.

Advertising, Editorial and Publication Offices,
500 N. Dearborn St., Chicago

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Advertising forms close on the 1st of the month preceding date of issue

Issued monthly. Vol. 3, No. 9. Subscription price, $2.50 a year.

Entered as second-class matter April 4, 1924, at the post office at Chicago, Illinois, under the act of March 3, 1879, original entry April, 1922.

A Chat With the Editor

RADIO AGE is off on its Fall drive. Beginning with this issue we are presenting an exeellent group of teehnical and feature artieles that are sure to emphasize this magazine's pre-eminent position as a praetieal help to constructors of reeeiving sets.

The first and most important of these eonsists of the RADIO AGE fae-simile blueprints — **printed in blue** and presented in such a way that they may be used as actual working drawings the same as any other blueprint.

To make this blueprint feature complete, we asked Mr. Rathbun to draw isometrie and hookup diagrams for two world-beating circuits.

He did it with an improved "Baby Heterodyne" and an aperiodic variometer set. Mr. Rathbun's first "Baby Het" took the country by storm. This improved model will be no less popular, for it ineorporates the latest ideas in simple and effieient set construction.

The aperiodie variometer hookup will meet the demands of fans who want something a little more eomplieated and yet easy to construct. These hookups, elearly illustrated with attraetive blueprints, will be found in RADIO AGE'S new blueprint section, whieh begins in this issue on page 29 and runs through to page 36.

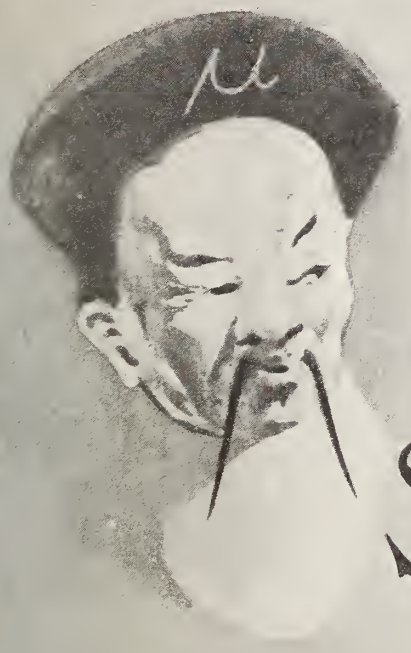
Four pages are devoted to the blueprints and four to the explanatory articles. Readers who wish may utilize the center pages eonsisting of from 29 to 36 and keep them for working aids and ready reference.

This blueprint feature is only a sample of what RADIO AGE has in store for this Fall and Winter. An abundance of the kind of technical articles that made RADIO AGE "The Magazine of the Hour" is in store for fans who are eager to start eonstrueting sets again.

Keep a elose watch on RADIO AGE, and if you let our hookups be your guide you will be assured of a sueeessful Radio Winter.

Frederick Smith

—Editor, RADIO AGE



THE GREBE SYNCHROPHASE

TRADE MARK

"It is only when the cold season comes that we know the pine and cypress to be evergreens."
—Confucius

In the coming cold season be not surpassed by thy neighbor—set the pace with your Grebe Synchrophase.

Doctor Hy

A BROADCAST Receiver that marks another long step forward in radio design and establishes a new set of standards in craftsmanship.

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Van Wyck Blvd., Richmond Hill, N.Y.
Western Branch: 451 East 3rd St., Los Angeles, Cal.

GREBE RADIO

ZENITH RADIO

TRADE MARK

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—MacMillan

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How Careful Mounting Will Bring

IMPROVED RECEPTION

By FRANK D. PEARNE

IN A RECENT issue of RADIO AGE we gave some of the reasons for poor reception, and the object of this article is to make plain to the layman just what takes place in the circuit when the coils and condensers are active, so that he may be better able to decide just how to mount the different parts of his set in such a way as to avoid as much as possible the interference and consequent losses occasioned in many of the sets in use today.

In the first place, it is necessary that he understand perfectly just how energy is passed from one coil to another without any electrical connection between them, or in other words, by induction. As explained before, when a current of electricity flows through a conductor, such a conductor is surrounded by invisible lines of force which are whirling about it either in one direction or the other.

The direction in which they whirl will of course depend upon the direction in which the current is flowing, and the number of lines and the distance they reach from the conductor will depend upon the amount of current flowing. Just how this would look if the lines were visible, is shown at "2" in Figure 1.

IF THE current flows along the conductor in the direction from the observer, then the lines would whirl in the direction in which the hands of a clock would move, and if it was flowing toward the observer, they would whirl in an anti-clockwise direction. Now if this conductor is wound up into a coil as shown at "1" in Figure 3, the lines will arrange themselves as shown in this diagram. Some of them will continue to whirl about each turn, but most of them will join forces with the adjacent turns, resulting in a magnetic field as shown at "1," Figure 3.

Now as this whirling magnetic field advances in an outward direction and encounters another conductor as shown in Figure 1, and this conductor is forming a complete circuit of some kind, it offers a resistance to the lines passing through it and the lines bend, objecting to passing through it; but nevertheless the lines are forced out by new lines emanating from the original source and regardless of the resistance so offered, they bend around the conductor so far that they finally snap across it on the opposite side as shown at A, B, C and D, in Figure 1.

If the direction in which the lines are whirling is traced as they bend around this conductor, until they eventually snap across on the other side, it will be seen that the lines have been made to whirl in a complete circle about the conductor resulting in the whirling magnetic field shown at "2" in Figure 1. Thus a magnetic field has been produced around it and a current will flow in this conductor, although it has no electrical connection whatever with the coil or conductor which is producing the magnetic field. This explains the question so often asked as to how the signals can pass from one circuit to another when there is no visible connection between them.

If this conductor is so located that it is out of the range of the advancing lines, then of course no current is set up in it and likewise it will be noted that the closer it is placed to the original source of the lines, the more of them will whirl about it and the more energy will be passed to it.

IF THIS conductor, however, is wound into the form of a coil or loop, as shown in Figure 2, which represents the lines cutting through a loop of a conductor which has been cut in two for simplicity, it will be seen that if this loop is placed at right angles to the loops or turns which are producing the magnetic field, then the lines cut through both sides of the loop in the same direction, setting up opposing currents in both sides and resulting in one neutralizing the other. No current is produced, so long as the same number of lines cut through each side. Apparently, if one desires to so mount a coil in the receiving set, so that it will not be inductively connected to another coil, the best method is to set it

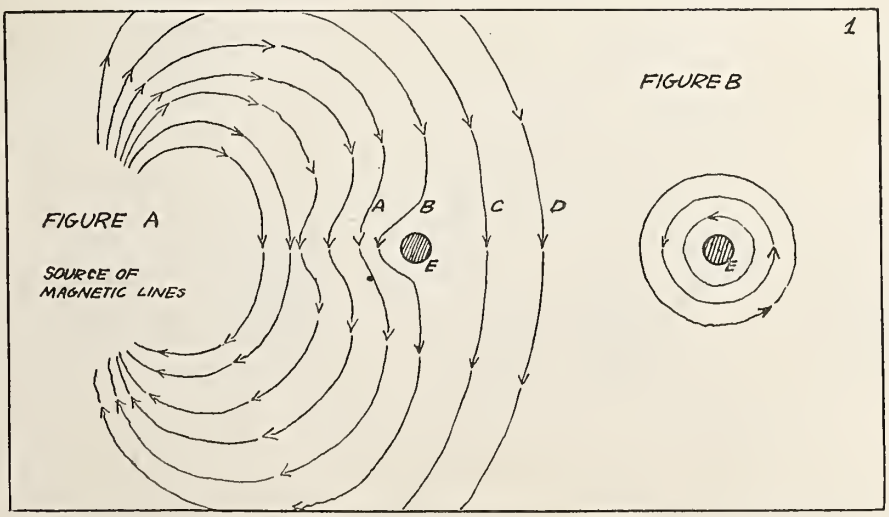


Figure 1. Showing how the whirling lines of magnetic force are made to cut through a conductor.

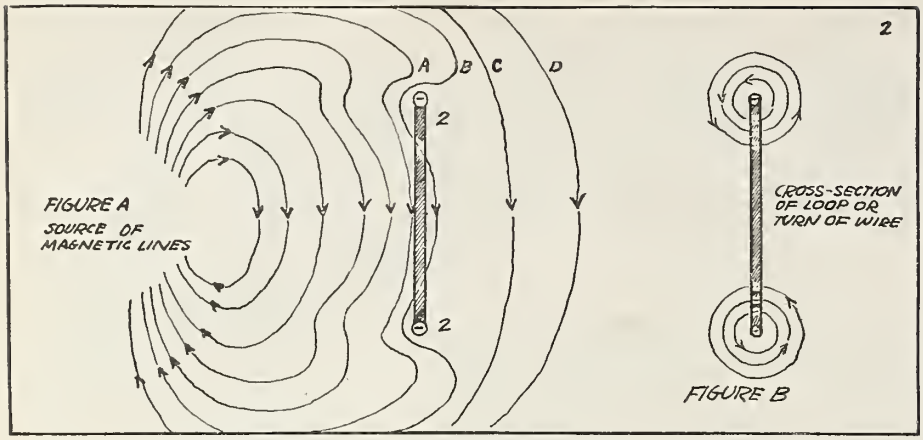


Figure 2. Showing how a loop or coil of wire set at right angles to an excited coil has opposing currents set up in each side, resulting in the neutralization of the current in the loop. This is what happens when your variocoupler is set at zero.

at exact right angles to it, but it must also be remembered that if it is not exactly at right angles, one side will be cut by a few more lines than the other and the result will be that the current in one side will be a little more than that in the other and a current which is equal to the difference between the two will flow.

This naturally will cause interference in the operation of the set which may be very slight, but it is interference just the same and the greater the angle of mounting diverges from an exact right angle, the greater will be the interference. This neutralizing effect is shown at "2" in Figure 2. If two coils which are not intended to be inductively connected are mounted as in Figure 3, care should be taken to mount them far enough apart so that the lines produced in one of them cannot reach the other, or, as shown in the diagram, some of the lines will cut through one side of the coil but will not reach the other side; or some might cut through both sides. But the side nearest the source would be affected more than the distant side, and in either case undesired currents would be produced and interference and losses would occur.

It must be remembered that because of the power required to force these lines past or through a conductor, as is usually stated, much of the energy is used up in this useless and harmful work. The only way to prevent such losses in a case of this type of mounting is to so locate the coils that they are beyond the range of the magnetic field.

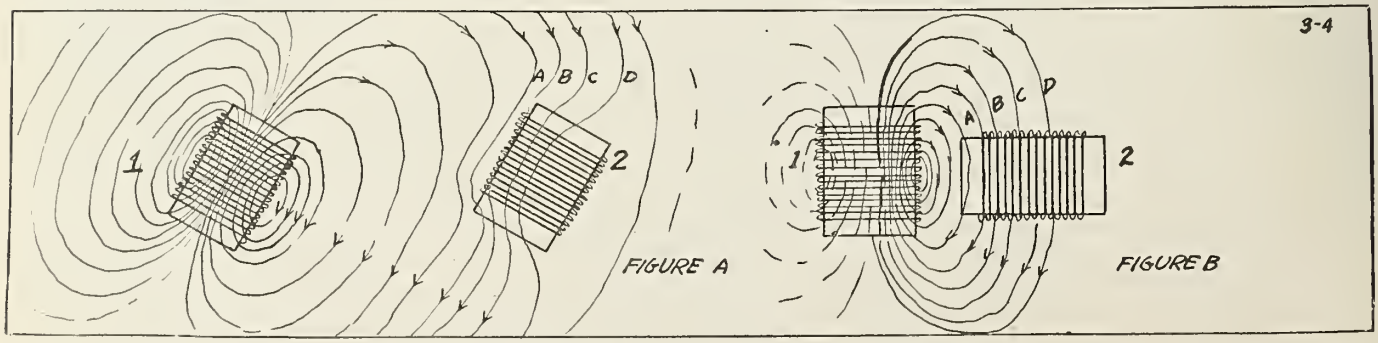
FIGURE 4 shows the ideal method of mounting two coils which are not inductively connected, but because of the danger of not getting them at exact right angles, it is best to keep them separated as far as possible and still consistent with short connecting wires. In this diagram the arrows shown at "2" explain the direction of the opposing currents set up in the two sides of the coil when set at an exact right angle to the coil "1," which is the original source of the magnetic field. Very often, however, it is necessary that certain coils be inductively connected to others and in such a case it is necessary to mount them in such a way that all the lines possible are made to cut through them, in which case they should bear the relationship shown in Figure 5.

Here we have one coil placed in inductive relation to the other. This is usually called a "coupling" of the two. It will be noticed that the winding of one is parallel to the other and a close inspection of this arrangement will show that the lines of force from the original source so cut through the turns of the coil "2" that they apparently whirl around them in opposite directions, but by carefully tracing them out in all positions it will be found that if the wire were laid out straight and parallel to the other, the lines would all be whirling in the same direction and consequently the maximum current would be developed in it. If the coils are separated some distance, it would be called a loose coupling and if they were close together, or one was wound on top of the other, it would be a tight coupling. If the coil "2" should be tilted slightly with one side higher than the other, more lines would affect one side than the other. This also would tend to give a looser coupling.

This method of changing the coupling is used in the standard variocoupler which is so arranged that coil "2" is mounted on a shaft and is placed inside of coil "1." Then by turning the shaft, the turns of coil "2" may be made to be parallel to those of coil "1" or may be turned at right angles to them. It is obvious that any position between these two extremes may also be obtained. It is this clever idea which makes it possible to get such a fine adjustment when a variocoupler is used in a set.

OTHER methods of producing a variable coupling have been devised, one of the best being the use of two flat coils, such as the honey-comb and spider web type. These are usually mounted in such a way that they are either close together with the turns parallel to each other, or by means of a hinged mounting, one coil may be swung away from the other until the turns are at right angles. Either of these methods is very efficient, so far as efficiency in a radio set is concerned, and it is often a question as to which is the best. Naturally the honey-comb and spider web coils are better than the straight coil wound upon a tube, because they are so designed that their distributed capacity is less than that of the flat straight winding, and their magnetic fields are more concentrated, which would appear to make less danger from stray fields. But it is hard to determine just how far these stray fields will wander.

From this description of the action of the magnetic lines, the reader will observe that the most important thing to remember in the construction of his receiving set is to so arrange the apparatus that he is sure that no interference due to stray magnetic fields is taking place. The visible defects are easily seen and remedied, but the invisible troubles are very seldom corrected, simply because one is not aware of their presence; but if they are recognized and guarded against as carefully as the visible defects, then the results obtained will more than pay for the extra trouble and thought used to



Figures 3 and 4. Figure A shows how magnetic lines from coil 1 cut through turns of coil 2 if they are placed too close together. This is important in neutrodyne and other radio frequency receivers. Figure B shows how losses are brought about when coils are properly placed at right angles. The lines from coil 1 cut through the coil 2 in the same manner as that of Figure 2, and no current is produced in coil 2.

eliminate them.

Now, how about the mounting of condensers in relation to the position of the coils? Here is another invisible problem. As stated in the August issue of RADIO AGE, stray magnetic fields which come in contact with any metal objects will also cause considerable loss of energy. Rapidly alternating currents will send out lines of force from a coil, which whirl first in one direction and then another. When such lines pass through a metal object, such as the plates of a condenser or a shield, they set up eddy currents in them. Just what this means is shown in Figure 6. Eddy currents derive their name from the fact that they arrange themselves in circular form similar to the circles appearing on the surface of the water, when several stones are dropped into it. They are sometimes spoken of as Faucault currents and are a source of loss of energy in any alternating current apparatus.

Naturally, a solid piece of metal is a very good conductor of electricity, and as these currents are set up in the metal itself, the resistance offered to them is very low. It is also known that the pressure which forces the current through the metal is very low, but because of this extremely low resistance, the very feeble pressure generated as the lines cut back and forth through the metal is able to force considerable current around in the circular form shown in Figure 6. In cases where a strong magnetic field cuts through a sheet of metal, it often happens that the current produced in the form of eddies is strong enough to heat the metal so hot that it cannot be touched safely by the hand.

THE currents used in radio reception, however, are not strong enough to produce eddy currents of sufficient strength to heat the metal condenser plates to such a degree that the heat can be noticed, but in a small way the same action takes place with these feeble currents, resulting in a dissipation of much needed energy.

Figure 7 shows how the lines cut through the metal plates of a variable condenser mounted across the end of a coil, which is enough to show that this is not a good method of mounting it. Here the lines naturally have to do considerable work in passing through the metal and in so doing not only do they waste energy in setting up the unnecessary eddy currents, but the resistance of the coil itself to the rapidly alternating current will be considerably increased, which will in turn cut down the current flowing through it. Condensers are not very often mounted in this way, although sometimes in order to save space on the panel, they are mounted inside of the coil. When this is done, the same condition exists and the lines are made to cut through the plates.

If mounted along the side of the coil, it will be seen that the plates will not be directly in the path of the lines, but even then some of them will pass through the plates, and while it is not a good way to mount them, it is better than the method shown in Figure 7. They should

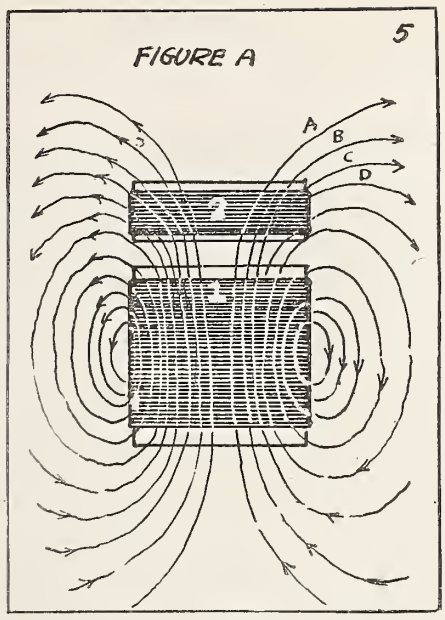


Figure 5. Showing how in this case all lines enter from the inside and pass out, producing maximum current in coil 2 by induction. This is the effect you obtain when your variocoupler is set at maximum.

really be mounted some distance from the coils if the best results are to be expected, and should be so located and in such a position that none of the lines from the stray magnetic fields can cut through the plates.

There are many fans who will dispute this theory in regard to mounting the condenser inside of the coil. They will say that they notice no bad effects from so doing, but it must be remembered that any one of these little things explained herein will not make any great appreciable difference in the action of the set, but a number of them in combination will make the greatest difference in the world. This article is written for the careful fan who wants to get the best possible results from his receiver and is willing to go to a little trouble to carefully lay out his work so as to avoid every unnecessary loss.

There are many sets in use today, the owners of which very proudly state what marvelous results they are getting, but who do not know that they could far exceed their present reception if they would only pay some attention to the little things which are invisible, but which at the same time are absorbing much of the energy of the set.

A NOTICEABLE improvement in body capacity effects may be made by mounting the coils and condensers a few inches away from the panel. A support may be made on which to brace the apparatus.

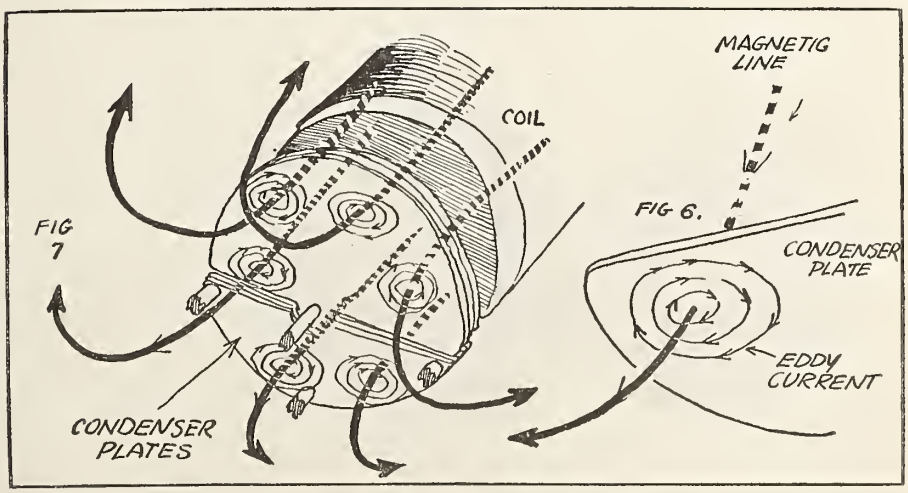
However, one should not forget that when a piece of insulation is under the influence of an oscillating current, the molecules moving back and forth tend to absorb the energy with each reversal of the current. As a result, it has been seen—the energy that was absorbed is totally lost, as far as radio reception is concerned. A small extension will be necessary to run the condenser shaft through the panel, the same applying to the rotor of a coil.

This will do away with the popular but not practical method of shielding the entire set by a sheet of copper or tinfoil.

A number of prominent manufacturers ground all the rotors of coils, condensers and switch shafts or any other part of the set that comes in contact with the hand while manipulating the controls. The transformers should be mounted at right angles to each other and not too close together, unless shielded

Body capacity is usually confined to the tuning controls, the effect being noticed when the hand is removed from the knob of the condenser or coil. Body capacity is usually noticed on distant stations and not so much on local stations. The average listener experiences the most body capacity in the grid circuit. However, it is noticed in many other parts of the circuit exclusive of the grid.

On some sets the effect may even be noticed on the phones when the hands are brought in close proximity to them or if your head is near the set. This, however, is not so noticeable on the regular three circuit tuner as on the Ultra-Audion.



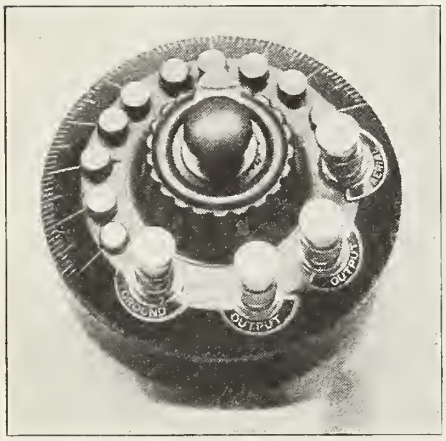
Figures 6 and 7. "A" shows the losses by eddy currents when a condenser is mounted on the end of a coil. The lines of force as indicated, in Figure B show the eddy current set up when the line cuts through the plate, which wastes power.

A Complete Radio Set on a Dial

By BERT WHITMAN

THERE are now about seven radio stations in Chicago that broadcast news reports, market reports, musical concerts and operas every day. All of these can be heard by any one who wishes to tune in accordingly.

Aside from using receivers of standard make, it is possible to home-construct a receiver, the simplicity of which involves only scant knowledge of radio. The set I am going to describe will be very efficient, providing you do not live in Pittsburg or some other point distant from Chicago and expect to hear all the Chicago stations.



A top view of the "Dial Crystal Receiver" showing the arrangement of the taps, binding posts and illustrating the manner in which the vernier knob of the condenser dial is used as the switch knob to vary the inductance.

A radio outfit is usually made up of an aerial to catch the incoming waves and also to catch waves that come in through the ground that are sent out by a broadcasting station. A coil is used so the listener can listen to one station at a time, thus avoiding two or more stations coming in at once, which would only result in a mass of noises. A crystal detector is used to change the waves, thus effecting the magnets in the phones; producing the sound which reaches the listening fan.

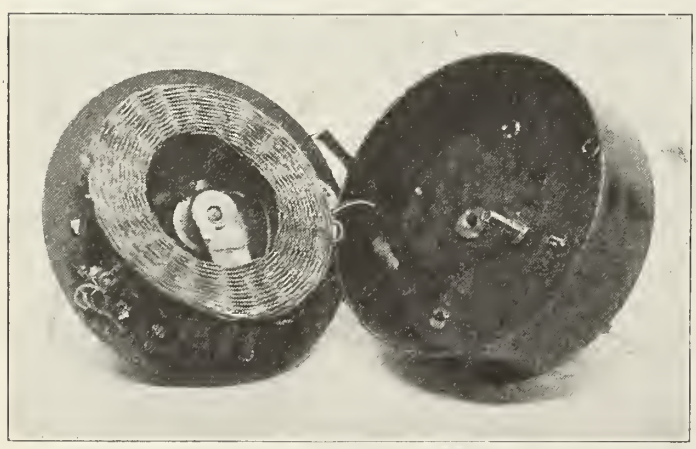
I will now proceed with the details of constructing this odd receiver. The entire set is made on an ordinary three-inch hard rubber dial. For the cabinet for the dial I used a discarded back of a dry cell case from a bicycle light. Where the numerals are marked off, drill a hole large enough for the taps to fit through, at the 10, 20, 30, 40, etc. Where the knob is to turn on a dial, in the middle equal with the shaft, drill a hole clear through. Use this for the switch-arm. The knob on the switch can be easily secured by using the top of a hard rubber binding post; for the shaft, use the shaft of an old rheostat; and for the arm of the switch-lever, you may use the arm of a rheostat. This shaft must go all the way through so it will hold on the crystal detector and the back of the battery case together with the dial. The pointer of this same old rheostat can be used to point out the taps from the switch-lever on the front of the dial.

Also drill four holes opposite of the taps and buy four plates marked aerial, ground phones, and another marked "phones." Place in the binding post where you just drilled the holes and put on the plates wherever desired.

How It's Done

Following are the details for making the coil: Secure a cork 1½ inches at the top. Anchor 19 pins, one-sixteenth of an inch deep, nearly ¼ inch apart, in a straight line all around. Proceed by wrapping twice, the end of the wire securely around the pin you wish to start from. Start winding with No. 22 D. C. C. wire over two pins, under two pins, over two, under two, etc., until having gone around six times, and upon coming to the pin you started from, tap it about one-sixteenth of an inch farther from the same. Take these taps off every six turns and stagger it a little farther than the previous one. Continue this until you have as many taps on the coil as you drilled on the dial.

After you have finished this, leave in your pins and give the coil a heavy coat of shellac or any other liquid varnish for coils. After this dries, pull out the pins and slide off the coil. It is advisable to place a small strip of paper on the coil before you place in the pins, so after you shellac the coil and pull out the pins the coil will not stick to the cork. When you have finished this, scrape the insulation off the taps and solder them to the switch points. Solder all connections.

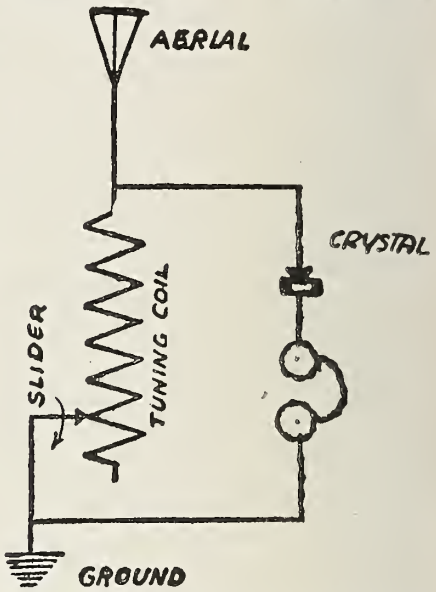


A view of the receiver "exploded" to show the manner in which the inductance is mounted. The crystal detector is mounted on case to the right, the mounting posts being visible in the photo.

The crystal detector was purchased at a Woolworth radio counter for ten cents, which serves the purpose very satisfactorily. After doing this, wire the set with the same wire you used to wind the coil with. Cover all the connections with spaghetti so it will make the connections more durable.

When this is finished, tighten up the bolt that holds the cabinet (back of the battery case) and the crystal detector and you have the complete receiver all ready to tune in the nearby stations.

To tune and work this set, buy a pair of good phones, about 100 feet of No. 14 copper aerial wire and about 50 feet of No. 14 rubber covered copper wire for your lead in and ground. Rig up your aerial, making it as long as possible. Attach your ground to the radiator. Put your aerial to the aerial post on the set, your ground to the ground post on the set and the phones to the two posts marked "phones."



A diagram illustrating the manner of wiring the various parts of the receiver. A .001 Mfd. condenser connected across the phone posts is often an aid to the detector in getting clearer signals.

Now you are all ready to tune in. Start by moving the switch lever on the first tap and moving the detector about easily on the crystal to find a good spot. If it does not work on the first tap try the second, third, fourth, fifth and so on until you find the sensitive spot of the crystal. When you hear plainly, lay the set on table sideways to make it stay steady or lay the set in an ordinary glass. It will fit right on the top.

King of Belgium Honors American Citizen

Dr. L. H. Baekeland, of Yonkers, New York, president of the American Chemical Society and honorary professor of chemical engineering in Columbia University, has just been highly honored by King Albert of Belgium, who made him commander of the Order of Leopold. Doctor Baekeland has already received such distinctions as officer of the Legion of Honor of France and officer of the Crown of Belgium.

Interference: the How and Why of It

Why It Is Impossible to Tune Out Local Stations When DX May Be Eliminated

By HENRY A. WORNER

THE average radio fan quite often is confronted with the problem of coping with interference caused by nearby broadcasting stations, while he is engaged in the interesting and absorbing pastime known as "fishing for DX."

What seems to puzzle him especially is the fact that certain stations are apt to interfere more than others. For instance, he knows that one station allows him sufficient latitude for satisfactory tuning of an out-of-town station broadcasting on a wave length which differs from that of the home station by 15 meters, while another local station operating on a different wave length entirely prevents the reception of a moderately distant station, whose wave length differs from that of the interfering station by as much as 17 meters.

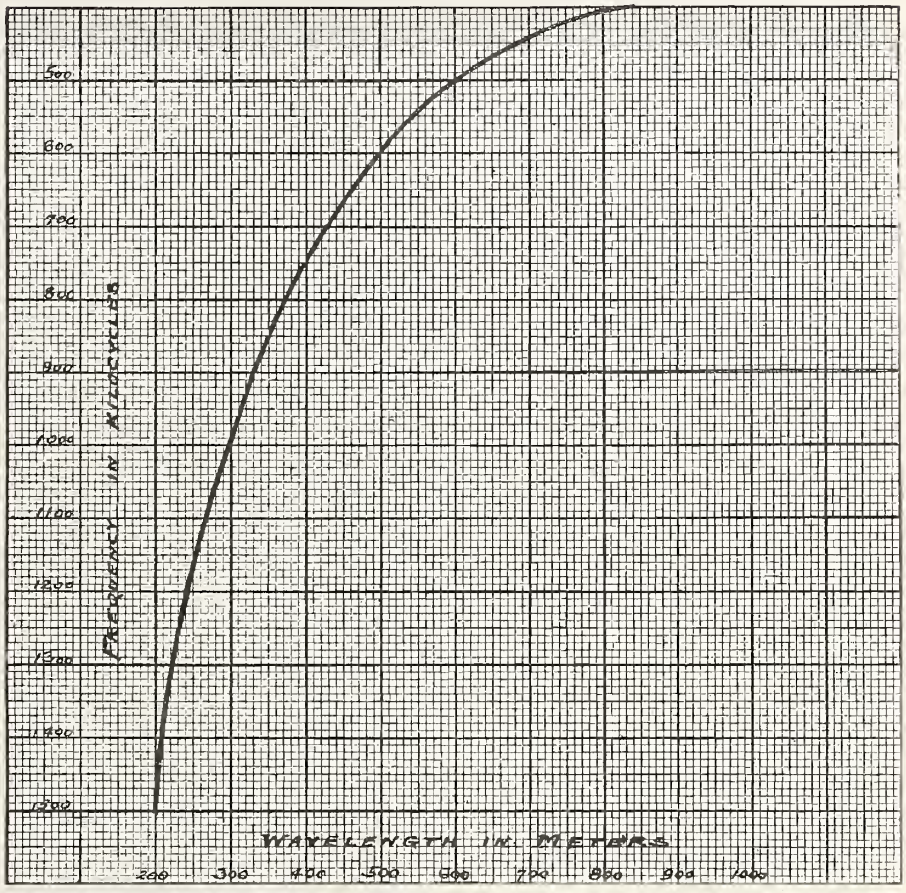
To make matters more perplexing, he learns that brother Jim, who lives in Pittsburgh, has on several occasions tuned out powerful KDKA transmitting on 326 meters, and received KGO, at Oakland, California, on the small margin of 14 meters difference in wave length.

Where's the Fault?

It is only natural to suppose that he is peeved over the matter, in view of the fact that Jim happens to be little more than a novice in matters radio, while he has dabbled in radio long enough to consider himself in the light of an expert. The fault cannot be with his set, he argues, for the reason that he built both, Jim's set and his own, and they are as alike as the proverbial peas in the equally proverbial pod, from binding post to phone jack.

IN HUNTING for the cause of the trouble he is apt to put the blame on the offending local station.

"They surely must be off their wave length," he complains, "for the other local station does not interfere to the same extent. The operating personnel must be becoming careless in their adjustments, causing a wave that is far from sharp." You see he has learned a little about such things as decrement, and other equally mysterious things, and comes to the conclusion that he has discovered the cause of it all by accusing the offending station.



The chart above shows the relation of wave lengths to kilocycles. Notice especially how steep the curve bearing this relationship becomes as it increases in frequency and decreases in wave length.

On the face of it he seems to be right, but nevertheless he is entirely wrong. The cause of complaint is to be found elsewhere, as I shall endeavor to demonstrate. In the first place, it is a mistake to associate broadcasting stations with their wave length assignments, as this practice leads to just such ambiguities as this. One should think in terms of frequencies instead of wave length, in calculating the amount of dial space a certain station ought to occupy.

The relation of wave length to frequency is not, graphically speaking, a straight line, but forms a rather steep curve, as may be observed in Fig. 1. It will be noted that a frequency of 1,500 kilocycles (1,500,000 cycles) produces a radio wave measuring 200 meters from crest to crest, while a wave 300 meters long is created by a frequency of 1,000 kilocycles. The average person is prone to jump at conclusions in a good many things, and radio is no exception. Having discovered at some time that the difference in kilocycles between 200 and 300 meters is 500, he concludes by inference that a hundred meters' difference equal a frequency difference of 500,000 cycles. A second glance at the graph will illustrate to the reader that such is far from being the case. We find that whereas 300 meters has a frequency of 1,000 kilocycles, the frequency for 400 meters is 750 kilocycles—a difference of 250 kilocycles! We also find that 500 meters equals 600 kilocycles, and 600 meters is the equivalent of 500 kilocycles.

How They Stand

The relationship of wave length to frequency is clearly expressed by the formula:

$$\text{Frequency in kilocycles} = \frac{300{,}000}{\text{Wave length in meters}}$$

At this juncture, the reader will begin to see a glimmer of light. However, he fails to see the connection between that and the fact that a station like WEAF, for instance, transmitting at a frequency of 610kc. (492 meters) is practically annihilated in Philadelphia by WIP or WOO, operating on a frequency of 590 kc. (509 meters)—or a difference of 20,000 cycles.

EVEN the novice in radio knows that in order to hear a station one must adjust the receiver to resonance with the

frequency of the carrier wave on which the station is operating. He is also aware that a nearby station allows him considerable latitude in the matter of accurate dialing, whereas a more distant station requires a little skill in the matter of tuning. Why does a local station "smear" itself over a considerable part of the dial? And why is a margin of 17 meters difference in wave length insufficient to tune in a distant station through local interference, in one instance, and 15 meters or even 14 meters difference, in another instance, plenty leeway to accomplish that very thing? These are questions that not only puzzle the novice but in a great many cases are conundrums to the seasoned fan as well.

The answer lies in the fact that one has to deal not with a single frequency but with a wide band of different frequencies in radiophone transmission and reception. The carrier wave of a broadcasting station upon which the voice and music is carried is the wave length upon which the station is permitted to operate. The wave length is determined by the oscillation constants of the transmitting apparatus, before the voice or music is impressed on it. The peak of this carrier frequency is quite sharply defined even in a local station.

When the carrier wave of a station is being modulated with the frequencies of the speech and music impressed upon the diaphragm of the microphone, the result is a composite wave, which modifies the character of the single carrier frequency to a considerable extent. Let us see just how this is effected. It is customary in music to refer to the oscillation of a musical note by the name of vibration. In effect, a vibration and a cycle of oscillation are identically the same thing.

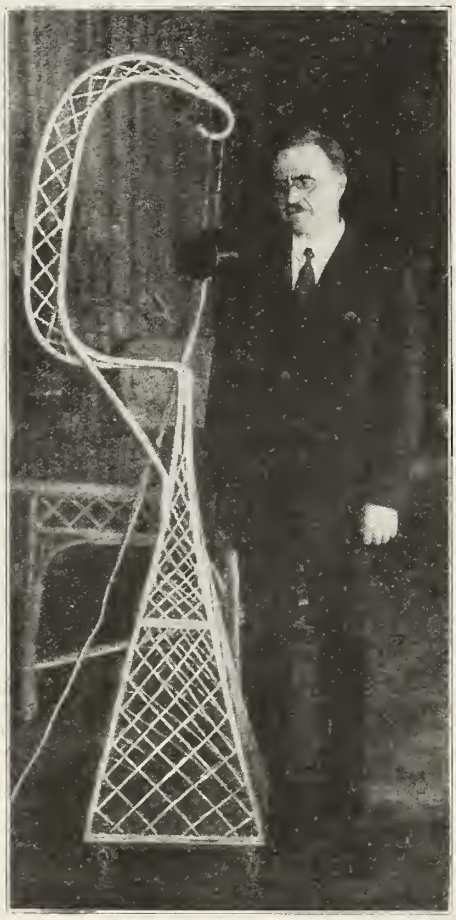
How Music Vibrates

A musical note is the result of vibrations or oscillations of a known frequency, which remains quite constant. When the pitch of the note is altered, the frequency of vibration is automatically changed. We will say that the musical note, referred to on the piano as Middle-C vibrates about 256 times per second to and fro. (Its actual vibration constant according to the International Standard of Pitch is 258.9.) That is to say, it oscillates at a frequency of 256 cycles per second. Since the frequency of a note doubles with each octave, it follows that the C one octave above Middle-C has an oscillation constant of, say, 512 cycles per second. The next C above would register 1,024 cycles and so forth, until we reach the uppermost C (last white key) on the piano which oscillates at the rate of 4,096 cycles per second.

Some instruments of the orchestra go still higher than that. The piccolo flute can produce notes whose frequencies are more than double that of the uppermost note on the piano, while the violin, when being played in the seventh position, reaches notes that are close to the upper audibility limit of the human ear, which is in the neighborhood of 10,000 cycles.

SO MUCH for the frequencies of fundamental tones. A fundamental tone is one having practically no harmonics or overtones. A tuning fork is the only device capable of producing a pure note practically free from harmonics. All musical instruments produce notes which have combined with them a certain number of these by-tones, or harmonics. As a matter of fact, were it not for the harmonics, all music would sound dull and there would be no distinction between the various instruments. It is due to the overtones that we are able to distinguish between the various instruments of the orchestra.

These harmonics supply that colorful



Fotograms, N. Y.

NEW YORK STATION OPENS

Mayor John F. Hylan of New York is shown officially opening WNYC, the $50,000 municipal broadcasting station to be used by New York City.

variety and exquisite shading so much in evidence in the modern orchestra, thereby adding enormously to our enjoyment of symphony concerts, not alone over the radio, but also in the concert hall, auditorium and theater. Thus, by means of these overtones we are enabled to distinguish a violin from a flute, a cornet from a saxophone and a xylophone from a piano. These overtones are therefore vitally necessary to the full enjoyment of music. There are fifteen important harmonics for every principal or fundamental note in music. All of these are not equally prominent. Chimes, carillons and church bells are richer in overtones than any other tone-producing devices.

If we consider the first ten harmonics as of most importance, let us see how they materially affect the music frequencies. High-C is the C situated two octaves above Middle-C on the piano and is the ultimate goal of every ambitious soprano. It is considered the upper limit of the range of the female voice in song and has a vibration constant of 1,024 cycles. The first harmonic has twice the frequency of the fundamental note—in our case 2,048 vibrations. The second harmonic generates frequencies three times that of the principal note, or 3,072 cycles per second—a little more than 3 kilocycles. The tenth harmonic has the enormous frequency of 11,264 cycles, which is over 11¼ *kilo*cycles. The lowest note of the Great Organ has a frequency of 32 or less cycles. We must therefore take into account a musical frequency band of over 11 kilocycles.

How Harmonics Function

As there is a plus and minus component in a radio wave, the carrier frequency is therefore modulated by a voice frequency alternately adding and detracting 11 kilocycles. A broadcasting station transmitting on a carrier frequency of 610 kilocycles therefore occupies a frequency band extending between 599 and 621 kilocycles. Expressed in wave length figures, this means that a station operating on 492 meters really covers a wave band lying between 501 and 483 meters. A local station operating on a carrier frequency of 590 kc. (509 meters) causes interference with the station transmitting on 492 meters, by reason of the fact that it blankets a wave band lying between 499 and 518 meters. (601 and 579 kc. respectively.)

A station like WOO occupies a waveband 19 meters wide, while WEAF uses one only 18 meters in width. WDAR on a frequency of 760 kilocycles occupies a band of only 11 meters with the same 22 kilocycle variation. It is therefore possible to tune out this station in Philadelphia and tune in WGY in Schenectady on 380 meters.

NOW let us see how much better we fare with a station using a comparatively low wave length. Take KDKA broadcasting on 326 meters (920 kc.). A listener in Pittsburgh desiring to hear KGO in Oakland, California, on 312 meters (960 kc.) has no difficulty in tuning out the Pittsburgh station. 11 kilocycles either side of 920 is the frequency range 909-931 kc. Transposed into wave length this equals a band barely extending 8 meters wide. This goes to show that the lower the wave length, the sharper will be the tuning.

The above covers all cases where the interfering station is a local station. The situation will be improved materially as the distance between the interfering station and the receiver is increased. With the interference located some distance away from the listener, a number of the overtones are lost in transmission, which has the effect of narrowing the operating band of the station, consequently lessening its interference possibilities.

(Continued on page 57)

Using One Tuning Control for Hair's Breadth SELECTIVITY

By BRAINARD FOOTE

Test of Best Circuits Now in Their Simplicity

IT IS a peculiar, yet universally recognized fact, that any single tube regenerative receiver will respond to broadcast signals from stations within the receiving radius of a set employing a radio frequency amplifier. This paradox may perhaps be best explained by the simple statement that a certain amount of signal energy is required to actuate any tube, whether it be the detector or the first tube of a radio frequency amplifier. The use of radio frequency amplification does, however, magnify the weak energy to such an extent that broadcasting from distant points may be more loudly heard with such an amplifier than without one.

The fact remains, nevertheless, that a single detector tube, properly connected and used by a keen-eared listener, will have practically the same receiving range as any other form of receiver with the possible exception of the super-heterodyne. There is little to be said in favor of this or that circuit, providing it is regenerative and the best of apparatus is chosen. The widespread differences of opinion regarding various forms of single tube circuits appear to arise mainly because a highly satisfactory form of one circuit has been compared with but a mediocre representative of some other type. To me it seems that one is as good as another as far as actual distance goes, but that there really is considerable difference in selectivity and ease of operation.

ASSUMING fairy equal sensitivity for all single tube circuits, then, they are not to be compared on this basis, but on selectiveness and simplicity of operation. Tendency toward radiation is also a most important factor to think about. Most regenerative receivers involve a most "ticklish" control of oscillation in addition to one or two controls for adjusting the set to the various wave lengths. Tickler feedback receivers and those having plate variometers come in this classification and are for that reason rather difficult to operate handily. In addition to these two objections, I might cite the natural tendency of operators of such equipment to permit the tube to oscillate and to hunt for the carrier wave or "whistle" while feeling around in the dark for some distant station.

Back to DeForest

In searching for a circuit which is not only selective and easy to use but which is not critical in its regeneration control also, we must hark back to the early days of radio when Dr. Lee DeForest brought out the Ultra-Audion circuit. Most circuits have a secondary coil with one end connected to the grid condenser and the other end to the filament. The Ultra-Audion, on the other hand, uses the grid condenser connection for one end but connects the other to the *plate* instead. This normally maintains the circuit in oscillation and depends upon the capacity of the antenna to absorb energy enough to stop oscillation. Heretofore the circuit has been objected to on the ground that a "hum" was picked up from the electric light line. This was due to the absence of the grid return wire to the filament and to the direct connection of the antenna to the grid coil.

In overcoming the hum and providing means for substituting something else for the antenna's absorption, I found it most satisfactory to use the so-called "aperiodic" or untuned antenna system and to insert a variable condenser as a by-pass across the phones. This eliminates the hum and provides a sure control of regeneration—and a non-critical one. The double circuit plan also increases the selectiveness—something that the Ultra-Audion arrangement has long been famous for, anyway.

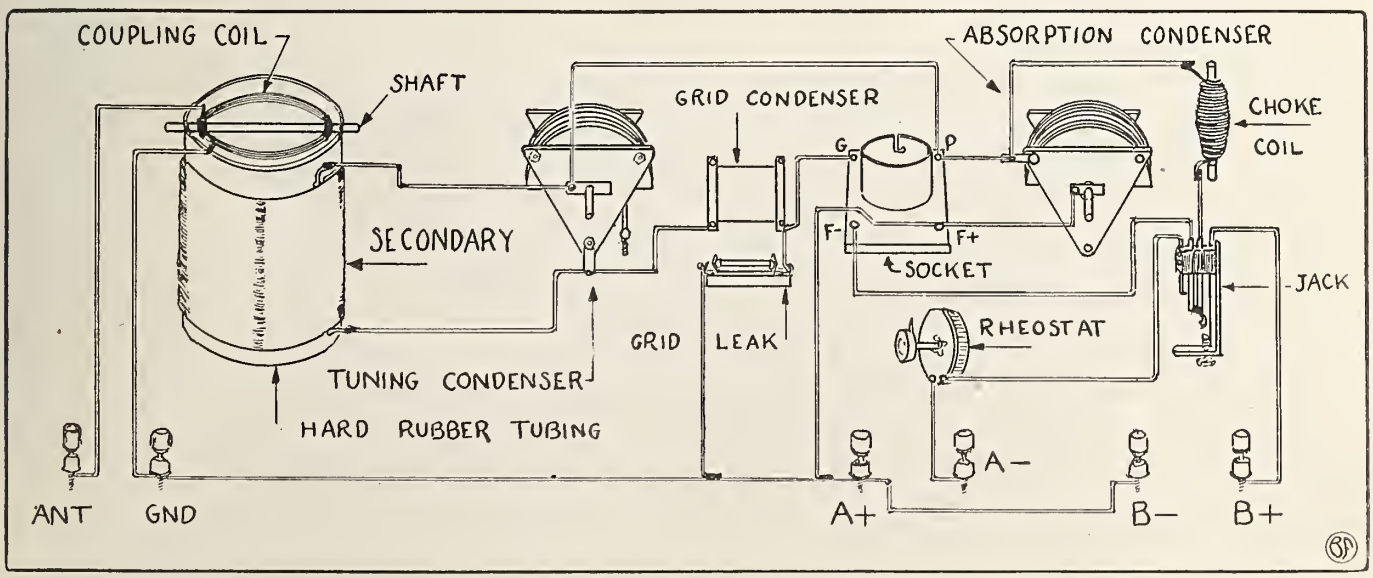
In view of the fact that the set is usually oscillating except when the primary and secondary is tuned to the natural period or wave length of the antenna, a condenser, preferably one of .001 mfd., may be inserted in the antenna or ground lead going to the primary of the vario-coupler.

When a set is oscillating, the incoming carrier wave will be found to tune very sharp.

As a result it would be advisable to exercise great care in the tuning. This will apply to the tuning condenser.

The Choice of Parts

I decided to use only the highest grade of apparatus and insulation; to use large wire for the coils, the best kind of grid



Circuit diagram of the Ultra-Audion receiver. There aren't many parts to assemble and the circuit is simple in operation. Special features are the antenna coupling coil, the low capacity grid condenser, the absorption condenser and the R.F. choke coil which keeps radio frequency current out of the phones.

From the rear. The sub-panel simplifies the mounting, and it's fastened to the socket. It supports the coil, rheostat and binding posts, besides the wiring underneath it. Note the geared and counterbalanced type of condenser.

condenser I could get, and to mount the outfit in the most accessible and pleasing manner. With No. 24 wire for the secondary, I could scarcely get rid of WEAF in a location in New York City in order to receive WIP, but with No. 16 wire, this was easy, thus bearing out the familiar statement that high resistance broadens the tuning.

SEVERAL makes of variable condenser were tried and differences noted in the oscillation point and signal strength in direct ratio to their quality. Results were slightly better with a reduced number of turns on the coil and a little larger size condenser. A vernier control on the tuning condenser is an absolute necessity, but do not select the type of vernier condenser having an extra plate and a small knob for operating it.

A condenser of this style cannot be used with much success since it is not possible to keep a list of the dial settings for various stations. The vernier should move the condenser as a whole and not one of its plates. A friction vernier on the rim will do very well, although a gear of some sort is more rugged and permanent.

The regular .00025 grid condenser was found rather large, and with a .00002 mfds. size the clarity was not only improved considerably but the selectiveness also became surprisingly better.

Some innovations in assembly are shown in the illustrations. The front view demonstrates the simplicity and good appearance of the completed receiver. There is a tuning control and a non-critical regeneration control and a phone jack. Nothing else to "monkey with." The rheostat is placed inside and is a new type which has both a small and a heavy wire so that the one rheostat permits the use of tubes of any character. It is mounted on a sub-panel in the cabinet so that it can be adjusted once and for all and never touched except when another tube is used. A filament control jack automatically turns the current to the tube as the phones are "plugged in." The rheostat is thus always set at the point where the tube operates best; and it doesn't clutter up the panel with an unnecessary knob.

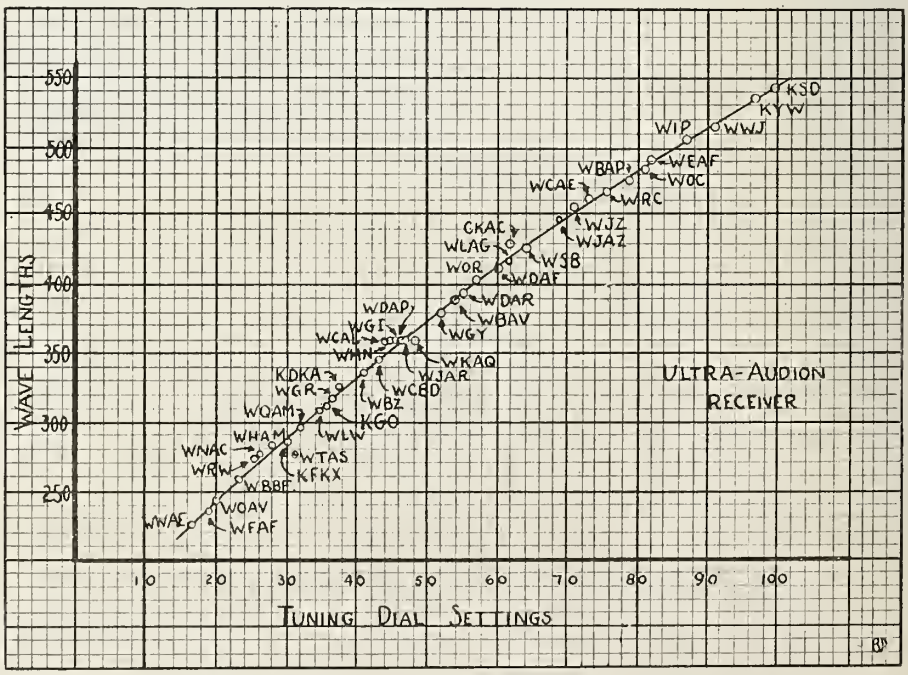
Connections in Rear

The appearance of the interior is good because nearly all the wiring is done underneath the sub-panel, passing the bus-bar wire through small holes drilled through at the proper place. All connections are made at the rear through little holes in the cabinet and again the front of the set is improved. There are no straying wires to binding posts in sight. Eby posts are used because each has a hole in the shaft into which the wire may be pushed from outside the rear of the cabinet with no need of bending the end around the post.

One other problem was met in a manner which will not greatly trouble even the most inexperienced builder. I found that the capacity between the cords of different makes of phones was different in each case and had a most important effect on the absorption of oscillation. With one pair of phones the set couldn't be made to oscillate and with another it was hard to stop it. The remedy lay in keeping all radio frequency current away from the phones, and this was done by the introduction of a radio frequency choke coil. This was a small item and the wire was wound on a short piece of insulating rod.

The parts used for the receiver itself are as follows:

1 7 x 14 inch cabinet.
1 7 x 14 inch panel.
1 7 x 10 black panel (as sub-panel).
1 panel mount socket.
1 grid leak mounting and 2 megohm leak.
1 specially built grid condenser (see below).
1 No. 23 "duplex wound" rheostat.
6 binding posts.
1 4 x 4 inch (hard rubber) tubing.
1 5 inch dowel stick about ⅜ inch diameter (or hard rubber).
¼ lb. No. 30 D. C. C. wire.
1 2 inch dowel stick about ⅜ inch diameter (or fiber).
1 single circuit filament control jack.
5 lengths bus bar.
1 lb. No. 16 D. C. C. wire.
1 .0005 variable condenser with vernier.



Here's what your own receiving record ought to look like, with other stations nearer to you. The condenser and coil are of such size that the broadcast band is just covered from zero to 100.

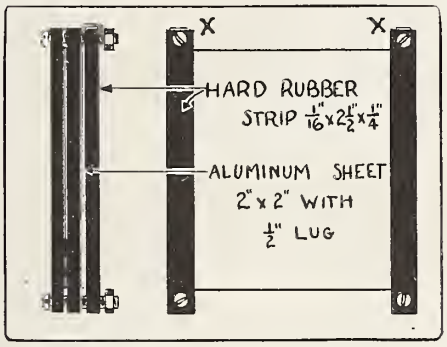
1 .0005 variable condenser with or without vernier.

The Coils

THE ANTENNA coupling coil consists of 15 turns of the No. 16 wire wound first on a bottle or other cylindrical form about 3 inches in diameter. Two pieces of bicycle tape are used to hold the coil in place as it is slipped off the winding form. The secondary consists of 42 turns of the No. 16 wire wound on the tubing very tightly and smoothly. Two holes through the tubing at each end of the winding serve to hold the ends in place. Mount the coupling coil at one end, and the winding of the secondary should be started right near the other end of the tubing so that there will be room enough for the shaft of the coupling coil. Drill two holes so that the shaft will fit rather snugly and tie the coil to the shaft with small pieces of insulated wire. If the shaft is rather large, it may facilitate matters to divide the coupling coil into two parts and put the shaft in the middle. White thread can be used to fasten the parts together as illustrated. The coil should be held in the center of the tubing by two washers which press tightly against the tube and the coil. These may be sawed from a length of fiber tubing. The coupling coil is adjusted to suit the particular aerial in use and then not touched again. Two short lengths of flexible insulated wire had best be used for connecting the coil to the bus leads to the antenna and ground binding posts. The tubing may be mounted to the sub-panel by two small brass angles with 6-32 machine screws in the panel and tubing for support.

Two aluminum sheets are cut 2x2 inches with a lug about ¼ inch wide on one corner and extending about ½ inch out from the edge. The sheets are hammered flat. Then six strips of 1/16 inch thick hard rubber are cut with a hacksaw ¼ inch wide and 2½ inches long. Each has a hole made with a No. 27 drill at each end, about ⅛ inch in from the end. Four 6-32 machine screws ½ inch long complete the parts and the sketch shows the assembly. The lugs are bent over the end of one strip to make contact underneath the screw head or nut—one lug connected at each side. The bus bar may be soldered directly to the screw-heads marked "X" on the sketch. The plates should be parallel and 1/16 inch apart. This form of condenser is simple to make and highly efficient—air is the most perfect dielectric.

The choke coil is made with about 500 turns of the No. 30 wire wound on a short length of dowel stick, hard rubber rod or fiber rod. A convenient way to wind this is to fasten the rod in the chuck of a wheel brace—clamp the wheel brace in a vise, drill two little holes in the rod to fasten the ends of the wire and wind it on. The number of turns is of no importance, the only essential being that it have enough so that the natural wave length of the choke coil is well above the broadcast band. At least 300 turns should be used, and if you wind enough wire so that the coil is about ¾ inch thick, you'll have plenty.



Details of the grid condenser. Two sheets of aluminum and six narrow strips of hard rubber form the condenser, with four screws for the assembly. The most efficient dielectric—air—is employed.

Making the Connections

LITTLE need be said about the method of mounting, as this is shown in the illustrations well enough. In wiring, do not use right-angled bends throughout but run the connecting leads the shortest distance, keeping the following wires at least one inch from all others:

The wire from lower end of secondary to stator connection of condenser;

The wire from stator end of condenser to grid condenser;

The wire from grid condenser to grid;

The wire from the grid condenser to grid leak;

The wire from upper end of secondary to rotor of condenser;

The wire from rotor of condenser to plate;

The wire from plate to stator of absorption condenser;

The wire from stator of absorption condenser to choke coil.

Make these leads short and direct. Some of them need not be made beneath the sub-panel because the points mentioned are nearby above it. The other wires may be run close together, at right angles, or any other way that suits the maker of the outfit.

Use very little soldering flux and wipe off any black deposit after the connections have been soldered. Be careful of the connections to the jack. The frame is joined to the B plus post and the long contact spring to the choke coil. The other two are in the negative filament circuit, for the insertion of the phone plug causes them to come into contact and light the tube.

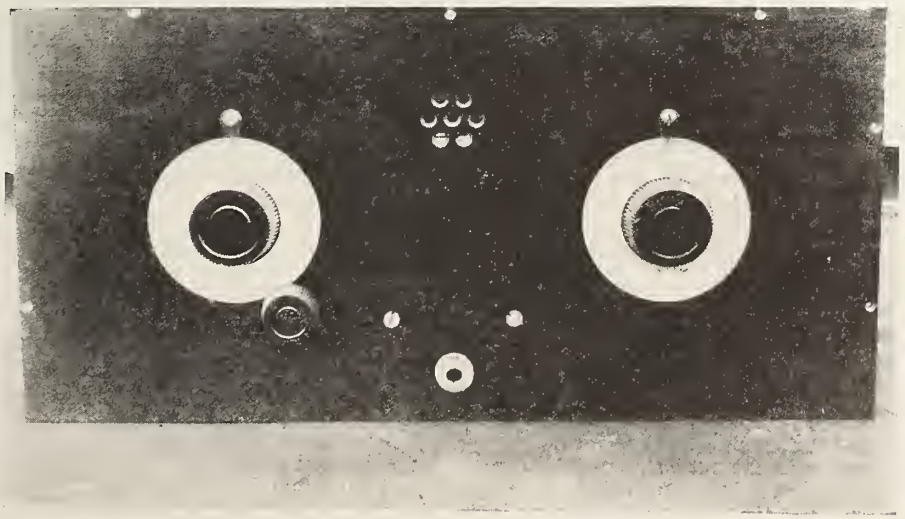
It is very important that you connect the grid leak to the positive side of the filament, as the tube will not function any other way. Moreover, ground the positive of the filament, as shown in the circuit diagram.

I have found the WD12 to give as good results as any other tube as far as distance is concerned. Just the least bit better volume can be had on the local stations with the UV201A or C301A. The UV199 is also satisfactory, and the rheostat specified will take care of any of them. A single dry cell forms the "A" battery for the WD12 (or C12 or WD11) but with the 201A or 301A tube, four dry cells are needed or else a 6 volt storage battery. The UV200 does not appear to be quite as satisfactory, and inasmuch as the other tubes require only about one-fourth as much current, they are more economical besides being slightly better. Forty-five volts of "B" battery are used for the plate supply.

For local reception, results are quite good with a connection to the electric light line through a .0005 fixed condenser or a plug. The very best aerial is a single straight wire from 75 to 125 feet long, without too long a lead-in. The ground connection is made to a clamp on the radiator or water pipe in the customary manner.

Set the coupling coil at a 45-degree angle to the secondary and the absorption condenser at zero. After making all connections except those to the "B" battery, insert

(Continued on page 55)



Doesn't it look simple? The rheostat's inside and is always set at the right value. The tube lights when the phone plug is pushed in. The left hand condenser has a vernier control and accomplishes the tuning.

Surviving a "Radio Summer"

By J. A. CALLANAN

[As Broadcast for RADIO AGE from Station WTAY.]

For the past few years, ever since the inception of Radio, sales have decreased during the Summer for no reason at all. As a matter of fact, theoretically, trade activities should be greater in the Summer than in the Winter, and undoubtedly during this and ensuing years that condition will prevail.

Heretofore the annual falling off of interest in radio communication has been erroneously ascribed to the belief that seasonal and atmospheric conditions prohibited a full measure of realization of the pleasures attending reception. I have analyzed this subject and have drawn the conclusion that this waning interest is in a much larger measure due to that irresistible call of the Great Out-of-Doors which makes itself felt as the Summer days come on.

But today there is a rival to that call, if we are to discern the signs of the times, from the innumerable inquiries as to the feasibility and the kind of a radio receiver to take on vacations. If it is a truism that a radio set in the home has become an essential of the first order, it is becoming equally a truism that the fan and his receiver are not readily divorced.

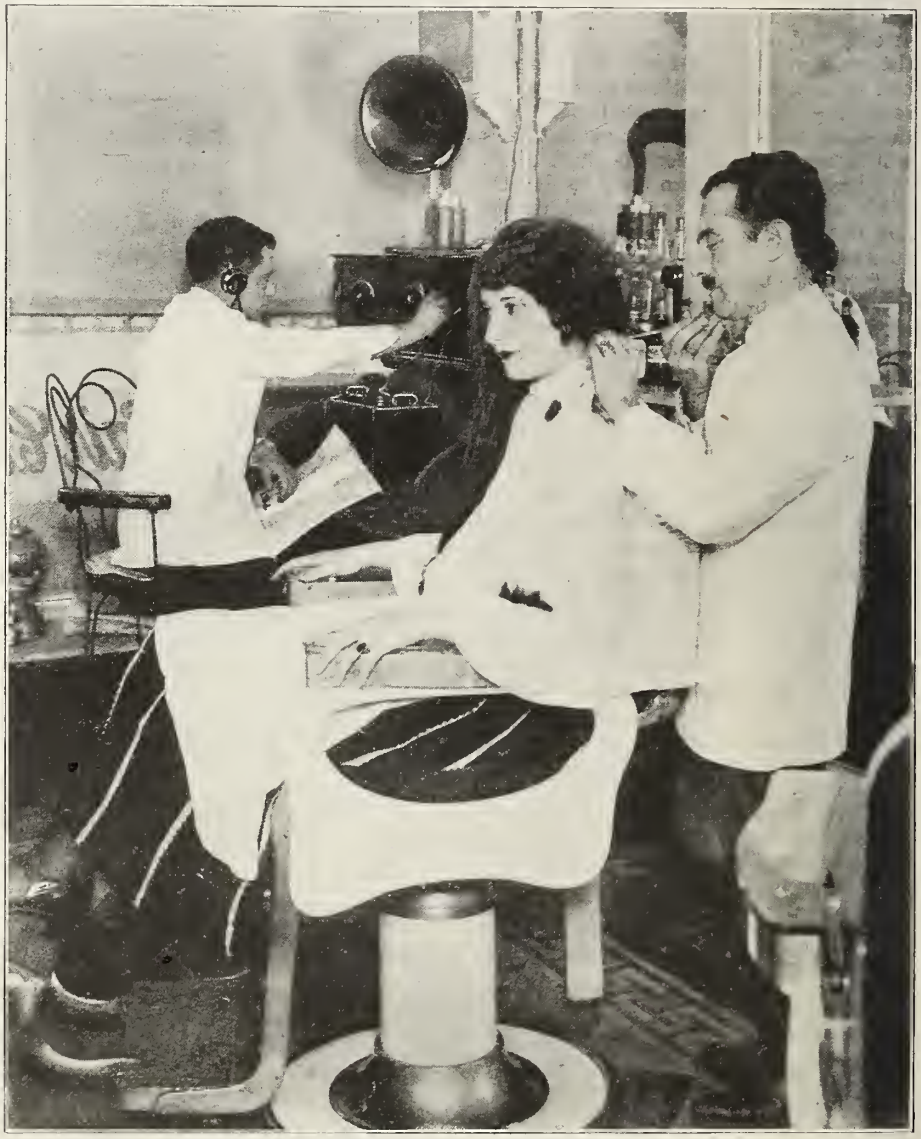
Nearly everybody who has a car and goes motoring, camping or touring this year will take along a radio set. No regrets need be experienced for leaving your radio receiver behind you as you journey forth into the open for a day, a week or a month, as the case may be.

Broadcasting will this year, as never before, receive the attention of the fan. All broadcasting stations will be alert for the advantages radio presents as a medium of entertainment through the national interest in vital political events during the Summer. Transmission of such programs is without precedent during the period of time in which radio communication has so gripped the popular mind, as no other one thing has ever done.

Trade has awakened to a new realization that there is to be no interruption. Manufacturers are preparing to supply demands for portable sets. RADIO AGE is deluged with an insistent demand for circuits and data for home construction, and is meeting in current issues these needs by a variety of practical suggestions for making and installing radio receivers in every conceivable way for adaptation to camper, motor and tourist requirements.

Let us consider for a moment the prejudice that admittedly exists in many minds as to the adverse conditions affecting radio reception during the Summer months. Let us admit that radio is variable; that its fascination is in its erratic and elusive characteristics. It unfolds many mysteries, many forces that are not within the ken or control of man. Those much over-worked terms, "Static and Atmospherics," however, carry many burdens which are not their own. While these forces in themselves remain constant in their seasonal manifestations, the refinements of man-made devices are immeasurable and have minimized the ill effects which hitherto have seemed insurmountable. We may always encounter trouble, more or less, at one time or another and must not be surprised or dismayed at its form; but these factors which have seemed a serious deterrent to the uniformed are to the technical mind a foundation upon which the art is building constantly to embrace larger and larger possibilities. Out of this experience the layman is becoming more and more familiar with underlying principles because he finds it a willing medium of helpfulness in diagnosing and correcting his troubles as they arise.

In this sketchy little talk I am not forgetting those of my listeners who will not go vacationing. For them I am suggesting the opportunities for fruitful work to be tackled during the Summer, rather than putting your radio set in the cellar for that hot spell when you think that static is going to be too bothersome. Don't. Rather, work your set for all it is worth and devise ways and means for doing away with that disturber. RADIO AGE will give valuable discussions on remedial measures of proven value. Don't forget that the man who invents a device to overcome any one type of interfering medium will go down in history as one of the outstanding inventors of the age.



WHY DO GIRLS LIKE BARBER SHOPS? Kadel & Herbert.

Surely not because they like the barber's time-worn chatter. Maybe the picture will explain why barber shops are no longer dens of torture for girls getting their hair bobbed. The radio set in the background keeps them occupied while the barber shears their locks. Lunella Young is seated in the chair, being assisted through the clipping ordeal by an ethereal entertainment.

Unsnarling Tube Connections

By FELIX ANDERSON, Assistant Technical Editor

How Characteristics of Vacuum Tubes May Be Dealt With Safely in the Various Circuits

IN THE July issue of RADIO AGE, we discussed in detail the various tube controls and accessories, their design and possible faults, and arrived at the conclusion that the choice of well made, low loss and efficient apparatus is a vital necessity in the process of realizing the utmost in results with vacuum tubes. As mentioned in that issue, poor apparatus and accessories are contributors of noises, critical tuning, and are often the underlying reason for the poor showing which some receiving sets make. I would consider the choice of the accessories to be used with the tube of the greatest importance in making a radio receiver, because it is in these little inexpensive parts that great faults may lie, and are overlooked because their action in circuits is considered so trivial.

Granting that we have on hand an assortment of rheostats, tube sockets, potentiometers, grid leaks and batteries that are of the best design both electrically and mechanically, we are confronted with a problem of equal importance. To attain the very greatest efficiency with a triode, we must connect it in a circuit in such a manner that its real virtues may be readily extracted, and we must use our accessories to the greatest advantage possible in arriving at our object.

Consider Little Things

It is a wise plan to consider first the medium with which we are going to connect electrically the various pieces of apparatus which we have assembled in the process of making a vacuum tube receiver. The wire used should be preferably of tinned copper bus bar, No. 14 gauge, soft drawn, so that it will bend easily. It is not wise to cover the grid and plate circuit leads of any receiver with spaghetti, as it may contribute small amounts of distributed capacity to the receiver as a whole. You may consider this trivial, but summing up all the little defects in a radio receiver and subtracting them from the results you should get, will make a great deal of difference.

Suppose you made a receiver that seemed to be ailing some place. Then suppose that you added one or two little improvements that increased the efficiency of the set 3 per cent. Now your ears would be poor judges of the increase in efficiency, because they would not be sensitive to improvements so small. But now suppose you made ten of these little changes, each contributing its little 3 per cent in operating efficiency all at once. When you put the phones on, you would notice 30 per cent increase in the effectiveness of the receiver, and it would prove to you quite conclusively the fact that it pays to respect trifles in radio.

Since the filament connections or wiring are nearly always common to the ground or in other words, because the batteries furnishing energy for the filament and plate circuits are usually not engaged in the actual conveying of the signal while it is of radio frequency nature, it is not important whether they are covered or not. The usual practice in high grade receivers is to insulate the filament and plate battery wiring to prevent any accidental short circuiting and subsequent destruction of some unit in the receiver.

Connections in General

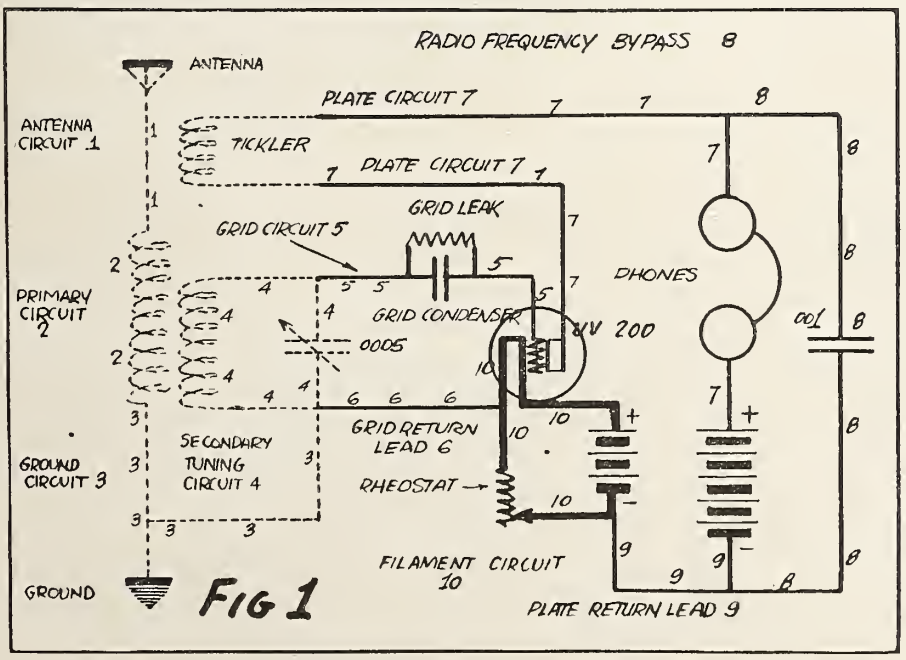
In the various tube circuits being published today, the details of such connections as grid and plate return leads, the position of the filament rheostat and potentiometer and other accessories have been unfortunately ignored, and it is no wonder that considerable doubt should exist in the minds of the tube users as to what connections are best suited to the type of tube they are using. I find that a number of inquiries addressed to our technical department are in search of information of this nature.

For the purpose of easier reference, I am showing in Figure 1 a model circuit with the various connections of the tube and circuit labeled with the terms as suit their value in the diagram. Briefly, the terms apply as follows:

The grid return lead is that lead which is connected to the filament circuit at either positive or negative potential, with its opposite terminal attached indirectly through the tuning system to the grid of the tube. This is vastly important in using different tubes, especially in the matter of which side of the filament battery the connection is made. Various actions can be obtained in circuits by merely changing the polarity impressed upon the grid by the connection of this grid return lead to either side of the filament circuit.

The plate return lead is that lead which connects the negative of the B or plate battery to either side of the filament circuit. It is of equal importance with the grid return lead in respect to the action of the tube in the circuit.

The other connections of the filament circuit, while not of so great an importance, should be carefully observed as one of the little trifles which contribute to the general effectiveness of a receiver.



The values of the wires in the circuit shown herewith are marked with respect to their function in the circuit.

Connection Chart

Allowing that all the present day tubes can be classified under various rules for connections, we can evolve a definite set of rules that can be followed out in the course of connecting the grid and plate return leads of a receiving set. We can then specify in general whether a potentiometer should be used or not from the start, and in this way establish a basis from which to start working. In Fig. 2 is shown a chart giving the various connections of

FIG 2.

CONNECTION CHART

TUBE	GRID RETURN			PLATE RETURN		
	DETECTOR	RADIO	AUDIO	DETECTOR	RADIO	AUDIO
C-301A UV201A	+ FILAMENT			+ FILAMENT		
DITTO		POTENTIOMETER OR – FILAMENT			+ FILAMENT	
DITTO			– FILAMENT OR – C BATTERY			+ FILAMENT
C-299 UV-199	+ FILAMENT			+ FILAMENT		
DITTO		POTENTIOMETER OR – FILAMENT			+ FILAMENT	
DITTO			– FILAMENT OR – C BATTERY			+ FILAMENT
WD-11 WD-12 C-11 C-12	+ FILAMENT			+ FILAMENT		
DITTO		POTENTIOMETER OR – FILAMENT			+ FILAMENT	
DITTO			– FILAMENT OR – C BATTERY			+ FILAMENT
C-300 UV-200	– FILAMENT			POTENTIOMETER		
RHEOSTAT	– F	– F	– F	– F	– F	– F

the grid and plate return leads, as well as the location of the rheostat.

While these rules apply to most tubes and circuits, there will be exceptions, and the most effective way to find them is to first sketch them out on paper and then work them out in practice. If the chart connections fail to give the expected results, the only certain recourse is experiment and trial. Invariably after one or two trials the proper one will be found.

Detector Tubes

We find in popular demand two types of detector tubes. Recently we mentioned that while we considered the UV200 tube a superior tube than the UV201A from a standpoint of a detector, this was an entirely personal view, and does not in any way mean that the UV201A is worthless in this capacity. In fact, it functions admirably in the detector socket, but to make it do so, we must use an entirely different set of connections than that of the UV200. Figure 3 illustrates the connections for the UV200 when employed as a detector. The UV201A should be connected in the manner shown at Figure 4 when used as detectors, as should all the high vacuum tubes. The UV199, WD11, WD12, C299, C301A, C11 and C12 all are classified as high vacuum tubes, and can all be used as detectors.

The connection of the grid return on a detector tube depends largely upon the type of tube used. Gas tubes work best with the grid return lead connected to the negative side of the filament. When high vacuum tubes are used as detectors, the general rule is to connect the grid return lead to the positive side of the filament when grid leak and condenser are used. The difference lies in the corresponding characteristics of the tube with regard to their action as amplifiers.

A few words might be said here about the action of the grid condenser and grid leak, and why they are so important in getting the proper quality of signal at the output end of the circuit. Referring to Figure 3, we have a circuit designed to give the greatest possible output to the amplifier circuit. To effect this condition, the grid leak resistance should be high compared with the input resistance of the tube; that is, about two megohms or more.

When a signal voltage is applied to the input terminals (in this case the secondary of the tuner), a voltage is built up across the resistance R, by the action of the rectifying characteristics of the grid circuit. This voltage is alternating in nature according to the modulation frequency. The condenser C bypasses the radio signal around the grid leak. When the voltage across R rises, this condenser becomes charged and after the wave has passed this charge must leak off by the way of the grid leak, so that the grid of the tube will be restored to its original potential.

Now if the grid leak and condenser are not properly proportioned, so that the charging current can leak off at the proper instant, we have distortion. The rate of discharge of the radio frequency signal which has been impressed upon the grid of the tube depends upon the proper choice of the grid leak and condenser. The customary way to obtain this proper action is to purchase a grid condenser having as the lowest consistent reactance with respect to the operating range of radio frequencies, and then make the grid leak have as high a resistance as we can without introducing distortion.

If static is strong, or you are near a strong local station, this idea does not work out very well, as the charges are excessive, and will not leak off fast enough when a high resistance leak is used. The high grid leak value should be used only on weak signals.

Many people question why a low resistance leak should be used with the gas content tubes, and this can be explained by saying that the gas which is allowed to remain in the tube during the process of manufacture furnishes in connection with irregularities in the plate and grid characteristics a conducting path for the charges to leak off. When the action described fails to accomplish this important leakage path, we use an additional grid leak to help it along.

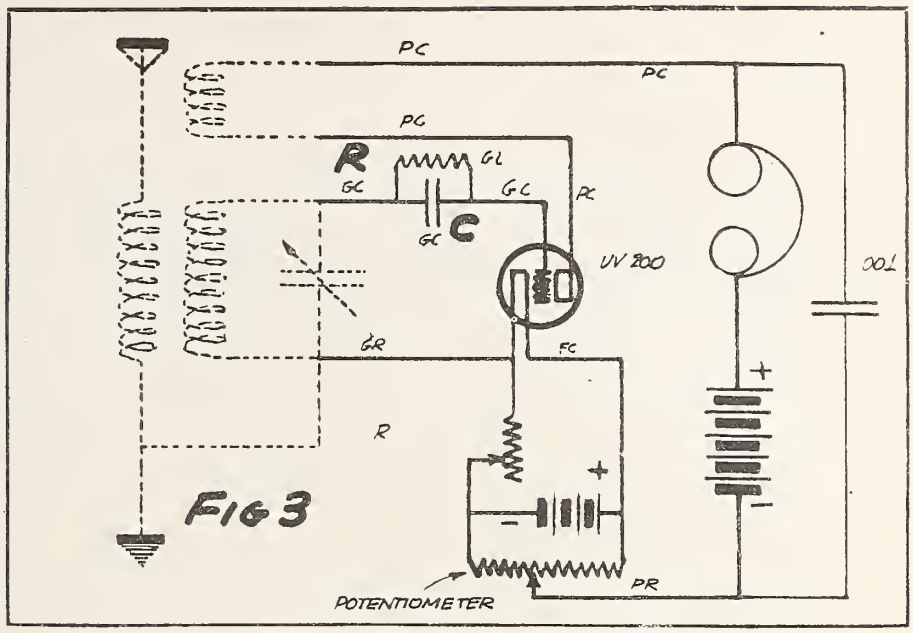
In some circuits, especially radio frequency amplifying, we find that there are connections (usually when impedances are used) which do not provide a direct current path through to the ground, and in such cases we connect the grid leak from the grid post to the positive filament. The Ultra-Audion circuit is another example of this case.

Radio Frequency

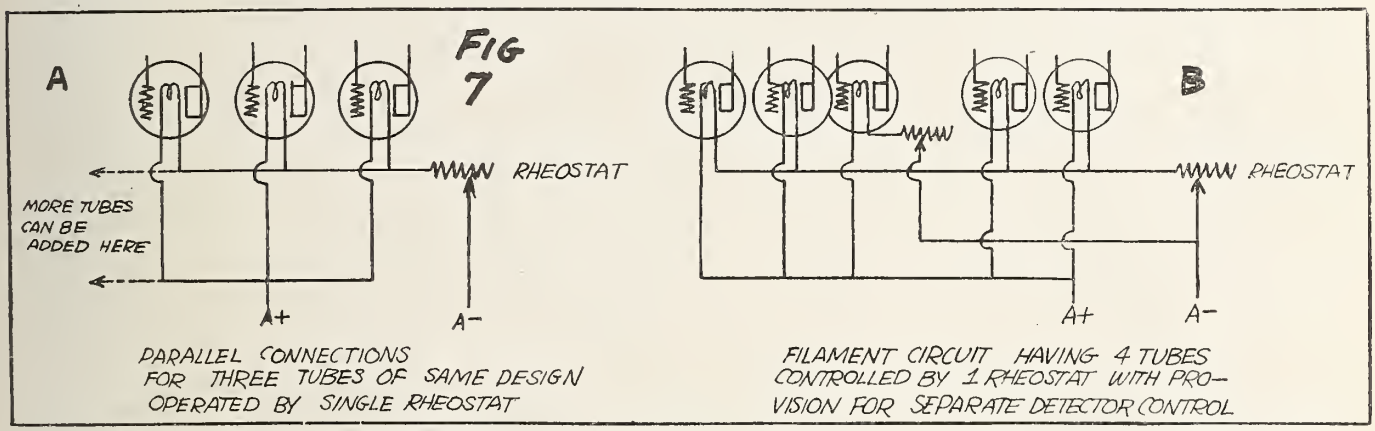
The grid return connection of the tube, when used as a radio frequency amplifier, is entirely dependent upon the nature of the circuit used. When potentiometers are used to suppress oscillations by varying the polarity impressed upon the grid, the grid return connection usually is made to the movable arm of the potentiometer, as shown in Figure 5. The action of the potentiometer in the circuit is to increase very finely the negative or positive charges on the grid.

When the movable arm is advanced toward the positive filament side of the resistance segment, the losses of the grid are increased, and the objectionable oscillations are suppressed. When the arm is moved toward the negative side, the grid losses are decreased, and full amplification value is had of the tube; but usually this state is not entirely possible, for as soon as the plate circuit comes into resonance with the grid circuit of the tube, oscillations start and we encounter distortion and radiation.

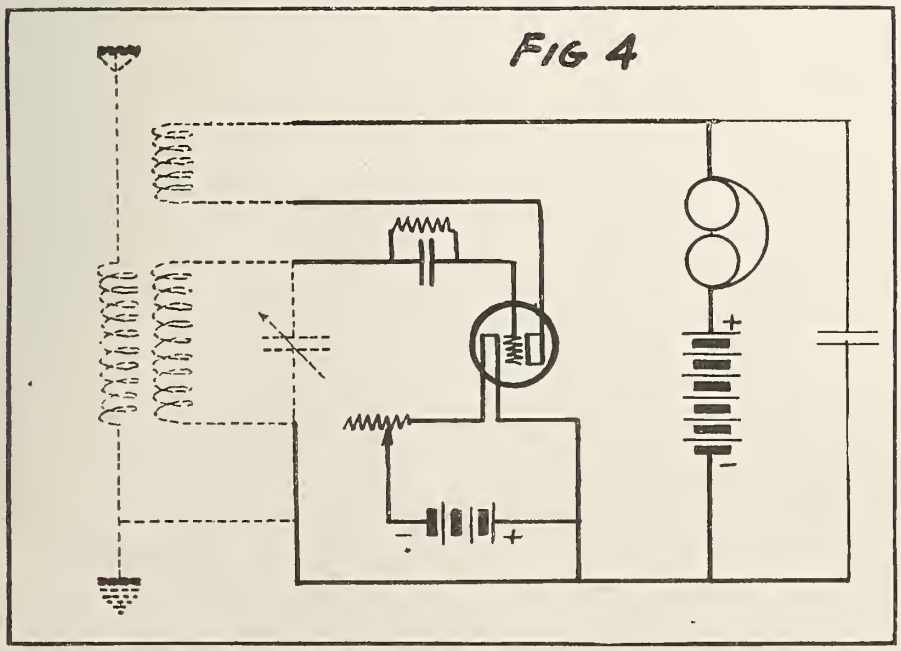
When some other means of stabilization is used, as an example the Neutrodyne, Rice and other circuits which balance off the plate and grid condenser action and oscillations, the grid return leads of these amplifiers should be connected to the negative filament. This gives full amplification efficiency, the obnoxious oscillations having been suppressed by or rather prevented by the neutralization of the plate and grid circuits.



These are the connections you should use when you employ a UV200 or other soft tube as a detector.



The filament circuits of several vacuum tubes may be controlled simultaneously with a single rheostat as shown on the wiring diagram above. This type of filament control is especially useful in multitube sets such as the super-heterodyne.

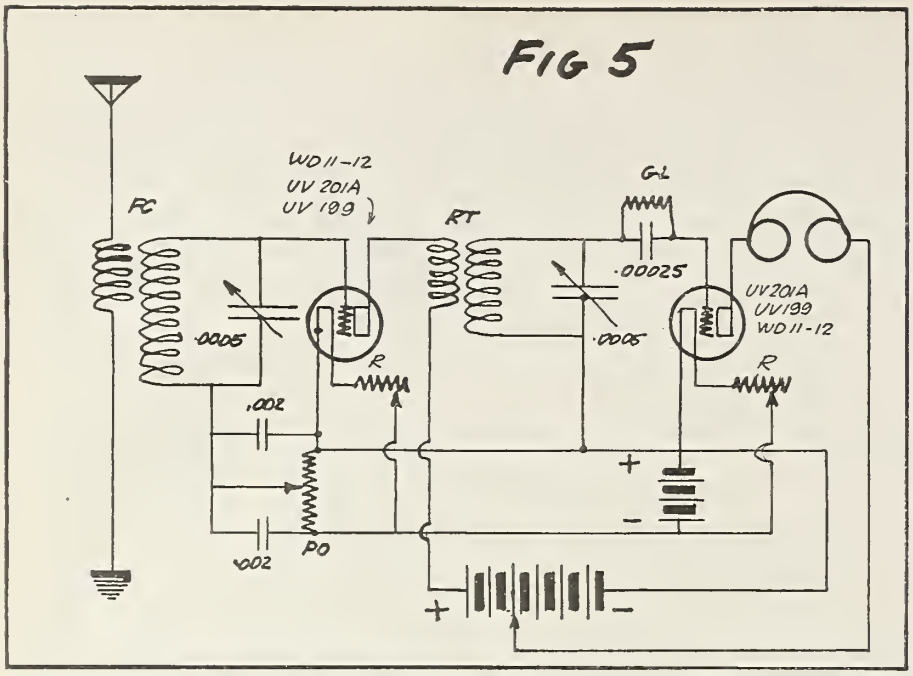


When a UV or WD tube is employed as a detector, the connections illustrated above should be used for the most effective results.

Potentiometer Losses

In radio frequency circuits, where a potentiometer is used to effect this stabilization, we introduce a great deal of losses, and as a consequence the strength of the signals suffer. It is therefore best when making any type of radio frequency amplifier which uses a potentiometer to first try the circuit with the grid return of the first radio frequency amplifier connected to the movable arm of the potentiometer, connecting the remaining stages to the negative side. In this way only the first tube operates at reduced amplification, while the remaining radio amplifiers work at full efficiency. The idea just described is shown in Figure 6.

For reasons that are quite evident, it



is not advisable to use more than normal voltages on the plates of tubes when they are used as radio frequency amplifiers. If more than 60 volts are used, it is advisable to use a grid biasing battery in order to offset an excessive drain on the plate battery. Usually it is only possible to make use of the grid biasing battery scheme when some other means of suppressing oscillations than a potentiometer is used. In other words, only such circuits as the Neutrodyne, Rice circuit and Superdyne or Teledyne is this grid bias battery idea practical.

The normal voltage for the standard tubes on the market as radio frequency amplifiers is 45, and it should be remembered that the little gain in amplification obtained when a higher plate voltage is applied does not compensate insofar as the drain on the B battery is concerned.

Other Radio Frequency Connections

Individual peculiarities of circuits and characteristics of the tubes themselves are often evident in radio frequency circuits, but this matter lies entirely within the scope of experimentation. If it is found that the circuit refuses to give the results expected, the proper recourse is as before mentioned—experiment. Peculiarities of this nature are really so different in nature that it is quite impossible to classify them under any definite head.

We have still another use for the potentiometer in the circuit, in this case controlling the plate return of the detector tube. It is espeially advisable with gas content tubes to use a potentiometer with its outer or resistance segment terminals connected to the positive and negative filament battery, and the movable center arm connected to the negative B battery.

This arrangement of the potentiometer affords a very delicate control of the plate battery current, and inasmuch as gas content tubes such as the UV200 are very critical with respect to plate current, it becomes a matter of much importance.

The A, C and UV, as well as the WD tubes, are not critical to either filament or plate current, and therefore do not require the potentiometer in this capacity.

The Technical Office of RADIO AGE is frequently asked to settle disputes as to whether the filament rheostats should be placed in the negative or positive leads of the circuit. In some cases, as in the UV200 detector tube, the position of the rheostat is not important, but it does make a difference in other cases. Specifically, this is the audio frequency amplifier, and for the sake of uniformity and consistency in wiring, it is always advisable to connect the rheostat in the negative filament lead.

Incidentally, many of our readers request that we designate for them the polarity of the tube socket connections with respect to the posts marked F and F. Often they ask us if the tubes have polarity action within the filament of the tube, because the sockets are marked F positive and F negative. The entire mystery is explained by saying that the filament connections are marked negative or positive for convenience in wiring, and it does not make any difference with regard to tube performance whether either end of the filament is made positive or negative.

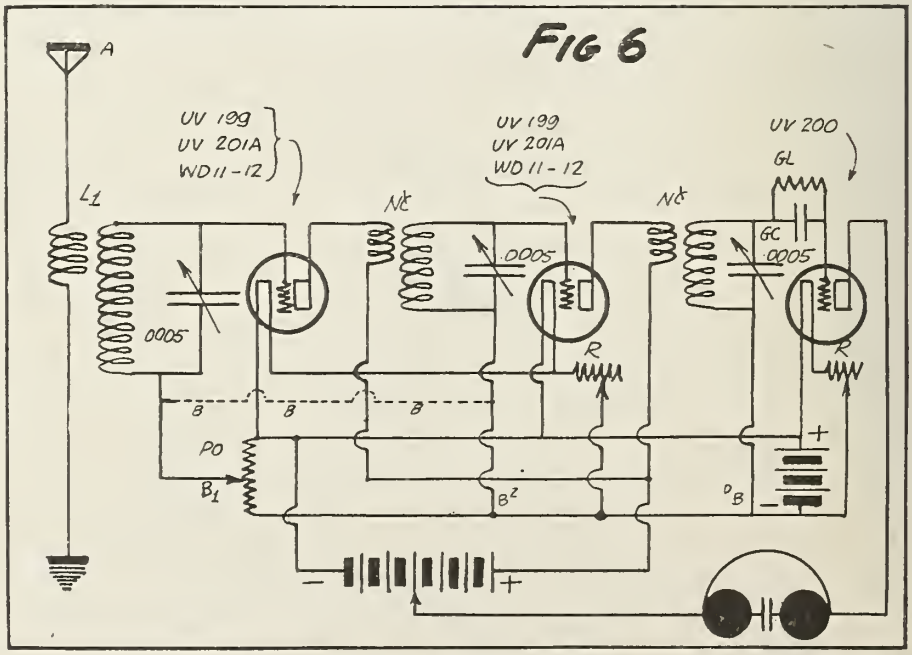
It is often desirable where space is valuable to use as few controls as possible, and the filament circuits, especially in the amplifier components, offer a chance to save panel space. Two or three amplifier tubes can be controlled effectively with one rheostat, and if desired both radio frequency and audio frequency amplifiers can be manually operated by the same resistance. The diagram shown in Figure 7 shows how additional tube may be added. It should be remembered, however, that as you add tubes, the resistance of the rheostat decreases.

Audio Frequency Amplifiers

The connections for audio frequency amplifiers of the cascade type are as old as the hills, and nearly every radio man can draw them from memory. However, many of them vary in design with respect as to how all connections are made, so for those who have any doubt as to the connections, I am showing in Figure 8 a diagram of a standard amplifier which can be added to any receiver without much trouble. It is considered good practice to omit the jack from the first stage, but if it is desired, follow out the dotted lines and the circuit will function just as well.

That leaves us with only one more

(Continued on page 51)



It is often necessary to connect the grid return of the second stage of RF to the potentiometer arm as shown, but should be avoided if possible. With a straight negative bias on the grid of the second RF tube, the circuit gives the greatest amplification.

DX With a Single-Dial

GO-GETTER

By PAUL THORNE

IN THE overwhelming excitement over supers and super-supers, and the ever-increasing members of the Dyne family, we seem of late to have largely overlooked several very important factors in radio development. What of the beginners—thousands of whom appear every day—or the old hands who have tired of many knobs and dials, and now want something that they can just turn on and listen? What of the modest experimenter who likes to tinker, but stands aghast at the multiplicity of controls and the network of wiring that makes even an old timer scratch his head? And what of that growing army of ladies who want to listen in on radio programs, yet are frightened away by "all those things you have to turn?"

These folks may all look far these days without finding any of the comparatively simple but effective hookups that used to appear regularly. Of course, the newcomers can go back and dig up some of the old stuff, but they feel that radio is advancing, and they are expecting something new. And even the old so-called simple hookups had their numerous taps and dials, so the ladies at least would be no better off.

While the engineers and experts are discussing their dynes and supers, here's something for the folks I've mentioned.

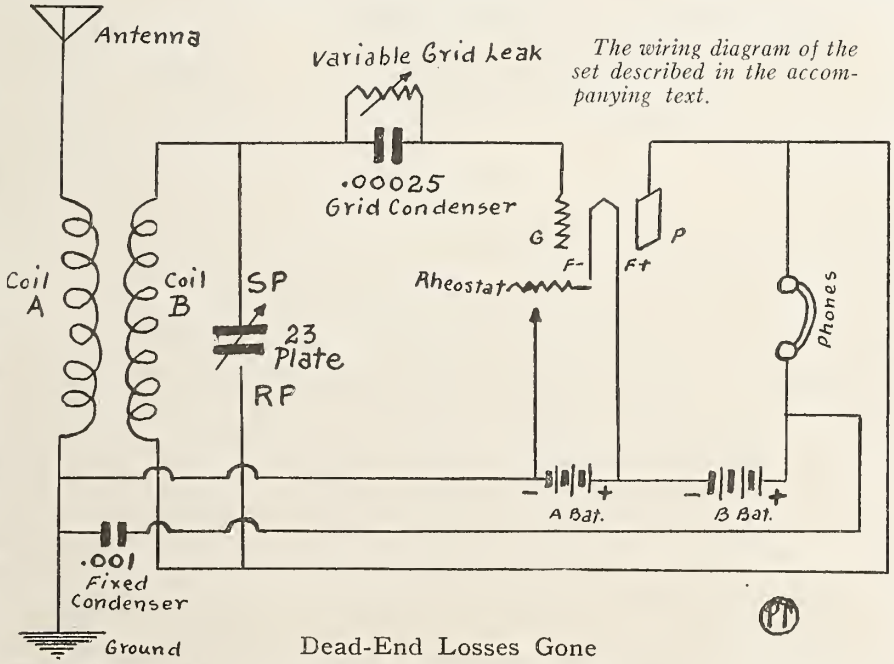
Are Supers Superior?

WHEN one compares the DX records sent in the various radio publications, the doubt often arises as to whether the newer super-circuits are really so superior to the simple circuits as we are sometimes led to believe. Looking over the records sent in by the proud and boastful owners of intricate sets, I find that I have had practically all of the stations listed on one or two tubes, using the hookup presented here.

For simplicity combined with effectiveness, this one-control hookup is hard to beat. It is very compact (note that, you portable set builders); it eliminates taps, operating on a minimum of fixed coupled inductance; uses spider web coils, and has only one tuning control—the variable plate condenser. Regeneration is controlled by the rheostat, but as the tube shows little inclination to "spill," it is seldom necessary to touch the rheostat again after the first station has been brought in with satisfactory volume and clearness.

It enables the beginner to experience the thrill of building his own set, and obtain really wonderful results right from the start, something which the average beginner often finds hard to accomplish. It offers the old hand who has tired of many controls an opportunity to get similar results with less effort. It is a set that the ladies will appreciate, for while the man of the house is away, they can easily tune in. To operate, they merely turn on the tube, and then turn the condenser dial to the station wanted, or if they don't know where to find the station, they simply turn the dial and some station will quickly come in. There is only ONE record to make when logging stations, and as they always come in at exactly the same point, it is easy to pick them up again if the station is on the air and weather conditions are right.

The set is easy and simple to build, and quite inexpensive. The circuit diagram gives all the necessary information except the preparing of the coils. This part is explained in detail further on.



The wiring diagram of the set described in the accompanying text.

Dead-End Losses Gone

AS USUALLY hooked up, however, a variocoupler is employed for inductance. Occasionally, coils wound on a tube, with a tapped primary, have been used. What I have accomplished is the eliminating of dead end losses, and useless work in building and tuning, by doing away with taps. At the same time I have made the circuit more selective. I have also greatly improved the volume and clearness by changing the rheostat to the negative side of the filament, and the addition of the ground connection from A—, and the lead containing a fixed condenser around the batteries. The increase in volume is considerable, especially on DX reception. The clarity of the reproduction is not excelled by any circuit, and is favorably commented upon by almost everyone who hears my sets.

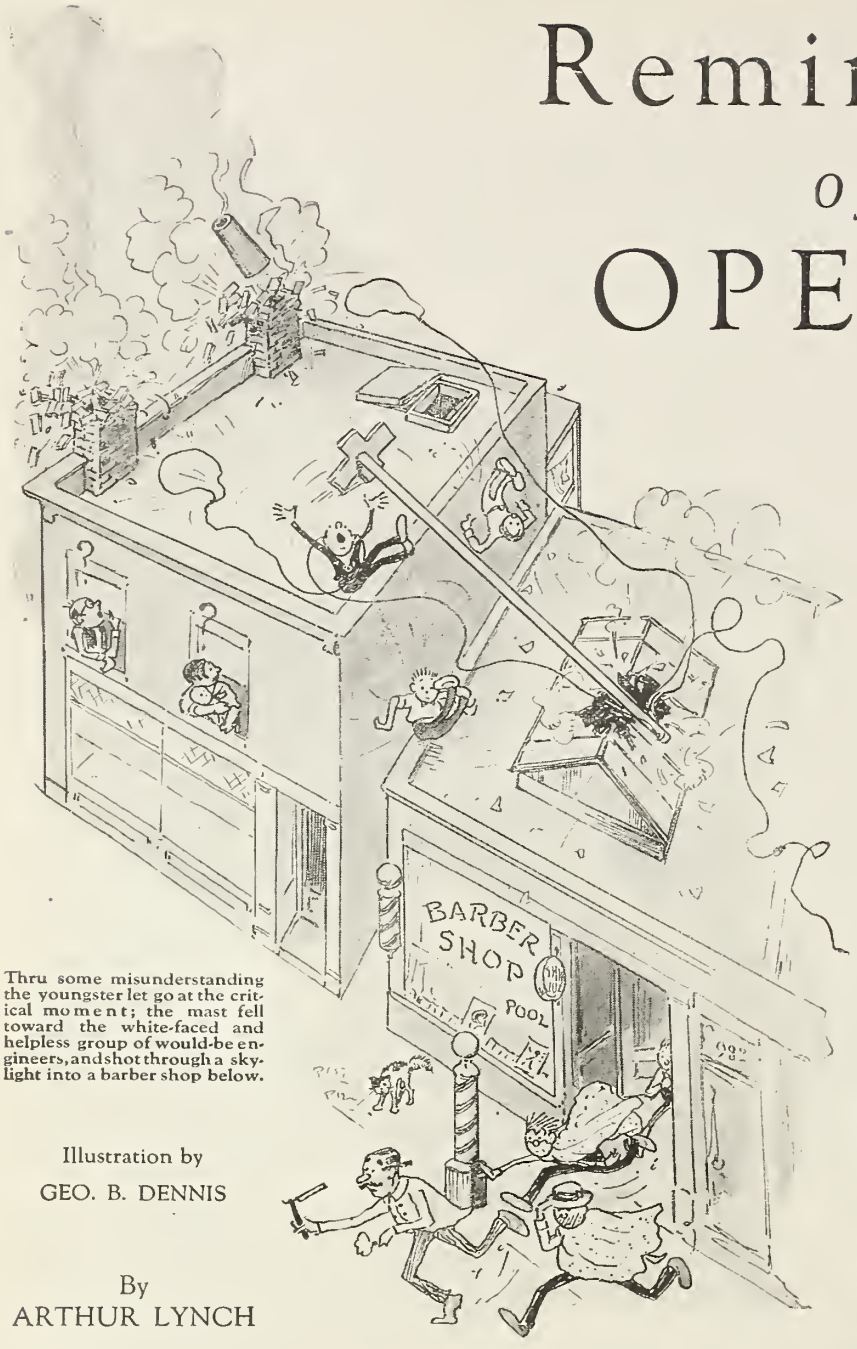
The size of the cabinet and panel is left to the builder's individual requirements. He may want to start with a one-tube set, and add amplification in a separate unit later, or he may wish to combine one or two steps of audio amplification in the set at once. While the diagram shows only the detector circuit, audio amplification can easily be added in the usual way. And in connection with this matter of size, let me say here that by using a compact plate condenser, and a UV199 tube, the set can be built into surprisingly small space, making a very efficient and convenient portable set.

An effective arrangement of parts is to place the antenna and ground binding posts in the upper left-hand corner of panel (looking at the front), and the phone and battery binding posts up and down the right-hand side. The plate condenser is put on the left, and the rheostat on the right, with the inductance coils behind the condenser and the tube back of the rheostat. If a variable grid leak is used it can be placed in the center of the panel. If a fixed leak is preferred, two megohms will be about right. I prefer the pencil type grid leak, as one can obtain very fine adjustment with it, which is highly important for good DX work.

In winding the secondary (B) coil, the

(Continued on page 53)

Reminiscences *of an Old* OPERATOR



Thru some misunderstanding the youngster let go at the critical moment; the mast fell toward the white-faced and helpless group of would-be engineers, and shot through a skylight into a barber shop below.

Illustration by
GEO. B. DENNIS

Part One: *"My Amateur Days"*

¶ A Vivid Retrospection of the Days When a Radio "Bug" Who Claimed to Extract Messages From the Ether Was Declared Mentally Unsound.

By
ARTHUR LYNCH

MY EARLIEST remembrance of wireless dates back to the latter part of 1906, or the early part of 1907, I am not quite sure which. The excitement started with my discovery in a current boys' magazine of a diagram for "a wireless receiving set which any boy can make," over which fortunate experimenters had heard stations "five miles distant." The diagram of this wondrous creation as it appears on a tattered piece of school drawing paper is now among my prized possessions in case some intrepid experimenter might desire to try it out alongside his superheterodyne.

The slogan "make it out of the junk you have" would hardly apply to a masterpiece of this magnitude, as few if any would find their shop stocked with the necessary apparatus. The list of materials was impressive, containing such highly scientific items as "200 feet of annunciator wire, one 75-ohm bi-polar telephone receiver," and again "one carbon rod from a common dry battery."

Among the concluding items stands out in my memory a shining item—"one brass head upholsterer's tack with head between 3/16" and ¼" in diameter." How I did sweat over that item! With foot rule in hand I visited some fifteen upholstery shops in my own and neighboring cities in search for this elusive item. Upholsterers' tacks by the bucketful, yea, by the wagon load, were to be found in profusion, but not one could I locate that fell exactly within the limits specified by my guiding genius.

Early in my search I found little interest in my micrometer standards as to tack head sizes, the dealers visited feeling that I should somehow squeeze in a tack 9/32" or worry along with one about 5/32". With scorn I rejected their counsel! What could a mere upholsterer understand of the niceties of science!

That was the trouble with the non-scientific gentry of those days. They looked askance at we youngsters' experiments in the mystic sport—wireless. They thought we were tinkering with instruments of the devil—to put it mildly. They offered us absolutely no co-operation at all, which made our efforts all the more difficult. But it was such dogged determination that finally overcame early obstacles and made radio what it is today. And now those same skeptics are our staunchest admirers and the first to say: "I told you so! I knew he'd make good!" But let us proceed.

THIS article is the first of an interesting series by a veteran commercial operator, who describes the facts and thrills of his rise from an awe-inspired experimenter, back in 1907, to a full-fledged radio expert. Don't fail to miss a single installment, you amateurs!

While searching for new stores to enter I concluded to take the next shopkeeper into my confidence, but after three trials I concluded that this would not do at all. In no case did I get beyond a third explanation of my purpose in procuring an upholsterer's tack with head between 3/16″ and ¼″. The first fellow was merely dumfounded. "Wireless telegraph!" he kept exclaiming. He HAD heard that it was possible to telegraph and talk with wires, but a *wireless* telegraph was absolutely beyond him.

All "Unbelievers"

HE HAD to call Lena, his wife, who came with two babies in arms and several afoot to hear me tell it all over again, which story was no sooner complete than friend Otto, from the bakery, happened in with his Meerschaum for a chat with his good friends. A third telling was finished amid an accompaniment of wondering exclamations from all but Otto. This sturdy German struck a jarring note in the symphony by expressing entire disbelief in the whole project.

In the argument which followed the object of my quest was entirely forgotten and I finally extricated myself, followed by thunderous advice against my foolhardiness from the now thoroughly aroused Otto.

My next conferee quickly became bored at my insistence upon such close dimensions and returned to his bench with the darkness dense and unpunctured by my careful explanations of the wonders of the new science.

The third auditor listened to my opening text, but as I began on the sermon itself he laid his tools down, came closer and started to scowl ominously. Then he interrupted and roughly informed me that I was crazy. Telegraph without wires! Any time a freckled, lanky, short-panted kid armed with a smudged foot ruler laid off in eighths tried to tell him he was going to hear some messages coming through the air without any wires—well, he was too dash-blamed, gadswocked wise for that. I was some young Edison, I was, etc.

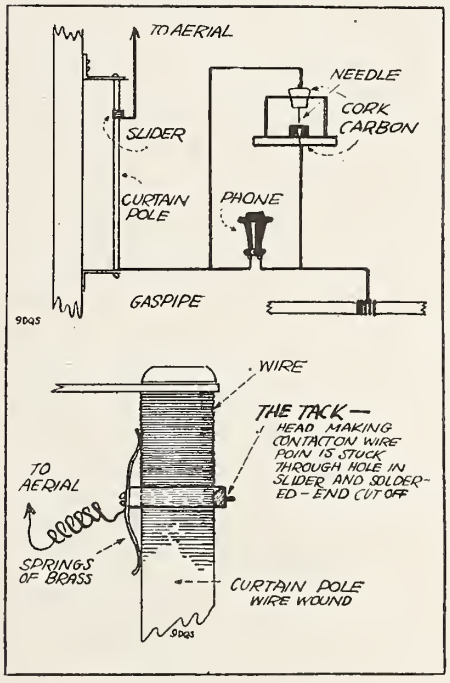
In despair I returned to my room and viewed the lavish outlay spread before me. Everything was there, right down to the "two blocks of soft wood 1¼″x 3″x 1″ thick" which were supposed to support the tuning coil on the base "3″x 3′2″ long by 1″ thick," all shaved down to the hair—but no upholsterer's tack with head between 3/16″ and ¼″. I almost gave up making the set because to my mind it never could work with an upholsterer's tack over ¼″; and at night I had dreams of Hertzian waves, little purple glowing rings something under ¼″ in diameter, dying by the millions, hanging in festoons on my wires with their leader stuck fast on the brass head tack some thirty-second of an inch too large.

Finally, with much care I filed down the circumference of a large tack to just a trifle under one and three-quarters of the eighth-inch spaces on my foot rule, and after polishing off the rough file marks, tried to convince myself that it would work.

With the set assembled, the first of many vigils at the one phone of the outfit began under awesome circumstances. My skeptical upholsterer friends had somewhat cooled my own ardor, and with my confidence further shaken by dissenting voices among my friends, I became chary of confiding my plans to anyone. Only my mother knew what I was doing and on the night of the first trans-continental tests she was in collusion with me falsely to announce that I had gone out for the evening.

In the darkness of my room I lay in hiding until quiet reigned in the household and mother's whisper at the door assured me that all was well. With curtains drawn and light turned low I made a final inspection of my connections from lead-in to gaspipe and found everything as per drawing.

THEN with a firm gulp swallowing my heart for the fifth time, I grasped the



This is the kind of "long distance Carbon receiver" that was in vogue back in the infant days of radio.

receiver and—witness the birth of the loud speaker idea—placed it within a close foot of my ear! Of course it was foolish of me to expect to hear the distant (four miles) station without radio frequency amplification, but remember that I was brand new at the game.

Suffice to say that I heard nothing from that receiver, even with it only an inch from my ear. Gaining courage I pressed it lightly to my ear, then, not suffering any ruptured eardrum, I squeezed it tightly, but no amount of grinding of receiver into ear produced anything but a dead silence. Right ear or left ear made no difference; light pressure or heavy pressure of needle on carbon block; brass curtain ring at top, center or bottom of tuning coil, all was silent as the grave.

Wrathfully I eyed the offending upholsterer's tack which, you recall, I had doctored into a semblance of proper dimensions. There, undoubtedly, was the trouble. However, I decided I would look over my aerial and outside connections on the morrow.

My aerial consisted of a brass rod stuck about four feet above the third story roof. Quite an antenna, at that, when a fellow can get Cuba on a loop—and six or eight tubes. Passing up the good or bad qualities, for I knew naught of either then, my daylight inspection showed everything shipshape, so I decided to give the outfit another tryout that night. Possibly, I thought, there were no messages being sent the night before.

But there was nothing doing that night or for several succeeding nights. Then as I was pondering one day I was chilled by a horrible thought. Possibly our only local station, "CG," Collingswood, N. J., was farther away than the four miles I had always believed lay between our house in Camden, N. J., and the suburb. The article regarding the set only claimed five miles for it, you will recall. Maybe the station was five and a quarter miles!

At first opportunity nothing would do but for me to pedal on my bike to Collingswood, watching the odometer tick off the tenths. 4.3 it registered from my house to Collingswood by road. In an air line it was no doubt much closer.

Now, absolutely stuck, I started doggedly listening, listening. In the morning before breakfast, at noon as soon as I was home from school, night after night, and still not a sound until—

One noon, as usual rushing up to my room, I was arrested at the doorway by a prodigious clicking coming from the general direction of my set. With heart standing still I breathlessly approached and soon traced the wild racket to the seventy-five ohm phone lying on the table. No need to put the receiver to ear—the clicking was of goodly bulk and strong and could be heard perfectly well with the phone where it was.

His Dreams Blasted

ON THE point of tearing madly through the house shouting the tidings to all, I paused. Somehow it struck me that something was irregular about all this. Picking up the receiver and placing it near my ear I immediately noted that the loud clickety-clicks emanating therefrom had little in them of a far off nature. They sounded more like good, healthy battery juice being fed directly into the coils of that phone. We had often used this very hook-up as a variation of our key and sounder circuits.

Hastily I examined my wiring. Sure enough, there were signs aplenty of dirty work at the cross roads. Hooked to my aerial and ground was an extra pair of wires leading over the window sill and down the outside of the house. Tiptoeing softly downstairs and down cellar, I came upon my Uncle Joe, a dabbler in electricity but a skeptic as to wireless, with a key, two dry cells and the other ends of two wires which I could gamble were furnishing sigs to my third floor "wireless" set.

Now that I am more or less grown up

and able-bodied, I am firmly resolved that if I ever meet my Uncle Joe again I am going to poke him hard at least once for that frameup. At that, his signals were the only ones I ever heard on my first set.

There follows a period in my radio career of which I can recall nothing. Then, perhaps a year later, I became acquainted with my first wireless friend, Norman Shepherd, who lived at 214 Broadway in my town, and who I found had quite a complete outfit. It always has been a mystery to me where he got his dope for the good equipment in his station. The details certainly were not being widely published—witness the diagram and description of my premier effort.

Shep had an electrolytic detector with platinum wire sealed in glass tube, later to be supplanted by the "whisker point"; he had fair receivers, a two-slide tuner, some potentiometers made of lead pencils, and a raft of other stuff. His sending set was a sight to behold. A ten-inch spark coil was used on 110 A. C. with about fifteen lamps series-multiple on a board right over the operating table. Broadway was a darkened country lane in comparison when Shep pressed the key. People came for miles to see the display.

The aerial would do credit to any good commercial station today. It was a ten-wire flat top a fair city block long, atop three-story houses and held forty feet farther aloft by two masts, each composed of a 4x6 below and a 2x4 above, supported by a maze of guys. The poles merely rested on the roof and were not fastened at the bottom. The guy wires were calculated to divide the strain equally and to do all the holding up necessary.

And believe me, they did that. I immediately became very active in the game and engineered many an aerial put up like Shep's in the following eighteen months—and always the same system of guys with no bottom support. I believe honestly I would hesitate a long time right now before I would swing a tall stick aloft depending solely on my calculated lengths of guy wires to tighten up and hold 'er there when it reached the perpendicular. Yet we did it dozens of times in those days with never a qualm, and with but one serious smash.

The author of this discordant recollection was barred forever from our construction force, and even now I can picture his disappointed little face in the crowd of smaller kids who were always on hand to pull the ropes, hold the guys and run the errands at every aerial raising.

An Aerial Calamity

ON THE day in question little Harry was detailed to hold for dear life onto one of the two topmast back guys, the two which above all were depended on to come to a comfortable tightness and STAY there as the pole reached its upright position. Through some misunderstanding, although thoroughly instructed, this youngster let go just at the critical moment. Pausing momentarily at the pinnacle, the stick continued its arc, first slowly, then more rapidly falling toward the white-faced and helpless group of would-be young engineers. The remaining top guy had only complicated matters by causing the stick to lurch sickeningly to one side, and the middle guys, not being greatly counted on, were too slack to exercise any restraint until the pole was well on its downward flight. Two fairly good chimneys to which these guys were fastened promptly crashed to the tin roof, upon which the assistant engineer in charge of the remaining middle guy let go the end, thinking to save his chimney from a similar fate.

Careening madly in a side-sweep, the pole knocked two of the boys for a row over the edge of the roof—fortunately a short story to the second floor roof of a wing of the building, then shot like an arrow, amidst a jangle of guy wires on the tin, straight through a skylight into a barber shop below. Although casualties could have been more numerous among us, perched fifty feet above, the nearest approach to actual death was in that crowded five-chair barber shop on a busy Saturday afternoon. A final check showed nothing more serious than several cases of panic, but wireless was strictly taboo in that household—yes, in the entire neighborhood.

ABOUT THE AUTHOR

Arthur Lynch, author of the reminiscent series beginning in this issue, has followed radio from its lowly birth to the lofty perch in the scientific world which it has now attained. After seven years in the commercial field, he spent two years as an operator for the Navy and four years as a practicing "observer" at home. He was one of the first to hear a raucous "Hello" from the De-Forest experimental station in New York in 1909. From all these years of experience, he will unfold to amateurs and "BCLs" some glimpses of the progress of radio through the eyes of one who loves the game.

—The Editors.

How long the Navy and commercial companies had maintained workable systems of wireless I do not know, but I clearly recall that at this period we could hear a string of stations up and down the coast from Cape Cod to Key West. Right fair distances, eh?

Which reminds me that never do I read an account purporting to chronicle the progress of radio that tells the real story of distances achieved or that is chronologically ten per cent correct. Per these accounts no understandable signals were ever received more than five hundred miles prior to about 1913. I am telling you right now that in these extremely early days we consistently copied Key West every night in the Winter, and later on in my accounts of commercial work on shipboard, I will tell of regular two-way exchange of volumes of business between ships and stations 2,500 and 3,000 miles apart. Furthermore, I remember Dave Heilg, my tutor prior to my entry into the commercial game, telling of the same regular transmission of messages as far back as his shipboard days on the Hamburg-American South American ships in 1904-5.

How we used to thrill at "Q1," Washington, with a wonderful high-toned spark —about 120 cycles!—trilling back at "PV," our coarse-voiced neighbor at League Island, now Philadelphia, Navy Yard. "PV's" spark would take fits of breaking, making noises like a big boy whose voice is changing rather late, except that its normal note was high and the break was downward. Catapulting up and down at every other letter, it must have been a "peach" to read through static.

"PT" I remember as Brooklyn Navy Yard and "PR" as Fire Island. If I miss on any of these, somebody please correct me. "QL" I believe was Norfolk's roughly spoken sign. And dear old "RD," Key West—what a triumph when he would rattle in on 1500 meters with a spark frequency of about twenty-five cycles. In the same period was "BX," later "BS," the United Wireless Telephone and Telegraph Company's station on the Bellevue Stratford Hotel, Philadelphia, working with "AX," Atlantic City, "NY," 42 Broadway, New York City, and "FS," the Plaza Hotel, New York City. As the United flourished, more ships and stations were added until any night our electrolytic and silicon detectors brought in a veritable beehive of stations. "WA," Waldorf-Astoria Hotel, New York City, and "DU," Dupont Building, Wilmington, Del., were late arrivals.

The First "World Criers"

SOMEWHERE in this period, too, "CC," Cape Cod Marconi, came on the air—or probably we just discovered him then, and after that, it was press every night at ten o'clock. These bulletins, which we could have read in five minutes in the evening paper, we would struggle for a good two hours, posting same on the kitchen door or back fence alongside of Washington's weather report at the same time we changed the weather flags for the day. Sure—every amateur in our neighborhood had a complete set of signal flags which all the laymen in the block marveled at, but, of course, could not understand.

How many here—hold up your hands —who remember the thrill of that cold, impersonal non-synchronous spark starting promptly at ten with . . . — . . . — . . . — — .—. —.—. —.—. —.—. then "To all Marconi ships and stations," followed by "New York Herald (or some other paper) says—" and a short editorial from some New York sheet and a long string of press, the items separated by the word "stop," with stock reports at the end? This press, we understood, was punched onto a tape and fed through a sending machine twice as both sendings were identical, even to any mistakes which had crept into the punching.

As I think back, however, I believe our biggest thrill came when we heard our first 500-cycle spark. The Navy was running some tests between the scout cruisers Chester and Birmingham and the land station at Brant Rock, Mass. We never heard the cruisers, but one night Shep and I landed "plop" on Brant Rock's tune

(Continued on page 40)

What the Broadcasters are Doing

Radio Station WIP Broadcasts From Bottom of Atlantic

Since radio broadcasting took this country by storm, many strange things and many strange sounds have been broadcast. The roar of the mighty Atlantic's waves, the rattle of a rattlesnake, the voice of an aviator high in the heavens.

And now, the marvels of the deep sea have been broadcast to the entire world. On Thursday, July 31, at 3 p. m. and 8 p. m. the Atlantic City Control Station of Radio Broadcasting Station WIP, of Gimbel Brothers, Philadelphia, broadcast from the bottom of the Atlantic Ocean.

Not satisfied with the new and novel idea of broadcasting the surf noises of the mighty Atlantic, Station WIP's engineers looked for a stunt that would be even more thrilling.

So a deep sea diver dropped over the side of a boat, to the floor of the Atlantic Ocean, fifty feet or so below. In his diving helmet, he had a special radio microphone, connected by lead cable to the boat and from there to the Remote Control Station of Station WIP, on the Steel Pier, Atlantic City, N. J.

C. O. Jackson, expert diver of the Philadelphia Derrick and Salvage Corporation, was the first man to talk over radio from the bottom of the sea.

Through the heavy glass windows of his diving suit, Mr. Johnson has seen many strange and wonderful sights of under-sea life. The special microphone, which was attached inside his helmet, enabled him to describe to the radio public, exactly what was going on at the bottom of the mighty Atlantic.

The strange fish, and other sea creatures living at the bottom of the sea were described. The appearance of the sub-sea foliage and mineral formations were broadcast in full detail.

This was the first time that any broadcasting station has sent a microphone to the bottom of the sea. Special cable, waterproof and flexible, is necessary to connect the diver to the boat. The voice originates from the helmet of the diver, thence to the boat floating on the surface of the water above. The boat, in turn, is connected by wire to the Remote Control Station on the Steel Pier. Here the voice from under the ocean is amplified many thousands of times, then transmitted over special telephone lines to the main station, located on the Gimbel Brothers store in Philadelphia, more than sixty miles away.

Movie Talks On WGY

WGY, the Schenectady broadcasting station, introduced a new weekly feature last month which is sure to be of interest to a great majority of the station's listeners. Quinn Martin of the New York World delivered the first of a series of "Movie Notions." Mr. Martin, who has made a study of the movie industry for years and has visited most of the large studios, told about the best pictures produced and took his listeners back of the silver sheet into the producing studios and explained how some of the stunts are done. He gives intimate pictures of some of the leading figures in the motion picture industry. In his first talk he discussed the slow but sure tendency of the producer to artistic production.

BURTON THATCHER

has gained considerable fame and following for his method of teaching vocal lessons over station WLS of Chicago. His listening clientele consists of hundreds of men, women and children who have profited by his instructions broadcast over the air in the past few months.

Musical Rehearsal Held by Telephone

One of the most unique musical performances in this age of startling achievements was accomplished when a musical rehearsal was successfully completed by means of long distance telephone.

Miss Wellman, who is one of the youngest vocal artists engaged in concert work, was invited by Victor Saudek, director of the KDKA Little Symphony Orchestra, to appear on the broadcasting program of station KDKA and render a few musical numbers. Miss Wellman gladly accepted the invitation and arranged to come to Pittsburgh before the date scheduled for her appearance for the purpose of rehearsing her numbers with the KDKA Little Symphony Orchestra.

A few days later Mr. Saudek received a telephone call at the East Pittsburgh broadcasting studio from Miss Wellman in New York stating she would be unable to leave New York in time for her rehearsal, and so she decided that it would be better to cancel her engagement. Mr. Saudek, however, suggested that she conduct the rehearsal by means of the long distance telephone over which they were conversing. She agreed.

The orchestra was soon in readiness, and with the telephone receiver to his ear listening to Miss Wellman singing, Victor Saudek was able to direct the Little Symphony Orchestra at the East Pittsburgh studio and thus conduct the rehearsal. "The Spring Song" from the opera "Samson and Delilah" by Saint Saens, and "Oh Rest in the Lord" from the oratorio "Elijah" by Mendelssohn, the two numbers which Miss Wellman sang at the concert, were played until the orchestration was satisfactory.

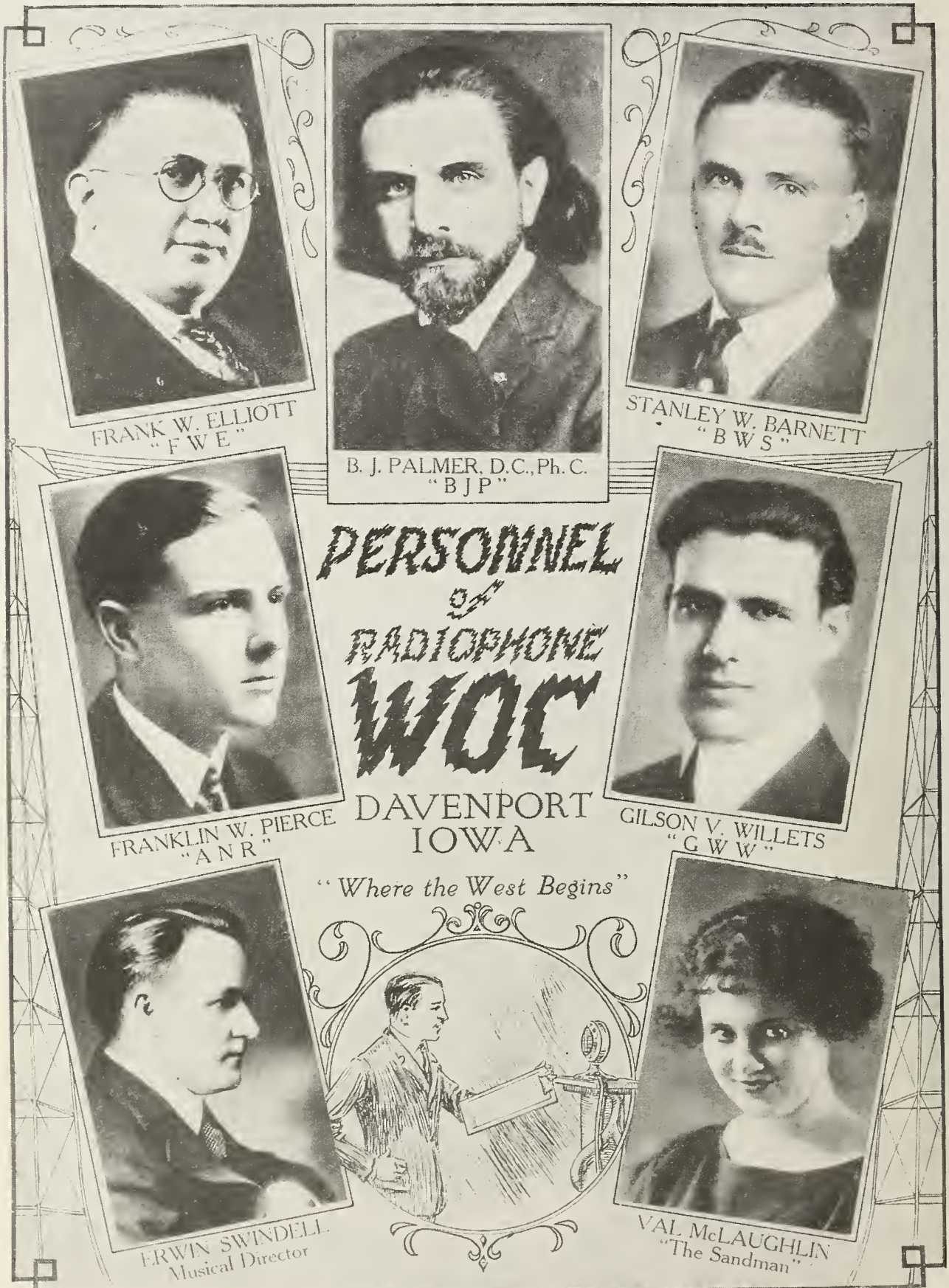
Radio Brings Help for Tornado-Stricken

At the time of the appalling Lorain tornado disaster some weeks ago, various Chicago stations co-operated in many ways toward bringing relief to the stricken areas.

Every one of the local broadcasting stations of the city read off regular announcements from the Chicago Herald-Examiner, soliciting the aid of doctors and nurses to aid and give medical attention to the sufferers of the terrible storm which struck the Ohio towns.

The value of this service can never be computed, but it is a convincing argument in favor of the use of radio broadcasting in times of disaster and danger.

"OUT WHERE THE TALL CORN GROWS"



Here are some of the folks you are sure to hear when you tune in on the Palmer School of Chiropractic station, WOC, at Davenport, Ia., "out where the tall corn grows." WOC recently celebrated its second birthday and for a "two-year-old" it is quite a husky youngster, as radio stations are rated.

A Radio Station That Receives 12,000 APPLAUSE CARDS WEEKLY!

THE "INSIDE STORY" OF WOC

THE radio broadcasting apparatus installed at WOC, the station of the Palmer School of Chiropractic at Davenport, Ia., puts its facilities for broadcasting on a favorable footing with those of the most powerful stations anywhere in the country.

Housed in specially fitted rooms on Up-E-Nuf, the roof auditorium of the school, are the broadcasting apparatus and the studio equipment, each the last word in modernity.

The studio is one of the most efficient in the Middle West. In the first place, the altitude is sufficient to eliminate street noises which might interfere with perfect broadcasting, and secondly, there is genuine beauty of surroundings as well as picturesqueness of furnishings.

Solidly constructed is the room in which the actual broadcasting is done, and the studio and reception room afford ample accommodations for any number of artists that could possibly be used on a single program.

Pipe Organ Programs

THE installation in the B. J. Palmer residence of the pipe organ gives another unique and unusual form of radiophone music. The organ is one of the finest in the country. The console is located at the east end of the music room and the main organ is located in a chamber especially built for it directly overhead.

The Echo organ is placed in a similar chamber at the extreme west end of the porch, and on account of its relative location to that of the main organ, the most charming and enchanting effects are possible.

The outlay of money entailed by WOC's broadcasting service approximates $60,000 annually, indicating the faith the owners of the station have in the permanency of radio as a public necessity. Other organizations in the country are convinced of the place of radio in the American scheme of things, and likewise have invested materially, although few have striven for the completeness of facilities which now characterizes WOC. The most vacillating of doubting Thomases must concede that the step taken by WOC has reacted to the satisfaction and entertainment of the school's friends and has brought the name of Davenport before the country as it could be brought in no other way.

That it has proven a boon to the thousands of receiving stations in Iowa and surrounding states is certain. WOC was planned by and manufactured under the supervision of the same engineers who startled the world in 1915 by establishing vocal contact between Arlington, Va., and Paris, Colon, Honolulu and San Diego, and who during the war contributed materially to radio telephonic developments undertaken by the Army and Navy.

Distance Tests Held

THE Palmer School of Chiropractic broadcasting station is unique in many respects. Designed to cover a region of from 100 to 150 miles from Davenport, and to deliver 500 watts of radio frequency power to the antenna system under all conditions, under favorable conditions it can be heard at very great distances.

In three days following the initial test of the apparatus on the evening of Tuesday, August 15th, 1922, over two thousand enthusiastic reports were received from this test program. These letters came from thirty-five states and from Canada and Cuba. The entire United States had been reached, with the exception of the New England states and the country west of the Rockies.

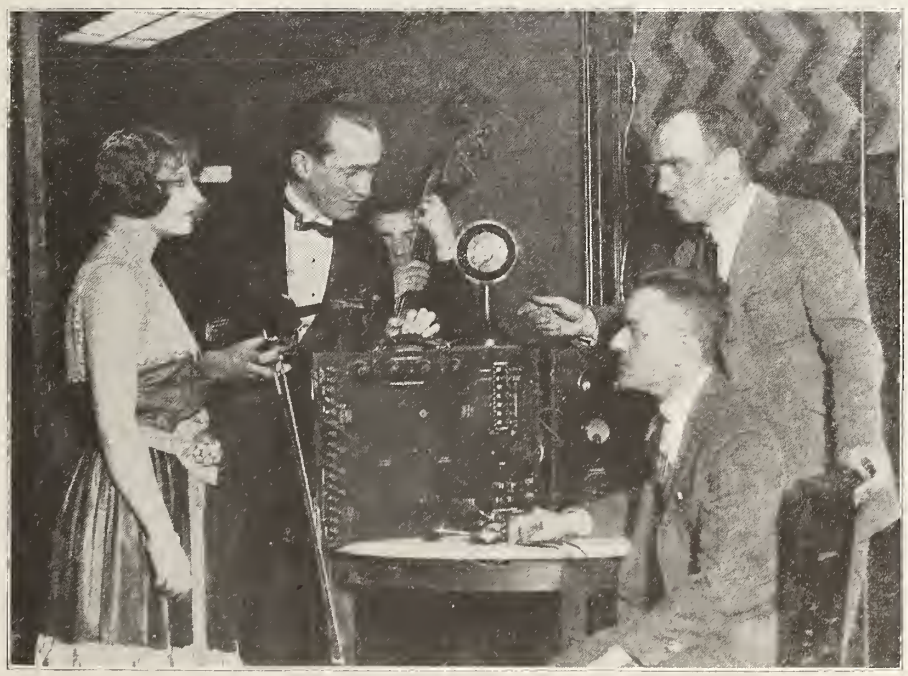
At the end of the first month's test broadcasting, in spite of severe summer weather, the remaining states had dwindled to three in number, with the record air line distance at 1,765 miles.

Shortly afterward was established the enviable record of being heard in every civilized state and province in the North American Continent on one single program.

To obtain ideal operating conditions for WOC, a special suite of rooms has been prepared, every means having been taken to insure suitable acoustic properties. The chamber that houses the microphone and forms the headquarters for the speakers, vocalists and musicians secured to conduct the broadcast programs is a mysterious compartment with walls shrouded beneath layers of draperies and a floor buried beneath the heaviest of carpets. Constant study has proved that to prevent the reflection of sound and to prevent the impairment of the quality of vocal and instrumental music such precautions are necessary.

WOC has received in one week as many as 12,000 applause cards from "listeners-in" within a radius of 4,000 miles. Acknowledgment cards, form letters, and circular letters are made to cover as much of this work as possible, but there are in addition an endless amount of requests for individual numbers, repeat numbers, replies to police reports, requests by speakers, requests for acknowledgment, etc., which require individual attention.

WOC operates on a 484 meter wave length. Tune in tonight and get acquainted with its peppy staff.



LITTLE LESSONS IN BROADCASTING

George Frenger, better known to WJZ-WGY listeners as "A. F. N.," is giving a few hints on broadcasting to Paul Specht, while the latter is waiting for his orchestra to "take the air" at the Alamac, N. Y. At the left Mlle. Sascha Beumont, dancer, is listening to George's warnings on how to speak to a microphone.

Usually it's hard to smile in the presence of an unresponsive microphone. But Howard I. Milholland, announcer of the Pacific Coast Station KGO, likes to announce. He is shown above at his favorite indoor sport.

How Would You Say 'Good Night'?

WHAT 'GOOD NIGHT' MEANS AT KGO

AS HE left the home of the Rev. Milholland in Roodhouse, Illinois, 39 years ago, how was the good old country doctor to know that his cheery "good night" would be echoed years later so significantly by the new voice he had just ushered into the world?

If KGO, the General Electric Pacific Coast Station, had then been in existence, "Daddy" Milholland surely would have preceded his son as announcer and broadcast the glad news to the world. Being of a humorous turn of mind, he perhaps imagined himself, megaphone in hand, on a steep, snowy roof, announcing to the sleeping world, "It's a boy!"

The following Sunday the Rev. Milholland blushed a little (he was only 22 at the time) announcing to his congregation, "God has been good to me and has given me a son; we shall christen him 'Howard'."

Howard weighed 10 pounds when he was born, and in less than three years he was big enough to say "good night" plainly. When he was 21, he graduated from the Eastern Illinois State Normal School. He then began writing his name "Howard I. Milholland," and decided to go West. After sizing up the Rocky Mountains in the distance, he settled in Denver, engaging in the photographic supply business.

BEING married now, and with a growing sense of his responsibilities, Howard I. Milholland is next found growing a mustache. "Straightaway," said "HM," when telling the story of his life recently, "I got the idea of being an impersonator."

A minister's son does not always stay out of church activities even when he fails to follow his father into the pulpit. So for the next few years it's natural that we should learn of "HM" singing in various churches and directing choirs. Meanwhile he also traveled considerably as a reader and impersonator.

"When I first stepped before a microphone on the evening of January 8, this year, at the opening of KGO," said "HM," "I naturally felt a little nervous, but my platform experience helped a lot. With the coaching given me by Mr. Hager of WGY, I saw that announcing required a technique, based upon the ability to enunciate clearly. I also found the routine of announcing very much different than the routine of platform work."

"HM's" ambition is to learn how to say "good night." He believes that much of an announcer's work is so cut and dried that he should give a lot of thought to the way he says "good night." With "HM" the phrase "good night" can mean many things. If your day has been a hard one, "HM" simply wishes you a "good night" or a "better night." Should you have taken a little step aside during the day, "good night" for you means—do a little better tonight. If you are grouchy or unsociable, "good night" is simply a friendly suggestion which might help you. If you have the spirit of malice in your heart, "HM's" "good night" may tell you that by kindness and love we fulfill our mission here.

Or you might just happen to be listening in on KGO for the first time. "Good night" then is meant to convey to you the hope that you have enjoyed the program and will listen again.

"Perhaps I take my job too seriously," said Howard I. Milholland. "I think I must have inherited a desire to preach from my father. And the best sermon I can think of is simply 'good night'."

N. Y. Philharmonic Orchestra on WGY

During the months of July and August, WGY gave a special musical treat for its audiences. A series of eleven concerts by the New York Philharmonic Orchestra and a series of eight concerts by Goldman's Band were broadcast.

Programs of both organizations, the New York Philharmonic Orchestra and Goldman's Band, were presented in New York, the former at Lewisohn Stadium, College of the City of New York, and the latter at The Mall, Central Park. WGY was connected to New York by wire and presented the concerts in co-operation with WJZ.

Broadcasting From Portable Station to Be Tested to Find WJAZ Location

Many Illinois Cities to Compete to Win Zenith Station

AN unusual occurrence took place when a metropolitan broadcasting station was recently disposed of by one of the pioneer radio corporations in broadcasting, because the station dominated the air to such an extent as to prevent radio listeners within its immediate scope from hearing any other stations. It probably began the movement of broadcasting stations having their ultimate location away from the thickly populated areas of the country.

This unexpected stroke of policy was announced by the Zenith Radio Corporation when it sold Station WJAZ, then located on the Edgewater Beach Hotel. Because of the uncontrollable interference caused by this station throughout the entire north shore of Chicago, the company decided to erect a new station far enough away from the city so as to be no longer an interference to the three million of people who live in the city.

A "Portable Test"

On the heels of this announcement, the Zenith Radio Corporation was deluged with letters from the Chambers of Commerce of many of the small communities in the outlying districts of Chicago. Some letters came from places two hundred miles away.

So urgent were many of the invitations from these smaller towns that it was decided to conduct a series of tests to ascertain the best locality for broadcasting and to determine at the same time the place offering the least opportunity for interference. The best working plan which suggested itself was to erect temporary broadcasting stations in all the towns selected for test. For a time it looked as though the plan of making tests would have to be abandoned because the attendant obstacles seemed to be insurmountable. But after planning and experimenting in the company's laboratories a way out was discovered.

The company is now building a complete broadcasting unit mounted on a one-ton truck. There have been portable transmitting stations for code work, but from all available information, this is the first portable broadcasting station in history. It will be equipped with a 100-watt transmitter. It will have the unusual setting of a glass-enclosed truck, so that the public may witness the operation of the station wherever it is taken. It will be operated entirely from storage batteries. Part of the truck equipment will be a motor generator for recharging the batteries. The aerial will be supported above the truck by means of telescoping masts. Gold plated antenna wire will be used, as gold reduces surface resistance and greatly increases efficiency in an antenna of this size.

Arrangements are under way with towns favorably disposed to receive the new broadcasting station. Tests will be arranged in each case for a definite night and the officials of these municipalities will be invited to extend the greetings of their respective communities to the world by themselves speaking into the microphone of the portable broadcasting station. Already programs with two towns provide for the local band taking part in the broadcasting.

To Award Prizes

In every town prizes will be awarded for the longest distance reception. The data gathered through these tests will be especially valuable to radio technicians and engineers. For, as is generally known, it is impossible for radio experts, with all their theory and practice, to predetermine the broadcasting value of any given locality without actual tests.

For this series of experiments the call letters 9XN will be used. They will be remembered as the call letters that played so important a part in the radio communication with the MacMillan Arctic expedition.

Kadel & Herbert.

EVEN THE INDIANS HAVE THE RADIO "BUG"
Radio is becoming the most popular entertainment of all among the Indians on the reservations in Wyoming, where thousands are encamped. The big chiefs and their families are showing a decided preference for radio in place of the traditional Indian tom-tom music. Here you see two Indian chiefs "listening in" on a set donated by a nearby Chamber of Commerce interested in Indian welfare.

Strictly Personal

Harry Aldyne Answers Some Pertinent Questions for Radio Fans

1. *Dear Mr. Alydne:*

Is Jack Nelson of Station WGN married?

—L. R. T., Des Moines, Ia.

Yes, Lois, our good friend Jack is very happily married. More than that, his romance was one of the first to have its origin through a radio courtship. Jack is well satisfied that it pays to broadcast. Come again.

2. *My Dear Mr. Aldyne:*

Are the "Duncan Sisters" that I hear on Wednesday and Friday nights over KYW really sisters, or have they assumed that relationship merely for publicity purposes?

—B. R. S., St. Louis, Mo.

You bet your sweet life they are sisters, and they have a brother and another married sister, too. We wish there were more of them. No trouble at all.

3. *Dear Mr. Aldyne:*

How is it the announcer of WLAG has such a high pitched voice?

—A. B. L., San Antonio, Tex.

We agree with you that the announcer of WLAG has a woman's voice. The announcer happens to be a woman. Don't shoot.

Popularity Contest Waxes Warm

Here Are the Ten Leading Candidates

By Harry Aldyne

They're off! The Radio Favorite Popularity Contest conducted by RADIO AGE has rapidly accelerated in momentum until definite indications of interest have come in from all four corners of the earth. Individuals make this contest a success, all with the one hope of making an impartial test of leadership in the great field of the radio industry.

It must be particularly noted that votes may be cast for any one connected with the radio industry; announcers, individual entertainers, orchestra, manufacturers, inventors, etc. One ballot counts only one vote.

To date the choices have been so widely scattered that it is hardly fair to say any group has a particular lead, and any one of five hundred or so stands a good chance of heading the list when the first of a series of monthly semi-final contests is held.

However, that you may know which direction the wind is blowing, there are listed above the names of the first ten who have a slight advantage over the field.

Name	Classification	Where Heard
Bill Hay	Announcer	KFKX—Hastings, Nebr.
Lamkin Kay	Announcer	WSB—Atlanta, Ga.
Duncan Sisters	Entertainers	KYW—Chicago
Husk O'Hare's Orchestra	Orchestra	WLS—Chicago
E. W. Tyson	Announcer	WWJ—Detroit
Jack Nelson	Announcer-Entertainer	WGN—Chicago
H. W. Arlin	Announcer	KDKA—E. Pittsbugh
Karl Bonawitz	Organist	WIP—Philadelphia
Fred Smith	Announcer	WLW—Cincinnati
Edward H. Smith	Director and Player	WGY—Schenectady

Get in your votes, and if there are any suggestions or questions bearing on the contest, entertainers or broadcasting stations in general, send your letters for the attention of the Contest Editor.

The first contest closes on September 12, so that results may be announced in the October RADIO AGE. Get busy and send in the coupon on this page NOW!

POPULARITY CONTEST COUPON

Harry Aldyne,
Contest Editor,
RADIO AGE,
500 N. Dearborn St., Chicago.

I wish to cast my vote for:

Name of favorite .....

Classification .....

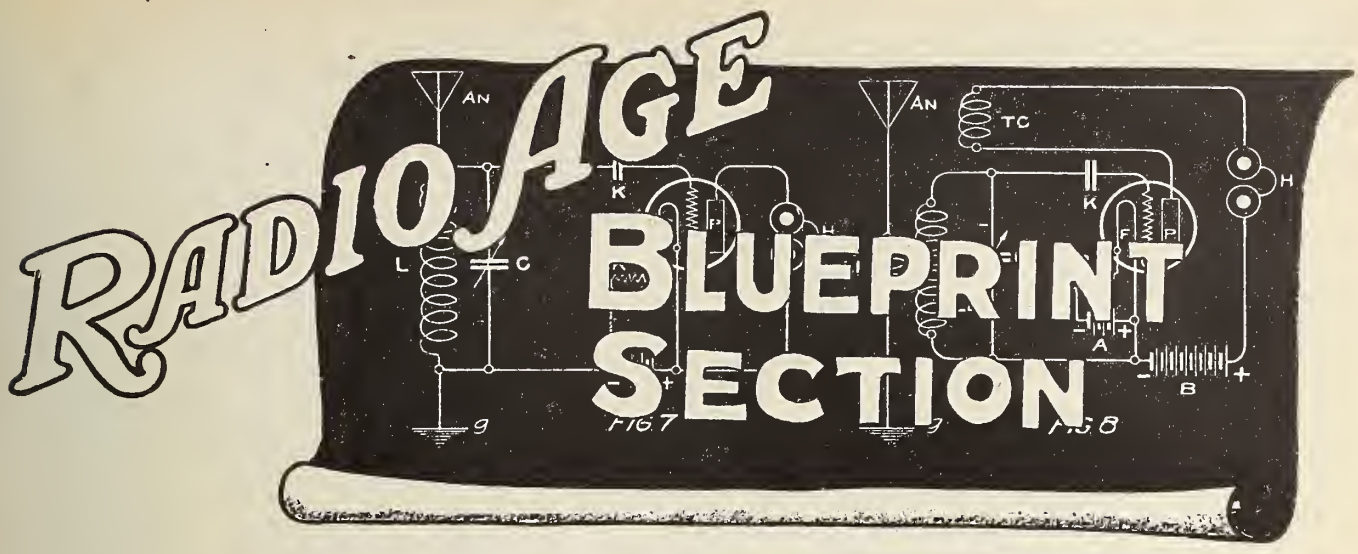
Station .....Date heard.....

Name [optional] .....

Address [optional] .....

RADIO INSTALLED IN SOCIETY SWIMMING POOL P. and A. Photo

Even swimmers like radio entertainment between dives and crawls. Here a group of swimmers, all members of Washington's "400," are paying rapt attention to a concert from New York. The set is installed in the Wardman Park Pool, one of the capital's most exclusive play spots.



For More Efficiency Try

An Aperiodic Variometer Set

By JOHN B. RATHBUN

TUNING the grid circuit inductively by means of a variometer is nothing new in radio. In fact, this is practically as old as the use of the fixed inductance tuned by a condenser, but the idea has considerable merit owing to the fact that it is possible to establish higher potentials on the grid of the tube in this way. Thus, the incoming signal has more effect on the tube grid when capacity is lacking in this circuit than when a variable condenser is used for tuning the circuit to wave length. Better results are therefore obtained.

In the older circuits, the grid variometer was used as a tuning agent for single circuit sets or else it was used in connection with the standard type of tapped variocoupler where the additional losses introduced rather offset the inherent advantages of the variometer inductance. Used in a single circuit set, there was a loss of selectivity. Used with a standard variocoupler, the losses in the taps and tap switches often offset the increased efficiency of the variometer. In other words, the variometer was never used so that it was allowed to develop its full possibilities in the grid circuit.

Variometer "Switched"

After carefully going over this matter and experimenting with various combinations of variometers, it was finally decided to make the variometer an integral part of the primary and secondary tuning circuits so that the variometer formed the secondary winding of the coupler, while a few turns of wire at one end of the variometer acted as an "aperiodic" primary coil. No condenser was needed, and the full selectivity of the variocoupler was attained without losses in the tapped coils and rotor. The construction is simplicity itself and lives up to expectations in every way.

Applying a Variometer Idea to a Wizard Circuit

HAVING progressed this far, the next thing was to apply the idea to some specific circuit where its full possibilities could be developed without complicating the controls. Various circuits were investigated and finally it was decided that the Rathbun Wizard circuit offered an excellent opportunity for the application when the plate circuit was tuned by a second variometer. While the original Wizard circuit worked very well without the plate variometer and with direct inductive feed-back, yet the addition of the plate variometer made the set even more selective than before and greatly increased the signal strength. Regeneration is more easily controlled without accurate filament current adjustment, and by the combined effects of the feed-back coil and the tuned plate circuit, a condition of resonance is more accurately approached in both circuits and the impedance of the circuit can be made more nearly the theoretical zero necessary for the establishment of maximum voltages.

In Fig. 1 on page 30 we show a picture circuit of the set called the "Aperiodic Variometer Set" with the two variometers used for the grid and the plate respectively. For maximum results and for loud speaker operation at fair distances, one stage of audio amplification has been added permanently which gives an excellent two-tube set with great volume and a very considerable range. Of course, the detector tube can be used alone or else another stage of audio amplification can be added, but for the best results for a given investment, I believe that the circuit is at its best the way that it is shown in the figures. It is certain that the addition of radio frequency steps only slightly increases its range and that the expense and trouble of adding the radio stages is not justified by the slight increase in performance.

Variometer as Secondary Coil

In Fig. 1, page 30, is the grid variometer marked (VI) which is used for tuning the set to wave length, this variometer acting as the secondary circuit coil of a two-circuit receiver. At the left is the aperiodic primary coil (L) consisting of about 25 turns of No. 26 D. S. C. wire wound on a four-inch diameter bakelite or cardboard tube. In addition to acting as the primary of the

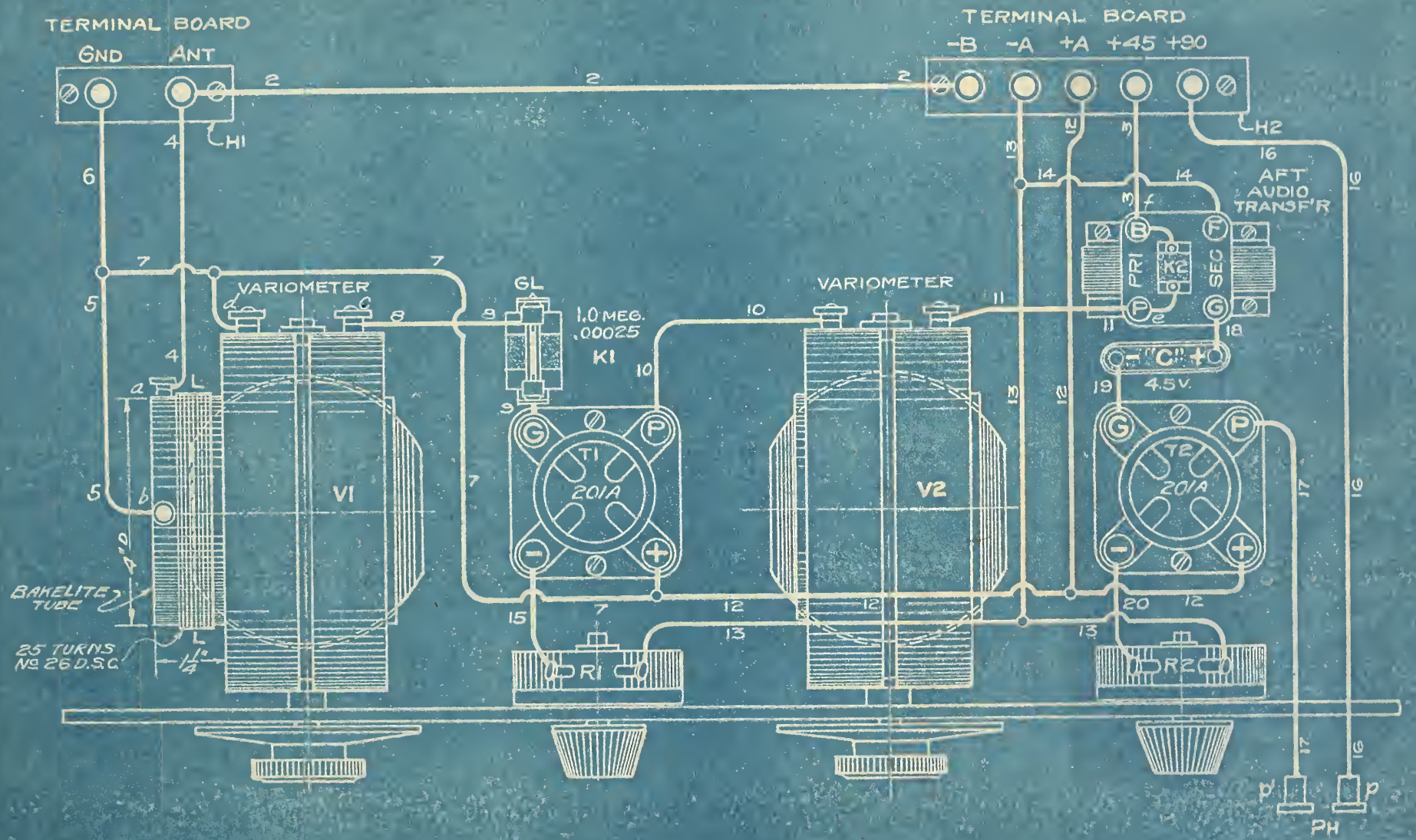
(Continued on page 36)

HOW TO USE RADIO AGE BLUEPRINTS

The blueprints printed in this section are so arranged as to form a complete unit with the explanatory articles when desired by the reader. For example, the center sheet consisting of pages 31, 32, 33 and 34 contains two blueprints and two pages about the Baby Heterodyne. Just follow this four-page sheet at the center and you will have a complete section to follow when you make the Baby Het. Likewise the second center sheet, which also can be followed as one unit, is devoted to the aperiodic variometer set. The blueprints for this hookup are on pages 30 and 35, and the article on pages 29 and 36.

Blueprints appearing in future issues will be arranged in the same manner. —The Editors.

Blueprints for the Aperiodic Variometer Set on Pages 30 and 35.



AN APERIODIC VARIOMETER SET

WITH TWO STAGES OF AUDIO AMPLIF.

FIG. 1

PAT. PENDING

J.B.R.

Radio Age Offers

An Improved Baby Heterodyne

By JOHN B. RATHBUN

A New 'Baby Het' that Has Proved to Be One of Year's Most Stable and Sensitive Receivers

OWING to the enthusiastic reception which greeted the first single tube "Baby Heterodyne" published in the February issue of RADIO AGE, it was thought advisable to make further experiments with this circuit with a view to improving its stability and reducing its rather critical adjustment. The result of this investigation is the "Baby Heterodyne II," which is a marked advance over the older circuit in a number of respects.

There have been no radical changes in the principles, but small refinements made here and there which will make the set easier to handle and much more compact. Those of you who are familiar with the original circuit will quickly note the changes that have been made by consulting the schematic diagram in Fig. 3, and the wiring diagram layout of Fig. 1, shown in the actual RADIO AGE blueprints in this issue.

For the assistance of our readers who are not familiar with conventional circuit diagrams, we have shown the wiring diagram in picture form in Fig. 1, where all the apparatus is drawn out in detail. This is further assisted by the isometric view of Fig. 2, which shows the installation of the apparatus in its proper relative positions, together with such of the wiring that can be seen from the back of the panel. All of the parts in the three illustrations are given the same letters and figures so that the parts can easily be traced from one drawing to the others. The schematic drawing of Fig. 3 is for the use of the more advanced students who wish to see clearly the functioning of the circuit, and to whom a drawing of this sort means more than the isometric and picture diagrams. The isometric is useful for the layout of parts, but in making the actual wiring connections we advise the use of either Fig. 1 or Fig. 3.

As a further help, these diagrams are printed as real blueprints to aid the "fans" when actually working on the set.

As with the old circuit, we still use the aperiodic type of coupler (L1-L2) which has proved so selective and effective, but to conserve space and simplify connections, the oscillator coil (L3) has been wound directly on the same tube with the primary and secondary coils. In the old circuit the oscillator coil and feed-back were wound on a separate form which gave the beginners considerable trouble when it came to making the winding. On the present winding (L1) is the primary, (L2) is the secondary and (L3) is the combined oscillator pickup and feed-back coil. The secondary (L2) is tuned to wave length by the vernier variable condenser (C1) and is the only wave length aerial control used.

Windings Without Shellac

ALL COILS are wound in the same direction with No. 26 D.S.C. wire the coils being separated by the distances shown in the coil detail of Fig. 1. The diameter of the tube is 3 inches and the length is about 5 inches, either a cardboard or Bakelite tube being allowed. The windings are dry wound without shellac, paraffin or other energy-absorbing materials. Ten turns are used for the primary (L1), 60 turns for the secondary (L2), and 25 turns for the oscillator pickup (L3). It should be remembered that the number of turns on the secondary (L2) is somewhat affected by the length of the aerial and that this number of turns is correct only for aerials running from 50 to 60 feet in length. Longer aerials require fewer turns, shorter aerials require more turns, but for the lengths given the set will easily tune within the ordinary broadcasting limits.

In making connections of the condenser (C1) we must connect the stator or stationary plates (S1) to the wire (8) which runs to the grid of the tube and "C" battery, and the rotor or moving plates must be connected to the line (12). This is necessary to avoid the effects of body capacity. Performance is very much improved and stabilized by the addition of the fixed condenser (K1) of 0.002 mf. capacity which connects the grid return line to the primary by capacity effect. This also reduces body capacity or the tendency toward body capacity.

One of the most important improvements is the use of the biasing or "C" battery placed in the grid circuit with its negative pole (—) to the grid of the tube. With hard amplifier tubes this increases the sensitivity and on local stations greatly increases the signal strength. It is a substitute for the more usual grid condenser and grid leak, and the grid leak and grid leak condenser can be used of course if preferred. By maintaining the grid at a fixed negative potential, the tube works on the most advantageous point in its characteristic curve and in most all cases will give far better results than the usual condenser and leak. A three cell, 4.5 volt flashlight or standard "C" battery is used with plate voltages of from 67.5 to 90 volts, but with lower "B" battery voltages the voltage of the "C" battery is correspondingly reduced. The bypass condenser (K2) is advisable in some cases, while it does no good in others. The necessity for this condenser can only be tried by experiment in the circuit used, for the units adopted may or may not require this part.

Variometer Less Critical

AFTER much experimental work conducted on plate inductances, I came to the conclusion that a variometer (VA) was less critical and gave better control of the oscillations than the condenser tuned impedance used in the first circuit. The variometer gives more latitude in the range of wave lengths than the former honeycomb coil and there is less tendency toward whistling than before. A very small fixed condenser (K4) is connected across the variometer and establishes the oscillations necessary for this type of circuit. With the apparatus used in the experimental outfit, a condenser of 0.0001 mf. capacity was found sufficient, although 0.00025 mf. might perform better with some classes of variometers. Any standard molded type or self-supporting winding type of variometer can be used at (VA), but we do not recommend wooden variometers as they seldom have sufficient inductance for this purpose.

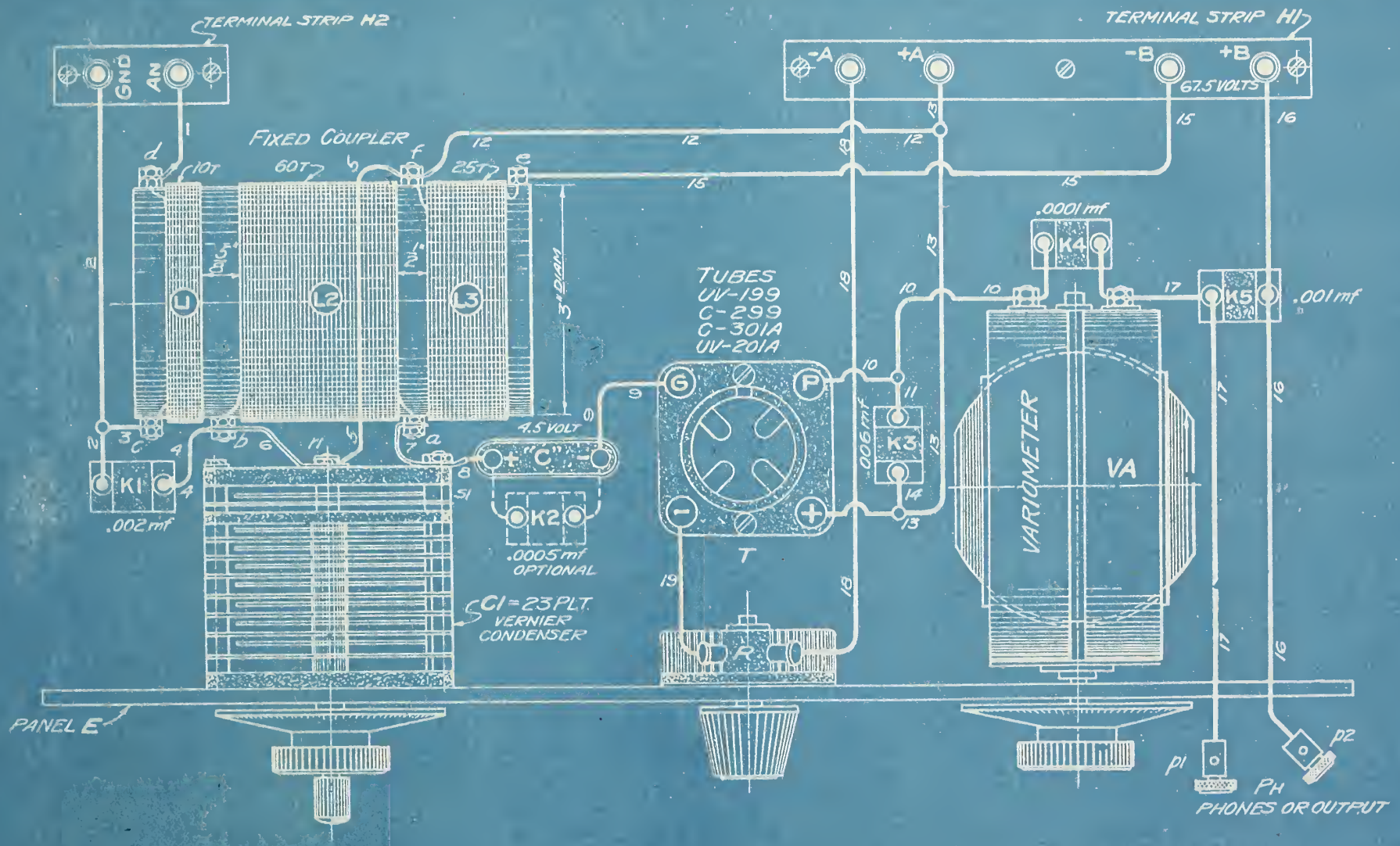
Some improvement can be had when (K4) is made a variable instead of a fixed condenser, but of course this includes the expense and complication of the circuit at a very little increase in effectiveness. In this case an 11 plate 0.00025 mf. variable condenser is sufficient for the purpose. However, a fixed condenser will perform very nicely, conserving space and simplifying tuning.

At (K3) is a 0.006 mf. fixed bypass condenser which is very effective in stabilizing the circuit and in reducing the resistance to the radio frequency current in the plate circuit. Again, it forms a capacious feed-back from the plate to the grid which materially increases the range and signal strength of the circuit. By examining Fig. 3 it will be seen that some plate energy passes to the primary through (K1) and therefore aids sharp tuning in the plate circuit. The phones (PH) are fitted with the 0.001 mf. bypass condenser (K5) which usually is of value in obtaining clear reception.

For the best results hard amplifying tubes must be used such as the UV201A, C301A, UV199 or C299. Detector tubes of the UV200 type cannot be used, and the WD11 or WD12 do not give very good selectivity or amplification. As a rule, a 67.5 volt "B" battery is the best, although 90 volts can be used with a little increase in volume. With 45 volts on the plate we do not get the proper signal strength, while with 90 volts we generally get noise and distortion. The voltage of the filament battery "A" and the resistance of the rheostat (R) of course depend upon the type of tube used.

(Continued on page 34)

Blueprints of the "Baby-Het" on Two Pages Following.



BABY HETERODYNE II

(WIRING DIAGRAM VIEW)

FIG. 1

PAT. PENDING

J.B.R.

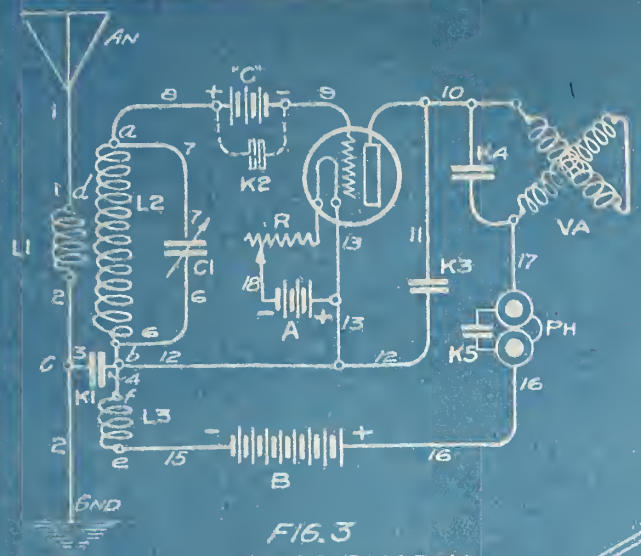


FIG. 3
SCHEMATIC DIAGRAM

Note!
OUTDOOR AERIAL BEST AT 50 FT. TO 60 FT. LONG. MUST NOT EXCEED 80 FT. UNDER ANY CONDITIONS.
LOOP AERIAL CANNOT BE USED SUCCESSFULLY.

USE ANY HARD AMPLIFYING TUBES SUCH AS UV-201A, C-301A, UV-199, C-299, WITH FROM 67 TO 90 VOLTS ON THE PLATE AND A "C" BATTERY OF 4.5 VOLT.

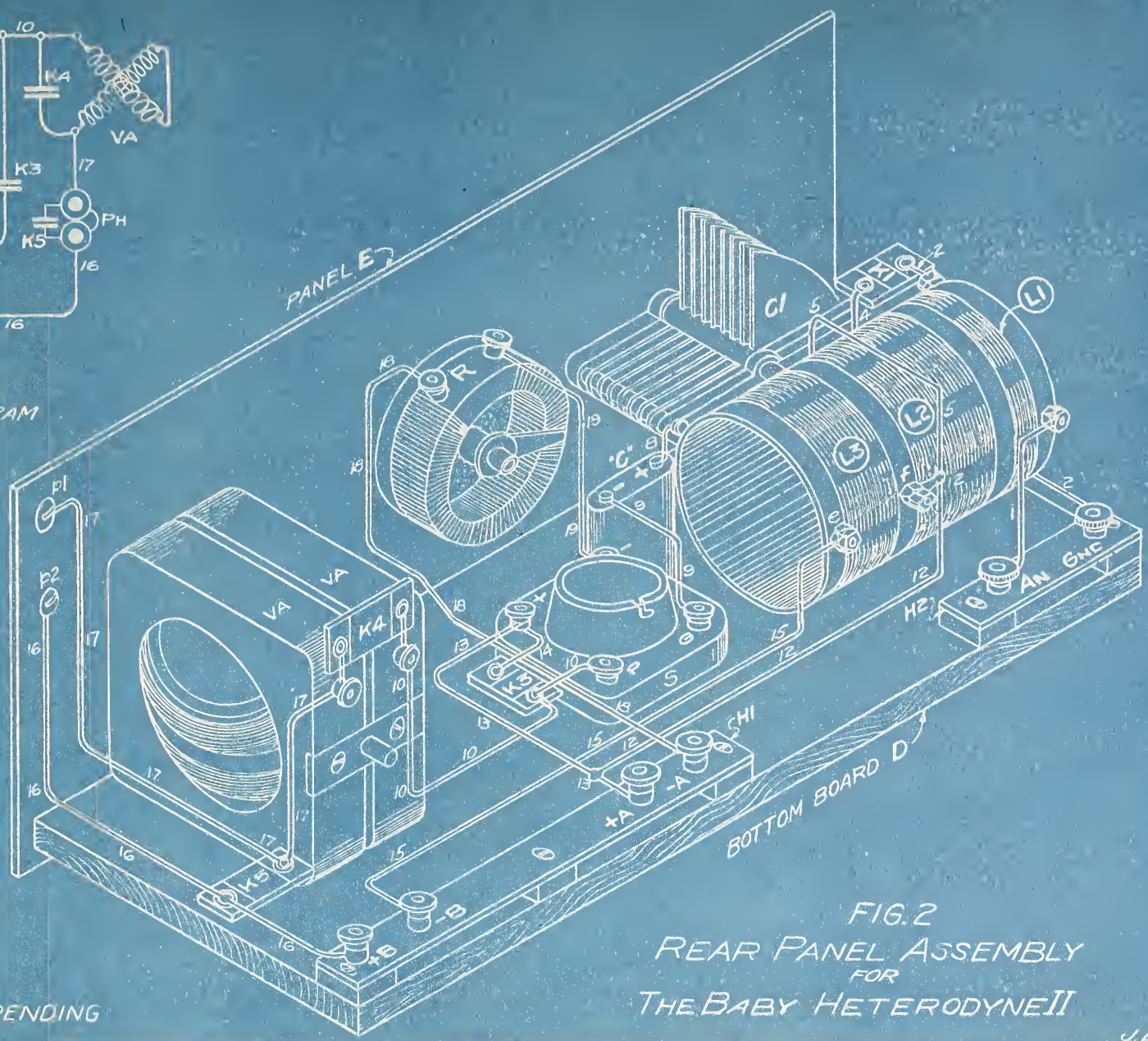


FIG. 2
REAR PANEL ASSEMBLY
FOR
THE BABY HETERODYNE II

PAT. PENDING

J.B.R.

An Improved Baby Heterodyne

(Continued from page 31)

Notes on Controls

THERE are two tuning controls, the variable condenser (C1) and the variometer (VA), both of which are very sharp and somewhat critical. This means that both controls should be of the vernier type, particularly (C1), since the latter brings in or drops a station completely on a very few divisions of the dial. Condenser (C1) is a 23 plate, (0.0005 mf.) variable condenser of the vernier type, and preferably should be of the so called "low loss" variety. The variometer (VA) can be the special vernier type of variometer now found on the market or else it can be made into a vernier type by the addition of the small knobs which act on the edge of the dial. Careful adjustment is needed at this point.

Filament control is also of the greatest importance and requires a rheostat which can be closely adjusted. With the proper rheostat the tube can be kept right on the edge of the "spilling point" where the amplification is at a maximum. One of the most important features of this circuit is its ability to work without distortion when the tube is being pushed hard, but to develop this properly requires accurate control of the filament current.

This receiving set will assemble nicely on a 7-inch x 14-inch x 3/16-inch panel as shown by (E) in the isometric view of Fig. 2. The panel should be of the hard rubber or bakelite type and is fastened to the baseboard (D) by wood screws which pass through the panel and attach to the front edge of the baseboard. The only wire connections carried by the main panel are the phone binding posts (p1) and (p2).

All battery binding posts and the posts for the connection of the aerial and ground wires are "back connected"; that is, are carried by the hard rubber or bakelite terminal strips (H1-H2) located near the rear edge of the baseboard. This arrangement does away with the unsightly wires and connections that are always in view in the front of a front connected panel. The terminal strips are about 1¼ inches wide and ⅛ or 3/16 inch thick, and are raised above the baseboard so that the bottom screws of the posts do not come into contact with the wood baseboard.

Careful attention should be paid to the wiring and wiring connections. All joints should be carefully soldered where possible, and at points where connections are made to binding posts solder lugs should be used to insure good contact. Ordinary No. 14 tinned square bus wire is best for the purpose as it is stiff enough to hold its shape and is easy to solder. While the wire should be covered with spaghetti at points where one wire passes over another, it is bad practice to cover the whole length of the wire as this increases the capacity without correspondingly increasing the insulation resistance.

SOCKETS are of prime importance in the successful operation of a receiving set and not enough attention is given to this point by the average builder. The best bakelite sockets are none too good for this job, for we must be sure that there is no leaking of the precious energy between the socket springs and prongs, and again there must be no unnecessary resistance between the prongs of the tube and the springs. The cheap "tar paper" sockets made of soft compositions are actually fairly good conductors for radio frequency currents and generally leak enough current to considerably reduce the range and signal strength. Some sockets I have tested leak more current than a 0.5 grid leak, and when the tubes were placed in these sockets no grid leak was necessary. However, this is a mighty expensive means of doing away with a grid leak and most certainly is not recommended.

In buying sockets, see that the springs are stiff and that they make the proper contact with the prongs of the tubes. A socket may carry the filament current so that the filament lights, but this is no guarantee that the grid prong conveys the radio impulse to the grid of the tube or that the plate prong is making sufficient contact to close the plate circuit. There have been all sorts of woe at this point and tubes and hookups have been unjustly accused for what is properly the fault of the socket.

Before wiring up the set, test each piece of apparatus separately so that you will not have to dismantle the whole thing later on in order to remove some faulty member. Scrape off the springs in the socket to a bright surface and then insert a tube to make sure that the springs are making uniform contact with the tube lugs before you screw the socket down to the baseboard. If the tubes are making proper contact, the springs will all move when the tube is pulled in and out.

Secondly, test out the coils (L1-L2-L3) to determine whether there are any broken wires or open circuits in the coils. Very often a wire is broken in winding, or the end of the wire does not make perfect electrical contact at the connection screws. It is not easy to see a broken wire, as it is covered by insulation; hence the only sure test is to connect the coil, a battery and the phones all in series. If the circuit is perfect, there will be a sharp click every time the circuit is closed. If there is no noise when the battery is connected, then the wire is broken or there is a poor connection at some point.

Both batteries should be tested at frequent intervals, particular attention being paid to the "B" battery. We can generally tell whether the "A" battery is working by the way it lights up the filament, but the "B" battery requires a voltmeter. Voltmeters for testing "B" batteries can be obtained at a very reasonable price and are the only insurance against the dead "B" batteries that so often are the cause of trouble. Just the other day I was called in to service a stubborn set which would not operate above a whisper, and found that the "B" battery which should have applied 90 volts on the plate only developed 16 volts when the voltmeter was applied. The owner was loud in his condemnation of the set until he saw where the trouble lay.

VACUUM tubes of the present day are rushed through the factory at such a rate that they are not properly tested and hence are a source of trouble when we have no means of making a proper test. Wherever possible, it is a good plan to make a trial of the tube in a set that you know is in proper operating order. Try it in a friend's set and compare it with the tube that he is using.

Next, connect a couple of dry cells in series and connect the end wires to the terminals of the variable condensers. If the sparks fly when you turn the rotor in the dark, it is sufficient evidence that the condenser is short circuited. This, if done before the condenser is mounted in place, may save you from burning out a tube, and at the least will save you a lot of trouble in the future. The fixed condensers should be tested in the same way, touching the battery terminals at each end of the condenser terminals. If you see a spark, throw the condenser away; it is short circuited. Unfortunately, a fixed condenser may have only a partial short circuit that is sufficient to cause trouble but not conductive enough to show a spark. This is not easily discovered without the proper instruments and the amateur is not usually able to determine the fault.

After going over all of the parts in this way before they are screwed into place and wired up, we will save ourselves a lot of trouble. The variometer, like the coils, should be tested for open circuits, due to broken wires and loose contacts at the rotor. The rheostat should also be tested for open circuits and also to see if the contact finger touches the wire coil at all points with equal tension or pressure. Much trouble is had with rheostats that "run off center," since the finger will not make contact at certain points and will open the circuit or dim the tube.

It is generally easier to hook up the filament circuit first—that is, connect all wires of the filament and "A" battery to the rheostat and socket before anything else is done. Then we can follow up with the plate circuit and then the tuning circuit.

In case the circuit tunes broad or the necessary selectivity is not obtained, reverse the aerial and ground connections at (d) and (c). If the variometer seems to have no effect on the control of the circuit, reverse the connections of the coil (L3) at the connections (b) and (e).

If the circuit does not tune down to low enough wave lengths, remove a few turns of wire on (L2). If it does not reach the higher wave lengths, a few turns can be added to (L2).

[*"Baby Heterodyne Notes," containing answers to questions regarding Mr. Rathbun's first "Baby Het" hookup will be published in October* RADIO AGE.]

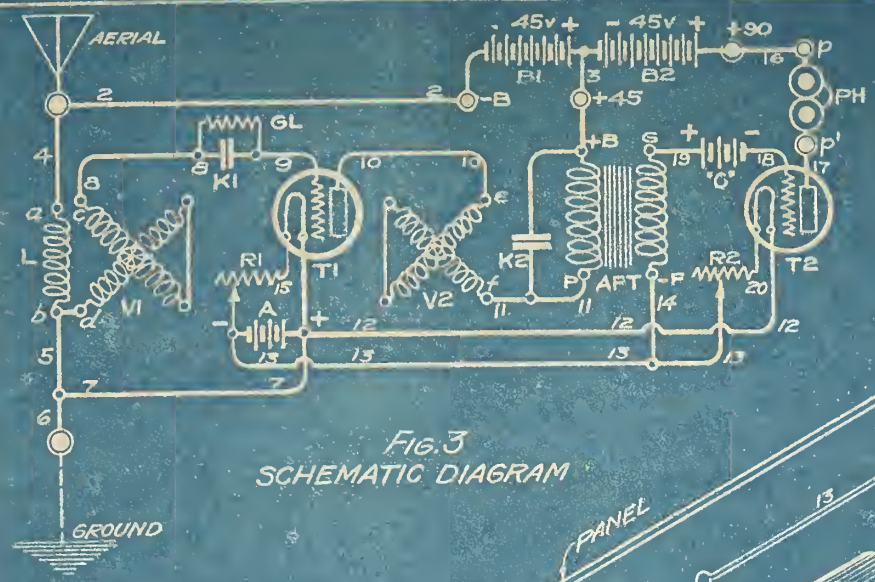


FIG. 3
SCHEMATIC DIAGRAM

OUTPUT OF SET TO BE CONNECTED TO PHONES OR LOUD SPEAKER AT POSTS p-p.

NOTE!
USE ONLY AMPLIFYING TUBES SUCH AS UV-201A OR UV-199 FOR BOTH THE DETECTOR (T1) AND THE AMPLIFIER.

PLATE VOLTAGE ON DETECTOR TUBE = 45 VOLTS. PLATE VOLTAGE ON AMPLIFIER TUBE = 90 VOLTS. USE TWO BLOCKS OF 45 VOLT "B" BATTERIES.

FIG. 2
REAR PANEL ASSEMBLY
FOR
APERIODIC VARIOMETER

PAT. PENDING

J.B.R

An Aperiodic Variometer Set for Efficiency

(Continued from page 29)

circuit, the coil (L) also acts as the tickler or feed-back coil which induces additional impulses into the secondary by connections with the plate circuit. The tube of (L) is fastened to the side of a standard molded variometer in any way that may be convenient with the instrument used. The distance between the coil and variometer is not critical and can be made as shown. Any type of molded or honeycomb variometer can be used, but a wooden variometer is not usually practical owing to the great clearance space ordinarily found between the rotor and stator of the wooden variometers.

AT (V2) we have the standard plate variometer used for controlling regeneration and for varying the inductance of the plate circuit. This can also be any standard type of molded or honeycomb variometer but usually the inductance value must be greater than can be attained with the ordinary wooden variometer. Very frequently the inductance of wooden variometers is so low that they have absolutely no effect on the regeneration when turned in any direction, and this fact is emphasized for the benefit of those of our readers who may attempt the building of the circuit with this type of variometer. The tuning is exceedingly sharp and fairly critical so that the addition of a "Tiny Turn" vernier button to the dials of the variometers will be of importance, or any other type of geared vernier adjustment which can be conveniently attached to the dials.

At (K1) we have the usual type of grid condenser with a capacity of from 0.00025 to 0.0005 mf, the former value usually proving best for the UV201A and UV199 tubes. Tube (T1) is the detector tube which is controlled by the filament rheostat (R1). Of course maximum results are obtained with the power tubes operated by a storage battery such as the UV201A, but very good results can also be obtained by the small dry cell tube known as the UV199. The WD11 and WD12 are not so selective but can be used if the other tubes are not practical under the given operating conditions. The soft detector tubes such as the UV200 will not give as much volume on strong signals as the UV201A or the UV199 for the reason that we cannot carry such high plate voltages on the soft detector tubes.

Distortion Eliminated

As shown in the diagram, 45 volts are used on the detector tube (T1) and 90 volts on the audio amplifier tube (T2). This gives the maximum results without distortion when the UV201A and UV199 are used. Using a higher voltage on the detector tube (T1) gives a somewhat greater signal strength on local stations but it also introduces undesirable tube noises and distortion. Lower voltages than those specified naturally give weaker signals, and the weaker voltages on the plate also reduce the selectivity of the circuit.

The grid leak (GL) is of the pencil mark or other variable leak. Its value is to be adjusted until the signals are strongest and clearest. If the resistance is too high, then there will be noises and the reception will have a whiney tone. If the resistance is too low, then too much radio frequency current will be bypassed and the signal strength will be reduced. The proper value for any one tube can only be tried by direct experiment.

THE aerial connection at (ANT) together with the ground (GND) and battery connections are placed at the rear of the set, thus allowing all wires to enter the rear of the cabinet and improve the appearance of the receiver. The binding posts at the rear are mounted on two strips of bakelite or hard rubber about 1" to 1¼" wide and about 3/16" thick. The strips are raised above the surface of the bottom board, so that no metal parts or wires will come into contact with the wood. This construction is clearly shown in both Fig. 1 and Fig. 3, page 35, the latter being the isometric view of the set.

USE THE ORIGINAL RADIO AGE BLUEPRINTS On Pages 30 and 35 to Make This Aperiodic Variometer Set.

Another Group of Unrivaled Blueprints in October RADIO AGE.

Audio Amplification

For aid in picking up distant stations at good volume and for loud speaker operation on local and at moderate distances, one stage of audio frequency amplification has been added. Stations 200 miles away have been picked up with good volume on the loud speaker with the single amplifying stage, and local comes in with terrific volume. In fact, local stations can be had on the loud speaker with the detector tube (T1) alone, but as will be explained, it is considered desirable to have the detector and the amplifier connected in one permanent unit.

A five-to-one ratio audio frequency transformer is shown at (AFT). The primary of the transformer is connected at the posts (P) and (B) to the detector circuit at the output wires (e) and (f).

The secondary of the transformer is at (G) and (F), and is connected into the circuit of the amplifier tube (T2). A three cell, 4.5 volt "C" battery is connected in the grid circuit of the amplifier tube for biasing the grid and is of great assistance in clearing up the reception and for obtaining maximum amplification. In all cases, the negative (—) terminal of the "C" battery should go to the grid (G) of the tube, so that the grid will receive a negative charge or bias. The output or plate (P) of the tube (T2) goes to the phones or loud speaker (PH).

In laying out this circuit, it was considered advisable to omit the usual jack between the detector tube and amplifying stage, both on the score of simplicity and effective operation. While both tubes must be used at all times with the present arrangement, yet it has certain advantages which are lacking when intermediate jacks are installed. For example, there are no losses or noises due to imperfect contacts in the jacks, and, further, as the audio stage is always in circuit, there is no danger of detuning a distant station when the audio stage is plugged in. When a jack is installed after the detector, and when one picks up a faint signal, it often happens that this station is lost when a stage or two of audio is plugged in at the jacks.

In this arrangement, this cannot happen, and when the reception becomes too strong, we have merely to turn down the rheostats.

DeForest Films Sound and Action Miles Apart

Dr. Lee DeForest, inventor of the Audion, which makes possible radio broadcasting and receiving, as well as talking motion pictures, has just achieved another triumph. He has invented a long-distance synchronizing device by which two cameras, one photographing sound and the other action, may be operated simultaneously, and the resultant product afterwards amalgamated in perfect synchronization.

The Democratic National Convention in Madison Square Garden in New York City afforded the opportunity for Doctor DeForest to test out his new invention. A regulation motion picture camera was set up in Madison Square Garden, where the wild scenes of the convention were photographed. At the same time a DeForest Phonofilm camera was in action in the studio of Doctor DeForest on East Forty-eighth Street. These two cameras were connected by radio, the one in the Garden photographing the action and the one in the studio the sound. From the two negatives thus produced, positive prints were made which contain both the sound and the action. The result was a photographic reproduction of the convention that is absolutely startling in its realism.

The possibilities of this latest invention of Doctor DeForest are almost incomprehensible. As an illustration, a great naval battle might be fought off the Pacific Coast, with a news reel photographer on the spot. He would communicate with DeForest at his studio in New York, for instance, and announce that fact. Then he would proceed with photographing the action of the battle, while in New York the sounds of the cannonading would be recorded, in perfect synchronization with the photographed action, and the two amalgamated later, on a standard motion picture film.

RADIOTORIALS

EIGHT of the largest radio manufacturing corporations in the United States were named recently as defendants in a complaint filed by the Federal Trade Commission, charging the use of "unfair methods of competition in commerce in violation of Federal Act."

The complaint alleges that the defendants have combined and conspired to create a monopoly in the manufacture, purchase and sale of radio devices and apparatus and other electrical articles. An attempt to monopolize domestic and trans-oceanic radio communication and broadcasting is also charged.

The Government's charges are the natural outcome of the recent trend in the progress of radio. Little manufacturers have been squeezed out of business, while the big corporations continue to absorb their weaker competitors and take over as many radio patents as they can buy.

If such wholesale absorption continues, radio will soon be in the tentacles of a one-man corporation operating only for profit and with no regard for the common good. The Government of the United States has shown wise foresight in investigating these alleged attempts at monopoly and to nip in the bud any effort to take radio out of the hands of the independent broadcaster, listener and manufacturer.

Of course the eight defendants will reply and deny the charges. But their alleged unfair activities have at least been restricted by the bulldog watchfulness of the Federal Trade Commission.

Regardless of who these corporations are, they are attempting to control the radio industry, as big corporations will. If they buy up all the patents of any importance, it is easy to foresee what will happen to the small but efficient manufacturer whose products are now the pride of the radio industry and whose inventions are helping to develop radio so rapidly. Monopoly of radio patents will drive independent incentive to the wall. Radio will become stabilized to the point of stagnancy.

The Federal Trade Commission's complaint also charges attempted monopoly over domestic and trans-oceanic broadcasting. Here the listener is affected. If broadcasting is monopolized, you can imagine the kind of cut-and-dried, political programs that will be served to the listening public in the not too distant future. The listeners will tire of censored programs and interest will drop off as a result.

The amateur operator will also be affected. He will be restricted because his devices are controlled by the big corporations. The corporations will tell him just what he can do and what he must not do. Domestic broadcasting, both in code and programs, will become a joke and the toy of a mercenary trust.

The foregoing examples of what *might* happen do not mean they *will* happen. In fact, the Government's action indefinitely forestalls any chance these corporations might have had to further their alleged monopolistic ideas. But this action should arouse the listeners, the amateurs and the independent broadcasters and manufacturers to such a stage of enthusiastic protest that any plans for a "Radio Trust" will disappear before they are well under way.

Here is a chance for the amateurs to get busy and render another service like that which characterized their fight gainst the proposed radio tax. The life of the amateur and the small broadcaster is at stake. It will be a fight extending over a period of years, and upon it will depend whether radio is to continue to be a public utility for public good or just another means for personal publicity.

A CONVICT in a Middle Western state penitentiary wrote to a storage battery dealer in his home town and asked for a second-hand radio battery to attach to a receiver that he had built and set up in his cell. He paid for it out of his meager earnings of a dollar and a half a month, saved during the four years of his imprisonment. The convict related his life as a shut-in and how the little radio set brought him his first touch with the outside world. He told how the set had cheered him and built hope in his heart that he will be able to live a straight life when his release comes. It was a human letter and touched the heart of the battery dealer, who decided to send the convict a brand new battery instead of a second-hand one. But before doing so he asked the warden of the penitentiary for his consent. The warden refused, explaining that "radio within prison walls has not yet been put through the experimental stage." So the convict didn't get his battery and the world beyond has been cruelly cut off. We believe radio in the future will do more than endless preaching, bullying and solitary confinement to reform prisoners in our jails. That warden would have been doing a public service toward reducing criminal tendencies if he had not only permitted that one convict to have his radio set, but had ordered sets installed in every cell. Some day we hope such a liberal and humane measure will be taken by forward-looking states.

RADIO FANS like nothing better than to make their own sets and be assured that they are making them correctly. The chief fault with thousands of home-made radio sets is that they are the result of wholesale guesswork and not of careful following of specified plans. In printing four pages of real blueprints in this and succeeding issues, RADIO AGE believes it is helping the exasperated radio fan to get down to a working basis and build his sets *right*. The building season is about to start, and there is no better insurance for successful reception than clear, accurate and authentic blueprints for working drawings. The blueprints in this issue are the last word in reliability—as are the hook-ups they portray.

WE NOTE with interest that a group of manufacturers has organized a Radio Manufacturers' Association for the general improvement and stabilization of the radio industry. This is only another indication that the big men in radio are realizing that the best sets and accessories can be made only by individual incentive and not by the hired talent of grasping corporations. The men who make up the Radio Manufacturers' Association are leaders in their respective radio fields and they know that their mutual co-operation will make radio safe for the listener, the amateur and the independent broadcaster who wants to give the public what it wants—not what the broadcaster wants.

You Cannot Afford to Miss the Priceless Hookup Ideas in the 'Annual'

The profound technical problems to be encountered in the study of Radio are all very interesting to the expert, but the great majority of "fans" are vitally concerned in the building of simple sets that really will work and produce effective results.

To supply this demand for practical, simple and efficient sets, RADIO AGE compiled THE RADIO AGE ANNUAL for 1924 in the belief that it contains more real help and meaty material than any other book on this subject ever published.

THOUSANDS have been sold at $1 each since they were first offered to fans early this year. The supply is rapidly becoming exhausted, so we are making this last appeal to the fans to order their ANNUAL now if they have not already done so.

Full of Hookups That Are Guaranteed to Work!

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This Book Is Endorsed by Expert and Novice Alike

The principal articles are illustrated with the well-known RADIO AGE isometric drawings, reputed by countless experts as the clearest construction diagrams ever put on the market.

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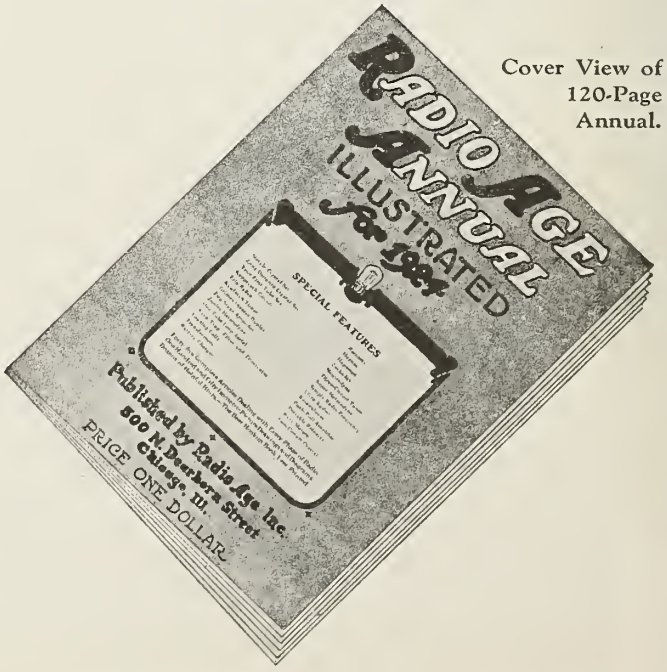
You cannot afford to be without this wonderful radio "guide book." Send your dollar today for this gold-mine of radio ideas.

A Few of the Features

Simple Crystal Set
Long Distance Crystal Set
Your First Tube Set
Erla Reflex
Kaufman Tuner
Grimes Inverse Duplex
Two Stage Amplifier
Baby Heterodyne I
One Tube Loop Aerial
Wave Trap, Filter and Eliminator
Loading Coils
Transformers
Battery Charger
Reinartz
Haynes
Hopwood
Cockaday
Neutrodyne
3-Circuit Tuner
Super-Heterodyne
Simple Radio Frequency
Ultra Audion
Rosenbloom
Push-Pull Amplifier
Portable Reinartz
Wave Meters
Two-Circuit Crystal



Cover View of 120-Page Annual.

Lack of Vision Prevents Germany From Taking Her Place in Radio Progress

By FREDERICK A. SMITH

BERLIN:—If the visitor to Germany were to judge by the number of aerials seen above the roofs of dwellings, he would make the error of assuming that popular use of radio receiving sets in the republic was in a flourishing state. It should interest every American lover of radio and every American official who has to deal with regulation of radio transmission and reception to read the following facts about the collapse of popular radio in Germany after a few months of feverish enthusiasm. By observing the errors other governments and peoples have made in connection with radio development, the United States may avoid committing similar disastrous mistakes.

One reason for the astonishing decline in home radio activities in Germany is perhaps to be found in the fact that Germany failed to perceive the vast possibilities in the new art, either as a social factor or as a richly profitable industry, until long after the people of the United States had made great strides toward developing and stabilizing radio.

Radio a "Toy"

An American in Berlin told me that no longer than a year ago he was requested by New York people to inquire as to the possibility of obtaining twenty thousand complete radio sets from German manufacturers. The Berlin interests to whom the American carried this proposal greeted it with derision.

"Why!" they exclaimed, "the German people are a serious minded people. They would not consider going so extensively into the business of producing such a toy as the radio set."

THAT ended the negotiations. Since then the same German manufacturers have seen the light and are desperately trying to make up for lost time and neglected opportunities.

With characteristic alertness in finding markets abroad for German products, the manufacturers there are constantly pushing out into new fields, offering credits and prices that sometimes are the despair of competitors in other countries. One important radio manufacturing concern in Germany is doing an extensive business and there are scores of smaller establishments that are capable of producing equipment in quantities. But the fact remains that Germany has not been able to make the same popular success with home radio that has been achieved in the United States. England also has far out-raced Germany in the development of radio in and for the home.

RADIO TRAVELOGS

Frederick A. Smith, editor of RADIO AGE and author of the series on foreign radio beginning in this issue, has just completed a tour of eight European countries observing radio conditions and practices. He was correspondent on the West Front during the World War for the Chicago Tribune and flew into Berlin a few days after the armistice in 1918. On returning to the American lines he filed a single cablegram of 17,000 words which was published in all the leading papers of the United States. These experiences equip him with the ability to travel intelligently and accurately observe conditions.

Frederick A. Smith

After looking over the situation in Germany, I would say that the almost tragic suspension of radio interest among the people is due to the following conditions, some of which are being corrected:

The Causes

Limitation of adjustment of receiving sets to 700 meter wave length.

Failure of German manufacturers to standardize standard parts such as bulbs, sockets, head phones and plugs. Fans who sought to replace parts in their sets had great difficulty in finding parts that would fit their sets.

Programs of an unsatisfactory character.

Taxes imposed on manufacturers, dealers and users of sets.

Sale of inferior tubes and insufficient production of tubes.

German broadcasting, manufacturers and use of receiving sets are under supervision of the Reichs Telegraf, which corresponds to the Post Office supervision in England and to the Department of the Interior supervision in the United States. But the paternalism of the German government's attitude is in striking contrast to the rather liberal methods employed by the American authorities. So far as radio is concerned, the German government officials attempted to do all the thinking for the people who might be interested in radio. In the end it was the people who did the thinking and the government is now left with a deflated bubble on its hands.

One of the restrictions placed upon radio operation in the German homes was that which prohibited the use of circuits which might reradiate. The wisdom of any arbitrary exclusion of a radio circuit may well be doubted at any time. In a case where an apparently flourishing home industry fell afoul of evil times, such exclusion must be considered as significant as a possible contributing cause of the collapse of radio interest.

In the next place, the manufacturers of radio sets in Germany were forbidden to make any sets that would pick up broadcasting on other than the 700 meter wave lengths. The manufacturer was compelled to submit a sample of the set he proposed to produce.

THE main telegraph office examined the set and either approved or condemned it. In case the set met with the approval of the telegraph office, the manufacturer was permitted to make sets, always with the provision that each set should be sealed by the government and have upon the seal the initials, "R. T. V." For each set thus made the manufacturer was compelled to pay seven marks (about $1.75) to the Reichs Telegraf. On June 1 of this year this tax was reduced to three and one-half marks per set. It is necessary to stamp each tube produced by a German manufacturer and to pay a government fee of one-half a mark for producing it. It

should be remembered that the mark mentioned herein is the new German mark which appears to have a stabilized value of about twenty-five cents in American money.

Factories which made bulb sets had to pay 2,500 marks to the government.

Retail dealers in radio sets and equipment formerly paid 800 marks to the government each year. It is interesting to note that 300 marks of this sum was for the privilege granted to the dealer to demonstrate receiving sets for customers who came to his shop. The total tax on retail dealers has now been reduced to 30 marks each month.

All Sets Taxed

Now for the tax on the broadcast listener. It appears that the burden placed upon the German radio lover was sufficient without adding a financial weight to it; but Germany insisted that the user of a set should pay 60 marks per year as a penalty for enjoying (?) those programs which might be available on the 700 meter wave length. This tax included the modest crystal set as well as the more expensive tube sets.

The tax on the listener-in produced much the same situation that England faced when it sought to make the receiving set owner pay a fee. Thousands upon thousands of users of sets ignored the tax and went on their way trying to make radio function without benefit of legal rights. The German government very sternly called attention to these delinquencies and serious punishment was prescribed for those who evaded the tax. But the radio fans apparently felt that the government's radio bark was worse than its bite and the tax evasion continued placidly. Nobody went to jail.

It was then decided to reduce the fee to only two marks the month. Immediately there was a substantial increase in the number of permits applied for. Whereas only 20,000 fans had declared themselves as such under the higher tax and obtained the ostensibly necessary government permission to use a set, one hundred thousand persons in Berlin alone now have government license to "listen in." Seven per cent of the proceeds of all these taxes was and is devoted to assisting the financing of broadcasting from the various public stations in Germany. This method of aiding broadcasters is followed in England and the situation there will be described in another article of this series.

There is no estimate available of the number of sets in use in Germany at the present time. Radio in the home was forbidden by the government up to October 3, 1923. There was a small exporting business and a few amateurs were trying out circuits of their own production in secret. On October 3 the government announced that use of home radio sets would be permitted. It was fondly hoped that a revenue could be obtained from the enthusiastic members of the radio fraternity that had refused to be suppressed by a frowning government. The first broadcasting station was established in Berlin, practically financed by the government.

Enthusiasm Grows

THE rush for receiving sets was enormous. The industry had had no chance to develop normally or effectively and there was a consequent rush of manufacturers into the business of making sets and parts. There was absolutely no uniformity of size of parts and the confusion of the fan who wanted to replace any accessory of his outfit may be imagined. He rushed from shop to shop in pursuit of tubes that would fit the peculiar sockets in his set, or went feverishly about looking for plugs that would fit the holes in his panel. Material was put on the market by inexperienced manufacturers who fell far short of excellent production. There was a famine in bulbs and radio folks know how aggravating it is to have a set for which no tubes are available.

Depite all these difficulties, fans bought outfits at prices ranging from 400 to 600 marks. German enthusiasts at first were not aware of the fact that crystal sets could be used and when they learned that this inexpensive form of radio fun had been withheld from them, with the consequent necessity of paying good sums for tube sets, many of them complained that they had been imposed upon.

In addition to all this the requirement that all sets should be sealed by the government and kept sealed caused confusion. If a fan wanted to open his cabinet to replace a worthless tube or other part he was forced to break the seal. Then who was to replace the seal?

Broadcasting stations were apparently unable to meet the varied tastes of German listeners-in. Many wanted jazz music instead of classic numbers, and vice versa. The merest suggestion of political flavor in a broadcast talk caused a whirlwind of protest from fans throughout the republic. And then there was the monotony of that 700 meter wave length. This restriction made it impossible for the Germans to pick up the stations that might have entertained them from England, France, Holland and other adjacent countries.

Radio Suffers Set Back

Then along came more serious financial difficulties in the German business world. In March of this year the radio business suffered a violent slump. Many manufacturers went out of business and sets that formerly had sold for 300 marks are now being offered at 100 marks, and this price is not a sufficient temptation to keep the fan in the game. German landlords appeared to have a strong objection to the erection of aerials on roofs and this led to legal complications, many suits having been brought by radio enthusiasts and by landlords.

I found radio manufacturers and dealers in Germany somewhat doubtful of the possibility of bringing the industry back to a flourishing condition. But I formed the opinion that it will not be long before the government and the business interests will find a readjustment of conditions that will yet put radio back on the map in music-loving Germany. I predict that Berlin one day will be one of the great radio centers, just as it is now one of the most important capitals of the continent.

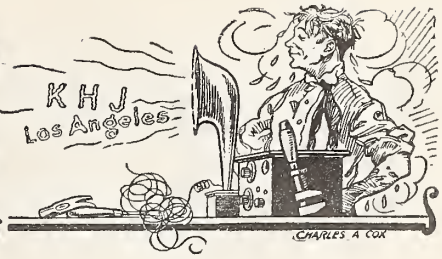
When the day comes that all the world will be linked in a chain of radio stations and all peoples will be aerial neighbors, it is to be hoped that Germany will have solved her radio difficulties and be a part of the great international game whose brilliant future we in the United States so confidently anticipate.

Keystone View.

GERMAN BROADCASTING STATION READY SOON

The largest broadcasting station in Germany is shown in the picture. It is located at Konigswusterhausen and is to be used, when completed, for broadcasting as well as code purposes. Its radius will be 4,000 meters. The entire plant will operate on three 350 H. P. Diesel engines.

Pick-ups and Hook-ups by our Readers



The material appearing under the title "Pickups and Hookups by Our Readers" in RADIO AGE, is contributed by our readers. It is a department wherein our readers exchange views on various circuits and the construction and operation thereof. Many times our readers disagree on technical points, and it should be understood that RADIO AGE is not responsible for the views presented herein by contributors, but publishes the letters and drawings merely as a means of permitting the fans to know what the other fellow is doing and thinking.

YOU remember the way old WDAP used to come on the air? All you old timer Dial Twisters do, I'm sure. They used to have a wonderful song that made you jerk your shoulders and sway when Jack Nelson sang "WDAP." Here's a little parody on his song that opens up this month's Pickups Section:

Hello John,
Are you on
To the good old Pickups Page?
If you haven't tuned in,
You've missed a bet;
It's the best in RADIO AGE.
Now I don't know where you
Happen to be,
But there's one thing sure
That is easy to see:
The contributions snappy,
Will make you happy
As a radio bug should be.

CHORUS

Oh, you ought to read the letters,
And the diagrams so clear;
Learn what the bugs are doing,
Though they live both far and near;
Now if you want to be a member
Of this Dial Twister rage,
You've got to learn to tune, so
You'll get a button soon
From
—The Editor of the Pickups Page.

CONTRIBUTORS

J. H. Fargnahr A. J. Secor J. J. Drey P. Edward Chapman

DIAL TWISTERS

Name	Address	Circuit
Ralph Mellon	25 King Street, Pottstown, Pa.	Regenerative
Ray Hahn	1517 Chestnut Street, Milwaukee, Wis.	Three Circuit
P. L. Hartnett	316 Henderson Avenue, Tampa, Fla.	Single Circuit ES Crosley
Robert M. Hillis	1462 Belle Avenue, Lakewood, Ohio	Ultra-Audion
Clair McCormick	Ewen, Mich.	Crosley Trirdyn
Franklin Troutman	11304 Coates Avenue, Cleveland, Ohio	Single Circuit

J. H. Fargnahr, of 3974 Olive Street, St. Louis, Mo., says that he is just "oscillating" with information on a new transformer for a neutrodyne receiver that he thinks is the stuff to neutralize easily. The following tells the story:

RADIO AGE,
Gentlemen:

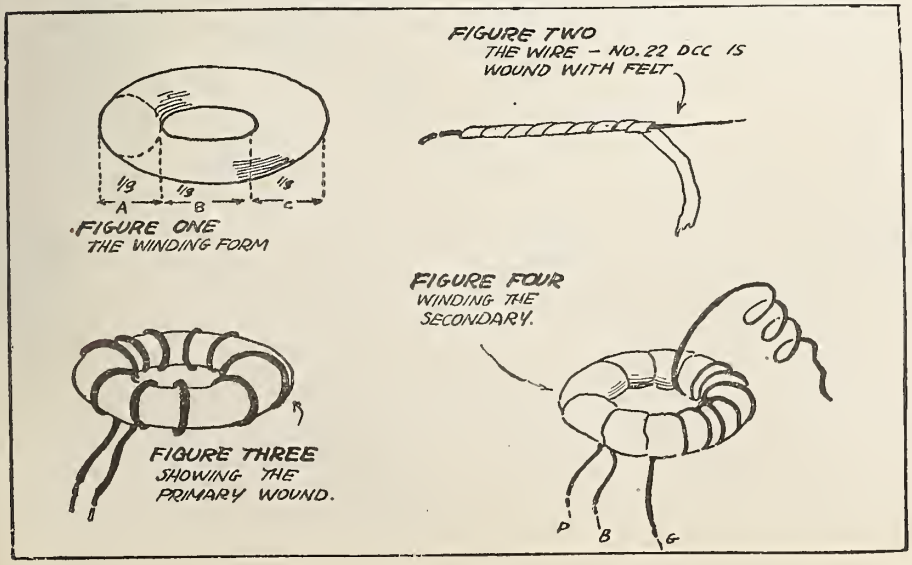
Experiencing quite a bit of difficulty in neutralizing a neutrodyne receiver, I hit upon quite an idea, which, while it gives complete magnetic coupling between primary and secondary, it magnetically isolates each transformer, which in turn prevents magnetic coupling between RF transformers, and also saves considerable space behind the panel in shortening leads.

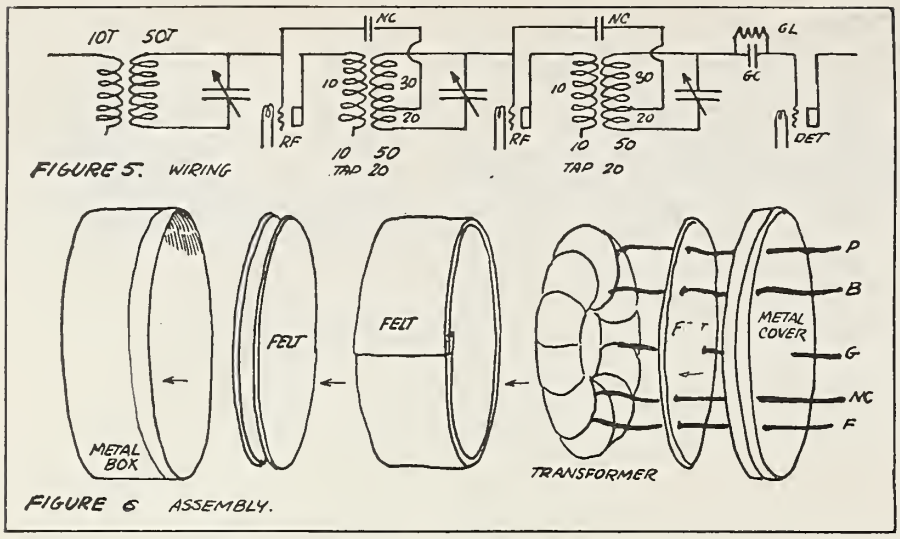
In this "doughnut transformer" the wire to be used for the primary and secondary is wrapped with felt in addition to double covered insulation (to get around the inter-turn capacity effects) in such a manner that the closed magnetic path is run directly through the center of the core. This doughnut core (having practically the same permeability as air) is used as a form only, and any other non-magnetic material would do just as well, as it serves only to guide the transformer windings. It should have an inside diameter, just roughly one-third of the outside diameter.

The primary is wound on the "doughnut" core (threading each turn through the hole in the doughnut) in such a manner that one or more complete layers are obtained. Fractional layers unbalance the magnetic field and defeat the original purpose of the transformer.

A thin layer of felt is wound on covering the primary, and the secondary is then wound, care being taken to obtain complete layers in the same manner as the primary.

Five holes are drilled in the lid of a metal box (obtained in most any drug store) in order to bring out the transformer leads and the neutralizing tap. (Note—If a straight RF transformer is made in this fashion, the neutralizing tap can be omitted. This would make only four leads—two primary and two secondary.) Holes are drilled in the bottom of





the metal box so that the unit may be fastened to the end plate of the tuning condenser. The bottom and sides are lined with felt (be generous) and the transformer windings are put into place.

The boxes should not be connected together, nor should they be grounded. The tube may be mounted directly behind this metal box-condenser unit, and much space may be saved in this manner.

In closing, I sincerely hope that this little suggestion may help some of the fellow DT's out of the neutralizing troubles.

Most oscillatingly yours,
J. H. FARGNAHR.

3974 Olive St.,
St. Louis, Mo.

You have no doubt seen shielded transformers before—but nearly all of them were of the fixed type. We don't know how the above idea works out, but it certainly looks good, and we're giving it to you just as our St. Louis friend gave it to us. If any of the readers of this department try it out, let us know how it works out. The sketches submitted by the contributor are given in Figures 1, 2, 3, 4 and 5.

Old readers of RADIO TOPICS and those readers of RADIO AGE who are interested in reflex stunts will like this next contribution. RADIO TOPICS readers will recall that Tri-Coil circuit, and RADIO AGE addicts have in mind the Sure-Fire circuit. The following is a contribution that can be applied to either of them:

RADIO AGE,
Gentlemen:

Just a few lines in appreciation of a good radio magazine and equally good hook-ups.

I try out all of the reflex layouts, as reflex is my hobby. I built the Sure-Fire reflex as shown in the June number and had very good results with it. I then rebuilt it in accordance with some ideas that I had and increased the volume considerably, without any sacrifice of selectivity, although I suppose Mr. Robbins would not approve.

I enclose hook-up as modified. You will note that I am not partial to potentiometers or the untuned primary.

I have also built the tuned impedance reflex as shown in the July number and had good results with that hook-up also, and then I modified it to better advantage. I enclose modified hook-up of that circuit.

Values for fixed condensers are not given because they are dependent on transformers and other apparatus used, and values are best determined by experiment.

On hook-up No. 1 a .005 MFD was used across the phones, while for No. 2 a .0015 was used.

The R. F. T. in No. 1 is a Tri-Coil type 9.

The variometer in No. 2 is a Raven.

The variable condenser in both hook-ups is of brass milled and turned from the solid block. (I used to be a tool-maker).

I can get WJZ and WOR on a table talker with both of these hook-ups.

Once more, keep potentiometers out of this circuit if possible, as they are "lossers."

Yours very truly,
A. J. SECOR.

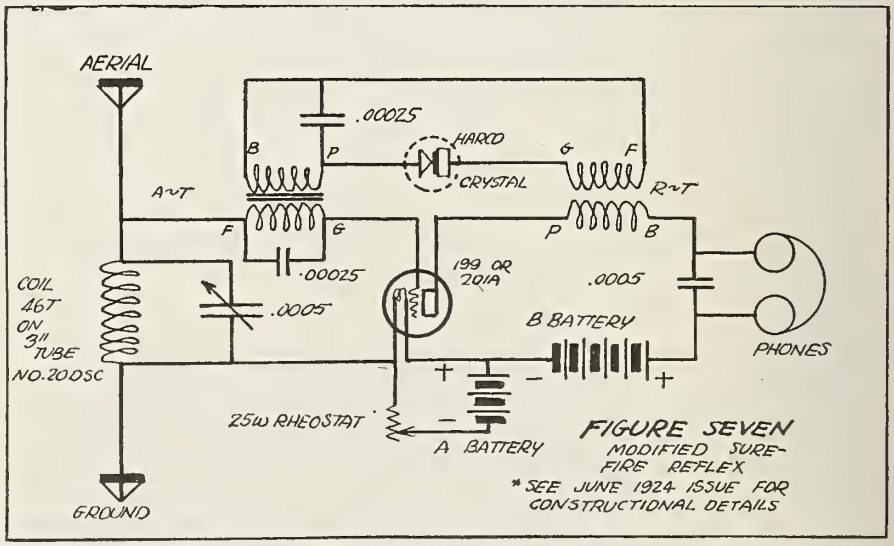
228 Laurel Ave.,
Bridgeport, Conn.
July 19, 1924.

This is just the type of letter and report we are looking for; concise and to the point with a report of results, type of apparatus and modifications used. Some of the experimenters who read this department might use Mr. Secor's form of giving the results with various circuits. Your suggestions are certainly appreciated, and we'll bet they will make a good many reflex fans change wires in their receivers.

And now we've got to devote some space to our friend, J. J. Drey, of Iron River, Michigan; who still continues to be flooded with mail. Evidently there is some question as to how he winds his coils, and he has kindly consented to tell the many Twisters just how he does it. Right here I might ask the fellows to be a little judicious about asking other Dial Twisters for information. Remember some of them are busy men; they have other things to do, and while they would be glad to help you out, they really *have* to devote some attention to private interests. If you really *must* ask questions of these generous radio men, make your questions to the point; ask only what you really need.

RADIO AGE,
Gentlemen:

In your June issue of RADIO AGE you have published my hook-up, as I have found, through experiment, to give exceptionally good results and through my experiments I have found the correct winding of a coil, that covers the general broadcasting waves, which is submitted in the sketch. To date I have received many letters requesting further information on the winding of the coil. You neglected to state the number of wire. It should be a 24 or 26 single cover cotton. Either one will do, but louder and clearer signals I have



found better with number 24 gauge.

There seems to be also a misunderstanding by the Reinartz fans in regard to the winding of the coil. I am herewith submitting to you a new sketch clearly illustrating the numbers on the taps. Will you kindly publish this as clearly as possible to enlighten numerous Reinartz fans. I am a very busy man with store duties and have not the time to answer each one personally in detail, but will always welcome any information, should one be in difficulty regarding the hook-up.

The instructions for widening the coil are as follows: Procure an ordinary spider frame which may be purchased at any radio shop. It has a wooden center of about 1¾ or 2 inches in diameter, with 17 spokes. Start winding the plate coil, which is on the inside of the frame. The starting end of the wire is the first tap. Wind 15 turns around in spider web form in weaving every second spoke in each one. This will form a Duo-Laterical air winding. Wind for 15 turns, make the second tap. Wind 15 more turns. This will be the fourth tap or the end of the plate coil. Cut the wire off, twist around the spoke. Now start your grid coil, which is wound right next to the plate coil, the end being about a quarter of the diameter away from the forty-fifth or end tap of the plate coil. The starting point of the grid coil is the first tap. Wind one turn, make the second tap. Wind two more turns, make the third tap. Wind two more turns, make the fourth tap. Wind one more turn, make the fifth tap. Wind one more turn, make the sixth tap. Wind one more turn, make the seventh tap. Wind one more turn, make the ninth tap. Wind two more turns, making the tap which goes to the ground. Wind eight more turns which will be the twentieth turn on the first tap for the grid switch. Wind seven more turns, make the second tap. Wind seven more turns, making the third tap. Wind three more turns, make the fifth tap. Wind three more turns, make the sixth tap, or the end of the outside coil. This end should be the forty-third turn from the end of the grid starting coil.

The other parts are to be connected as shown in the hook-up of the June issue of RADIO AGE.

I also wish to call attention to the fact that the second or third stage radio frequency transformer cannot be used in this hook-up. It must be a first stage radio frequency transformer. I have had many requests for this information.

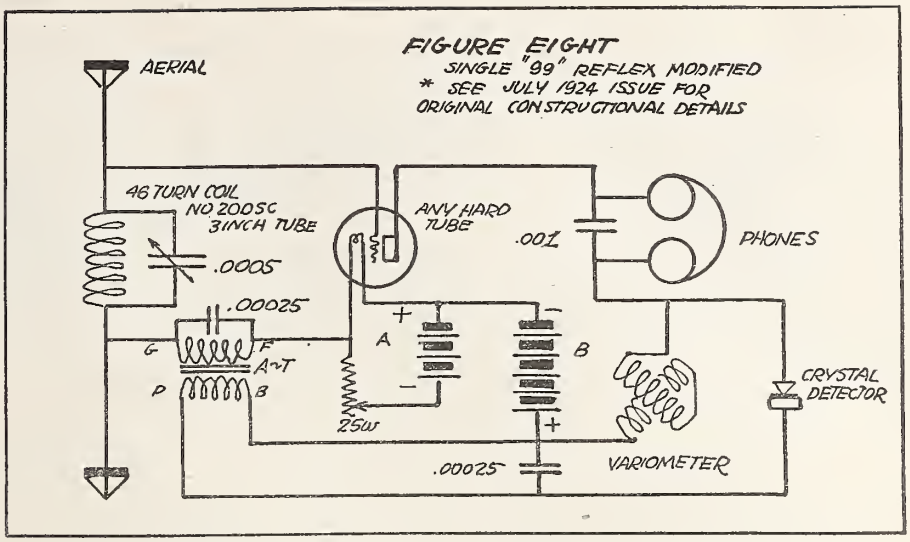
I did not realize that your RADIO AGE was so popular, but by the numerous letters the writer has received from practically every state in the union, requesting further information regarding the Reinartz hook-up, and from this fact it is evident that the readers have confined themselves to a good magazine.

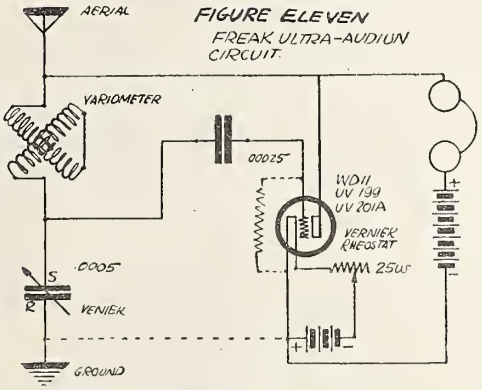
Thanking you to please publish the instructions of the coil in full detail so that all Reinartz fans will know how to construct it. If this is done correctly, according to my specifications, and according to the publication of your June issue, they will have a hook-up that will give remarkable results. I remain,

Yours very truly,
J. J. DREY.

Iron River, Mich.

Mr. Drey's procedure for winding the coil for this Reinartz circuit is illustrated in Figure 8.





P. Edward Chapman, of 805 North Preston Street, Philadelphia, Pa., is prompted by the article of the June issue Pick-ups Section on the Improved Superdyne, by M. C. Williams, to submit a few of the results he obtained with his four-tube "Selectdyne." Here they are; the hookup will be printed in our next issue.

Calls Heard By
P. E. Chapman,
805 N. Preston St.
Philadelphia, Pa.

WOR, WJZ, WEAF, WJY, WDT, WGI, WHAZ, WCAE, KDKA, WOC, KYW, WDAP, WNAJ, WSB, KSD, WGY, WRL, WRR, WFAA, WLW, WAAD, WSAI, CKY, WGR, WWJ, WOP, WRAX, WDAF, KFAW, WMAF,

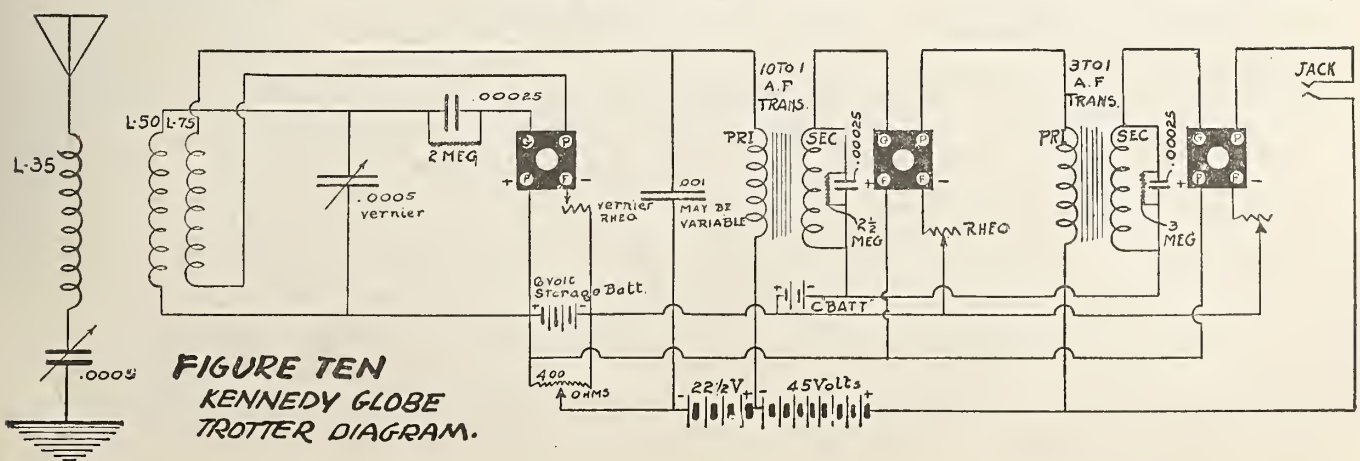
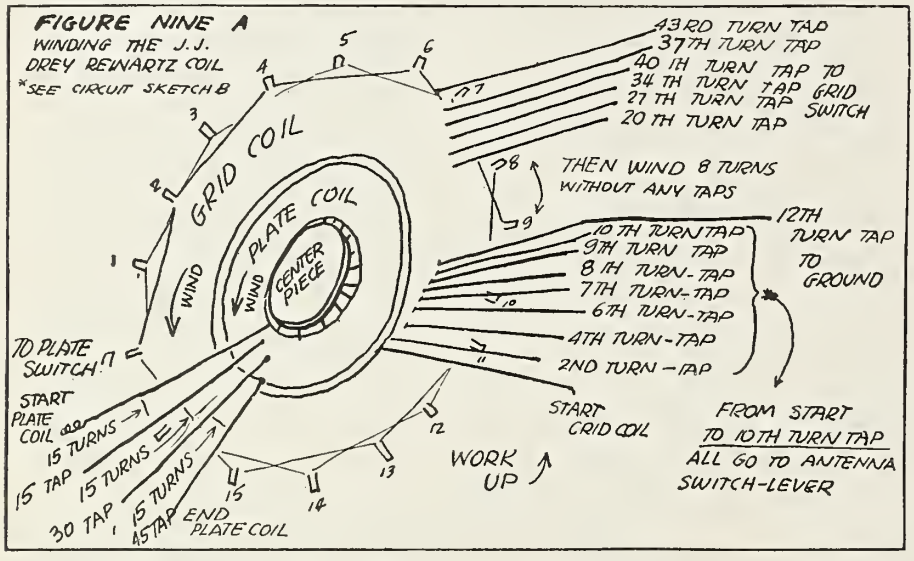


FIGURE TEN
KENNEDY GLOBE TROTTER DIAGRAM.

WSAQ, WCAP, WRC, WCAW, WOAW, WPO, PWX, 6KW, WMAQ, WJAX, WTAM, WIAF, WBZ, WLAG, WBAH, KHJ, KDYQ, KZN, KFIQ, CFCA, WIAD, WCBD, WEAH, KFAS, WSAL, WCAH, WBT, WHAS, WHAA, KFI, WCAT and verified receptions of 2ZY Manchester, England, and 2LO London, England.

From England to California—that's some receiver if you think it over. And only four tubes, too! (At this point the owners of super-heterodynes will plug in another stage in the tooth gnashing-hair pulling act.) Some of the fellows who felt that the six tube affair of Mr. Williams printed in the June issue is just a trifle too large will without question seriously consider this little four tube "Selectdyne" of Mr. Chapman's. In the popular vernacular, it's what you would dub "the berries."

Two Dial Twisters have called our attention to the fact that in our diagram of the Kennedy "Globe Trotter" hook-up, published in our June, 1924, Trouble-shooter Section, there are several inconsistencies which would confuse the average beginner. Louis A. Cass of Chicago, and T. J. Kennedy, the designer of the circuit, are the watchful bugs who are responsible for the corrected diagram shown in Figure 10.



A Prize Offer

We would like to mention the fact that the idea of giving a free copy of RADIO AGE to each fellow who points out an error in the Corrected List of United States, Canadian and Cuban Broadcasting Stations works out fine; so far we have had to give out only a few copies. But don't let that keep you from helping us to make that list just as up-to-date as possible.

Incidentally, does anyone happen to have a complete, reliable list of British and French broadcasting stations that they would like to have added to our regular monthly list?

September means the commencement of the DX season, and we are sure to have reports of more and more fellows hearing foreign broadcasting, so the list will be handy.

Before we leave the contributions and go on to the DX lists, we want to say that we are still open to suggestions, and more contributions. The Summer has run us a little short of our supply of available contributions for the first part of the Pickups Pages, so if you fellows want to read more of them, you've got to loosen up and let us hear from you.

The response to the Static Puncturing Contest was not as great as we would have expected it to be, but nevertheless when one considers that the idea of listening in through static is not one to be relished, we can hardly blame the boys. At any rate, here are the results for June and July.

First Prize List

RADIO AGE,
Gentlemen:

As I would like to enter your "Static Puncturing Contest," I enclose the list of stations I have heard during the month of June. The receiver I used in getting this list was a single tube portable set, using a regenerative circuit. The list of stations is as follows:

Calls Heard

WTAR, KDKA, WBZ, WHN, WGY, WTAM, WFI, WEAF, WJZ, WRC, WOR, WCAP, WJY, WGN, WJAR, WBBR, WSAN, WTAT, WLW, WIP, WDAR, WOO, WCBD, WHAZ, KFKX, WTAS, WDAP, WLS, WHAM, WPAB, WGR, WEAN, WANC, WSAI, CKAC, WEAP, WAAM, WSB, WJAX, KFNG, WCAE, WWAP, WBS, WJAS, WRAX, WCAU, WEAM, KQV, 2XR, 2XI, and WNAT.

I will leave it to you whether this is a good DX record or not. What little DX I do get, your magazine helps me to make it possible. Last Summer I did not read your magazine and the best I could do with a three tube set was WGY.

I think that speaks for itself.

Yours truly,
RALPH MELLON.

25 King St.,
Pottstown, Pa.

Ralph is mighty modest about that list. Fifty-one stations in Summer time is a good list. Last Winter we used to make a fellow a Dial Twister for a list like that. So Ralph Mellon's name goes down on the subscription list for one year—FREE!

Second Prize—June

RADIO AGE,
Gentlemen:

Ever since reading about your Dial Twisters, I have had a desire to become one of them, so I looked over my log book to see if my list might entitle me to admittance. In the past three months I have heard the following (excepting all local) DX stations:

Calls Heard

WLW, WBZ, WGY, WHAZ, KHJ, PWX, WLAG, WDAF, WSB, WOS, WIP, WOAW, KFKX, KGO, WGR, KDKA, WEAF, WGI, WHB, WJZ, WSAI, WTAY, WOR.

I am using the old two-variometer-variocoupler hook-up, slightly modified as per the enclosed diagram. This change makes the set oscillate more freely and gives slightly more volume. (Editor's Note: The above list is not the prize winner; the one following did the trick).

Using this set on June 12th, from 9 to 10 p. m., I heard the following:

Calls Heard

KYW, KSD, WLS, KDKA, WTAS, WMC, WCBD, WOC, WBAP, WDAF, WEBH, WQJ.

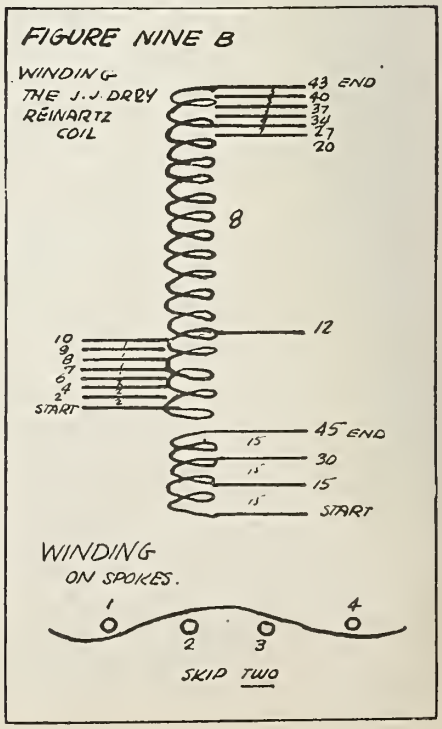
A curious thing was noticed about WOC. They were transmitting on two wave lengths; one their regular wave, and the other one right among the "hams." (A harmonic.)

I hope that this at least makes me a Dial Twister.

Yours truly,
RAY HAHN.

1517 Chestnut St.,
Milwaukee, Wis.

(*Continued on page 54*)



Trouble Shooter

E. K., New London, Conn.

Question: I am constructing the four tube neutrodyne receiver as described in the RADIO AGE ANNUAL. May I use a 5:1 ratio transformer instead of a 4:1 with equal results? I am going to use UV199 tubes. If not, please name a good 4:1 transformer. What is the use of the C battery? Where should this C battery be connected? What is the correct voltage of such a battery when using about 75 volts on the plate?

Answer: You may use a 5:1 ratio audio frequency transformer without impairing the results of the set. The UV199 tubes are good for the circuit you are building. Use the 5:1 transformer you have on hand, and save yourself the price of another one of 4:1 ratio, which is not absolutely necessary. Don't forget that we cannot answer questions which relate to comparison of manufactured and advertised apparatus. It is the purpose of the C battery to place a strong negative charge of the grid of the tube when excessive plate voltages are used. This lowers the drain on the battery and makes it last longer. The proper voltage of the C battery with UV199 tube 75 volts plate potential would be from three to four volts. The negative of the C battery is connected to the F post on the audio transformer (the grid return post), while the positive of the C battery is connected to the negative A battery.

C. P. J., St. Louis, Mo.

Question: I have a radio receiving set using the Reinartz hookup. I am not getting any results with respect to long distance stations. If I get any distant stations, there is a howl or whistle in the coil or tube all the time. If I put my hand near the dials or tuning switches, it makes the noise worse. Sometimes I can put my hand in a certain place and if I hold it there, I can tune the station in, but as soon as I move my hand it will start to whistle. I have a two-strand aerial about 30 feet long. I have the 23-plate condenser connected with the rotary plates to the ground, and I have the 43-plate rotary plates to the aerial side. Have a .0005 MF condenser hooked between the grid and the coil and I am using a UV200 detector tube. I am not using any amplification at all. Could this be my trouble? If I use a crystal coil in series with the aerial to the tube set, I can get pretty good results. If I do not use this coil, there is a howling noise all the time. I get KSD loud enough to hear all over the room with the phones, without the crystal coil. The crystal coil just works good on long distance stations.

Answer: The howl or whistle can be due to several causes. First it may be due to improper tuning, inasmuch as the set may be oscillating at the time you are receiving, which is not correct. The set should be so adjusted that it is just at the spill-over point, which is just below the point of regeneration, where the maximum amplification effects are obtained without distortion. The second possibility lies in the grid leak. Make or buy one that is variable, and adjust it. I find that many of the sets now in use are hampered in not using a leak that is adjustable in some way or other. Noises are common from poorly adjusted grid leaks. The hand capacity you mention may be due to the fact that your grid and plate wiring comes too close to the panel or mounting board, and it would be a wise move to rewire the set, and keep the leads short and direct, at the same time running them high in the air and at right angles to other wiring. Your trouble might also be due to a set of poor variable condensers. Get yourself a set of the new low loss type of condenser which is now being sold everywhere, and you will note a difference in both tuning and results. Adjust the plate battery voltage carefully; to do this it is wise to use a potentiometer connected across the A battery, with the center arm connected to the negative B battery lead. The B battery in addition should be tapped. The crystal coil in the aerial circuit is an indication that your antenna is too short. Thirty feet is ideal for 150 to 200 meter reception, but not for 300 to 400 meter work. If you can't lengthen your antenna, add a few more turns (about 15 or 20) to the antenna coil (the one with the 10 single turns), which is connected to the switch and the 43-plate condenser, and about 10 more turns on the grid coil. A local station of any appreciable strength will break through the tuning of a receiver (especially if the condensers are poor), even though the set may be way off resonance, and for local reception tuning does not have to be so accurate.

VACUUM TUBES (JJ-9-25)
OPERATING CHARACTERISTICS

BIASED AUDIO FREQUENCY AMPLIFICATION. High vacuum tubes used for audio amplification circuits should always be given a negative bias when the plate voltage of these tubes exceeds 45 volts, and even at 45 volts a saving is shown in the plate current and hence in the life of the "B" batteries. Greater amplification, greater freedom from distortion and a smaller demand on the "B" batteries are obtained by proper biasing voltages on the grids of the tubes.

Biasing the audio stage tubes is generally performed by placing a "C" battery in the grid line or return grid line with the negative post of the battery next to the grid post (G) of the socket. Potentiometers are seldom used because of the comparatively high plate voltages used with the amplifying tubes. As the "C" batteries supply only a very small amount of current during the operation of the set, and are automatically placed on an open circuit when the tubes are turned out, a small flash-light battery will last a long time on this service without the necessity of switches or special attention. The small special "C" batteries now on the market are excellent for this purpose, and after installing will last for more than a year without replacement or attention.

Fig. 1 on the adjacent data sheet shows the biasing battery "C" in the grid line of a single stage audio circuit. It will be seen that the negative of the "C" battery is placed toward the grid, and in addition to the negative pole of the "A" battery maintains a negative potential on the tube. That is all the secondary in circuit (SEC) of the audio frequency transformer (AT).

Fig. 2 shows the same effect obtained by placing the biasing battery in the grid return line, but it is likely that this is not so effective as the direct connected battery shown in Fig. 1. While the current drawn from the battery is so small that there cannot be much resistance loss, due to the resistance of the secondary winding of the transformer, yet there is an impedence loss which is likely to pull down the voltage slightly on extremely loud signals, and which would therefore tend to reduce the bias at the time when biasing was most needed. However, this system works very well and is used extensively.

Fig. 3 shows a two stage audio amplifying circuit in which a single "C" battery biases the grids of both tubes by a connection of the negative of the "C" battery to the secondaries of both transformers. The battery is therefore in the grid lines. The same results could of course be obtained by the use of two "C" batteries, one battery being placed directly in the grid line of each tube as in Fig. 1. The system outlined in Fig. 3, however, saves one battery and simplifies construction. The audio frequency transformers are shown at (AT-1) and (AT-2). Two "B" batteries (B1-B2) give minimum distortion but only (B1) need be used.

At voltages of approximately 40, biasing has not much effect on reducing distortion, nor does it noticeably increase the volume. It does, however, reduce the demand for current on the "B" batteries and in this way prolongs the life of the "B" batteries. At about 60 volts, the effect of biasing becomes very noticeable with a considerable increase in volume and less distortion when the tubes are being pushed hard. At 90 volts the volume depends very greatly upon the degree of bias and the proper bias voltage eliminates the mush and distortion that would otherwise be present without the "C" battery.

The biasing voltage must be increased as the plate voltage is increased. The proper biasing voltage varies with different tubes, and is given in the tables in the next data sheet.

COMPILED BY
J. B. RATHBUN

VACUUM TUBES (JJ-9-26)
OPERATING CHARACTERISTICS

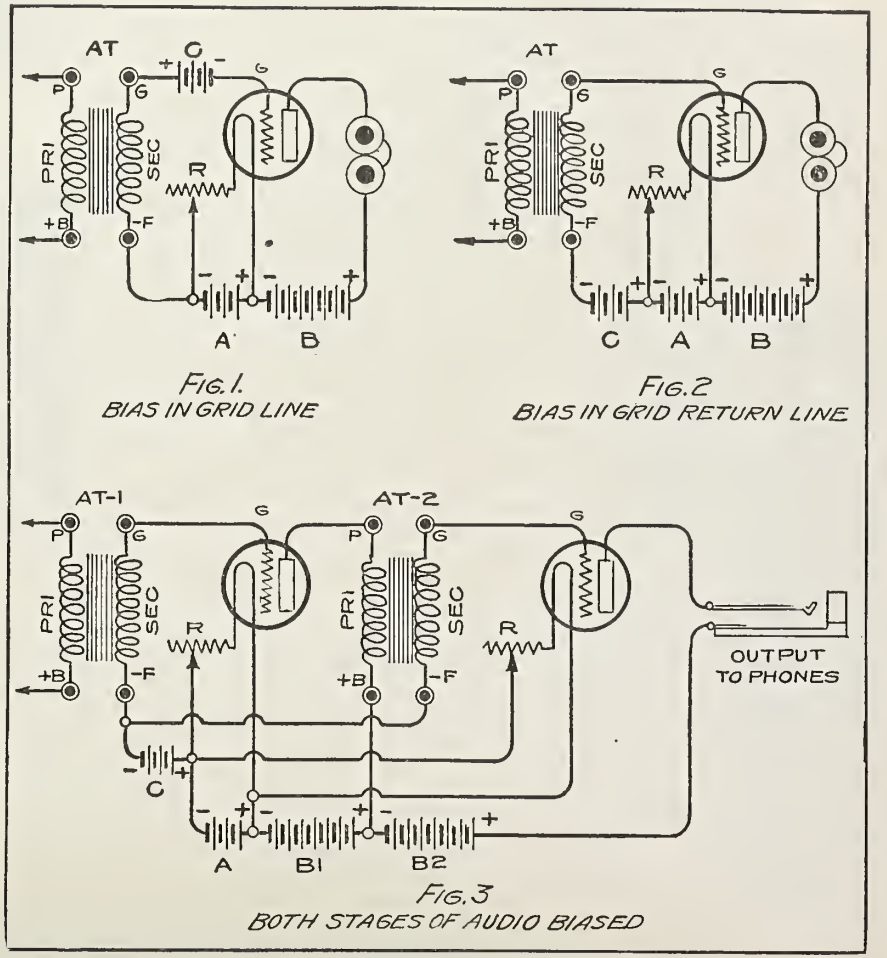


FIG. 1.
BIAS IN GRID LINE

FIG. 2
BIAS IN GRID RETURN LINE

FIG. 3
BOTH STAGES OF AUDIO BIASED

COMPILED BY
J. B. RATHBUN

Reminiscences of an Old Operator

(Continued from page 22)

at something above fifteen hundred and we positively did not get over it for weeks. The sound of that marvelous Fessenden synchronous rotary, with its pure soft whistle, will live with me forever.

And then—Shep went to sea. Which marked the turning of my footsteps toward the commercial game, and, incidentally, nearly marked the head of my grave with the usual inscription. It happened like this:

Shep, being away on the ships, had commissioned me to dismantle his set, for which I was to receive most of the equipment. The ten-wire flat top had been replaced by an enormous two-wire triangle extending along two sides of a city block and diagonally from one corner to the other, this last side being about 500 feet long.

In taking this long stretch down, I was standing on a tin roof, grounded through the rain spout, heaving away on these two long strands when they swung low onto some old 4,600-volt power lines in the alley on which the insulation was hanging in shreds. There was a tremendous report and a great flash and I found myself sitting on the roof with the ends of the wires dangling over the roof—absolutely untouched and without having felt a slightest tingle.

Very quietly I sat while the neighbors returned, one by one, indoors, figuring how in Sam Hill I was still there, absolutely as green and uncooked as if I had not just a moment before shorted, or grounded, or in some way run counter to a lot of volts on the wrong side of the transformer. Cautiously investigating, picking up a couple of handfuls of perfectly rounded copper marbles in the alley under the power lines, where some six feet of aerial wire had been melted, I found a perfectly satisfactory explanation. It was a nicely fused ground switch from which I had "neglected" to disconnect the lead before trying to pull the wires over to my roof. That was all—but that was enough.

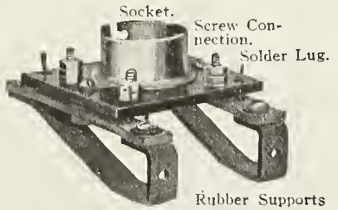
My amateur days overlap into my commercial with my first trip to "BX" station and my adoption by Dave Heilig as one of the men "posting up" for a ship job. But more of that in the next issue, if the good editor will let my sigs get through.

(In an early issue of RADIO AGE *Mr. Lynch will write on "My Initiation Into the Commercial Game," in which he experiences some hazardous adventures while serving as operator on the S. S. Seminole to Haiti. Watch for it.)*

BUYERS' AND SELLERS' SERVICE SHEETS

TUBE SOCKETS No. 3-A-24

1. **Spring Contacts.** Design:—Double contact springs or the new "side swipe" springs are desirable, since single contact springs are apt to bend out of contact and **stay bent**. Note that springs are so designed and fastened that they will not work loose.



Tube Socket Assembly.

Material:—Phosphor bronze, not too thin, is the best material, and gives longest life. It should be punched with the grain lengthwise with the spring not cross-wise, or the springiness will be diminished.

German silver is more apt to bend out of contact, and its resistance is higher. Test the springs by plucking them to ascertain that the material is springy and strong.

2. **Insulation**. Material:—Bakelite, hard rubber or porcelain. The latter when thoroughly glazed has low specific inductive capacity and high insulating qualities, but cannot be so well designed, and is more easily broken.

Soft compositions called "moulded mud" and used in cheap sockets, are partial conductors and to a large degree short-circuit signals to be detected or amplified. Such material is easily cut with a knife. Felt, and fibre are apt to gather moisture and are not first choice.

3. **Connections.** Design:—Lugs for soldering are desirable since contact must be perfect. If you are going to solder, be sure the insulation is good and will not soften under heat, as melting is not only unsightly but metal parts may be disarranged and open-circuited.

4. **Cleanliness.** Do not accept socket which has dirt, pencil marks or grease on the base.

5. **Shock-absorbers.** Design:—For tubes which are microphonic, such as U. V. 199 and C. 299, supports made from strips of rubber or a cushion of sponge rubber are desirable. Some cushioned tubes are fastened to the base by a screw through the socket. Such a method of connection does away with the effect of the cushion.

6. **Finish**. Style:—Metal posts should be nickeled and polished in order that they may not tarnish.

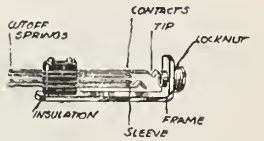
7. Socket must be so designed that there is no possibility of the tube prongs touching any of the springs unless the guide pin on the tube base is in the corresponding slot on the socket. Some sockets are so made that when the tube is put into the socket and rotated until the guide pin drops into the socket, the prongs will often make contact so that B-battery will burn out the filament.

COMPILED BY
EDMUND H. EITEL

BUYERS' AND SELLERS' SERVICE SHEETS

JACKS No. 4-A-24

1. **Springs**. Material:—Phosphor bronze or German silver. Former has lower resistance and greater elasticity; latter matches other metal parts and its appearance may be preferred.



Length:—Longer the better to insure long life, constant tension; short springs crystallize and break. Thickness: Heavy springs preferred for long life and to eliminate complication of booster springs. Design: If tip or short spring is placed next to frame with an insulation between spring and frame, plug may sometimes cause spring to touch frame and short circuit, especially after thimble wears a little.

2. **Terminals.** Design:—For convenience in soldering spread lugs preferred, and should be well tinned; to accommodate wires, holes of sufficient wire up to No. 12 B. & S., or whatever is to be used, needed for security and neatness in soldering.

3. **Contacts.** Material:—Pure silver will not oxidize, turn black or corrode, and therefore insures a clean and satisfactory contact; be sure contact points are clean.

4. **Insulation**. Material:—Such special compositives as Bakelite, Formica, or Micarta preferred, since these do not expand, contract, or absorb moisture. Design:—Insulation if attached to springs prevents slipping of springs from one side of frame to the other. An insulating sleeve or tube should extend for the full length of the screws which pass through the ends of the springs when held by lock washers; the screws are more secure.

5. **Frame**. Material:—Brass or heavy iron, nickel-plated; may be polished (there is little to be said in favor of an argument sometimes advanced that iron frame may become magnetized except that in certain positions iron may encourage flow of stray lines of force). Design:—Straight or tapered; width of latter type is such that greatest strength of frame is located where greatest strain occurs, at the bend; also bent frame eliminates insulation stack-up between frame and springs and makes for more solid mounting for the springs. Straight jacks may be turned upside down and make mounting for a subpanel. Special mounting screws and washers for tapered jacks make same thing possible with them; also this type permits wires to be run beneath it.

6. **Jack Thimble.** Design:—To compensate for varying panel thicknesses washers are supplied; stationary thimble riveted to frame with adjustable lock-nut preferred, since this insures against incorrect mounting and makes for plug entering correct distance and consequent good connection. If plug enters too far, it may reach cut-off springs; if not far enough, may rest on insulator of plug. Size:—Test with plug if possible; standard diameter is ¼ inch; some jacks and plugs are made oversized; a loose plug may fail to lift springs high enough to make contact in a filament control jack; or it may short-circuit against a misshaped frame; therefore be sure to make test, at least, before making radio assembly. Heavy thimble preferred to light one because threaded part may be twisted off.

7. **Capacity**. The capacity of standard jacks is negligible as compared with the capacity of the two lead wires to the phones or loud-speaker, and moreover you generally use a condenser across the phones anyway. On a few circuits using very short waves, a so-called low-capacity jack may be needed.

8. **Soldering.** Beware of a jack with soldering flux on it. Most soldering fluxes are corrosive and contain zinc chloride, a conductor of electricity which will short-circuit the jack.

COMPILED BY
EDMUND H. EITEL

Unsnarling Vacuum Tube Connections

(Continued from page 18)

problem to cope with: namely, the filament and plate batteries. Not infrequently we receive questions asking how long a battery will last with a certain tube. It is impossible to answer this; unless one knows how long you listen, an accurate record of the current used and the tube or number of tubes uesd.

About the best answer I can give to a question like that is to say that to obtain the greatest life and efficiency with dry cells, never let the drain per cell exceed one-quarter ampere, and it is decidedly wiser to connect batteries in series parallel so that the current rate of discharge is in the neighborhood of one-eighth ampere. Have a voltmeter handy, and never discard the cell until it falls below 1.0 volt.

A standard 6-inch, 1½-volt cell used for two hours per day at a discharge rate of six hundredths of an ampere will last a good deal more than 300 hours. At a discharge rate of one-eighth ampere, under the same conditions, it will last somewhat over 200 hours; at .18 of an ampere discharge, the cell will last about 125 hours, and with a quarter ampere discharge rate, under the conditions as above mentioned, it has a life in hours of about 100 or slightly more. This also assumes that the battery is useless after the voltage has fallen to 1.0.

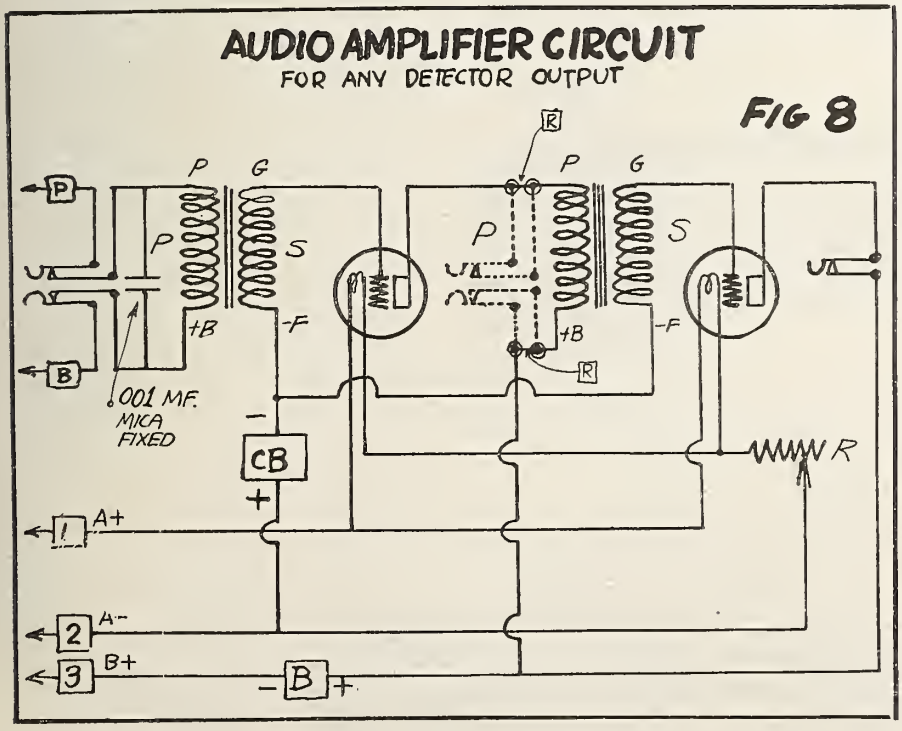
Knowing the amount of current it takes to operate your tube, and knowing the voltage, it is a comparatively easy matter to figure out from the above scale the number of batteries you will need.

Tapped B batteries are always advisable, especially in detector circuits. I have found that many times I could bring in five or six stations which I had never heard before by simply varying the plate battery voltage of the detector tube. It is decidedly wise to run up and down the scale of these taps in the course of long distance listening, for I am sure that you will discover its worth.

In conclusion, I would like to bring up the subject of poor tubes. Not infrequently do I run on to these "duds," and if I find a circuit properly connected and not giving the best results or none at all, I immediately suspect a "dud" tube. The only real way to determine this is to substitute it for one that you know is good.

In adjusting any receiver, it is a good plan if more than one tube is used to try changing the tubes around in the sockets, as often it will be found that a tube will work more effectively in one socket than in another.

Editor's Note: This is the second and last article on vacuum tube efficiency. The first part dealing with the choice of apparatus was published in the July issue of RADIO AGE, which is available at the customary price of 30 cents in stamps. Brainard Foote gave a discussion of detector tubes with grid bias battery, in the July issue. Further information on vacuum tube efficiency appears in the DATA SHEETS of the months of June and July. Readers who have not read these articles, on operating efficiency, should by all means do so.



"Reminiscences of an Old Operator,"
the True Story of an Amateur's Early Struggles,
Begins in This Issue.

WITH THE MANUFACTURERS

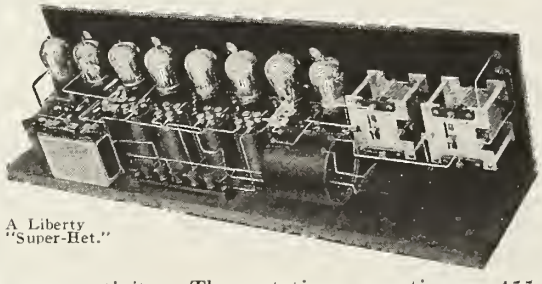
Deresnadyne Receivers Give Clear Tones

The Deresnadyne Receiver introduces a new principle in radio reception, which seems to possess decided possibilities. It is the invention of E. A. Beane and E. F. Andrews of Chicago. The circuit itself is similar to that of standard tuned radio frequency hookups, differing in the omission of certain parts heretofore considered necessary and in the proportioning and placing of the parts. Its performance is different from previous types. Its most impressive feature is its clear reproduction. This tone quality is, however, attained without the slightest sacrifice of volume or distance. On these points, the Deresnadyne is easily the equal of the best present-day receivers. It is extremely selective, tuning sharply enough to eliminate any ordinary interference, even in congested areas, and at the same time avoiding the critical sharpness which makes tuning difficult. Another feature is its freedom from undesired oscillations that produce whistling and distortion. No setting of the controls will cause the set to whistle. Tuning is still further simplified by the fact that each station will always be found at a particular setting of the dials and can be logged.

Liberty Electric Corp. Moves

The Liberty Electric Corporation moved recently to a new factory at Stamford, Conn. The factory is of the modern type, with more than 35,000 square feet of floor space to accomodate the need for increased manufacturing facilities.

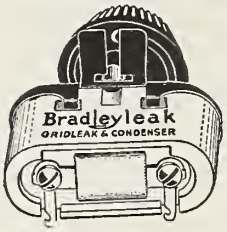
The principal Liberty product is the Liberty Super-Heterodyne Kit No. R-40. Liberty intermediate wave transformers have been especially designed for perfection with super-het reception. These transformers are shielded to prevent interstage couplings and may be placed close together. Liberty units are also known for their selectivity. Three stations operating on 455, 462 and 469 meters—one of them a 1,000-watt station near by—were completely separated with Liberty units. The Liberty super-het kit comes complete.



A Liberty "Super-Het."

The Bradleyleak

The Bradleyleak, manufactured by the Allen-Bradley Company of Milwaukee, Wis., is one of the very finest type of variable grid leaks on the market. The accompanying cuts illustrate its appearance, which is very much like the familiar Bradleystat filament control. The leak is variable continuously from about one-quarter to ten megohms of resistance, and can be used with any type of tube now on the market with perfect satisfaction.



A special provision is made for the grid condenser connections, in the form of a sunken bed in the porcelain itself to accommodate the small size fixed condensers now in vogue. Screws are provided for the mounting of this condenser and short grid leads are effected by its use.

New Electrad Products

Several new and improved radio products have been placed on the market recently by Electrad, Inc., New York City.

Among them are the Electric Certified Grid Leak, which is accurately calibrated and fixed, having permanent resistance; the Electrad "Hydrogrounds," made in the temporary drive type for campers; disc permanent type, and drive type—permanent. The hydroscopic element in the Hydroground has an affinity for moisture and holds it permanently in suspense.

Other new Electrad products include lightning arresters, indoor and outdoor types; vernier dial; lamp socket antenna, Electrad Diode tube, grid leak mountings, resistance coupled amplifier kits, etc.

Reichmann Designs "Thorola"

Frank Reichmann, inventor of the thorite horn and the thorophone loud speaker, has just designed a new reproducing unit known as the Thorola, which is being manufactured by the Reichmann Company of Chicago.

"The Thorola has proven its superiority in direct competition with other amplifying and reproducing devices in the $25 class," says Mr. Reichmann. "It reproduces the highest violin notes and the lowest drum beats without distortion and with great volume."

This design uses for the first time the push and pull principle with a permanent adjustment. The horn is one piece thorite and cannot be thrown into resonance with any audible sound wave frequency.

Franklin a Freshman Stockholder

Albert W. Franklin, chief engineer of the Charles Freshman Co., manufacturers of radio apparatus, of New York City, has just been made a stockholder in the concern.

Mr. Franklin is the inventor of the Freshman Variable Grid Leak and many other popular radio items.

Marshall-stat for All Tubes

The Marshall-stat, known as the "Universal Rheostat," is a smooth accurate-adjustment rheostat. Specially treated Marshall resistance discs enable the operator to obtain any resistance down to the finest vernier adjustment for any tube or combination of tubes. Breakage impossible. Only one hole required in panel.

The New Liberty Electric Corp. Factory at Stamford, Conn.

A One-Control "Go Getter"

(Continued from page 19)

builder may have to be governed somewhat by the plate condenser used. I find that different makes of condensers of the same rated capacity actually gives varying results, calling for from 48 to 55 turns. Therefore, while I give 48 turns as standard (and this will usually be satisfactory), the builder may find that it will be best to wind on about 55 turns at first, and then remove one or two turns at a time, if necessary, until the correct number for the condenser being used is found. This is easily done without disturbing the coils or any other part of the completed set. To get correct dial reading and number of turns, select, say, a 360-meter station. When this station tunes in at approximately 30 on the dial, you have the right number of turns on your secondary, and will then be able to cover all the broadcast wave lengths.

Get Correct Spacing

COIL "A," the primary, consists of *six* turns of No. 18 DCC wire. Coil "B," the secondary, has 48 turns (see suggestion above) of No. 22 DCC. Be sure to wind the wire on both coils in the same direction, and leave the ends of the wire of sufficient length to make your connections. For winding these coils use the wooden type of spider web form, with a center approximately 2½ inches in diameter. This type has thin round spokes, and in winding you pass the wire under two and over two, and so on until required number of turns is completed.

When completed, place the centers of the two coils evenly together, which automatically gives correct spacing between coils, and securely fasten together with a small *brass* machine bolt and nut. A neat effect can be obtained by cutting off the unused ends of the spokes down to the wire on both forms. On the secondary, which is toward back of set when set up, leave *one* spoke untouched. Drill a hole of proper size in baseboard and insert this long spoke. This gives an easy and secure mounting for coils.

The set as described will cover the entire band of broadcast wave lengths with an average-size outside antenna, and under favorable local and weather conditions will give the fan all the DX records he wants.

Magnavox Produces a Tube

The engineers who developed the Magnavox line of reproducing and amplifying equipment have now produced a vacuum tube which has been placed on the market at a price of $5.00. The Magnavox tube, Type A, is a storage battery tube for use as audio frequency and radio frequency amplifier in all standard circuits. Also recommended for detector use. It is not critical of adjustment either as to plate or filament. Filament consumption is one-quarter of an ampere. Its principal feature consists in its capacity for eliminating the grid.

First of a Series of Technical Radio Articles by Armstrong Perry Begins in October RADIO AGE

Pickups by Our Readers

(*Continued from page 44*)

I think Mr. Hahn's letter is a good one, and I think he will be glad to receive RADIO AGE for one year FREE. You fellows who missed out on that contest—MISSED SOMETHING!

I feel that this fellow deserves some recognition at least, for his good work. His listening is done in static the year around, far away from broadcasting stations, and his perseverance gets him a RADIO AGE ANNUAL.

RADIO AGE,
Gentlemen:

I have been getting your magazine from newsstands ever since you published your first number. I have every issue. I would sooner lose my tuning arm than to miss a number. I think that RADIO AGE is the biggest and best publication on the market.

I am a ham (my call being 4VA) but I would rather mix in with this bunch of Pick-up Birds of RADIO AGE than anything else. I have a single tube single circuit, and a Crosley Model X. I understand that the Crosley won't count in the lists, will it? Do I have to use one tube? I want to be a Dial Twister—I think it is more fun to be a BCL with the RADIO AGE bunch than getting a glass arm from poking at a key.

Here is a list I got on my one tube set:

KDKA, KJS, WBAP, WSY, WSAI, WOC, WSB, WWI, WLW, WMC, WGY, WOO, WJAX, WTAM, WCAI, WEAH, WDAR, WEAO, WOR, WMAJ, WFI, WDAT, WOAI, PWX, 6KW, WHAS, WSAF, WWJ, KSD, CYL, WGY, WSI, KWG, 2BY, WIAS, KGO and one in Porto Rico, the call of which I missed in tuning.

Now I don't think this is so bad, because all you fellows are up there amongst all the stations; where I am, way down here, there aren't many stations. To get any, you've got to reach out a long way first.

I want to wish you all the success in the world with your "million dollar RADIO AGE."

Yours truly,
P. L. HARTNETT.
316 Henderson Ave.,
Tampa, Florida.

Yessir! That letter deserves third prize. Down in the land of everlasting Summer, you do have static. I've had some of the radio bugs tell me that if it ever gets much worse, it would be fatal to listen. HI!

Score so far, by the courtesy of the Pick-ups Station of RADIO AGE is as follows:

June Game:

	Prizes					
	1	2	3	4	5	Total
Dial Twisters....	1	1	1			3
Old Man Static...	0	0	0			0

Here's another live wire:

RADIO AGE,
Gentlemen:

I am sending the following article for the Pick-ups Page in RADIO AGE. (He's quite a poet, and doesn't know it—makes 'em rhyme any time).

I am using the following hook-up employing a UV200 tube and have an antenna 40 feet long and 25 feet high. I have received as far as 200 miles with a wire 20 feet long and 10 feet high. My list of stations is as follows:

Calls Heard

KGO, KLZ, WCAP, WRC, WDAE, WSB, KFAU, KYW, WLS, WEBH, WGN, WMAQ, WQJ, WTAS, WTAY, WCBD, WGAZ, KFLZ, WOC, WHAA, KFKB, WEAH, WEAR, WNAC, WGI, WBZ, WDAS, KOP, WCX, WWJ, WBAH, WLAG, KFMX, WCAL, WOS, WDAF, WHB, WOQ, KFEZ, KSD, WCK, WEB, KFKX, WAAW, WOAW, WCAJ, WOR, WEAM, WOB, WGR, WSAW, WCAP, WMAC, WMAK, WEAF, WHN, WJY, WJZ, WHAM, WGY, WHAZ, WBT, WABW, WLW, WSAI, WTAM, WJAX, WHK, WBAV, WEAO, WABD, KGW, KDKA, WDAR, WOO, WIP, WIF, KQV, WCAE, WIAS, WPAB, WEAN, WJAR, KFDY, WNAV, WMC, WCM, WFAA, WBAP, WEAV, WCAR, KTW, WHA, WCAY, WHAD, CFCN, CKAC, CKCK, CFCA, CKY, PWX.

This makes 94 stations in all, in 30 different states, 5 in Canada and 1 in Cuba. A good part of this list was made during June and July.

ROBERT M. HILLIS.
1462 Belle Ave.,
Lakewood, Ohio.

Some time ago, a fellow, when subscribing, wrote in and told us that our magazine was not filled with a lot of crazy DON'TS—so we are going to spoil his perfectly good opinion of RADIO AGE by printing the following:

Don't forget to point out errors in the broadcast line.

Don't forget to renew your subscription.

Don't fail to read the October issue of RADIO AGE containing the story of the August Static Puncturing Contest.

New Lego Detector

A new fixed detector, The Lego Wonder, is being put out on the market by the Lego Corporation, of 225 West 77th Street. The engineers of this concern, after months of experimentation, maintain that the Lego Detector is ideal for Reflex and Crystal sets. Among the features of the Lego Wonder are the following:

No parts to replace or wear out; the use of a *new material* that effectively eliminates distorted and interrupted reception, and substitutes clarity and increases volume; 100 per cent sensitive; no searching for sensitive spot; glass encased, is immune from sun and dust.

Attaining Hair's Breadth Selectivity with One Control

(Continued from page 13)

the tube and put the phone plug in the jack. The tube should then be illuminated and the rheostat knob turned until the brilliancy is in accordance with directions accompanying the tube. Then connect the "B" battery and a sharp click should be heard. The tube should respond with a bell-like note when it is jarred slightly. Rotate the tuning condenser dial until a bird-like whistle is picked up—signifying the "carrier wave" of a broadcasting station. Increase the absorption condenser to about 70, when the whistle should cease and voice or music be heard.

IF THE absorption condenser does not stop the oscillation, increase the coupling between the antenna coil and the secondary until the oscillation does stop. The proper degree of coupling will be such that oscillation may be started and stopped by a movement of the absorption condenser at any point on the tuning condenser's dial. In the case of a small aerial, it may not be possible to stop oscillation, and in that case, wind about five more turns on the coupling coil.

Without oscillation, and with the absorption condenser at 100, tune in a local station on the tuning condenser and adjust the rheostat for best reception, using no more brilliancy than is necessary for loud and clear signals. Then decrease the absorption condenser to a point near oscillation, when the volume will be several times as great.

It is important to note that the circuit may be quite close to the point of oscillation over a wide range on the tuning dial. In searching for DX stations, the best and most thoughtful practice is to keep the reading of the absorption condenser slightly higher than is needed to produce oscillation, and at that point there will be sufficient regeneration to bring in the stations well. The presence of a DX station, or in fact any station, is indicated by a swishing sound caused by the contacts of the high voltage generator at the station. This slight swishing noise is very sharp in tuning, and if the station is weak it is utterly impossible to get it without the use of the vernier control.

How the Scale Should Read

Users of some condensers (.0005 in size, however) may find that the condenser scale isn't just right as regards its tuning range. To be sure of getting 546 meters (KSD), the highest broadcast wave length, WIP or WOO should come in at about 84 on the tuning condenser. The accompanying "curve" will show plainly about where the various stations may come in and will also give the reader an idea of the appearance of a "DX List." Anyone can make up such a curve

CLASSIFIED ADVERTISEMENTS

Ten cents per word per insertion, in advance. Name and address must be counted. Each initial counts as one word. Copy must be received by the 10th of month for succeeding month's issue.

RADIO CIRCUITS

SPECIAL FOR SEPTEMBER
The Reinartz Radio Booklet, by Frank D. Pearne, fully illustrated, and RADIO AGE, for $2.50. Price of booklet alone is 50c. Send check, currency or money order to RADIO AGE, 500 N. Dearborn Street, Chicago.

RADIO EQUIPMENT.

WHOLESALE PRICES ON STANDARD RECEIVERS, 25% discount; list for stamp. LIVE PROPOSITION to DEALERS. Thomas Radio Co., 111a Dix St., Muncie, Ind.

RADIO BATTERIES

Super Radio A and B Circuit Batteries, which bring in long distance reception. Sold for cash or on payment plan. Write for prices and details. Radio Battery Corporation, 501-B Industrial Bank Bldg., Flint, Mich.

MISCELLANEOUS

158 GENUINE Foreign Stamps. Mexico War Issues. Venezuela, Salvador and India Service. Guatemala, China, etc., only 5c. Finest approval sheets 50 to 60%. Agents Wanted. Big 72-p. Lists Free. We Buy Stamps. Established 20 Years. Hussman Stamp Co., Dept. 152, St. Louis, Mo.

QUALITY PRINTING—200 bord letter heads, $1.50; 250 envelopes, $1.50; 250 cards, $1.25. Samples. Midland Press, 543 West Hickory, Kankakee, Ill.

after he has listed the tuning dial numbers for a dozen stations or so, all that is required being a sheet of plain graph paper. Divide the lower line into tens for the dial numbers and the left vertical margin into tens for wave lengths between 200 and 550 meters.

The selectivity of the circuit will be sufficient to bring in WKAQ, Porto Rico, without a whisper from WDAP (now WGN) or WJAR—both 360 meter stations also. The fact is that WKAQ is a bit higher than 360 meters. The selectivity will also be sufficient to tune out WLW of Cincinnati (309 meters) and bring in KGO, Oakland, California (312). Of course, such long distance as KGO cannot be accomplished every night or even every week, but there are dozens and dozens of stations within the reach of this Ultra-Audion receiver. All that is necessary to get them is patience with the vernier "knob," as this is the heart of the control. Keep the regeneration up near the oscillation point, but be careful not to let it "spill over" and whistle very often as this will interfere with other listeners within a quarter of a mile or so. The circuit is not nearly as serious an interferer as a regenerative circuit where the aerial circuit is tuned, but it can radiate to some extent. The beauty of the arrangement shown is that the tendency is to tune the set without allowing it to oscillate whereas in other forms of regenerative circuit users are naturally more prone to use oscillation as a means of picking up DX stations.

The little "swishing" sound mentioned is your guiding notice and you can turn the vernier from 15 to 25 past eight or ten easily receivable broadcasting stations without having to touch the absorption condenser at all.

RADIO AGE
The Magazine of the Hour

RADIO AGE is a monthly periodical published on the 25th of each preceding month. There is one volume per year, 12 numbers constituting a volume. The subscription price for RADIO AGE in United States, its possessions and Canada is $2.50 per year; foreign, $3.00 per year. Single copies in United States, 25 cents each. Sample copy will be sent upon request. United States postage stamps in good condition, United States coin, money orders and personal checks accepted. No foreign stamps or coin will be honored. Checks and money orders should be drawn to the order of RADIO AGE, Inc.

All contributions should be addressed to R. H. Hopkins, Associate Editor, Suite 730, 500 N. Dearborn St., Chicago, Illinois. Contributions such as are not available will not be returned unless full return postage is enclosed. Remuneration for contributions printed in RADIO AGE is made upon publication, the word rate and amount being decided at the judgment of the Editor. Rates differ for various subjects. Good gloss photographic prints or other illustrations are solicited.

Other communications should be addressed to various departments as follows: Technical, Felix Anderson; Advertising, H. A. Ackerburg, advertising manager. Davidson & Hevey, Eastern representatives, 17 West 42d St., New York City; business and magazine returns. A. M. Leeb. All departments, excepting New York agency, are located at 500 N. Dearborn St., Chicago, Illinois, in care of RADIO AGE.

RADIO AGE. Monthly. Established March, 1922. Entered as second class matter at the Post Office at Chicago, Illinois, under the act of March 3, 1879, April 4th, 1924. Title Registered in U. S. Patent Office. Copyright: 1924: By RADIO AGE, Inc., 500 N. Dearborn St., Chicago, Illinois. The contents of this magazine are copyrighted, and must not be reproduced in part or in full without permission.

RADIO AGE is on sale on or about the 26th of each month on various new-stands and magazine agencies in the United States, Mexico, South America, England and Canada.

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The How and Why of Interference

(Continued from page 10)

Distinguishing Instruments

How often have you found that, were it not for the announcer telling you that such and such a composition was a violin solo, you would be unable to tell whether it was played by a violin or a flute? Having been told that it was a violin playing the piece, your imagination comes into play and you believe that you are listening to a violin.

The above explanation also accounts for the fact that one can separate equally distant stations operating on nearly the same wave length, within less than the space of one degree on the tuning dial, while with the case of a comparatively near station and an extremely distant one, a goodly number of harmonics have to be reckoned with in the music from the near station, which are entirely absent in the distant one.

So, don't tear your hair in exasperation when your receiver fails to obliterate that local interference sufficiently to allow you to bring in that coveted DX. No wave trap or filter is of any help in this case, for its use would also eliminate the signal itself. And, above all, do not blame the offending station.

The fault lies in the proximity of your receiver to the local station and the obvious remedy is—remove your receiver to a more advantageous location with respect to the home station or wait until local stations get "off the air" before you attempt to tune in DX.

New Ray-dio "B" Battery

The famous Lavier Formula, a new method for making batteries, has just been applied to radio batteries by the Jordan Battery Company, Ypsilanti, Michigan, manufacturers of Ray batteries.

Ths battery is called the Ray-dio "B" Storage Battery and is said to be a revolution in radio battery construction.

Among the many unusual features of this battery is the fact that no separators are used, giving free, unobstructed passage of the current, thus eliminating the hissing and sizzling that are often laid to static.

Ray-dio "B" Storage Batteries, it is said, respond instantly to atmospheric variations, and eliminate the annoyance of constant tuning.

"Babydyne" Latest in One-Tube Reception

The latest marvel in the radio world is the International Babydyne Radio Receiver, made by the A. and T. Radio Co. of Danvers, Mass. It owes its efficiency to a well-balanced hookup and to the newest radio improvements it incorporates. The Babydyne is compact, durable and easy to handle. It can be placed easily in a handbag, can be coupled to two stages of amplification and will tune in distant stations 1,500 miles away with ease. Static is reduced to a minimum.

Have You Seen the Real Blueprints in This Issue?

Corrected List of U. S., Cuban, Canadian, British and French Broadcasting Stations

Complete Each Issue

THE list of broadcasting stations on these pages is brought up to date each month by additions of new stations and deletion of those which have suspended operation. The list is the product of a vast volume of correspondence and its completeness is due in large measure to the assistance of our special news service in Washington, D. C. Suggestions, corrections and additional data will be welcomed from readers and broadcasters.

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh 326
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio 270
KDPT	Southern Electrical Co.	San Diego, Calif. 244
KDYL	Telegram Publishing Co.	Salt Lake City, Utah 360
KDYM	Savoy Theatre	San Diego, Calif. 244
KDYQ	Oregon Institute of Technology	Portland, Oreg. 360
KDZB	Frank E. Siefert	Bakersfield, Calif. 240
KDZE	Rhodes Department Store	Seattle, Wash. 270
KDZI	Electrie Supply Co.	Wenatchee Wash. 360
KDZR	Bellingham Publishing Co.	Bellingham, Wash. 261
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz. 360
KFAE	State College of Washington	Pullman, Wash. 330
KFAF	Western Radio Corporation	Denver, Colo. 278
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif. 280
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif. 280
KFAY	W. J. Virgin	Medford, Oreg. 283
KFBB	F. A. Buttrey & Co.	Havre, Mont. 360
KFBC	W. K. Azbill	San Diego, Calif. 278
KFBE	Reuben H. Horn	San Luis Obispo, Calif. 242
KFBG	First Presbyterian Church	Tacoma, Wash. 360
KFBK	Kimball-Upson Co.	Sacramento, Calif. 283
KFBL	Leese Bros.	Everett, Wash. 224
KFBS	Trinidad Gas & Electrie Supply Co. and the Chronicle News	Trinidad, Colo. 360
KFBU	The Cathedral (Bishop N. S. Thomas)	Laramie, Wyo. 283
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz. 238
KFCF	Frank A. Moore	Walla Walla, Wash. 360
KFCH	Electric Service Station (Inc.)	Billings, Mont. 360
KFCL	Leslie E. Rice	Los Angeles, Cal. 236
KFCP	Ralph W. Flygare	Ogden, Utah 360
KFCV	Fred Mahaffey, Jr.	Houston, Texas 360
KFCZ	Omaha Central High School	Omaha, Nebr. 258
KFDD	St. Michaels Cathedral	Boise, Idaho 252
KFDH	University of Arizona	Tuscon, Ariz. 368
KFDJ	Oregon Agricultural College	Corvallis, Oreg. 360
KFDR	Bullocks' Hardware & Sporting Goods (Rob. G. Bullock)	York, Nebr. 360
KFDX	First Baptist Church	Shreveport, La. 360
KFDY	South Dakota State College of Agriculture and Mechanics Arts	Brookings, S. Dak. 360
KFDZ	Harry O. Iverson	Minneapolis Minn. 231
KFEC	Meier & Frank Co.	Portland, Oreg. 360
KFEL	Winner Radio Corp.	Denver, Colo. 254
KFEQ	Screggin & Company Bank	Oak, Nebr. 268
KFER	Auto Electric Service Co.	Fort Dodge, Iowa 231
KFEV	Radio Electric Shop	Douglas, Wyo. 263
KFEX	Augsburg Seminary	Minneapolis, Minn. 261
KFEY	Bunker Hill & Sullivan Mining and Concentrating Co.	Kellogg, Idaho 360
KFEZ	Asso, Engr. Societies of St. Louis	St. Louis, Mo. 248
KFFB	Jenkins Furniture Co.	Boise, Idaho 240
KFFE	Eastern Oregon Radio Co.	Pendleton, Oreg. 360
KFFP	First Baptist Church	Moberly, Mo. 266
KFFR	Nevada State Journal (Jim Kirk)	Sparks, Nev. 226
KFFV	Graceland College	Lamoni, Iowa 280
KFFX	McGraw Co.	Omaha, Nebr. 278
KFFY	Pincus & Murphy	Alexandria, La. 275
KFGC	Louisiana State University	Baton Rouge, La. 254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla. 248
KFGH	Leland Stanford University	Stanford University, Calif. 273
KFGL	Arlington Garage	Arlington, Oreg. 234
KFGQ	Crary Hardware Co.	Boone, Iowa 226
KFGX	First Presbyterian Church	Orange, Tex. 250
KFGZ	Emmanuel Missionary College	Berrien Springs, Mich. 268
KFHA	Western State College of Colorado	Gunnison, Colo. 252
KFHD	Utz Electric Shop Co.	St. Joseph. Mo. 226
KFHH	Amhrose A. McCue	Neah Bay, Wash. 283
KFHJ	Fallon & Co.	Santa Barbara, Calif. 360
KFHR	Star Electric & Radio Co.	Seattle, Wash. 270
KFI	Earle C. Anthony (Inc.)	Los Angeles, Calif. 469
KFID	Ross Arhuckle's Garage	Iola, Kans. 246
KFIF	Benson Polytechnic Institute	Portland, Oregon 360
KFIL	Windisch Electric Farm Equipment Co.	Louisburg, Kans. 234
KFIO	North Central High School	Spokane, Wash. 252
KFIQ	First Methodist Church	Yakima, Wash. 242
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska 226
KFIV	V. H. Broyles	Pittsburg, Kans. 240
KFIX	Reorganized Chureh of Jesus Christ of Latter Day Saints	Independence, Mo. 240
KFIZ	Daily Commonwealth and Oscar A. Huelsman	Fon Du Lac, Wis. 273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa 248
KFJC	Seattle Post Intelligencer	Seattle, Wash. 233
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla. 252
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg. 252
KFJK	Delano Radio and Electric Co.	Bristow, Okla. 233
KFJL	Hardsacg Manufacturing Co.	Ottumwa, Iowa 242
KFJM	University of North Dakota	Grand Forks, N. Dak. 229
KFJQ	Valley Radio, Div. of Elec. Constr. Co.	Grand Forks, N. D. 280
KFJR	Ashley C. Dixon & Son	Stevensville, Mont. (near) 258
KFJX	Iowa State Teachers' College	Cedar Falls, Iowa 229
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa 248
KFJZ	Texas National Guard, One hundred and twelfth Cavalry	Fort Worth, Texas 254
KFKA	Colorado State Teachers College	Greeley, Colo. 248
KFKB	Brinkley-Jones Hospital Association	Milford, Kans. 286
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark. 224
KFKV	F. F. Gray	Butte, Mont. 283
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr. 286
KFKZ	Nassour Bros. Radio Co.	Colorado Springs, Colo. 234
KFLA	Abner R. Willson	Butte, Mont. 283
KFLB	Signal Electric Manufeaturing Co.	Menominee, Mich. 248
KFLD	Paul E. Greenlaw	Franklinton, La. 234
KFLE	National Educational Service	Denver, Colo. 268
KFLO	Bizzell Radio Shop	Little Rock. Ark. 261
KFLR	University of New Mexico	Albuquerque, New Mexico 254
KFLU	Rio Grande Radio Supply House	San Benito, Texas 236
KFLV	Rev. A. T. Frykman	Rockford, Ill. 229
KFLW	Missoula Electric Supply Co.	Missoula, Mont. 234
KFLX	George Roy Clough	Galveston, Tex. 240
KFLY	Fargo Radio Supply Co.	Fargo, N. Dak. 231
KFLZ	Atlantic Automobile Co.	Atlantic, Ia. 273
KFMQ	University of Arkansas	Fayetteville, Ark. 263
KFMR	Morningside College	Sioux City, Iowa 261
KFMT	Dr. George W. Young	Minneapolis, Minn. 231
KFMW	M. G. Sateren	Houghton, Mich. 266
KFMX	Carleton College	Northfield, Minn. 283
KFNF	Henry Field Seed Co.	Shenandoah, Iowa 266
KFNG	Wooten's Radio Shop	Coldwater, Miss. 254
KFNJ	Warrensburg Electric Shop	Warrensburg, Mo. 234
KFNL	Radio Broadcast Ass'n.	Paso Robles, Calif. 240
KFNV	L. A. Drake Battery and Radio Supply Shop	Santa Rosa, Calif. 234
KFNX	Peabody Radio Service	Peabody, Kansas 240
KFNY	Montana Phonograph Co.	Helena, Montana 261
KFNZ	Royal Radio Company	Burlingame, Calif. 231
KFOC	First Christian Church	Whittier, Calif. 236
KFOD	Vern Peters	Wallace, Idaho 224
KFOJ	Moberly High School Radio Club	Moberly, Missouri 246
KFOL	Leslie M. Schafbush	Marengo, Iowa 234
KFON	Echophone Radio Shop	Long Beach, Calif. 234
KFOO	Latter Day Saints University	Salt Lake City, Utah 261
KFOQ	Ora William Chancellor	Galveston, Texas 240
KFOR	David City Tire & Electric Co.	David City, Nebraska 226
KFOT	College Hill Radio Club	Wichita, Kansas 231
KFOX	Board of Education, Technical High School	Omaha, Nebraska 248
KFOY	Beacon Radio Service	St. Paul, Minn. 226
KFOZ	Leon Hudson Real Estate Co.	Fort Smith, Ark. 233
KFPB	Edwin J. Brown	Seattle, Wash. 224
KFPG	Garretson and Dennis	Los Angeles, Calif. 238
KFPH	Harold Chas. Mailander	Salt Lake City, Utah 242
KFPL	C. C. Baxter	Dublin, Texas 242
KFPM	The New Furniture Co.	Greenville, Texas 242
KFPN	Missouri National Guard	Jefferson City. Mo. 242
KFPO	Colorado National Guard	Denver, Colo. 231
KFPP	G. & G. Radio & Electric Shop	Olympia, Washington 236
KFPQ	Clifford M. Esler	Denison, Texas 231
KFPR	Los Angeles Co. Forestry Dept.	Los Angeles, Calif. 231
KFPS	Carter L. Ross Motor Service Co.	Casper, Wyo. 242
KFPV	Heintz & Kohlmoos, Inc.	San Francisco, Calif. 236
KFPW	St. Johns M. E. Church, S.	Carterville, Mo. 268
KFPY	Symons Investment Co.	Spokane, Wash. 283
KFPX	First Preshyterian Church	Pine Bluff, Ark. 242
KFQA	The Principia	St. Louis, Mo. 261
KFQB	The Searchlight Publishing Co	Fort Worth, Tex. 254
KFQC	Kidd Brothers Radio Shop	Taft, Calif. 227
KFQD	Chovin Supply Co.	Anchorage, Alaska 280
KFQE	Dickenson-Henry Radio Laboratories	Colorado Springs, Colo. 224
KFQG	Southern Calif. Radio Ass'n	Los Angeles, Calif. 226
KFQH	Albert Sherman	Hillshourgh, Cal. 231
KFQI	The Thos. H. Ince Corp.	Culver City, Calit. 234
KFQJ	Harbour-Longmire Company	Oklahoma City, Okla. 236
KFQK	Democrat Leader	Fayette, Mo. 236
KFQL	Oklahoma Free State Fair Assn.	Muskogee, Okla. 252
KFQR	Walter LaFayette Ellis	Oklahoma City. Okla. 250
KFQS	Dickenson-Henry Radio Laboratories	Manitou, Colo. 246
KFQT	Texas National Guard	Denison, Texas 252
KFQU	W. Riker	Holy City, Calif. 234
KFQV	Omaha Grain Exchange (Portable)	Omaha, Nebr. 231
KFQW	C. F. Knierim	North Bend, Wash. 248
KFQX	Alfred M. Hubbard	Seattle, Wash. 233
KFSG	Angelus Temple	Los Angeles, Calif. 278
KGB	Tacoma Daily Ledger	Tacoma, Wash. 252
KGG	Hallock & Watson Radio Service	Portland, Oreg. 360
KGO	General Electric Co.	Oakland, Calif. 312
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach 360
KGW	Portland Morning Oregonian	Portland, Oreg. 492
KGY	St. Martins College (Reb. Sebastian Ruth)	Lacy, Wash. 258
KHJ	Times-Mirror Co.	Los Angeles, Calif. 395
KHQ	Louis Wasmer	Seattle, Wash. 360
KJQ	C. O. Gould	Stockton, Calif. 360
KJR	Northwest Radio Service Co.	Seattle, Wash. 270
KJS	Bible Institute of Los Angeles	Los Angeles, Calif. 360
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif. 360
KLX	Trihune Puhlishing Co.	Oakland, Calif. 509
KLZ	Reynolds Radio Co.	Denver, Colo. 283
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif. 273
KMO	Love Electric Co.	Tacoma, Wash. 360
KNT	Grays Harbor Radio Co. (Walter Hemrich)	Aberdeen, Wash. 263
KNX	Electric Lighting Supply Co.	Los Angeles, Calif. 360
KOB	New Mexico College of Agriculture & Mechanic Arts	State College, N. Mex. 360
KOP	Detroit Police Department	Detroit, Mich. 286
KPO	Hale Bros.	San Francisco, Calif. 423
KQP	Apple City Radio Club	Hood River, Oreg. 360
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa. 360
KQW	Charles D. Herrold	San Jose, Calif. 360
KRE	V C Battery & Electric Co.	Berkeley, Calif. 278
KSD	Post Dispatch (Pulitzer Pub. Co.)	St. Louis, Mo. 546
KTW	First Preshyterian Church	Seattle, Wash. 360
KUO	Examiner Printing Co.	San Francisco, Calif. 360
KUY	Coast Radio Co.	El Monte, Calif. 256
KWG	Portable Wireless Telephone Co.	Stockton, Calif. 360
KYQ	Electric Shop	Honolulu, Hawaii 270
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill. 536
KZM	Preston D. Allen	Oakland, Calif. 360
KZN	Cope and Johnson Co.	Salt Lake City, Utah 268
WAAB	Valdemar Jensen	New Orleans, La. 268
WAAC	Tulane University	New Orleans, La. 360
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio 360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill. 286
WAAK	Gimbel Brothers	Milwaukee, Wis. 280
WAAM	J. R. Nelson Co.	Newark, N. J. 263
WAAN	University of Missouri	Columbia, Mo. 254
WAAW	Omaha Grain Exchange	Omaha, Nebr. 286
WABB	Harrisburg Sporting Goods Co.	Harrisburg, Pa. 266
WABD	Parker High School	Dayton, Ohio 283
WABE	Young Men's Christian Association	Washington, D. C. 283
WABG	Arnold Edwards Piano Co.	Jacksonville, Fla. 248
WABH	Lake Shore Tire Co.	Sandusky, Ohio 240
WABI	Bangor Railway & Electric Co.	Bangor, Me. 240
WABL	Connecticut Agricultural College	Storrs, Conn. 283
WABM	F. E. Doherty Automotive and Radio Equipment Co.	Saginaw, Mich. 254
WABN	Ott Radio, Inc.	LaCrosse, Wis. 244
WABO	Lake Avenue Baptist Church.	Rochester. N. Y. 252
WABP	Rohert F. Weinig	Dover, Ohio 266
WABQ	Haverford College, Radio Club	Haverford, Pa. 261
WABR	Scott High School. N. W. B. Foley	Toledo, Ohio 270
WABT	Holiday-Hal, Radio Engineers	Washington, Pa. 252
WABU	Victor Talking Machine Co.	Camden, N. J. 226
WABW	College of Wooster	Wooster, Ohio 234
WABX	Henry B. Joy	Mt. Clemens, Mich. 270
WABY	John Magaldi, Jr.	Philadelphia, Pa. 242
WABZ	Coliseum Place Baptist Church	New Orleans, La. 263
WBAA	Purdue University	W. Lafayette, Ind. 283
WBAH	The Dayton Co.	Minneapolis, Minn. 417
WBAN	Wireless Phone Corp.	Paterson, N. J. 244
WBAO	James Millikin University	Decatur, Ill. 360

Corrected List of Broadcasting Stations

WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex. 476
WBAV	Erner & Hopkins Co.	Columbus, Ohio 390
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa. 360
WBAY	Western Electric Co.	New York, N. Y. 492
WBBA	Newark Radio Laboratories	Newark, Ohio 240
WBBD	Barbey Battery Service	Reading, Pa. 234
WBBE	Alfred R. Marcy	Syracuse, N. Y. 246
WBBG	Irving Vermilya	Mattapoisett, Mass. 240
WBBH	J. Irving Bell	Port Huron, Mich. 246
WBBJ	Neal Electric Co., P. E. Neal	West Palm Beach, Fla. 258
WBBL	Grace Covenant Presbyterian Church	Richmond, Va. 283
WBBM	Frank Atlass Produce Co.	Lincoln, Ill. 225
WBBN	Blake, A. B.	Wilmington, N. C. 275
WBBR	Peoples Pulpit Asso.	Rossville, N. Y. 244
WBBT	Lloyd Brothers	Philadelphia, Pa. 234
WBBU	Jenks Motor Sales Co.	Monmouth, Ill. 224
WBBV	Johnstown Radio Co.	Johnstown, Pa. 248
WBBW	Ruffner Junior High School	Norfolk, Va. 222
WBBY	Washington Light Infantry, Co. "B" 118th Inf.	Charleston, S. C. 268
WBBZ	Nohle B. Watson	Indianapolis, Ind. 227
WBL	T & H Radio Co.	Anthony, Kans. 254
WBR	Pennsylvania State Police	Butler, Pa. 286
WBS	D. W. May, Inc.	Newark, N. J. 360
WBT	Southern Radio Corp.	Charlotte, N. C. 360
WBZ	Westinghouse Elec. & Mfg. Co.	Springfield, Mass. 337
WCAD	St. Lawrence University	Canton, N. Y. 280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa. 462
WCAG	Clyde R. Randall	New Orleans, La. 268
WCAH	Entrekin Electric Co.	Columbus, Ohio 286
WCAJ	Nebraska Wesleyan University	University Place, Nebr. 263
WCAK	Alfred P. Daniel	Houston, Texas 263
WCAL	St. Olaf College	Northfield, Minn. 360
WCAO	Sanders & Stayman Co.	Baltimore, Md. 360
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C. 469
WCAR	Alamo Radio Electric Co.	San Antonio, Tex. 360
WCAT	South Dakota State School of Mines	Rapid City, S. Dak. 240
WCAU	Durham & Co.	Philadelphia, Pa. 286
WCAV	J. C. Dice Electric Co.	Little Rock, Ark. 360
WCAX	University of Vermont	Burlington, Vt. 360
WCAY	Milwaukee Civic Broadcasting Station	Milwaukee, Wis. 226
WCAY	The Milwaukee Civic Broadcasting Assn., Inc.	Milwaukee, Wis. 266
WCAZ	Carthage College	Carthage, Ill. 246
WCBA	Charles W. Heimbach	Allentown, Pa. 280
WCBC	University of Michigan	Ann Arbor, Mich. 280
WCBD	Wilbur G. Voliva	Zion, Ill. 345
WCBE	Uhalt Radio Co.	New Orleans, La. 263
WCBF	Paul J. Miller	Pittsburgh, Pa. 236
WCBG	Howard S. Williams (Portable)	Pascagoula, Miss. 236
WCBI	Nicoll, Duncan & Rush	Bemis, Tennessee 226
WCBJ	J. C. Maus	Jennings, Louisiana 244
WCBK	E. Richard Hall	St. Petersburg, Fla. 266
WCBL	Northern Radio Mfg. Co.	Houlton, Me. 280
WCBM	Charles Swarz	Baltimore, Md. 229
WCBN	James P. Boland	Ft. Benj. Harrison, Ind. 266
WCBO	The Radio Shop, Inc.	Memphis, Tenn. 250
WCBQ	First Baptist Church	Nashville, Tenn. 236
WCBR	University of Mississippi	near Oxford, Miss. 242
WCBR	Charles H. Meester (Portable Station)	Providence, R. I. 246
WCBT	Clark University, Collegiate Dept.	Worcester, Mass. 238
WCBU	Arnold Wireless Supply Co.	Arnold, Pa. 254
WCBV	Tullahoma Radio Club	Tullahoma, Tenn. 252
WCBW	George P. Rankin, Jr., and Maitland Soloman	Macon, Ga. 226
WCBX	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J. 233
WCBY	The Forks Electrical Shop	Buck Hill Falls, Pa. 268
WCBZ	Coppotelli Bros. Music House	Chicago Heights, Ill. 248
WCK	Stix, Baer & Fuller Dry Goods Co.	St. Louis, Mo. 360
WCX	Detroit Free Press	Detroit, Mich. 517
WDAE	Tampa Daily Times	Tampa, Fla. 360
WDAF	Kansas City Star	Kansas City, Mo. 411
WDAG	J. Laurence Martin	Amarillo, Tex. 263
WDAH	Trinity Methodist Church (South)	El Paso, Tex. 268
WDAK	The Courant	Hartford, Conn. 261
WDAR	Lit Brothers	Philadelphia, Pa. 395
WDAS	Samuel A. Waite	Worcester, Mass. 360
WDAU	Slocum Kilburn	New Bedford, Mass. 360
WDAY	Radio Equipment Corp.	Fargo, N. Dak. 244
WDBA	Fred Ray	Columbus, Ga. 236
WDBB	A. H. White & Co., Inc.	Taunton, Mass. 229
WDBC	Kirk, Johnson & Co.	Lancaster, Pa. 258
WDBD	Herman Edwin Burns	Martinsburg, W. Va. 268
WDBE	Gilham-Schoen Electric Co.	Atlanta, Ga. 252
WDBF	Robert G. Phillips	Youngstown, Ohio 246
WDBH	C. T. Scherer Co.	Worcester, Mass. 268
WDBI	Radio Specialty Co.	St. Petersburg, Fla. 226
WDBJ	Richardson Wayland Electric Corp.	Roanoke, Va. 229
WDBK	M. F. Broz Radio Co.	Cleveland, Ohio 248
WDBL	Wisc. Dept. of Markets	Stevens Point, Wis. 278
WDBN	Electric Light & Power Co.	Bangor, Me. 252
WDBO	Rollins College, Inc.	Winter Park, Fla. 240
WDBP	Superior State Normal School	Sunerior, Wis. 261
WDBQ	Morton Radio Supply Co.	Salem, N. J. 234
WDBR	Tremont Temple Baptist Church	Boston, Mass. 256
WDBS	S. M. K. Radio Corp.	Dayton, Ohio 283
WDBT	Taylor's Book Store	Hattlesburg, Miss. 236
WDBU	Somerset Radio Co.	Skowhegan, Maine 258
WDBV	The Quimby Enterprises, The Strand Theatre	Fort Wayne, Ind. 258
WDBW	The Radio Democrat	Columbia, Tenn. 268
WDBY	North Shore Congregational Church	Chicago, Ill. 258
WDBM	Church of the Covenant	Washington, D. C. 234
WDZ	James L. Bush	Tuscola, Ill. Star Store Bldg. 278
WEAA	F. D. Fallain	Flint, Mich. 280
WEAF	American Telephone & Telegraph Co.	New York, N. Y. 492
WEAH	Wichita Board of Trade	Wichita, Kans. 244
WEAI	Cornell University	Ithaca, N. Y. 286
WEAJ	University of South Dakota	Vermillon, S. Dak. 283
WEAM	Borough of North Plainfield (W. Gibson Buttfield)	North Plainfield, N. J. 252
WEAN	Shepard Co.	Providence, R. I. 273
WEAO	Ohio State Universitv	Columbus, Ohio 360
WEAP	Mobile Radio Co.	Mobile, Ala. 360
WEAR	The Evening News Publishing Co.	Baltimore, Md. 261
WEAU	Davidson Bros. Co.	Sioux City, Iowa 275
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Texas 350
WEB	Benwood Co.	St. Louis, Mo. 273
WEBC	Walter Cecil Bridges	Superior, Wis. 242
WEBD	Electrical Equipment and Service Co.	Anderson, Ind. 246
WEBE	Roy W. Waller	Cambridge, Ohio 248
WEBH	Zenith-Edgewater Beach Broadcasting Station	Chicago, Ill. 380
WEBI	Walter H. Gibbons	Salisbury, Md. 242
WEBJ	Third Avenue Railway Co.	New York, N. Y. 273
WEV	Hurlburt-Still Electrical Co.	Houston, Texas 360
WEW	St. Louis University	St. Louis, Mo. 261
WFAA	Dallas News & Dallas Journal	Dallas, Texas 476
WFAB	Carl F. Woese	Syracuse, N. Y. 234
WFAH	Electric Supply Co.	Port Arthur, Texas 236
WFAM	Times Publishing Co.	St. Cloud, Minn. 360
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn. 360
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr. 275
WFBB	Eureka College	Eureka, Ill. 240
WFBG	The Wm. F. Gable Co.	Altoona, Pa. 261
WFBH	Concourse Radio Corporation	New York, N. Y. 273
WFBW	Ainsworth-Gates Radio Co.	Cincinnati, Ohio 309
WFI	Strawbridge & Clothier	Philadelphia, Pa. 395
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa. 248
WGAN	Cecil E. Lloyd	Pensacola, Fla. 360
WGAQ	Glenwood Radio Corp. (W. G. Patterson)	Shreveport, La. 252
WGAW	Ernest C. Albright	Altoona, Pa. 261
WGAZ	South Bend Tribune	South Bend, Ind. 360
WGI	American Radio & Research Corp.	Medford Hillside, Mass. 360
WGL	Thomas F. J. Howlett	Philadelphia, Pa. 360
WGN	The Tribune Co.	Chicago, Ill. 270
WGR	Federal Telephone & Telegraph Co.	Buffalo, N. Y. 319
WGY	General Electric Co.	Schenectady, N. Y. 380
WHA	University of Wisconsin	Madison, Wis. 360
WHAA	State University of Iowa	Iowa City, Iowa 484
WHAD	Marquette University	Milwaukee, Wis. 280
WHAG	University of Cincinnati	Cincinnati, Ohio 222
WHAH	Hafer Supply Co.	Joplin, Mo. 283
WHAK	Roberts Hardware Co.	Clarksburg, W. Va. 258
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y. 283
WHAP	Otta & Kuhns	Decatur, Ill. 360
WHAR	Paramount Radio & Electric Co. (W. H. As Pulus)	Atlantic City, N. J. 231
WHAS	Courier-Journal & Louisville Times	Louisville, Ky. 400
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del. 360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y. 380
WHB	Sweeney School Co.	Kansas City, Mo. 411
WHK	Radiovox Co. (Warren R. Cox)	Cleveland, Ohio 360
WHN	George Schubel	New York, N. Y. 360
WHO	Bankers Life Company	Des Moines, Iowa 526
WIAB	Joslyn Automobile Co.	Rockford, Ill. 252
WIAC	Galveston Tribune	Galveston, Texas 360
WIAD	Howard R. Miller	Philadelphia, Pa. 254
WIAH	Continental Radio & Mfg. Co.	Newton, Iowa 258
WIAK	Journal-Stockman Co.	Omaha, Nebr. 278
WIAO	School of Engineering of Milwaukee	Milwaukee, Wis. 246
WIAQ	Chronicle Publishing Co.	Marion, Ind. 226
WIAS	Home Electric Co.	Burlington, Iowa 283
WIAT	Leon T. Noel	Tarkio, Mo. 360
WIAU	American Trust & Savings Bank	Le Mars, Iowa 360
WIAY	Woodward & Lothrop	Washington, D. C. 273
WIK	K. & L. Electric Co. (Herbert F. Kelso and Hunter J. Lohman)	McKeesport, Pa. 234
WIL	Continental Electric Supply Co.	Washington, D. C. 360
WIP	Gimbel Brothers	Philadelphia, Pa. 509
WJAB	American Electric Co.	Lincoln, Neb. 229
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas 360
WJAG	Norfolk Daily News	Norfolk, Nebr. 283
WJAK	Clifford L. White	Greentown, Ind. 254
WJAM	D. M. Perham	Cedar Rapids, Iowa 268
WJAN	Peoria Star	Peoria, Ill. 280
WJAQ	Capper Publications	Topeka, Kans. 360
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I. 360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa. 250
WJAX	Union Trust Co.	Cleveland, Ohio 390
WJAZ	Chicago Radio Laboratory	Chicago, Ill. 448
WJD	Richard H. Howe	Granville, Ohio 229
WJY	R. C. A.	New York, N. Y. 405
WJZ	R. C. A.	New York, N. Y. 455
WKAA	H. F. Paar	Cedar Rapids, Iowa 268
WKAD	Chas. Looff (Crescent Park)	East Providence, R. I. 240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Texas 360
WKAN	United Battery Service Co.	Montgomery, Ala. 226
WKAP	Dutee W. Flint	Cranston, R. I. 360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R. 360
WKAR	Michigan Agriculture College	East Lansing, Mich. 280
WKAS	L. E. Lines Music Co.	Springfield, Mo. 360
WKAV	Laconia Radio Club	Laconia, N. H. 254
WKBF	Dutee Wilcox Flint	Cransten, Rhode Island 286
WKY	WKY Radio Shop	Oklahoma, Okla. 360
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn. 417
WLAH	Samuel Woodworth	Syracuse, N. Y. 234
WLAL	Naylor Electrical Co.	Tulsa, Okla. 360
WLAP	Wm. V. Jordan	Louisville, Ky. 286
WLAQ	Arthur E. Shilling	Kalamazoo, Mich. 283
WLAV	Electric Shop	Pensacola, Fla. 254
WLAW	Police Dept., City of New York	New York, N. Y. 360
WLAX	Putnam Electric Co. (Greencastle Community Broadcasting Station)	Greencastle, Ind. 231
WLB	University of Minnesota	Minneapolis, Minn. 360
WLBL	Wisconsin State Dept. of Markets	Stevenspoint, Wis. 278
WLS	Sears, Roebuck and Co.	Chicago, Ill. 345
WLW	Crosley Manufacuring Co.	Cincinnati, Ohio 423
WMAC	J. Edw. Page (Olive B. Meredith)	Cazenovia, N. Y. 261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass. 360
WMAH	General Supply Co.	Lincoln, Nebr. 254
WMAK	Norton Laboratories	Lockport, N. Y. 273
WMAL	Trenton Hardware Co.	Trenton, N. J. 256
WMAN	First Baptist Church	Columbus, Ohio 286
WMAP	Utility Battery Service	Easton, Pa. 246
WMAQ	Chicago Daily News	Chicago, Ill. 448
WMAV	Alabama Polytechnic Institute	Auburn, Ala. 250
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo. 280
WMAZ	Mercer University	Macon, Ga. 261
WMC	"Commercial Appeal" (Commercial Publishing Co.)	Memphis, Tenn. 500
WMH	Precision Equipment Co.	Cincinnati, Ohio 248
WMU	Doubleday-Hill Electric Co.	Washington, D. C. 261
WNAC	Shepard Stores	Boston, Mass. 278
WNAD	University of Oklahoma	Norman, Okla. 360
WNAL	Omaha Central High School	Omaha, Nebr. 258
WNAM	Ideal Apparatus Co.	Evansville, Ind. 360
WNAP	Wittenberg College	Springfield, Ohio 231
WNAR	First Christian Church	Butler, Mo. 231
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa. 360
WNAW	Peninsular Radio Club (Henry Kunzmann)	Fort Monroe, Va. 360
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak. 244
WNYC	Dept. of Plant and Structures	New York, N. Y. 526
WOAA	Dr. Walter Hardy	Ardmore, Okla. 360
WOAC	Maus Radio Co.	Lima, Ohio 266
WOAD	Friday Battery & Electric Corp.	Sigourney, Iowa 360
WOAE	Midland College	Fremont, Nehr. 280
WOAF	Tyler Commercial College	Tyler, Texas 360
WOAG	Apollo Theater (Belvedere Amusement Co.)	Belvedere, Ill. 224
WOAH	Palmetto Radio Corp.	Charleston, S. C. 360
WOAI	Southern Equipment Co.	San Antonio, Texas 385
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn. 360
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind. 360
WOAQ	Portsmouth Kiwanis Club	Portsmouth, Va. 360
WOAR	Lundskow, Henry P.	Kenosha, Wis. 229
WOAT	Boyd M. Hamp	Wilmington, Del. 360
WOAV	Pennsylvania National Guard, 2d Battalion, 112th Infantry	Erie, Pa. 242
WOAW	Woodmen of the World	Omaha, Nebr. 526
WOAX	Franklyn J. Wolff	Trenton, N. J. 240
WOC	Palmer School of Chiropractic	Davenport, Iowa 484
WOI	Iowa State College	Ames, Iowa 360
WOO	John Wanamaker	Philadelphia, Pa. 509
WOQ	Western Radio Co.	Kansas City, Mo. 360
WOR	L. Bamberger & Co.	Newark, N. J. 405
WOS	Missouri State Marketing Bureau	Jefferson City, Mo. 441
WPAB	Pennsylvania State College	State College, Pa. 283
WPAC	Donaldson Radio Co.	Okmulgee, Okla. 360
WPAJ	Doolittle Radio Corp.	New Haven, Conn. 268
WPAK	North Dakota Agricultural College	Agricultural College, N. Dak. 283
WPAL	Superior Radio & Telephone Equipment Co.	Columbus, Ohio 286
WPAM	Auerbach and Guettel	Topeka, Kan. 275
WPAP	Theodore D. Phillips	Winchester, Ky. 360
WPAR	Ward Battery and Radio Co.	Beloit, Kans. 236
WPAU	Concordia College	Moorhead, Minn. 286
WPAZ	John R. Koch (Dr.)	Charleston, W. Va. 273
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa. 360
WQAC	E. B. Gish	Amarillo, Texas 234
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt. 275
WQAF	Sandusky Register	Sandusky, Ohio 240
WQAL	Coles County Telephone & Telegraph Co.	Mattoon, Ill. 258

U.S. Gives Amateurs New Wave Lengths.

WASHINGTON. — Practically 15,545 amateurs will rejoice over the news that Secretary Hoover's radio aides have opened four new short wave bands for their exclusive use.

Nine district radio supervisors have received orders from Commissioner of Navigation D. B. Carson, under whose direction the Radio Section operates, to issue general and restricted amateur radio station licenses permitting the use of the wave lengths between 75 and 80 meters; 40 and 43 meters; 20 and 22 meters; and 4 to 5 meters, for pure CW telegraphy, 24 hours a day.

COMING IN OCTOBER RADIO AGE

Just to show you RADIO AGE has a bag of surprises for its readers in the October issue, we are giving you an inkling of some of the features. Look these over:

First of a Series of Technical Hookup articles by
ARMSTRONG PERRY

TWO More Unique Hookups illustrated with Four Pages of
REAL BLUEPRINTS
By John B. Rathbun

The Latest in
SIMPLE, EFFICIENT HOOKUPS
for Beginners, by
FRANK D. PEARNE
ROSCOE BUNDY
BRAINARD FOOTE
FELIX ANDERSON
And others.

Also, all the latest studio features for some entertaining reading between work on RADIO AGE hookups—including:

The Sunny Side of Running a Broadcasting Station

Being The "Inside" of WGN.

The WINNERS of the First RADIO POPULARITY CONTEST and all about them.

Handling Temperamental Movie Stars With Radio

A Unique Dispatch from Hollywood.

Second article on "Reminiscences of an Old Operator."

And a Choice Portion of "PICKUPS BY OUR READERS"
MORE FEATURES—MORE PAGES

ON THE STANDS SEPT. 22

Corrected List of Broadcasting Stations

WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	360
WQAQ	Abilene Daily Reporter (West Texas Radio Co.)	Abilene, Texas	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAX	Radio Equipment Company	Peoria, Ill.	248
WQJ	Calumet Baking Powder—Rainbow Gardens Station	Chicago, Ill.	448
WRAF	The Radio Club (Inc.)	Laporte, Ind.	224
WRAL	Northern States Power Co.	St. Croix Falls, Wis.	248
WRAM	Lombard College	Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	236
WRAO	Radio Service Co.	St. Louis Mo.	360
WRAV	Antioch College	Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRBC	Imanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corporation of America	Washington, D. C.	469
WRH	Chicago Herald & Examiner	Chicago, Ill.	536
WRK	Doron Bros. Electric Co.	Hamilton, Ohio	360
WRL	Union College	Schenectady, N. Y.	360
WRM	University of Illinois	Urbana, Ill.	360
WRR	City of Dallas (police and fire signal department)	Dallas, Texas	360
WRW	Tarrytown Radio Research Laboratory (Koenig Bros.)	Tarrytown, N.Y.	273
WSAB	Southeast Missouri State Teachers College	Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural College	Clemson College, S. C.	360
WSAD	J. A. Foster Co.	Providence, R. I.	261
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	309
WSAJ	Grove City College	Grove City, Pa.	259
WSAN	Allentown Radio Club	Allentown, Pa.	229
WSAP	Seventh Day Adventist Church	New York, N. Y.	263
WSAR	Doughty & Welch Electrical Co.	Fall River, Mass	254
WSAU	Camp Marienfeld	Chesham, N. H.	229
WSAX	Chicago Radio Laboratory	Chicago, Ill.	268
WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	233
WSAZ	Chas. Electric Shop	Pomeroy, Ohio	258
WSB	Atlanta Journal	Atlanta, Ga.	429
WSL	J. & M Electric Co.	Utica, N. Y.	273
WSY	Alabama Power Co.	Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAF	Louis J. Gallo	New Orleans, La.	242
WTAG	Kern Music Co.	Providence, R. I.	258
WTAH	Carmen Ferro	Belvedere, Ill.	236
WTAJ	The Radio Shop	Portland, Me.	230
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gordon & Son	Osseo, Wis.	220
WTAR	Reliance Electric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	286
WTAT	Edison Electric Illuminating Co.	Boston, Mass. (portable)	244
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	360
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	242
WTAW	Agricultural & Mechanical College of Texas	College Station, Tex.	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAY	Oak Leaves Broadcasting Station	Oak Park, Ill.	283
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTG	Kansas State Agricultural College	Manhattan, Kans.	273
WWAB	Hoenig, Swern & Co. (John Rasmussen)	Trenton, N. J.	220
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	Alamo Dance Hall, L. J. Crowley	Joliet, Ill.	227
WWAO	Michigan College of Mines	Houghton, Mich.	244
WWI	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	517
WWL	Loyola University	New Orleans, La.	260
WYAM	Electrical Equipment Co.	Miami, Fla.	283
WYAW	Catholic University	Washington, D. C.	236

Canadian Stations

CFAC	Calgary Herald	Calgary, Alberta	430
CFCA	Star Pub. & Prtg. Co.	Toronto, Ontario	400
CFCF	Marconi Wireless Teleg. Co. of Canada	Montreal, Quebec	440
CFCH	Abitibi Power & Paper Co.	Iroquois Falls, Ont.	400
CFCJ	La Cie de L'Evenement	Quebec, Quebec	410
CFCK	Radio Supply Co.	Edmonton, Alberta	410
CFCL	Centennial Methodist Church	Victoria, British Col.	400
CFCN	W. W. Grant Radio (Ltd.)	Calgary, Alberta	440
CFCQ	Radio Specialties (Ltd.)	Vancouver, B. C.	450
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCW	The Radio Shop	London, Ont	420
CFDC	Sparks Co.	Nanaimo, B. C.	430
CFQC	The Electric Shop (Ltd.)	Saskatoon, Saskatchewan	400
CFRC	Queens University	Kingston, Ontario	450
CFUC	University of Montreal	Montreal, Quebec	400
CHAC	Radio Engineers	Halifax, Nova Scotia	400
CHBC	Alberton Publishing Co.	Calgary, Alberta	410
CHCB	Marconi Company	Toronto, Ont.	410
CHCD	Canadian Wireless & Elec. Co.	Quebec, Quebec	410
CHCE	Western Canada Radio Sup. (Ltd.)	Victoria, B. C.	400
CHCL	Vancouver Merchants Exchange	Vancouver, B. C.	440
CHCM	Riley & McCormack	Calgary, Alberta	415
CHCS	The Hamilton Spectator	Hamilton, Ont.	420
CHYC	Northern Electric Co.	Montreal, Quebec	410
CJCA	Edmonton Journal	Edmonton, Alberta	450
CJGC	London Free Press Prtg. Co.	London, Ont.	430
CJCD	T. Eaton Co.	Toronto, Ont.	410
CJCE	Sprott-Shaw Radio Co.	Vancouver, B. C.	420
CJCI	Maritime Radio Corp.	St. John, New Brunswick	400
CJCM	J. L. Phillipe	Monti Joli, Quebec	430
CJCN	Simons Agnew & Co.	Toronto, Ont.	410
CJSC	Evening Telegram	Toronto, Ont.	430
CKAC	La Presse Pub. Co.	Montreal, Quebec	430
CKCD	Vancouver Daily Province	Vancouver, B. C.	410
CKCE	Canadian Independ. Telephone Co.	Toronto, Ont.	450
CKCK	Leader Pub. Co.	Regina, Saskatchewan	420
CKCO	Ottawa Radio Association	Ottawa, Ont.	440
CKCX	P. Burns & Co.	Calgary, Alberta	445
CKLC	Wilkinson Electric Company	Calgary, Alberta	400
CKQC	Wentworth Radio Supply Co.	Hamilton, Ont.	410
CKY	Manitoba Telephone System	Winnipeg, Manitoba	450
CNRO	Canadian National Railways	Ottawa, Ont.	435

Cuban Stations

PWX	Cuban Telephone Co.	Habana	400
2DW	Pedro Zayas	Habana	300
2AB	Alberto S. de Bustamante	Habana	240
20K	Mario Garcia Velez	Habana	360
2BY	Frederick W. Borton	Habana	260
2CX	Frederick W. Borton	Habana	320
2EV	Westinghouse Elec. Co.	Habana	220
2TW	Roberto E. Ramires	Habana	230
2HC	Heraldo de Cuba	Habana	275
2LC	Luis Casas	Habana	250
2KD	E. Sanchez de Fuentes	Habana	353
2MN	Fausto Simon	Habana	270
2MG	Manuel G. Salas	Habana	280
2JD	Raul Perez Falcon	Habana	150
2K	Alvara Daza	Habana	200
2HS	Julio Power	Habana	180
2OL	Oscar Collado	Habana	290
2WW	Amadeo Saenz	Habana	210
5EV	Leopoldo V. Figueroa	Colon	360
6KW	Frank H. Jones	Tuinucu	340
6KJ	Frank H. Jones	Tuinucu	275
6CX	Antonio T. Figueroa	Cienfiegos	170
6DW	Eduardo Terry	Cienfiegos	225
6BY	Jose Ganduxe	Cienfuegos	300
6AZ	Valentin Ullivarri	Cienfuegos	200
8BY	Alberto Ravelo	Stgo. de Cuba	250
8FU	Andres Vinnet	Stgo. de Cuba	225
8DW	Pedro C. Anduz	Stego. de Cuba	275

British Stations

2LO	London	365	
5IT	Birmingham	475	
5WA	Cardiff	350	
6BM	Bournemouth	385	
2ZY	Manchester	375	
5NO	Newcastle	400	
5SC	Glasgow	420	
2BD	Aberdeen	495	
6SL	Sheffield (relay station)	303	

French Stations

YN	Lyon	740	
FL	Paris (Eiffel Tower)	2,600	
8AJ	Paris	1,780	
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Department of RADIO ENGINEERING

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We will be pleased to receive and test any materials that are offered on the market and give them our endorsement where they meet all Institute tests. Send materials to RADIO AGE INSTITUTE, 504 N. Dearborn St., Chicago.

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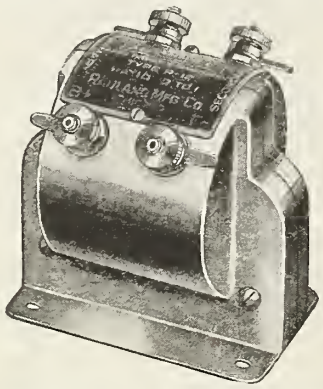

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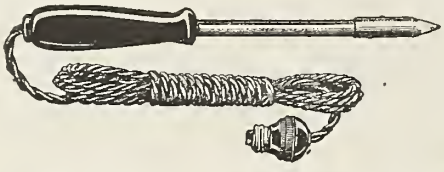

Test No. 3. Security electrical soldering iron No. 25. Made especially for radio work. Designed to reach heretofore inaccessible points of complex sets. A 3/8" rod 5" long and with 1/2" removable copper tie 2" long. Heating element of nichrome wire at tip where heat is needed. Flows solder freely. Guaranteed for one year and passed by Radio Age Institute Tests. Made by Security Electric Mfg. Co., Chicago, Ill.

Test No. 4. Allen Special Radio Soldering Paste. Manufacturers' tests with this item permanently eliminated 122 potential noise centers. Allen soldering paste is non-corrosive, acidless and protective. Guaranteed to eliminate noises, squeals and whistlings caused by loose connections. Volume increased and greater reception gained. Passed by Radio Age Institute Tests. Made by L. B. Allen Co., 4519 N. Lincoln St., Chicago.

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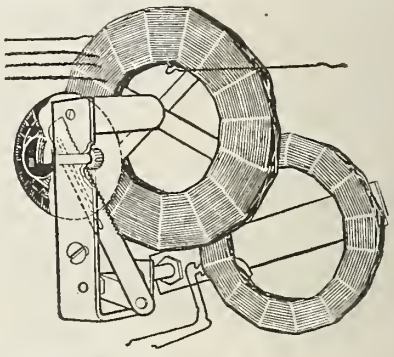

Pfanstiehl tuning unit—above.

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Your Radio Troubles Ended for 30 Cents in Stamps

HOW LONG have you postponed making that favorite hookup of yours because you couldn't find reliable and clear diagrams? Too many sets have been spoiled and dispositions ruined because fans have followed inaccurate diagrams. If you are constructing a receiving set and need diagrams that will produce perfect results, RADIO AGE can help you by return mail.

We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed hookups and diagrams to be found in these issues. Select the ones you want and enclose 30 cents in stamps for each one desired.

An Index to the Best in Radio Hookups!

May, 1922
—How to make a simple Crystal Set for $6.

September, 1922
—How to make a Regenerative Set at a low cost.
—Getting good results from Armstrong Super-Regenerative Set.

October, 1922
—How to make a Tube Unit for $23 to $37.
—How to make an Audio Frequency Amplifying Transformer.

November, 1922
—Photo-electric Detector Tubes.
—Design of a portable short-wave radio wavemeter.

May, 1923
—How to make the Erla single-tube reflex receiver.
—How to make a portable Reinartz set for summer use.

June, 1923
—How to build the new Kaufman receiver.
—What about your antenna?

December, 1923
—Building the Haynes Receiver.
—Combined Amplifier and Loud Speaker.
—A selective Crystal Receiver.

January, 1924
—Tuning Out Interference—Wave Traps—Eliminators—Filters.
The article which was announced from stations WJAZ, WOC and WOAW.
—A Junior Super-Heterodyne.
—Push-Pull Amplifier.
—Rosenbloom Circuit.

February, 1924
—How to make a battery charger.
—Improved Reinartz Circuit.
—Interference rejectors.
—Single Tube Heterodyne.
—How antenna functions.
—Adding two audio stages to selective receiver which began as a crystal set.
—Superdyne receiver.

March, 1924
—An Eight-Tube Super-Heterodyne.
—A simple, low loss tuner.
—Junior Heterodyne Transformers.
—A Tuned Radio Frequency Amplifier.
—How to make the Kopprasch Receiver.
—Adding Radio Frequency to the Variometer Set.
—Simple Reflex Set.

April, 1924
—An Efficient Super-Heterodyne (fully illustrated).
—Selecting the Right Receiver.
—A Ten-Dollar Receiver.
—Anti-Body Capacity Hookups.
—Radio Frequency Amplification.
—Reflexing the Three-Circuit Tuner.
—Index and first two instalments of Radio Age Data Sheets.

May, 1924
—Construction of a Simple Portable Set.
—An Ideal Set for the Summer Camper.
—A Traveling Man's Receiver.
—Radio Panels.
—Making a Basket-Weave Tuner.
—Third Instalment of Radio Age Data Sheets.

June, 1924
—Important Factors in the Construction of a Super-Heterodyne.
—A Universal Amplifier.
—A Sure Fire Reflex Set.
—Adding Radio and Audio to Baby Heterodyne.

July, 1924
—A Portable Tuned Impedance Reflex.
—Operating Detector Tube by Grid Bias.
—Getting the Most Out of Vacuum Tubes.
—A Three-Tube Wizard Circuit.
—Recharging Storage Batteries From a 32-Volt Lighting System.

August, 1924
—The Invisible Circuit.
—Breaking Into Radio Without a Diagram.
—The English 4-Element Tube.
—Filtered Heterodyne Audio Stages.
—An Audio Amplifier Without an "A" Battery.

RADIO AGE, Inc.

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The PAUL REVERE of TODAY

TWENTY MILES in a single night. That was the wonderful broadcasting achievement of Paul Revere as he galloped from village to village, waking the countryside with the cry "the British are coming."

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In every part of the United States Crosley Radio Receivers are bringing in far distant stations clearly and distinctly. Up to the minute news, concerts, music, lectures, are yours to enjoy right in your home when and from where you choose if you own a Crosley.

Keeping always at the head of the procession in improvements and innovations, the Crosley Radio Corporation has made it possible for every one to possess the maximum efficiency in radio reception at the minimum cost.

The Crosley Trirdyn 3R3 illustrated below is, in the opinion of many experts, the best radio receiver ever offered to the public at any price. The experiments of over 200 experts have shown that in ease of tuning, sharpness of signals and nicety of calibration, the Trirdyn cannot be excelled. Local stations may be easily tuned out even if very close to you, and far distant reception almost instantly brought in.

The Trirdyn 3R3 illustrated below is a three tube set incorporating tuned radio frequency amplification, regeneration and reflex. It has been proven to give the efficiency of a four or five tube set. And yet it is priced at only $65 without batteries, tubes and headphones. The Trirdyn Special, set in a special solid mahogany cabinet which is made to house all the necessary accessories, may be had for only $75.

Before you purchase a radio receiver, listen in on a Crosley Trirdyn.

For Sale by Good Dealers Everywhere.

Crosley Trirdyn, 3R3 $65.00

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Crosley 51	The two tube Armstrong Regenerative set that became the biggest selling receiver in the world in just 24 days. Price, less accessories, $18.50. By adding the Crosley 51-A, a one stage amplifier at $14.00, a three tube set may be formed.
Crosley 50-P	The Crosley 50 in neat, strong, portable quartered oak cabinet for only $18.00.
Crosley 51-P	The Crosley 51 in compact leatherette portable case, completely self containing, at $25.00.
Crosley 52	A new Armstrong Regenerative three tube set assuring loud speaker volume on distant stations under almost any conditions. Price, without accessories, $30.00.
Crosley X-J	One of the best known and most popular four tube receivers on the market. A radio frequency set at $55.00, without accessories.
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RADIO AGE

The Magazine of the Hour

OCTOBER
1924

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Greensburg, Pa.

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Corona, L. I.

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This page contains only a few of the thousands of letters we receive from successful graduates. Many write in to praise the set of Free instruments which are furnished without charge to all students. Among these is the famous Natrometer —a wonderful patented device for learning the code which can be used only by our students. Employers are constantly sending in requests for our graduates—offering them fine positions at splendid salaries.

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Dept. 53KA, Washington, D. C.

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City.....State.....

Occupation.....

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RADIO AGE

The Magazine of the Hour

Established March, 1922

WITH WHICH IS COMBINED RADIO TOPICS

Volume 3 *October, 1924* *Number 10*

CONTENTS

Radio Age is published monthly by
RADIO AGE, Inc.
Member: Audit Bureau of Circulations.

Advertising, Editorial and Publication Offices,
500 N. Dearborn St., Chicago

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Advertising forms close on the 25th of the 2nd month preceding date of issue

Issued monthly. Vol. 3, No. 10. Subscription price, $2.50 a year.

Application made for transfer of second class entry from the post office at Chicago, Illinois, to the post office at Mount Morris, Illinois

A Chat With the Editor

THE "BIG GAME" season for Radio has opened. Armed with better receiving sets, America's army of radio fans is prepared to go into the present season with more technical knowledge and ability and *real interest* than ever before. If radio had millions of followers last year, just imagine how many will follow its progress during the Fall and Winter of 1924 and '25!

RADIO AGE is not making an over-confident prediction when it forecasts the season which is getting under way with the coming of cool weather and the elimination of Summer static. Its optimism is based on hundreds of actual predictions from the fans themselves.

Thus assured, RADIO AGE is prepared to publish the sort of material the fans want.

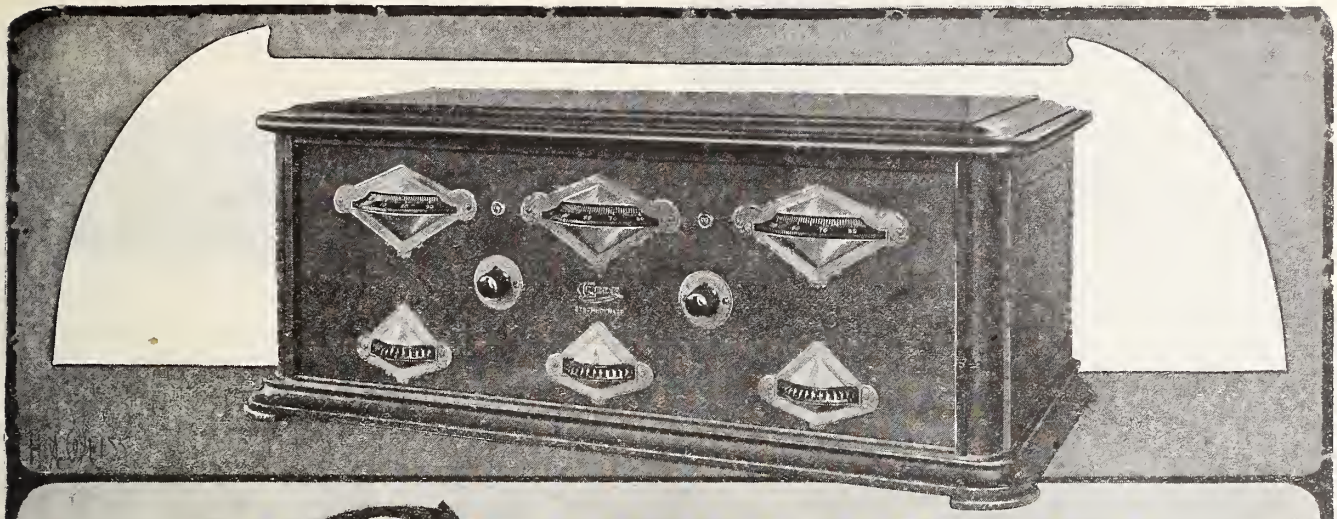
We have arranged with some of the best known radio experts in the country to print their contributions during the coming months.

Armstrong Perry, known to a million Americans for his work in pioneering the radio field, is the latest addition to our technical staff. One of the most interesting and authoritative articles he has written begins in this issue. Frank D. Pearne, known to every radio fan in the Middle West, will be on hand monthly with the latest in radio hookups and theories, told as only Frank Pearne can do it. And John B. Rathbun, who draws the RADIO AGE blueprints, has a bag of surprises that will keep fans "fishing" with their sets long after the bedtime stories have signed off. Beginning with this issue, every conceivable kind of set from the simplest crystal and one-tube hookups to the most complicated "Ultradyne" will be given due attention.

There you have RADIO AGE'S promise for radio's biggest season. It is RADIO AGE'S ability to fulfill its promises to its readers that makes it a reliable radio magazine —and the *only* radio magazine that gives you $5 worth of real blueprints in every issue—for 25c.

Frederick Smith

Editor of RADIO AGE



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TRADE MARK

"If a house is crammed with treasures of gold and jade, it will be impossible to guard them all."
—Lao Tzu

Of worth far greater than things of gold and jade is your Grebe Synchrophase. Highly will you treasure it; zealously will you guard it.

Doctor Thu

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(Not regenerative)—6 tubes—2 stages tuned frequency amplification—detector and 3 stages audio frequency amplification. Installed in a beautifully finished cabinet of solid mahogany—44⅞ inches long, 16¾ inches wide, 10⅝ inches high. Door panels inlaid. Slanting panel of sheet bronze, mahogany finish, with scales and indicators in metallic relief. Gold plated pointers, to prevent tarnish. Compartments at either end for dry batteries. Can be operated on either wet or dry batteries. Either inside or outside antenna.

Price (*exclusive of tubes and batteries*) $230

Super-Zenith VIII

Same as VII except—built with mahogany legs of well-proportioned appropriate design, converting model into console type.

Price (*exclusive of tubes and batteries*) $250

Super-Zenith X

New and exclusive Zenith features make this model supreme in the field of Radio. See Super-Zenith X at the Radio World's Fair, Madison Square Garden, New York, September 22nd to 28th.

Price (*exclusive of tubes*) $550

Super-Zenith IX

Same as VII except—built with legs and additional compartments containing built-in Zenith loud speaker on the one side and generous storage battery space on the other.

Price (*exclusive of tubes and batteries*) $300

It Tunes Through *Everything*

The New SUPER-ZENITH

The new Super-Zenith is NOT regenerative. It is a six-tube set in four different models ranging from $230 to $550, with a new, unique and really different patented circuit controlled exclusively by the Zenith Radio Corporation. Amplification is always at a maximum in each stage for any wavelength. *The Super-Zenith line is not affected by moisture.* For the first time, you have here a set that—

1—tunes through *everything* and selects the station you really want.

2—requires only *two* hands—*not three*—to operate.

3—brings in each station *at only one point on the dial.*

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Write for the name of the nearest dealer from whom you can obtain a demonstration of this outstanding marvel of the radio world.

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RADIO AGE
The Magazine of the Hour
M. B. Smith
Business Manager
A Monthly Publication
Devoted to Practical
Radio
Frederick A. Smith
Editor

An Unusual Discourse on RHEOSTATS *and* AUDIBILITY

By ARMSTRONG PERRY

How the Radio Fan May Determine What Apparatus Gives the Best Signal Strength

THE radio manufacturer and dealer have never yet given the radio user any definite method by which he can determine what apparatus gives the best results in audibility, so far as I can discover. Yet audibility—the amount of sound that comes out of the phones or loud speaker—is the thing in which the user is most interested.

Even my search for a unit of audibility has been unsuccessful, and I have learned that the "audibility meter" does not measure audibility. There is a definition, formulated by The American Institute of Radio Engineers, which states that "audibility is a measure of the ratio of the telephone current producing a signal in a telephone receiver to that producing a barely audible signal," and that "a barely audible signal is that which permits the differentiation of the dot and dash elements of the letter." In practical application, that definition works out like this:

I put onmy Baldwin 'phones and bring in a signal that I can just hear. According to the definition, that is where audibility begins. Then I change, putting on the 75-ohm 'phone that I began with as a radio novice and that is of a type still purchased by some beginners. I find that audibility, with it, has not begun yet and never will begin on that signal with that 'phone. Next, I find an opportunity for an octogenerian friend to hear a concert brought in with six stages of amplification and a loud speaker, and I find that for him audibility does not begin even with that amount of sound and never will begin unless he hears through his false teeth like a man whose picture has been in the magazines. If ten stages of radio-frequency and ten of audio could just make him hear, then that would be the beginning of audibility in his case, according to the definition.

Need Basis of Comparison

IT ought to be possible to establish a basis of comparison such as vibrations of specified frequency and amplitude in a standard diaphragm. Radio users might not understand it, but it would give a manufacturer of a filament rheostat, for example, a chance to make claims that could not be criticized on the ground that some 'phones and ears were more sensitive than others. Anyone who wanted to pursue the subject could then refer it to an engineer and have the claims verified or disproved by actual tests.

Eventually, I ran across a manufacturer who had tested his filament rheostat with a view to finding out whether his device would make a radio user hear any better than he would if the receiver were equipped with a different type of filament control, but with all other parts and adjustments exactly the same. If his rheostat was not better than all the others, he intended to make it so.

How Tests Were Made

The tests were made by a physicist, F. R. Hoyt, who has a laboratory and all the equipment needed in radio experimentation. It cost the manufacturer a lot of money and he ran the chance of having to begin all over again after having spent two years in expensive development, but he said it was worth while.

With a copy of the report in my possession, I sought an interview with Mr. Hoyt. If there is one person whom Mr. Hoyt dislikes to meet, it is a newspaper reporter or a magazine writer. His latest invention, the phusiform circuit, was written up by a New York daily paper without his name being mentioned, which was the condition on which he gave out the story.

When I got to Mr. Hoyt, he disclaimed any desire to appear modest or retiring. He said that he disliked publicity and had avoided it merely as a business proposition. He is a scientist and has no organization through which he can capitalize public interest in his work. He has all the work he can do, is making all the money he wants, and does not want to be pestered by inquiring reporters and admiring letter writers who want to know whether his invention is going to revolutionize radio.

Mr. Hoyt confessed, when I asked him if there was a real unit of audibility, that he had never heard of one. That made me believe in him. Many experts, in dealing with a non-technical man who cannot trip them up when they try to duck a question that they cannot answer, will bring out something that they do know rather than to acknowledge that there is something they do not know. He went over his report with me.

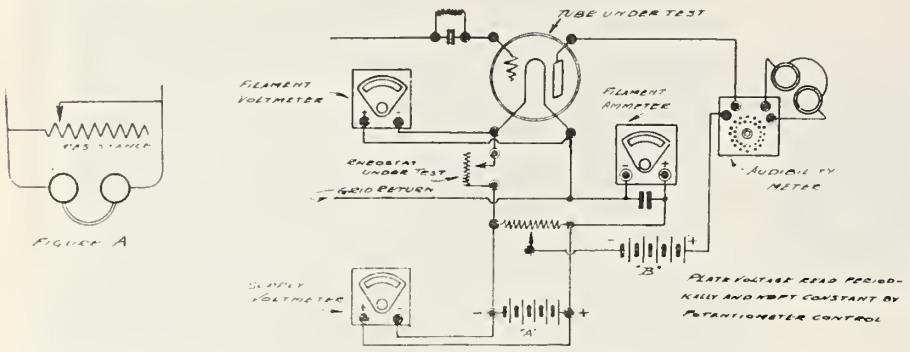
Circuit for Testing Audibility

FIRST, we examined the circuit with which he made his tests. (See diagram.) It can be used by anyone who wants to test for audibility. It consisted of a radio receiver—any type that employs vacuum tubes will answer the purpose—a filament voltmeter, a filament ammeter, a supply voltmeter shunted across the "A" battery, and an audibility meter, so-called, between the output terminals of the receiver and the 'phones.

The audibility meter maintained a constant impedance across the detector. If an audibility meter is not available, Mr. Hoyt says that a fairly accuratc approximation can be had by shunting a variable resistance across the 'phones that will balance out the signal, and ignoring the impedance. He read the plate voltage periodically and kept it constant by potentiometer control.

For purposes of comparison he tested four types of filament rheostats, with three types of electron tubes. One of the other types that Mr. Hoyt tested employed graphite and mica; another employed discs of carbon and the third was the familiar wire rheostat. Four different kinds of wire rheostats were tested, but they all gave such similar results that their performances were reported under the name "wire rheostats" instead of being given separately.

(Continued on next page)



The accompanying diagram shows the meters, and apparatus, and their connections for testing out the current curves for maximum audibility. The meters across the A battery and tube socket terminals are used to measure the current and voltage going to and being consumed by the tube when the loudest signal value is obtained by adjusting the filament rheostat for the proper electron flow.

All of these rheostats carried satisfactorily a steady load of six watts without excessive heating. Two of the wire rheostats showed an appreciable increase in resistance when they became heated. The carbon disc rheostat showed a slightly decreased resistance under the same circumstances. These changes produced a voltage variation at the terminals of the vacuum tube and a corresponding change of audibility in the headphones.

Several of the wire rheostats showed slight mounting difficulties that might trouble a user who did not have the knowledge or the tools for adjusting them. The graphite and mica rheostat turned in its mounting bushing when the knob was turned forcibly enough to raise the filament voltage to the point of maximum audibility.

Some of the devices showed that the manufacturers had overlooked the value of convenient terminal facilities, evidently assuming that the amateur constructor could stand on his or her head, or tie himself in a bow-knot for the purpose of attaching the wires.

Is Filament Control Important?

EXPERTS have been telling me for a year or more that the filament rheostat should not be used for tuning purposes. They assert convincingly that if the filament voltage is once adjusted properly maximum audibility and freedom from distortion can then be obtained by adjusting inductance and capacity only. Fine adjustment, they say, does not affect the flow of electrons in modern vacuum tubes. My own experience is contrary to what these experts say and I have shamelessly twisted the rheostat knob whenever it did any good, though with a feeling that if I were as smart as the experts I could get results the same way they say they do. It pleased me, therefore, to find in Mr. Hoyt's report the following:

"Too little importance has been placed in the past on the precision necessary in the control of the filament voltage of vacuum tubes used in radio reception where efficient operation is the objective, and too much importance has been given to plate voltage regulation by potentiometer control. Since the tendency toward the latter will of necessity obscure the desirability of the former (filament voltage control), and since potentiometer control of the plate voltage can in no way compensate for improper filament regulation, a brief discussion of these two forms of regulation will not be amiss.

What the Positive Does

"The vacuum tube used in radio reception functions primarily as a result of the ability of certain materials, when heated, to emit electrons—carriers of electricity—and thereby to permit a flow of current from the positively charged plate to this heated material or filament across the inter-electrode space. The positive potential of this plate determines the number of these electrons which it can attract per unit of time.

"This electron flow is generally referred to as the electron stream and determines the plate current. The operating efficiency of a radio tube depends entirely on the electron emitting properties of the filament or cathode material when heated, and the ratio between this electron stream or plate current and the filament energy required to emit the necessary electrons, is the measure of relative efficiency of the tube.

"It must be seen from the foregoing, therefore, that plate voltage regulation (control of electron attraction) can in no way compensate for inefficient filament voltage regulation (control of electron emission), and both are of tremendous importance to the efficient operation of the radio tube.

"The introduction of potentiometers having inductance into the plate circuit of a detector tube may bring about a regenerative action (feed back) and thus exaggerate (to the uninitiated) the importance of what they believe to be plate voltage regulation."

As I understand it, this means that you cannot pull through the tube any electrons that are not there, no matter how strong a pull you may have through the plate, and that the number of electrons in the tube will depend on how you control the pressure, called voltage, that pushes the electrons off the filament. The thing that controls that pressure is the filament rheostat. So I shall continue to "tune" with the rheostat, even if the effect I produce may not be properly called "tuning," for what I want is more sound.

Results With Different Tubes

MR. HOYT tested the rheostats on three types of radio tubes, taking six stock samples of each type of tube and plotting his curves on the average of the tests. The typical tubes selected were: UV 200, a detector; UV 201-A and C 301-A, amplifiers (three of each); and the UV 199 dry cell tube.

The first tests were made with the UV 200. (See Curve Sheet No. 1).

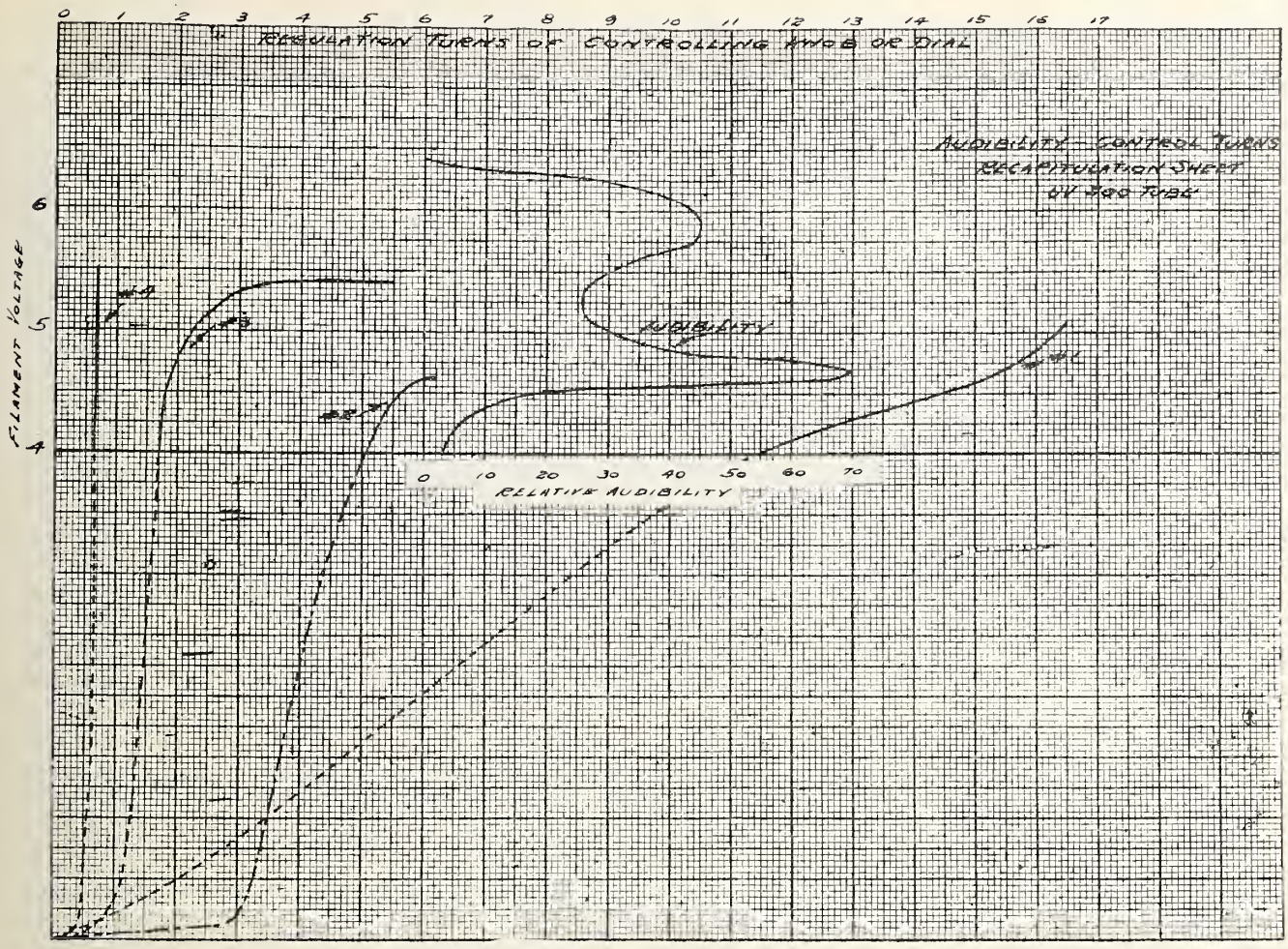
In making the curves, the voltage at the filament was indicated by figures at the left of the curve sheet and the filament amperes by figures at the right of the sheet. At the top, the numbers of turns of the rheostat knob are shown as related to the filament amperes; at the bottom the turns are shown in relation to the voltage of the filament.

The number of turns of the rheostat knob is important. The human hand is not sensitive enough to make minute changes with a knob that makes a very small number of turns, or only a fraction of one turn, in passing from the "off" position, in which no current should flow, to the maximum position, in which the entire battery voltage takes effect on the filament. It is a common fault, not only with rheostats but also with condensers and inductances, that the fine adjustments needed to bring in weak or distant stations cannot be made by a person of average temperament and experience. I have frequently passed a station without hearing it, even when turning a dial slowly and carefully, and discovered later that it could be heard distinctly if the tuning dials were placed in exactly the right positions.

In the tests the voltage and amperage of the filaments rose abruptly from zero to maximum, of course, with half or three-quarters of a turn of the knob of the ordinary type of wire rheostat, since it covers its entire range in that space. The carbon disc rheostat admitted a very small amount of current during the first three turns, then in three more turns it shot the voltage up to maximum. The rheostat using graphite and mica had a different tendency, sending the current to maximum values in the first three turns and showing practically no change during two and a half turns more. The rheostat employing carbon and metal, in powder form and under pressure from the beginning, raised the filament voltage and amperage gradually and evenly from zero to maximum while the knob made sixteen and one-half turns.

A Circuit Adapted to Tube

THE audibility obtained by using the UV 200 tube was taken as the arbitrary standard for comparison. In the hook-up with this tube, the grid condenser had .00025 mf capacity; the grid leak 2 megohms resistance; the plate potential averaged 21 volts; the grid return was to the positive terminal of the filament. In the circuit with the amplifier tubes, UV 201-A and C 301-A,



The above graph shows the relation of the filament voltage to the audibility obtained in the phones, and also shows the various voltages at which maximum results were obtained with respect to loud signals. Each tube has a definite point with respect to filament current incidental to maximum signal strength, and the graph shows that different types of rheostats provide this value of current with varying degrees of effectiveness.

which were of course used as detectors in this test, were: a .0005 mf grid condenser, a 2 1-2 megohm grid leak, and a "B" battery that delivered 40 volts on the average. The grid return was to the positive terminal of the filament. The circuit for the UV 199 included: .00025 grid condenser, 2-megohm grid leak and "B" battery averaging 40 volts. The grid return was to the positive terminal of the filament. The "A" battery voltage, which was 4.5 at the battery terminals, showed a drop in the leads of .2 at one-half ampere.

Audibility, in terms of the UV 200 tube from zero to 80. Filament voltage is shown by figures at the bottom of the sheet. The numbers of turns of the rheostat knobs are shown at the right of each group of curves.

The curve showing the audibility that can be obtained from the UV 200 tube has two peaks, one at 4.7 volts and the other, a little more than half as high, at about 5.9 volts. The wire rheostats reached the first peak, of course, somewhere within the half or three quarters of a turn of the knob that is the limit of their motion. As the peak is very sharp, it was easy to turn past it without finding it. It seems probable that many radio users, having the impression that the more juice you use the more sound you get, never hit the right spot for maximum results. The device using graphite and mica barely reached the principal peak in the one turn that was left in it after arriving at the minimum voltage at which the tube would operate. The carbon disc rheostat had two turns to go after the tube began to deliver sound at four volts, and it passed the main audibility peak and the bottom of the hollow between it and the secondary peak. The rheostat employing carbon and metal under pressure required five full turns to cover the same range of audibility, giving twice as fine control as its nearest rival. No hand could turn its knob fast enough to pass the peak of maximum audibility without knowing it.

Audibility Curve Has Broad Peak

THE audibility curve of the UV 201-A and the C 301-A has but one peak. Audibility begins at 2.5 volts, rises abruptly to maximum at about 3.5 volts and remains there until the voltage passes 5. The broad top of this curve gives the wire rheostat a better chance to establish a reputation, though even here it has less than one-tenth of a circle to traverse in covering the peak. The knob of the carbon disc rheostat can make .8 of a turn and that of the graphite and mica device a whole turn in crossing this peak; but the knob of the rheostat with carbon and metal powder under pressure can be turned six times around without sliding off the peak.

The audibility curve of the UV 199 is somewhat similar to that of the UV 201-A and C 301-A tubes. It starts at 2. volts, rises abruptly to 2.5, then more gradually to maximum at 3.8. Its maximum falls eleven points below that of the amplifier tubes and 21 points below that of the UV 200 detector, illustrating the difficulty of getting equal output from lower input. In passing the peak of this curve, the rheostat with the carbon and metal powder under pressure takes 1.7 turns, the graphite and mica rheostat 1.2 turns, the carbon disc device .7 of a turn, and the wire rheostats .05 of a turn.

It should be understood that the audibility curve of the UV 200 which was arbitrarily taken as the standard because this tube showed greater audibility than any other that was tested, was worked out with each of the rheostats. Below the region of audibility in this tube, the wire rheostats had .7 of a turn, the carbon disc device 1.7 turns, the graphite and mica device 5 full turns, and the rheostat with carbon and metal powder under pressure 11.5 turns. These superfluous turns are valueless in connection with this type of

(Continued on page 62.)

Blazing The Trail

FOR RADIO BEGINNERS

In the belief that radio will win thousands of new adherents this coming season, RADIO AGE is beginning in this issue a new section for "greenhorns" just breaking into the fascinating sport of radio building and reception. We have asked Edmund H. Eitel, a well known radio engineer, to start off this interesting series. He has chosen to explain the most simple theory and practice of radio building by presenting a list of comprehensive questions and answers dealing with every conceivable topic apt to creep into the mind of the beginner who wants to know "what it's all about." Mr. Eitel has not been too technical in answering the questions, for he knows the beginners know little if anything about "the inside" of radio. And his questions were compiled after studying the sort of queries sent by perplexed radio fans to radio manufacturers, dealers and engineers. Watch for the Beginners' Section in every issue of RADIO AGE.

By EDMUND H. EITEL

MR. RADIO FAN, as you lean over the radio counter and ask the patient clerk foolish question No. 18,510, did you ever ask yourself "Why radio clerks go mad"?

And again, when you write that longwinded message to the manufacturer, telling him the names of each part of that wonderful set of yours which won't work, and inquiring of him "Why not?" did you ever consider how you are placing "silver threads among the gold" over the angelic brow of the man who has to read that letter?

Once a fan asked me what was the worst trial and tribulation suffered by the radio seller. I want the reply to go into the public record. The greatest trial is to try to answer a question and to realize that before you can possibly do so adequately, you will first have to give the questioner about two hours of education in the elements of radio.

The Editor of RADIO AGE, who has had *his* trials, agrees with me that there ought to be a limit to the questions a fan *could* legitimately ask, a kind of set of regulations—you might say a sort of Marquis of Queensbury rules to the game. If the fan asked "What will happen, sir, if I hitch my filament up to my B-Battery," he should be led gently over to the rule board and told that he is "out of bounds." He must first review the questions and answers set down on such a board and representing what any respectable fan should know.

I gathered most of the questions and answers submitted below from the experience of a large selling and distributing company. Their unique value lies in the fact that they represent the boiled-down queries of thousands of letters. P. C. Cloyd, old radio "ham," and expert and head of the radio department of Babson Brothers, K. C. Smith, of Matteson, Fogarty and Jordan & Company, one of the best-informed radio merchandizers in the game, contributed their analysis and system, and Mr. Carl Pfanstiehl and the writer have both reviewed the answers and questions contributed from their experience.

I believe it will be a service to Radio to publish this system of fundamental questions for use and reference of fans and clerks. Mr. Fan, could you pass 100% in this test? Mr. Clerk, why not cut out these 35 questions and answers, paste them on a board where customers may read them? You will observe these questions are practical answers to the questions which arise in operation rather than any attempt to answer the million possible, and for the most part foolish questionings, as to theory.

For this reason this system will prove convenient, if reprinted, for those who are burdened with the duty of answering radio mail and want some convenient insert to return checked for the question asked and its answer.

ANTENNA

1. *How long should my antenna be to get the best results?*

Antenna, including lead in, should be about 125 ft. long. If you make it longer, you increase your set's volume, and distance somewhat, but it makes your set less selective.

2. *How high should my antenna be above ground?*

From 25 to 30 feet. If you stretch it higher, you gain some volume and distance; also you will very likely gather in more "static" and you will certainly decrease selectivity

3. *Of what kind of material should antenna be made?*

Single copper wire solid preferred, is customary. The ribbon aerial is a little more effective.

4. *Will a short multiple-wire aerial give the same results as a longer wire aerial?*

No. The best type of aerial for receiving is a single wire. Where you can possibly find room for a single aerial of 100 ft. in length there is no advantage whatever in going to the work and expense of erecting a multiple wire aerial.

5. *When there are other antennae about, how near to them may I stretch mine?*

Keep it as far away as possible and certainly not *less* than three feet distant. Have it run as nearly as possible at right angles to any other antenna. Having done this, you will not be likely to experience any lack of efficiency in reception due to antenna interference.

6. *Will a building between me and a broadcasting station affect the efficiency of my antenna?*

Not unless it be a steel-frame building.

7. *Should I be able to operate my set on an indoor aerial?*

Try it. If you have powerful nearby stations, you will probably get them satisfactorily on an indoor aerial. Do not expect to receive distant stations on an indoor aerial. The use of a short indoor aerial greatly increases the selectivity of a receiver but at the same time cuts down the range and volume very decidedly.

8. *Should I get satisfactory reception on a loop?*

Loop aerials are sometimes unsatisfactory, used in connection with anything less than a six tube set designed particularly for loop reception. In effect, a loop and a straight wire antenna are esentially different. The former is an *inductance;* the latter makes with the ground, a *condenser.* A large loop is to be preferred to a small one, since it will gather more energy. A 5-tube set will often give fair results if a 23 plate condenser is used in series with the loop and the condenser varied for best results. The condenser need be set only once.

9. *Are light-socket aerial plugs satisfactory?*

In general, no; but this depends upon the electrical wiring about the house and other conditions. A light-socket aerial plug will seldom give as satisfactory results as a well planned antenna. If there is any reason why you can not erect an antenna, try the plug and see how it works.

10. *Is it absolutely necessary to solder the connection between the ground wire and the pipe to which it is connected?*

Not necessarily; soldering may be the best means of making the connection, because it not only insures an absolutely perfect contact, but it also prevents corrosion—thus keeping this contact permanently perfect. The use of a ground-pipe clamp will be perfectly satisfactory, providing the pipe is cleaned before the clamp is put into it, and that the joint is inspected from time to time to see that corrosion has not set in.

11. *If it is impossible to reach a cold water pipe with my ground wire, will a connection to a radiator serve the purpose?*

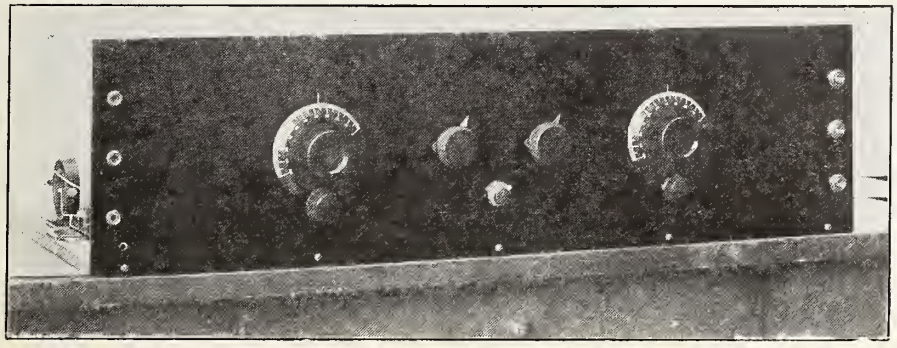
In theory, radiator connection is not so effective, but in actual practice many people use radiator connection without apparent loss of efficiency. Make sure that your radiator pipe is not separated from the system by a rubber connection, however.

(Continued on page 63.)

Here's Something Unusual

AN EASILY MADE SUPER-HET

BY PAUL GREEN



Photograph of the assembled super-heterodyne. Note the absence of numerous controls as commonly found on other eight tube Super-Heterodynes. Mr. Green has made the set simplicity itself and uses but two controls in the operation of the whole set.

THE THEORY of the super-heterodyne is rather generally recognized as answering a long felt want. However, some place between theory and practice most super-heterodynes seem to have slipped most woefully. This is true to such a degree that it is extremely rare to hear of a super-heterodyne that is producing results anything like in keeping with the theory.

With this thought in mind, the purpose of this article is to point out some of the pitfalls that are to be avoided. Also, it is the intention to give instructions for the building of this circuit in the simplest possible language—devoid of technical pyrotechnics.

We have long been accustomed to consider crystal reception as the standard of perfection so far as clearness of reception goes. On the other hand, the radio frequency circuit has perhaps come nearest to answering the needs for distance reception. Therefore, to be of any additional advantage the super-heterodyne must combine the advantages of these two circuits, giving at least as good quality as the crystal and greater range than the radio frequency circuit.

What a "Super" Does

THE super-heterodyne overcomes the faults characteristic to radio-frequency amplification and gives greater selectivity. It provides for radio-frequency amplification at a frequency at which the intermediate transformers function to best advantage with least possible distortion, and with the smallest possible circuit losses. The difficulties of radio-frequency amplification at radiocast wave length are overcome by heterodyning or transferring the voice modulation from the incoming wave to a new wave of a frequency at which the internal capacity and inter-coupling effects disappear. The super-heterodyne amplifies all radio-frequency at a fixed frequency irrespective of the incoming impulses. Full amplification, however, can only be obtained when the intermediate-frequency transformers have been built to function at highest efficiency at the selected frequency and when the input impedance matches the output impedance of the tube.

Owing to the fact that this circuit is extremely powerful, while at the same time extremely sensitive, greatest care must be exercised in the selection of the component parts. There are certain of these parts around which most of the trouble experienced seems to have centered. The effort as above suggested then will be to indicate how any such difficulties that may arise may be overcome by adjustments or changes in these parts.

The set described has been carefully worked out in every detail, and the illustrations are so clear that the average fan should have no great difficulty in building it or of securing satisfactory operation from the outset, providing the parts are of the best.

A Combination Circuit

NO particular originality is claimed for this circuit, it being a combination of several. It will be noted that the wiring diagram coincides almost perfectly in general baseboard arrangement with the manner in which the set is wired. This is done to simplify the wiring of the set, and to eliminate as far as possible the chances of making wrong connections.

The loop condenser and the oscillator condenser are shown for the sake of clearness in their respective positions in the circuit, rather than as regards their relation to other apparatus on the panel. The only portions of the circuit that might give the average fan any trouble are the oscillator and amplifying circuits. The construction of the input transformer and the oscillator coupler is clearly shown in diagrams 4 and 5.

Output Coil

THE output is of the air-core type, consisting of 200 turns on the primary, using No. 28 silk covered wire, and for the secondary, 1500 turns of No. 36 silk covered wire. It is important to use materials for the bobbin of this transformer which will not absorb moisture. For this purpose bakelite seems best suited. In the writer's work, he has made the core of a one inch cylinder of bakelite, two inches square by three-sixteenths of an inch in thickness, for the sides. A brass machine screw, passing through the sides and core, holds the two ends against the core. By using a machine screw of one inch and a half or two inches in length, the free end can be chucked in a hand drill, it in turn being held in the jaws of a vise. This furnishes a very convenient means of winding this coil, getting the right number of turns without the tiresome necessity of turning the coil through 1700 complete revolutions by hand.

The ratio of the average hand drill is about 4½ to 1 and therefore, it will only be necessary to turn the handle of the drill about 380 times to put on the 200 turns on the primary and 1500 turns on the secondary. As an example, if your hand drill is geared in the ratio of 5-1, then it will be necessary for you to turn the handle 40 times in winding the primary and 300 times in winding the secondary.

Provide four small holes in one of the sides for bringing out the primary and secondary terminals.

After winding this coil, dry it out thoroughly in an oven heated to a temperature not to exceed 110 to 115 degrees Fahrenheit. This drying-out process should take from 6 to 8 hours. After the coil is dry, impregnate it by immersing it in molten paraffin. In doing so, however, be careful that the temperature of the paraffin is not high enough to cause the parafin to smoke, as it then would scorch the insulation on the wire and render the coil inoperative. After the air bubbles have stopped coming off the coil, it is a pretty safe indication that it is saturated. It is now removed from the paraffin and allowed to harden. Soldering lugs or binding posts can now be put on four corners of this coil, to which the leads from the primary and secondary are run.

Oscillator Coupler

THE oscillator coil is wound in two sections of 43 turns each on a bakelite or cardboard tube of two inches in diameter. The primary is one straight winding of 12 turns on a tube of one inch in diameter and of the same material as used for the secondary.

If the tubes are not of these sizes, it will be found necessary, in order that proper coupling and range may be secured, to add or take off turns, depending on whether larger or smaller tubing than specified is used. For instance, if the primary tubing is too large, fewer turns

(Continued on next page.)

can be used on this tube. A fairly loose coupling rather than tight coupling is usually to be desired, and accordingly a larger primary tubing is not recommended. The two secondary coils are wound in reverse directions. This is most easily done by winding both coils from middle of tube outward, turning tube in the same direction in both cases.

It will be noted that the inner and outer ends of one of these coils go to the soldering lugs on one end of the tube. The ends of the other secondary coil go to the lugs on the opposite end of the tube. Care should be taken to see that inner ends go to opposite lugs and outer ends likewise go to opposite lugs. In case soldering lugs are not obtainable, small brass machine screws with washers and nuts may be substituted if the nuts are turned down tight on the buss wire and soldered.

Now, regarding intermediate-frequency transformers and fixed condensers: a great deal has been said relative to matched construction, etc. Matched construction, of course, is to be assumed in the first place, or otherwise satisfactory operation cannot be secured. The most painstaking care must be taken in the construction of these transformers. They must work in unison.

Watch Fixed Condensers

IN the writer's experience, a great deal of trouble has been found in securing fixed condensers which can be relied upon to have the capacities at which they are rated. Not only that, but frequently it is found that fixed condensers have such a high conductance that they cease to function as condensers and function instead as high resistances. It is well, therefore, when buying condensers, to buy an extra one, at least, of each of the capacities required, so that you can change condensers in case your circuit refuses to remain stable. A condenser having high conductance characteristics will be found to cause the circuit to change its characteristics entirely, depending upon weather conditions.

This is also true of the output coil unless it is well impregnated. A poorly seasoned base board will give trouble in the same way. A friend of the writer's recently built a super, but found that under certain weather conditions the set oscillated furiously. The output coil was found to have taken up an untold amount of moisture. A new coil with better impregnation eliminated the trouble and brought in San Francisco, on the loud speaker with one stage of audio. This is a pretty fair record for Summertime, considering that Chicago stations were on at the time.

Do not use soldering paste or flux, especially when soldering to condenser lugs, since by so doing the condenser is almost certain to be rendered useless, or partially so, depending upon weather conditions. Too much cannot be said as regards the importance of building your set so that weather conditions will not change its operation, and anything which will tend toward excluding this variable factor is to be recommended by all means.

Reliable "Super-Hets" Combine Clearness of Crystal Circuit with Radio Frequency's "DX"

Get Low Loss Condensers

In the purchase of variable condensers it is necessary to obtain those of low loss. The condensers play a very important part in the reception of radio signals.

Condensers that contain a great deal of moulding for the supports and insulation are examples of high loss. The low loss condensers of today have but a few strips of insulating material to separate the plates. If possible, avoid the use of a separate vernier condenser, as this may cause losses equal to the main condenser.

Throughout the construction of the super-heterodyne, remember to keep the losses down.

The U. V. 199 tube has been selected for the circuit owing to its sturdiness, low current consumption, and compactness. The entire eight tubes consume a total of between 1-4 and 1-2 an ampere, using a four and one half volt "A" battery. There is no particular advantage in using larger tubes, in view of the fact that the smaller tubes will be found to give more than sufficient volume when operated at full efficiency. In fact, in the average home it is rather rare to find a second stage of audio used.

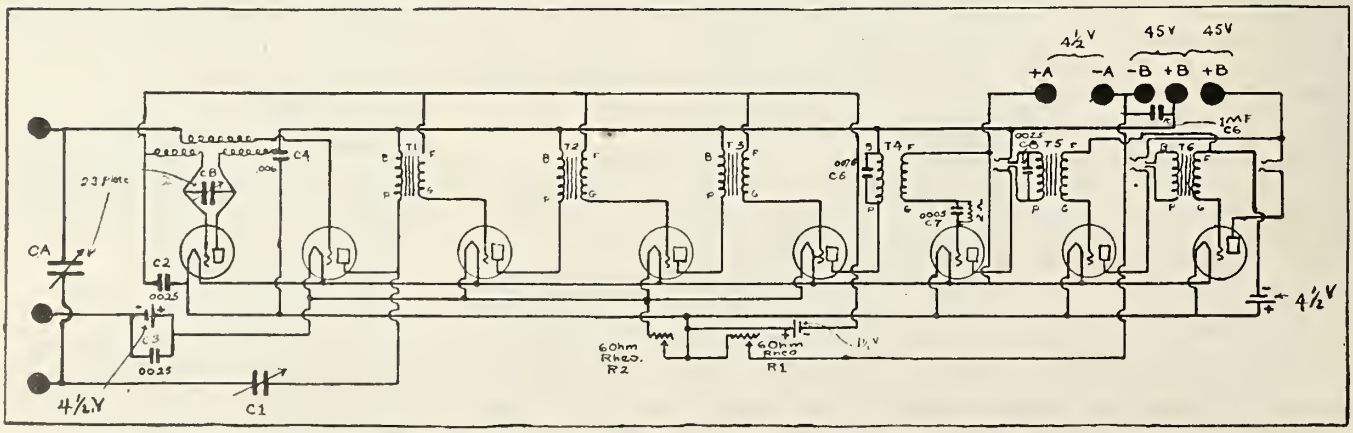
PRACTICALLY all tuning can be done with the loud speaker instead of head phones. All of the fixed condensers should be fairly close to rated capacities, especially condenser C-4 and C-8, the former being .00025. The large condenser, C-6, is not critical, but should by all means be at least 1 mfg. Plate voltage of 45 is used on all tubes except the amplifying tubes which take 90 volts. It should be noted in this connection, however, that a first indication that the condensers used are defective, or that the input transformer is absorbing moisture, will be evidenced by the set oscillating or fading, or showing body capacity, in which case it may be necessary to reduce temporarily, the effective plate voltage on the negative B post. This will have the effect of reducing the body capacity, while at the same time cutting down on distance reception.

As the filament circuit is divided into two parts, the rheostats should each be of 6 Ohms resistance. The rheostat R-1 is used to regulate filament voltage of all the tubes; R-2 governing the filament of the first detector and the three intermediate Amplifying tubes control the volume. Instead of the conventional loop of two taps, the one used with this circuit is one having 12 turns and three taps; the center tap being taken at a point equidistant from the two outer ends of the loop.

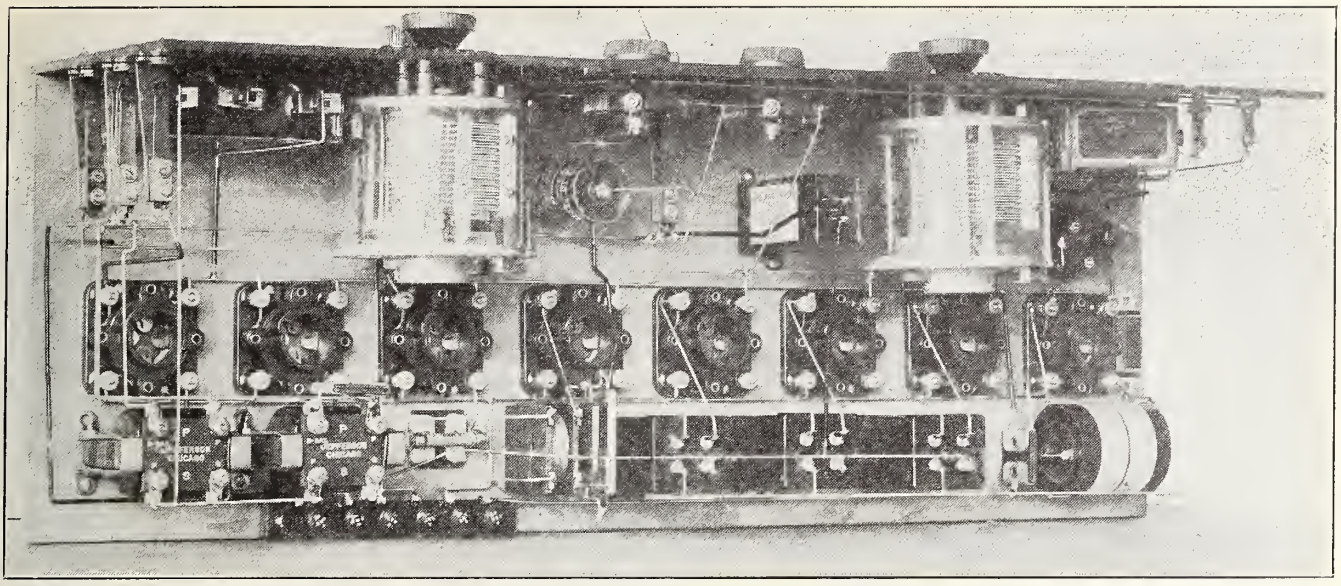
A panel layout is not given, owing to the fact that it is extremely simple and not an especially critical consideration. Most radio fans who are thinking of building supers will have had enough previous experience in laying out and drilling panels that this will not be found to be difficult at all. The panel dimensions should not be less than 26x7". In fact, 28x7" will be found to give rather better apparatus arrangement.

The baseboard should be one inch shorter than the panel and 9 inches wide. While a kiln-dried wood baseboard was used in the set shown in the illustration, it is to be earnestly recommended that a bakelite baseboard be used instead, as it will prevent the absorption of moisture.

Considering the requirements of this particular circuit, the writer has found the best No. 23 plate covered condensers with vernier control very satisfactory,



Wiring diagram pictured above shows the simple but efficient way in which the super-heterodyne is wired up. The filament jack shown in the photograph is omitted in the diagram as it is not necessary in the operation of the set



The above photograph illustrates very clearly the wiring and general layout of the super-heterodyne described in the accompanying article.

Note the two condensers that are used as the main tuning units. As may be seen, the layout is extremely simple, and will be of great advantage to the beginner who wants to start on a super-heterodyne.

UV 199 or C 199 tubes are used throughout the set, which makes it possible to use dry cells for filament lighting. Practically all the tuning can be done with the loud speaker.

although there are a number of other low loss condensers on the market which will be found to tune equally as well. Condensers having solid end plates of insulating material should be avoided by all means, as dielectric losses will tend to broaden the tuning and cut down the efficiency considerably. With a good pair of condensers the writer has frequently tuned past Chicago stations bringing in outside stations with less than two degrees separation.

A Sponge Rubber Support

IF the set is to be operated fairly close to a loud speaker, it will be found advisable to mount the first detector tube and audio-frequency amplifiers on a strip of insulating material supported on the two ends by sponge rubber; otherwise the tubes may take up and reamplify the sound vibrations from the loud speaker, causing troublesome distortion of the signals. In wiring this set, it is good practice to wire the filament circuit first. The first detector circuit and oscillator circuit can then be wired. After this, the long wave or intermediate-frequency circuit can be wired, followed by the last detector and the audio-frequency units. In wiring up to this point, the leads running to the panel are omitted. The panel is now fastened to the front of the baseboard by means of brass angles and brass machine screws, and the connections are made to imp jacks, loud speaker jacks, loop jacks, and rheostats, as well as "C" batteries. A filament jack is shown in the photos of this set, but may be easily omitted; hence is not shown in diagram. The photos also show a separate "B" battery binding post for the oscillator circuit. This also is not necessary, five binding posts being sufficient to cover all of the requirements.

"Test Before Using!"

BEFORE inserting the tubes or connecting the batteries, turn rheostats on full. Now, connect the "A" and "B" batteries to their respective binding posts, making sure that no short circuits exist. When the batteries are fully connected, test across the filament binding posts of each tube separately with a voltmeter so that there can be no possibility of excessive "B" battery voltage on the filaments and also so that you are sure of your joints. Insert a 50 watt, 110 volt lamp in the positive "B" battery lead, so that it is placed between the positive end of (45 volt), battery and the plus binding post. This will prevent any possibility of the tubes burning out through accidental short circuit. Unlike most super heterdoyne circuits, it will be found impossible to burn out the filaments by shorting the condenser plates either variable or fixed (unless the rheostats are turned off). The 50 watt lamp will insure protection in this case.

Now, insert the tubes after first turning the rheostats off. Turn the rheostats up about half way, work the two dials simultaneously, picking up the stations with the left hand condenser and bringing them to a better modulation with the right hand dial (loop condenser). On distant stations, it will be found necessary to use vernier adjustment as the tuning will be very sharp, indeed. If the by-pass condenser values and the imput transofrmer and oscillator coil are correct, it will be found that by working the two condensers simultaneously, extremely sharp tuning can be secured even on local stations.

How to Tune

A GOOD procedure when tuning in is to place the loop condenser at five degrees, gradually turning the oscillator condenser. If no station is heard, move about two degrees farther and repeat the operation. On very distant reception, it usually is found necessary to change the loop condenser one degree each time in making the adjustments. It will be noted that each station comes in on two dial settings instead of one, as on other circuits.

Signals are usually received with about equal intensity on either of the two settings. However, sometimes radiocast conditions are such that one setting is superior to the other. From the very outset the logging of stations should be carefully kept, as it will greatly assist in future tuning and prevent confusion. With a good assortment of stations logged you will have little difficulty in proving the superiority of the circuit over even the best of radio frequency sets.

The condenser C-1 should be adjusted when receiving some distant station of wave length of about 300 meters. Increasing the capacity setting of this condenser will increase the signal strength. This capacity should be increased to the highest possible point that can be reached without causing distortion.

Once found, the setting need not be changed. The failure of tube to oscillate can be detected by touching the oscillator tube grid post. If a click is not heard when the finger touches and again when the finger is removed, the tube is not oscillating and an error should be looked for in the wiring of the circuit. As there are eight tubes in the circuit, it is highly imperative that every one of them should make perfect contact with the prongs.

A failure of any one of these tubes to make a contact will render the set inoperative. If upon connecting up the set and making all preliminary tests, you are unalbe to receive stations at first, do not be discouraged. Many a super-heterdoyne owner has had a similar experience when first testing his set.

It will usually be found that the stations are there all right, but that the operator has not yet learned how to find them.

[Mr. Green will be glad to answer fans' questions regarding his super-heterodyne.]

Trouble-Shooting with your Neutrodyne

By CHARLES MANLEY

THE location and correction of faults in a radio receiver are greatly simplified if done in a systematic and logical manner. It is not the purpose herein to outline all causes of trouble which may confront the man who builds his own, but rather to enable the man who has purchased a factory-built set to find the bug in his installation, and perhaps in a number of cases to save the mutual inconvenience of having to call upon the manufacturers or their representatives for aid.

In the broadest sense, the trouble in a neutrodyne may usually be listed under one of the following heads:

1. Receiver does not operate, or signals are very faint.
2. Receiver squeals or oscillates.
3. Receiver tunes broadly.

We will endeavor to take up the various causes and corrections of these faults in order.

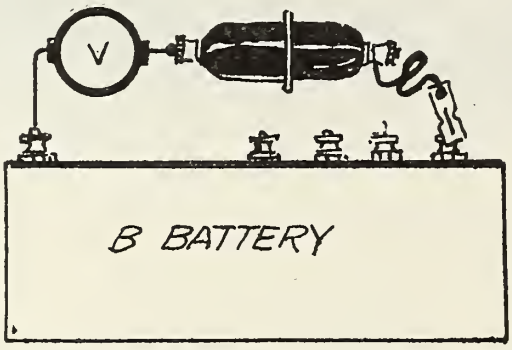
First, we will assume that all external battery, aerial and ground connections have been properly made, and before proceeding farther we will check these against the diagram furnished with set. Some means must also be had of knowing that "A" and "B" batteries are in proper condition, for without this information we can establish nothing. Every set owner, then, should have a hydrometer for the purpose of testing his "A" battery, and a pocket voltmeter reading up to 100 volts to determine the condition of his "B" battery. A "B" battery which gives a reading of less than two-thirds of its rated voltage is of little value, and should be discarded.

Now we have come to the actual trouble shooting and shall take up case (1) where the receiver is inoperative, or signals weak.

Tubes Cause Trouble

DEFECTIVE tubes are the most frequent cause to which trouble of this nature may be attributed, and therefore the first opration is to place the phone plug in the detector jack, removing audio amplifier tubes from their sockets and interchange them with the tubes in the other sockets in all possible combinations, checking results as to audibility in the head phones. (Or, better still, use a couple of new and tested tubes in radio frequency and detector sockets, comparing results.) We can now check up on the audio amplifier tubes in like manner, inserting plug in first and second audio jacks in turn and noting volume secured using different tubes.

Another frequent cause of weak signals is traceable to a short in the lightning arrester. This condition can easily be ascertained by connecting the voltmeter and battery in series around the terminals of the lightning arrester, as in the accompanying diagram. A short circuit, of course, will produce a voltmeter reading. Another method is to remove the ground wire from the arrester, and listen in for results. The same connection of battery and voltmeter may be used to test all suspected short or open circuits



The sketch above shows how to test your lightning arrester for short circuits or leakage. The high voltage terminals of a B battery are shunted by a voltmeter (left) and the lightning arrester in question (right). If, the voltmeter shows a current flowing through this circuit, the arrester is defective.

as in the neutralizing coils, or audio transformers.

A neutrodyne, while exceedingly sensitive in some locations and under certain conditions, will not produce satisfying results on out of town stations when using a small indoor antenna. This particularly holds true when the installation is on a lower floor of a large metallic structure. The remedy in this case is obvious.

We have practically covered all troubles of this nature that are external to the set. For the benefit of those who have the mechanical knowledge to look from trouble in the set itself, we may add the following tests.

It may be possible that one or more tubes does not light, even though it is not burned out. In this case it should be determined by pressing on tubes that each one is making proper contact in its socket. If this test indicates that tubes are not making good connection, the contact prongs of sockets may be bent upward, though making sure first to disconnect batteries. Another cause of failure of tubes to light is due to failure of one or more jacks to make contact. To determine this, the set must be taken from cabinet, by removing panel screws, after which the set slides out as a unit. The operation of the jacks should be noted by inserting and withdrawing the plug, and any contacts, the spring tension of which is weak, should be suspected, and carefully bent in shape.

When a neutrodyne oscillates, which condition is manifested by clicks when the dials are tuned, and by loud squeals which vary in pitch as the dials are turned, it is the impression of the average owner that the set is "out of balance." This is seldom true, since a carefully built set has a considerable latitude of balance. In an inspection of over two hundred neutrodyne receivers in owners' homes, only two cases were found where the sets were out of balance, and these had been tampered with by well meaning friends or "radio experts," so it is safe to say that your set is probably not out of balance.

Poor Aerial Hinders

THE most frequent cause of an oscillating receiver is an aerial lead which runs near or parallel to the cabinet, or is bunched with the battery or ground wires. This is easily remedied, and it is surprising what a vast difference in results such a mere detail may produce. The aerial lead should always be well separated from the set and from all other wires. Location and weather have a marked effect upon the stability of a neutrodyne. On some days any neutrodyne will show a pronounced tendency towards oscillation, or may even oscillate vigorously. This may be overcome frequently by making a better ground connection or by using a longer aerial. A proper ground connection is always necessary for the successful operation of a neutrodyne receiver, and a poor ground is a frequent cause of oscillation.

Many instances have been found where this type of set will not operate without oscillation in a steel building when using an indoor aerial about the molding of a room. In this case it will be found preferable to use an outdoor wire, even if only a short one, parallel to the wall of the building, and an indoor wire, if used, should be kept well away from the walls of the room, to avoid effects set up between this wire and the steel girders of the building. Other less frequent causes of oscillating receivers unclude too high a "B" battery voltage, a tube for which the set was not designed, and which does not possess the proper capacity.

For best results, it is not sufficient to insulate the lead-in from the building, but it should always be kept as far away from it as possible. If this wire is run down the side of the building, wooden supports from two to three feet long may be used at the top and bottom. If it drops through a courtyard, it is a simple matter to run it diagonally. It should be kept in mind that the lead-in is part of the aerial system, and as such should act as an energy collector and not as a dampener. The interior of the cabinet should be kept free from dust, as dust on the parts will cause leakage and damping of signals. A pipe cleaner may be used to clean between the tuning condenser plates occasionally.

Two Radio and Two Audio for Volume, Distance and PURE TONE

By BRAINARD FOOTE

Beautiful and Clear Music Attained by Using a Good Circuit and Good Apparatus

EVERYBODY wants volume. Everybody wants distance. And everybody wants selectivity. Besides these three sterling attributes of the "best" receiving set, folks are coming to realize that perfection in tonal quality and faithful reproduction of occurrences at the broadcast studio are just as essential; indeed, perhaps more necessary than some of the others.

The necessary volume to operate one's loud speaker may be readily obtained by enough audio frequency amplification, two stages doing the trick easily. Distance may likewise be secured by using sufficient stages of radio frequency amplification, two usually sufficing. The use of two or three tuning circuits of fair sharpness brings the desired selectivity. But beautifully clear and unadulterated musical quality is not so easily attained. It is by a proper combination of good circuit and good apparatus that we may have good quality.

The Detector

To the ordinary ear, broadcasting as received with a single tube detector, not too close to the regeneration point, and that received with a crystal detector, may seem to be equal so far as clarity is concerned. Yet, if we add two steps of audio amplification, the difference immediately shows up, the crystal winning by a most pronounced margin. Many builders of sets and well-known circuit designers are announcing that to be good for quality, "a circuit must have a crystal in it somewhere."

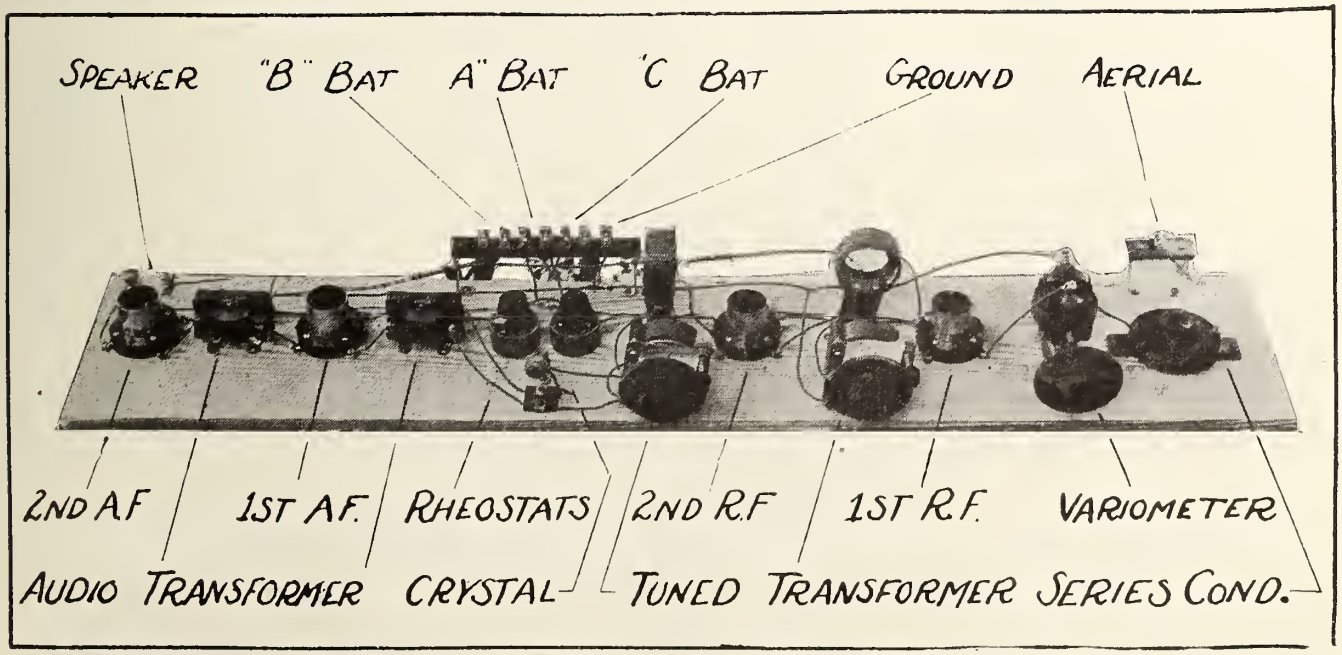
OF COURSE, the crystal as a detector isn't as sensitive as a tube. In fact, it's quite a bit inferior to one, even though it does surpass the tube in clearness. Hence, to compensate for this difference in sensitivity, radio frequency amplification must be tacked on ahead of the detector. Thus, our musically ideal receiving set, which incidentally does some satisfying stunts in DX reception, requires four tubes, two of them audio, two others radio, and a crystal as the detector.

Another angle of the constructional problem, and perhaps a novel one, may be found in the method of arranging and wiring the components. Although it seems to be a rigid rule that radio sets must be laid out with the antenna at the left and the loud speaker at the right, most of us have overlooked the fact that something may be gained by swinging things around the other way, from right to left. And in the case of a set of the type under discussion, where two rheostats serve for all tubes, there is considerable gain in wiring simplicity by running it "backwards" as shown in the photo. Normally, as sets are built, the sockets are placed with the grid and plate terminals at the rear and the filament posts in front; that is, nearest to the panel. With all the binding posts for batteries, aerial, etc., placed at the rear, the leads to the filament posts must cross under or over the grid and plate leads of the tuning circuits.

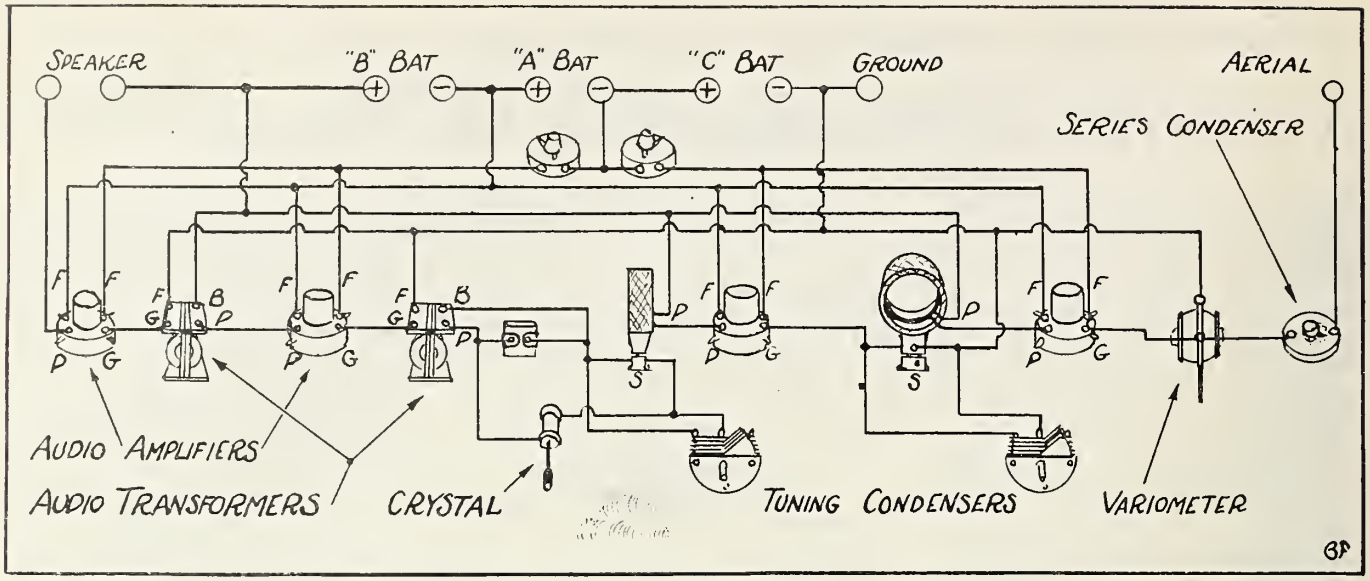
This increases undesired coupling to these grid and plate leads and also lengthens the filament connections. Now if the sockets are turned about, the grid posts are to the right instead of to the left. Hence, to keep grid and plate leads short and direct, the wiring and assembly procedure must be run in the opposite direction.

The board layout of the set in question is made in this way. The wiring diagram is similarly drawn, for easy comparison. The antenna post is placed on a little sub-panel all its own, at the extreme right end of the baseboard. The grid circuit of the first tube is tuned by a variometer, a variable condenser of the semi-variable style being inserted in series with this variometer. Hence the grid circuit of the first R. F. tube is included in the tuned antenna circuit, something which would broaden the tuning were it done with only a single stage of radio. But with two stages, the selectivity is maintained, and far greater volume secured than in cases where the grid circuit of the first tube is merely coupled by the untuned antenna coil method.

(Continued on next page)



While satisfacory for limited DX, this outfit is intended for clear and pure loud speaker operation. It has two steps of radio, crystal detector and two of audio. Wiring proceeds from right left to facilitate connections and shorten the leads.



The circuit is laid out in accordance with the actual arrangement of the parts. Note how direct grid and plate connections become when the sockets are turned about, with filament posts at the rear.

THE tube at the extreme right is the first R. F. amplifier, and it is coupled to the next or second R. F. amplifier tube through a tuned transformer whose secondary consists of a 50-turn honeycomb coil shunted by a .0005 mfds. variable condenser. The primary coil by which the plate of the first R. F. tube is coupled to this tuned secondary is made by winding 15 turns of No. 20 wire into a "doughnut" coil—just the right size to fit inside the honeycomb coil. The next R. F. transformer is made in a similar manner, having 20 turns instead of 15 on its primary. The secondary of the second R. F. transformer is also a 50-turn honeycomb coil, in its usual mounting.

The tuning instrument at the extreme right is a variable condenser; not necessarily a regular plate condenser like the other two. It may be a mica variable or other form of compact condenser, inasmuch as its dial readings need not be recorded nor a great deal of tuning done with it. The variometer, next in order, may be a small instrument, since the capacity of the antenna is in shunt to it through the series condenser. Following the two tuned stages of radio frequency comes the crystal detector. The very best sort of mineral is a combination of zincite and bornite, such detectors being fairly numerous in the radio market. Other detectors having cat-whisker contacts are very easily upset and the mineral surface quickly oxidized or "burned" by the heavy discharges released by the second R. F. amplifier tube. The zincite-bornite detector holds its adjustment for hours and sometimes days on end. Moreover, a heavy pressure is required, so that the setting is rugged and very difficult to upset

Low Ratio Transformers

Low ratio transformers are advised for the two audio stages, to conserve the good quality of tone that the crystal delivers. To still further improve the clarity, and to cut the drain on the "B" battery practically in two, a 4½ volt "C" battery is inserted in the grid return leads from all four tubes. Moreover, the receiver is intended altogether for loud speaker operation, and complications in wiring and in excess contacts are avoided by omitting jacks and providing but two output binding posts for the speaker at the left end of the board.

Sensitivity

A 90 to 120 volt "B" battery is employed, together with four UV201A or C301A amplifier tubes and a 6 volt storage battery. The antenna need not be especially large because the tuned antenna circuit adapts the set to very short antennas. Sixteen-ohm rheostats are used, one for the two radio tubes and the other for the audio amplifiers. In mounting the parts, good separation between adjacent instruments is advisable, and the R. F. transformers are set at right angles to each other. Connections are indicated in the circuit diagram. The R. F. transformers may require further explanation, however. The primary windings are inserted between the plate of the tube and the positive "B" battery in each case. The secondary connections, running to the 50 turn honeycomb coils, are brought to the usual binding posts on the honeycomb coil mounts, the two tuning condensers being connected in shunt to the secondaries. Primary connections are marked "P," and secondaries "S."

IN ACTUAL operation, the position of the series condenser exerts great control over the sensitivity of the outfit. Inasmuch as the variometer and the series condenser are in series with each other, it is possible to tune to the same wavelength, by any number of combinations of these two. For instance, 360 meters might be heard with a low value of inductance on the variometer and a high value of capacity on the series condenser. On the other hand, 360 meters could also be tuned in with a high value of variometer and a low value of condenser. When the capacity of the condenser is high, the antenna absorbs energy to a large extent and prevents the R. F. tubes from oscillating. But with a low value of capacity, the antenna's absorbing effect is very little, and the tubes can be made to oscillate. Hence, the sensitive point is found with such a combination of series condenser and variometer that the circuit is near, but not actually at the point of oscillation. When this point is found, signals are loud, selectivity is good, tuning is easily done and the series condenser may be left alone.

Tuning

As previously stated, the sensitivity of the circuit is greatly influenced by the series condenser. As a result, great care should be exercised in the manipulation of this particular part of the set.

As the condenser is not a part of the closed circuit, there will be no noticeable effect in body capacity. In view of the fact that a station may always be found on the combination of the condenser and variometer, a chart or graph may be drawn and notations made as to the dial settings.

In this way the operator will not have any trouble finding the desired station.

The adjustment of the tuning condenser connected to the detector will not be found very critical, but that of the variometer and also of the first tuning condenser is sharp in adjustment. In case difficulty is met in stopping oscillation of the R. F. tubes, as may be the case with a very small aerial, the series condenser may be omitted or several turns removed from the primary windings of the R. F. transformers.

The crystal is perhaps more than anything else responsible for the clear and pleasing quality of speech and music which such a receiver is capable of delivering. Properly amplified before and after detection, the entire unit becomes a receiving outfit which will grow in the esteem of all members of the family. More suited to unusually clear reception of the nearer stations than to extreme DX, the set fills a demand on the part of those who appreciate true musical tone for a receiver reproducing events at the broadcast studio with utmost fidelity.

A Simple Regenerative Receiver

That *Minimizes* SQUEALING *and* RADIATION

By FRANK D. PEARNE

FORGETTING for the present the late deluge of complicated circuits with their equally complicated "dynes," super and otherwise, and getting back to the good old "sure fire" sets which come within the scope of understanding of the ordinary beginner, I am explaining in this issue a circuit which is quite simple and efficient, although not decorated with a fancy name.

It is of the regenerative type, but not one which will disturb your neighbor by producing whistles and other noises, if carefully handled. There are three separate and distinct circuits employed in its construction; the primary, secondary and tickler. The primary inductance is fixed and does not require any taps, or switches. The secondary is also a fixed inductance shunted by a 23 plate condenser by means of which it is tuned; and a tickler coil supplies the regeneration.

Tuning units of this kind are now for sale in all radio stores, but as many of our readers get considerable enjoyment out of constructing their own apparatus, details of the construction will be given.

FIRST, procure an old vario-coupler and strip it of all winding. The tube on which the tapped primary was wound will be from 3 to 3 1-2 inches in diameter. Beginning at the lower end of the tube at approximately 3-4 of an inch from the bottom, wind 15 turns of No. 22 double silk insulated wire. Anchor the ends of this coil by drilling small holes in the tube in the proper position to take the end down through one hole and up through the other.

These holes should be about 1-4 inch apart and in line with the winding. At a distance of 1-8 of an inch from this coil, start the secondary winding, which consists of 40 turns of the same kind of wire used in making the first coil. Both the starting and finishing ends of this coil are anchored in the same way. Next, the rotor is to be wound with 42 turns of No. 26 double silk insulated wire and the ends fastened to the same terminals to which the unwound coil was fastened. This completes the tuner.

It might be well to state that the two coils wound upon the tube must be wound in the same direction. When mounted in the set, the top end of the 15 turn coil is connected to the aerial binding post and the lower end to the ground binding post. This forms the primary winding. The top end of the 40 turn coil is connected to the grid leak and condenser and to the stationary plates of the 23 plate condenser, and the other end to the junction of the negative "B" and positive "A" batteries, and also to the rotating plates of the 23 plate condenser, as shown on the circuit.

One of the rotor terminals is connected to the top spring of the detector jack and the other one to the plate binding post on the detector tube socket.

THE other end of the grid leak and condenser is connected to the grid binding post on the socket. Now, as this set is to be equipped with two stages of audio frequency amplification, we will temporarily leave the filament circuit and trace the connections through the amplifier. The second spring from the top on the detector jack is connected to the post "P" of the first audio frequency transformer and the third spring from the top connects to the post marked "B positive" on the first transformer. The bottom spring on this jack is connected to the positive binding post of the 22 1-2 volt "B" battery. The post marked "G" on the first transformer is connected to the grid binding post on the first amplifier tube socket, while the post marked "F negative" on both of the transformers is connected to the negative side of the filament battery as shown.

Connect the top spring of the first amplifier jack to the post marked "P" on the socket of the first amplifier tube, the second spring of this jack being connected to the post marked "P" on the second transformer.

The third spring from the top on the first amplifier jack is connected to the post marked "B positive" on the second transformer and the bottom spring, as well as the bottom spring of the second amplifier jack is connected to the positive terminal of the 90 volt plate battery. The post "G" of the second transformer is connected to the post "G" on the second amplifier tube socket. The top spring on the second amplifier jack should be connected to the post "P" on the second amplifier tube socket. Now the filament circuit should be controlled by a switch, so that the battery current may be conveniently switched off when the set is not in use. From the negative terminal of the filament battery, a wire leads to this switch and the other switch terminal is connected to the "negative F" posts on the two transformers, as before mentioned, and to one side of each of the rheostats.

Each of the other rheostat terminals is connected to its respective "F" binding post on the socket of the tube which it is to control. The other "F" posts on all the sockets are connected together and to the "A positive" and "B" negative terminal as shown. The aerial, ground and all battery binding posts should be mounted at some convenient place on the back of the baseboard. The sockets should be of good substantial manufacture, preferably with a bakelite base and a metal sleeve, with good strong springs for making contact with the tube terminals.

The grid condenser should be of the fixed mica type, having a capacity of .00025 M. F. The grid leak has a resistance of 1 1-2 megohms. These should be mounted as close as possible to the grid binding post on the detector tube socket. This is important, as a difference of one inch in the length of the grid leak, after passing through the condenser, may cause the set to howl. No mistake will be made if it is soldered directly to the binding post. For the detector tube, use either a UV-200, or a C-300 and the amplifier tubes may be either UV-201-A, or C-301-A. The rheostat which controls the detector tube should have a resistance of 6 or 8 ohms and those used to control the amplifier tubes must have a resistance of 25 ohms. The selection of the transformers is left to the judgment of the builder, but these should be of some standard, well known make which are known to be good.

IF VOLUME is desired, in preference to good tone quality without distortion, then one having a ratio of 10 to 1 should be used in the first stage and that of the second stage should be of a lower ratio, of from 3 1-2 to 1, to 4 to 1. Two low ratio transformers of about 4 to 1 ratio will, however, give much better musical quality to the reception, although perhaps with a little less volume.

Any of the standard jacks will answer the purpose, two of which should be of the double circuit type and one of the single, as shown in the drawing. In some cases better reception is obtained if a fixed mica condenser having a capacity of .002 M. F. is connected across the posts marked "P" and "B" positive

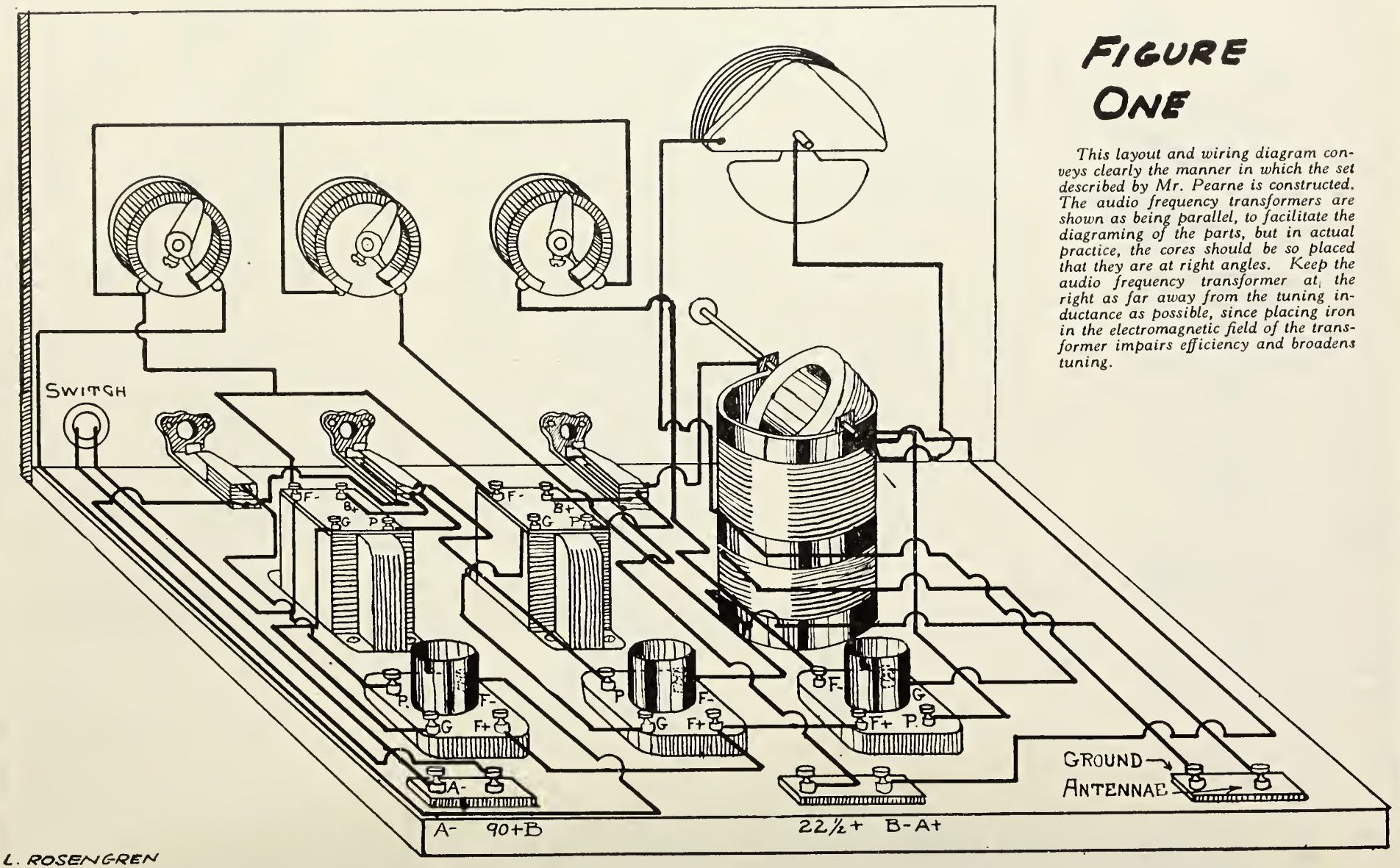
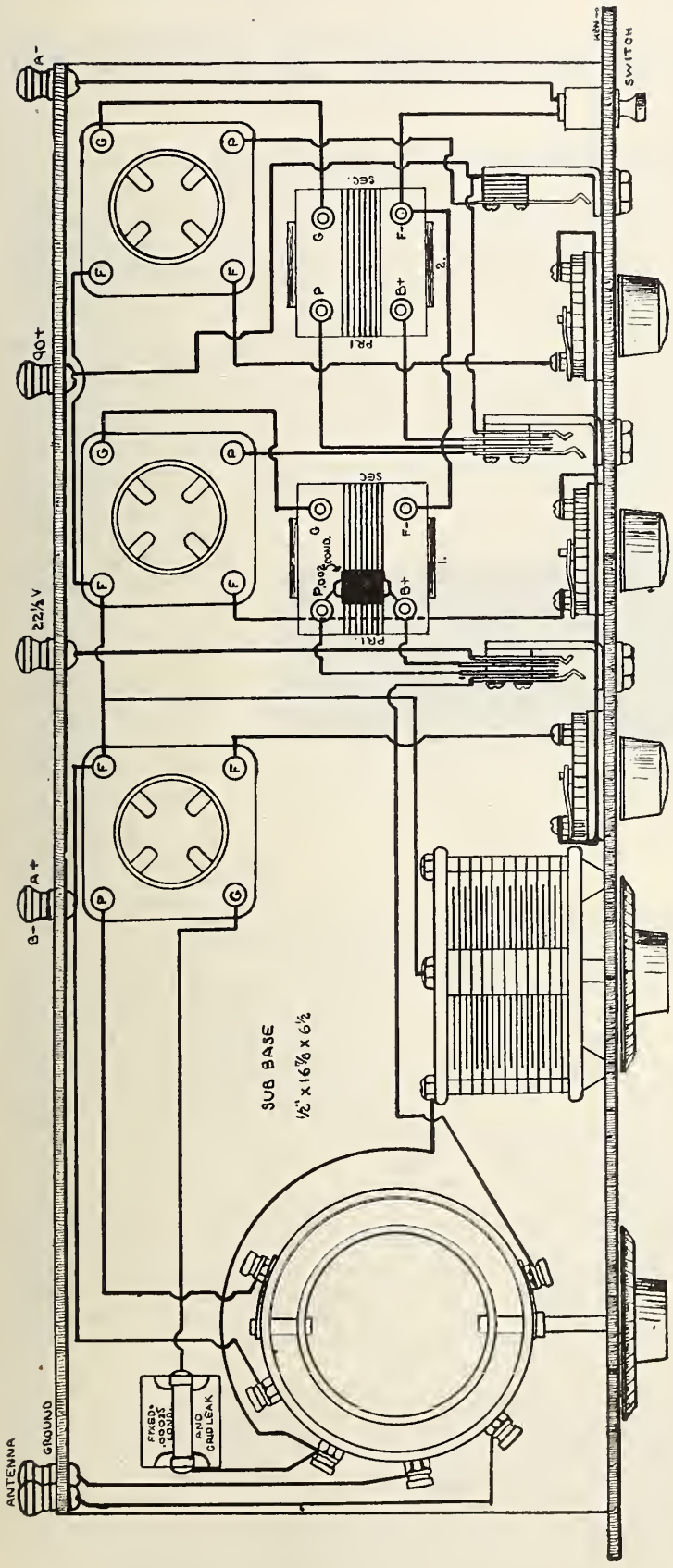


FIGURE ONE

This layout and wiring diagram conveys clearly the manner in which the set described by Mr. Pearne is constructed. The audio frequency transformers are shown as being parallel, to facilitate the diagraming of the parts, but in actual practice, the cores should be so placed that they are at right angles. Keep the audio frequency transformer at the right as far away from the tuning inductance as possible, since placing iron in the electromagnetic field of the transformer impairs efficiency and broadens tuning.



A schematic wiring diagram of the receiver isometrically illustrated on page 16. This is the diagram which should be followed out, should any of the connections of the isometric sketch puzzle you. This receiver is an old reliable circuit with several new trimmings added, making it just about as efficient a three tube set as any "bug" can build. The antenna or primary coil is fixed, making only two adjustments necessary in the process of tuning. The secondary condenser dial (second dial from the left) can be calibrated in terms of wavelengths after the tickler coil readings have been ascertained.

on the first transformer, but whether or not this will be of any use will depend upon the particular transformer used. This entire set is mounted on a bakelite panel 18 inches long, 7 inches high and 3-16 of an inch thick, with a baseboard 17 1-2 inches long, 6 1-2 inches wide and 1-2 inch thick mounted at the base of the panel.

All parts should be mounted as compact as possible to avoid the necessity of long lead wires between the different parts. Standard cabinets to fit the size of panel described may be obtained at any radio store. The list of material required is as follows: one bakelite panel 18x7x3-16 inches, one base-board 17 1-2x6 1-2x1-2 inches, two 3-inch dials, one tuning coil as described, one fixed mica grid condenser having a capacity of .00025 M. F. one grid leak having a resistance of 1 1-2 megohms, 3 standard sockets, one UV-200 detector tube, 2 UV-201-A amplifier tubes, 2 audio frequency transformers as described, one 23 plate vernier variable condenser, one 6 ohm rheostat, two 25 ohm rheostats, two double circuit jacks, one single circuit jack, one toggle switch, six binding posts, 20 feet of No. 14 tinned copper bus bar wire, one 6 volt storage battery, two 45 volt plate batteries with taps, so that a lead may be taken off at 22 1-2 volts, one pair of head phones and a loud speaker.

Solder all connections well and use a good aerial at least 40 feet in length and place as high as possible. Connect the ground binding post to the water pipe by means of a ground clamp. This set, if properly constructed, will give good loud speaker volume on long distance stations.

"Big Bill" Off for South Seas

Having penetrated the polar regions with MacMillan, amateur radio is now about to take the opposite extreme and set forth on an adventure in the South Sea.

The auxiliary yatch "Big Bill," which sailed recently from Chicago in the interest of the Deep Waterways Commission on a two year trip that will ultimately go around the world, has as its radio operator E. C. Page of Evanston, Ill., a young amateur and member of the American Radio Relay League.

The selection of Page was approved by Captain A. J. Dukan, who is in command of the vessel, following his recommendation by local radio representatives. He has for his equipment a Zenith radio apparatus capable of working on both commercial and amateur wave lengths including the shorter waves.

On a trial trip to Great Lakes Naval Training Station, the transmitter reached the East coast on low power, and reception of both East and West coasts were recorded on a special Zenith low loss receiver.

The Big Bill has been constantly in touch with Chicago amateur stations since its departure from Chicago several weeks ago.

Page expects to communicate regularly with amateurs. The official radio call assigned to the vessel is WHU.

The ULTRADYNE

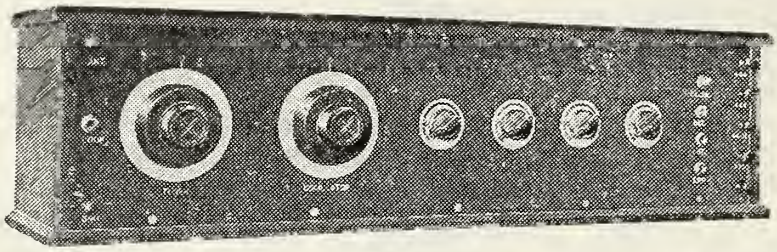
The LAST WORD in Doing An Old Thing in a New Way

By HERBERT H. STEINKAMP

CLAIMS to the contrary notwithstanding, practically every popular circuit used in receiving sets today is but an improvement or a modification of some long established, universally accepted method of reception which has been recorded in the Patent Office for years.

It has been the degree or the scope of these improvements that has kept the fires of interest alive and made each slight change in these fundamental circuits appear as some new and revolutionary method of bringing in signals destined to consign all the old principles to the scrap heap.

There has been nothing fundamentally new. Names have been changed, the trimmings have changed, some of the units have changed, but whether the set possesses one tube or twenty, the process of detection and amplification is still accomplished by one of the several tried and proven methods.



A front panel view of the completed Ultradyne Receiver. The tuning of this receiver is the same as that of any other super-heterodyne receiver; the secondary and oscillator controls with an occasional adjustment of the potentiometer being the only controls needing adjusting.

No such foolish claim is made for the ultradyne circuit, which has been developed by R. E. Lacault, formerly Radio Research Engineer of the French Signal Corps. It is merely a new way of doing an old thing better. Essentially it is the super-heterodyne system with modification, carried through to its ultimate.

Consequently those who understand the super-heterodyne in its original form will easily comprehend the beneficial changes that have been incorporated in its outgrowth—the ultradyne.

This same basic principle is employed in the ultradyne circuit, except that instead of employing the first tube as a detector, an arrangement known as the modulation system is used. This is the nerve center of the ultradyne.

Let us see how this unique modulation system functions. For enlightenment we turn to the broadcast station. The system employed there to transmit speech and music consists mainly of a generator of radio-frequency oscillations, a modulator system and a microphone.

When the transmitter is turned on, but no one is speaking into the microphone, a continuous stream of waves leaves the aerial, and this train of waves is known as the "carrier." When some one speaks into the microphone the carrier wave is varied in accordance with the voice, and if the carrier could be seen, small ripples would appear on its crest. In short, the voice waves are impressed on the carrier wave so as to modulate it.

Employs Modulation

THE ultradyne modulation system functions in precisely the same manner, except that it is the incoming modulated carrier wave that modulates the oscillations produced locally. The first tube in the ultradyne circuit, therefore, is the modulator, and the second tube the oscillator. Any wave picked up by the aerial system is, of course, impressed on the modulator tube first. This tube, being connected to the oscillator through the plate, has a direct effect on the local oscillations.

There is no "B" Battery voltage on the plate of the modulator tube, the plate being connected to the grid of the oscillator tube.

Consequently, the oscillator impresses a radio frequency current on the plate circuit of the modulator tube. Since an incoming wave will vary the resistance existing between the grid and filament of the modulator tube, the flow of the radio-frequency plate current furnished by the oscillator will likewise be varied. Hence, the local oscillations are modulated in accordance with the incoming wave.

The modulated radio-frequency "beat" produced by the conflict of the incoming wave with the local oscillations and with the modulation of the beat by means of the modulator tube is then passed through the long-wave radio-frequency amplifiers for further magnification. Here the signal is increased thousands of times in amplitude. From the radio-frequency amplifier the signal passes into the detector tube, where it is rectified. It is then, if desirable, amplified at audio-frequency. The first tube is the modulator, the second the oscillator, the third, fourth and fifth the radio-frequency amplifiers, the sixth the detector and the seventh and eighth the audio-frequency amplifiers.

The potentiometer in this circuit has a resistance of 300 ohms and controls the grids of all three radio-frequency amplifier tubes. The first rheostat has a resistance of six ohms and regulates the current flow of the filaments of the modulator, the three radio-frequency amplifiers and the detector tube. The second and third rheostats have a resistance of thirty ohms each and regulate the current flow through the filaments of the respective audio-frequency amplifier tubes.

No rheostat is employed in the filament circuit of the oscillator tube, as it is of no advantage. With the other tubes lit, there is a drop of potential so that the voltage across the filament of the oscillator tube is approximately correct. Consequently, the filament cannot be harmed.

Three jacks are provided so that the detector, first or second audio-stage can be plugged in at will. A fourth jack, placed on the extreme left of the panel, is automatically disconnected from the secondary of the tuning coil and connected across the loop. At the same time the aerial and ground circuits are opened.

The Tuning Unit

The tuning unit or the aerial tuning inductance employs an untuned primary. Necessity of an aerial tuning condenser is thus dispensed with. Tuning, however, is made sharp by utilizing loose coupling between the primary and secondary of the aerial tuning inductance.

A radion tube three inches in diameter constitutes the support for this coil, which is wound with eight turns of No. 20 dcc wire on the lower portion for the primary. The secondary consists of sixty turns of the same size wire wound on the upper portion of the same tube and so placed that there is a spacing between the two coils, thus formed, of 1 1-2 inches. The secondary coil is shunted by a variable twenty-three plate condenser of .0005 mfd. capacity. This forms the tuning control.

for Real "DX" Super-Heterodynes

Inductance of the oscillator unit consists of thirty-two turns of No. 20 dcc wire wound on the lower portion of a radion cylinder, three inches in diameter. This is the plate coil. A second coil is wound on the upper portion of the tubing with thirty turns of the same size wire. This is the grid coil. A spacing of one-quarter of an inch to provide coupling is left between these two coils. This may be seen in the wiring diagram.

The grid coil of the oscillator inductance is shunted by a variable condenser having a capacity of .001 mfd. This condenser is employed for varying the radio-frequency oscillations produced by the oscillator tube. A fixed condenser having a capacity of .001 mfd. is connected from the grid to the plate coil and in this position functions as a by-pass for the radio-frequency currents.

IN ADDITION, there are the necessary ultraformers. These are long-wave radio-frequency amplifying transformers, designed, as explained before, to amplify at one frequency or wave-length only. The first or input transformer is slightly different in design from the other three, and has both its primary and secondary coils tuned.

They are tuned to such a wave-length that no interference is experienced from the long-wave trans-atlantic stations, nor from the lower-wave navy stations. The frequency band to which they are tuned is just wide enough to avoid cutting off any portion of the frequencies covered by speech and music.

In order to make the ultraformers resonant at one frequency only, small, fixed .00025 condensers are shunted across the secondary of each, as shown in the wiring diagram, Fig. 1. It is important that the capacity of each of these condensers be exact, so they should be tested on a capacity bridge for accuracy. The input transformer is even more sharply tuned, having a fixed condenser of .001 mfd. shunted across its primary coil, aside from the .00025 mfd. condenser across its secondary.

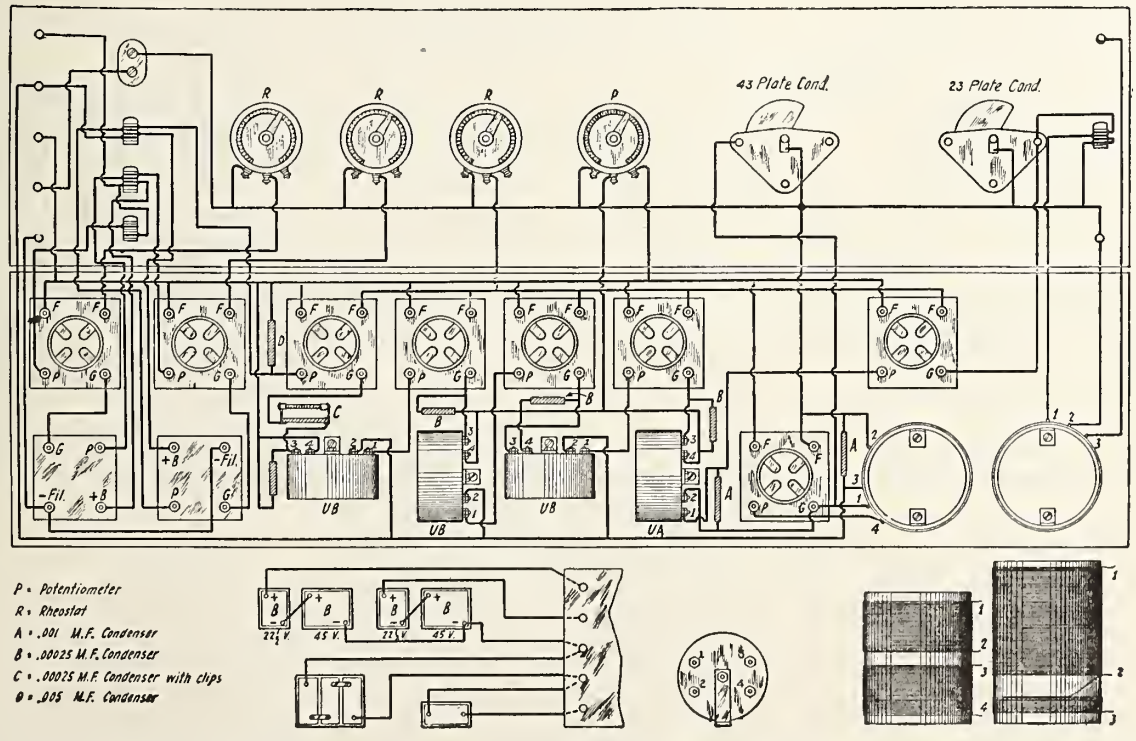
The sketch shows the layout of an eight tube ultradyne receiver and the photograph gives an idea of the appearance of a complete set constructed after the same layout.

Materials Required

The parts required for the construction of an eight-tube ultradyne are:—

One 7 by 30-inch cabinet with baseboard.
One 7 by 30 panel.
One .0005 mfd. variable condenser.
One .001 mfd. variable condenser.
Two vernier knobs and dials.
One tuning unit.
One oscillator unit.
One ultraformer, Type A.
Three ultraformers, Type B.
Eight vacuum tube sockets.
One potentiometer (300 ohm).
One 6-ohm rheostat.
Two 30-ohm rheostats.
Three double-circuit jacks.
One single-circuit jack.
One filament switch.
Two audio-frequency transformers.
One variable grid leak.
Seven binding posts.
One .00025 mfd. grid condenser with grid leak mounting.
Four .00025 mfd. mica condensers.
Two .001 mfd. mica condensers.
One .005 mfd. mica condenser.
Thirty-six feet No. 14 Copper tinned bus bar wire.

It will be best for the constructor to follow the layout given, as each part is

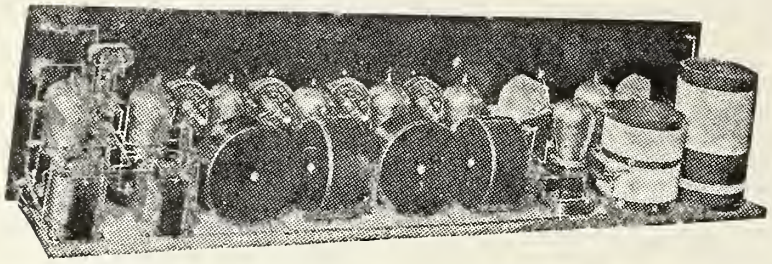


A wiring diagram of the Ultradyne Receiver as described by Mr. Steinkamp in the accompanying text. This illustration may also be used as a baseboard layout for the apparatus, as the arrangement of the apparatus coincides with the front panel and back panel views of the set shown in other photographs.

FIGURE 1

located so that all leads from one instrument to another are as short as possible. A deviation from this arrangement may bring about disagreeable complications in actual operation which would eventually be traced to capacity coupling between the successive radio-frequency amplifier stages.

It is to be noted that the ultraformers are mounted directly behind the radio-frequency amplifier tubes to which they are connected, and that each ultraformer is placed at right angles to the next. Be sure you mount them all uniformly. Nothing more need be said concerning the layout, as the sketch is complete enough for the constructor.



The accompanying back panel view gives an excellent idea of the way in which a compact and effective super-heterodyne receiver should be constructed. Note especially the short distances between the tubes and transformers, and the right angle mounting used. This set is truly a distance getter.

Although any type of vacuum tube may be used in conjunction with the circuit, it is advised that either UV-201-A or C-301-A tubes be used throughout. Since these tubes draw but one-quarter of an ampere each, the drain on the storage "A" battery is not so excessive as it would be with such tubes as the UV-201 or C-301. Furthermore, the electrical characteristics of the UV-201-A's and C-301-A's are quite uniform and they prove to be good oscillators, radio - frequency amplifiers, audio - frequency amplifiers and detectors.

To Bring in Stations

THIS receiver is very easy to tune. After connecting up the "A" and "B" batteries after the manner shown in the lower portion of the sketch, Fig. 1, pull the filament switch and plug in the headphones or loud speaker. Move the knob of the potentiometer toward the right until the oscillation point is found, and then turn it back slightly.

With both the tuner and oscillator dials set at zero, start working toward 180 degrees, moving the oscillator dial one degree at a time only. For each degree change of the oscillator dial, the tuning dial should be varied through ten or fifteen degrees. It will be found that a slight hissing noise is heard at certain points on the oscillator dial adjustment. This denotes that the tuner and oscillator are in resonance with each other. It is at such settings that stations will be picked up.

As soon as a station is heard, no matter how weakly, the tuning dial should be set for maximum volume, and not until this has been accomplished should the adjustment of the oscillator dial be made. The final adjustment will consist of moving the potentiometer knob toward the right until a point is reached where maximum volume is had without distortion.

It is to be remembered that a broadcast station cannot be located by the carrier wave in the manner usual to a regenerative set in a state of oscillation; hence one is apt to pass by a station that is "on the air" but not broadcasting. However, one can usually tell that there is a station on the air by a hissing noise that will disappear as soon as that point on the tuning dial is passed.

The ultradyne, like the neutrodyne, can be calibrated and a chart or a graph made with the dial settings on the tuner and oscillator plotted against the wave length or marked down for each individual broadcast station.

A. R. R. L. Endorses Esperanto as Radio Lingo

Hartford, Conn.—After a two years' survey of the international language situation, the American Radio Relay League has decided in favor of Esperanto as its official international auxiliary language, this action having been taken by the A. R. R. L. board of directors at their annual meeting in this city.

This decision was made on the ground that Esperanto is easily the chief of the auxiliary languages and has by far the greatest number of followers, with hundreds of thousands of users. Not wishing to enter upon the subject unadvisedly, the League first communicated with all of the national amateur radio societies of the world and all of these which expressed an opinion in favor of any artificial language recommended Esperanto.

Interest in an international language developed rapidly among members of the A. R. R. L. following the successful communication in radio telegraph code between transmitting amateurs in the United States and Canada and those in many foreign countries. The necessity for the endorsement of an auxiliary language has become particularly apparent as a result of the increasing interest of amateurs in international communication during the past year.

There is every reason to suppose, the A. R. R. L. believes, that radio communication in code between the private citizens of one country and those of another will become even more popular the coming Winter.

International Radio Week in November

International Radio Week will be held November 23d to 30th, inclusive, according to announcement by the Radio Week committee of the National Radio Trade Association, who conducted this event last year and who are making plans for an even greater international expcsition of radio progress this season.

In addition to the activities in the United States among broadcasters and the radio trade in general, Great Britain, France, Australia, Canada and Cuba will join in the celebration.

In England the various trade associations already organized will have complete charge of the English part of the celebration, while in the other countries special committees appointed by the trade bodies in the radio field will handle the details to make all the special programs dovetail so as to insure the success of this world-wide movement.

Henry M. Shaw, president of the National Radio Trade Association, in announcing the committee report for dates, also announced the appointment of Powel Crosley, Jr., president of the Crosley Radio Corporation, as executive chairman; Arthur H. Lynch as international broadcasting chairman; Paul B. Klugh, executive chairman of the National Association of Broadcasters, as chairman of the broadcasting committee, and Clyde P. Steen, secretary of the Window Display Advertising Association of Cincinnati, as chairman of the window display committee for Radio Week.

Announcements of other committees and special features for Radio Week will doubtless be made in a short time, Mr. Shaw explained.

Special postal cards for radio fans to use in inviting friends to Radio Week parties will be prepared. Other features of public interest will also be announced.

Radio Week originally started as a national affair, rapidly spread to Canada and England, proving the world-wide power of wireless communication. The spontaneous co-operation of the entire radio world in the 1924 event gives considerable foundation to the claim of Paul Weil, prominent New York advertising man, who expresses the belief that "Radio Week for the promotion of better understanding between all nations" would be more expressive of the possibilities of Radio Week.

"Dream Girl" from WGY

The entire performance of "The Dream Girl" was broadcast by WGY, Schenectady, from the stage of the Ambassador Theatre, New York, on September 1.

This musical comedy of Messers J. J. and Lee Shubert was put on the air in place of the program originally scheduled by WGY for that evening. The Schenectady station is able to offer the entire performance as a result of the co-operation of station WHAZ of Troy, N. Y., which is ordinarily scheduled to go on the air at 10 o'clock.

Now Come the Radio *Politicians*

¶Best Radio Candidate Will Be Victor at National Elections, Is Prediction

WASHINGTON—Well, "it's all over but the shouting," but there is sure to be a lot of that before the polls close November 4th, and much of the shouting will be over the radio broadcasting circuits of the country.

With the broadcasting of the political conventions this year, a new slogan was born. It no longer holds "That he who runs may read," but rather, "He who listens in may hear." Blase politicians, and even those who still believe something new is possible, were astounded at the interest displayed in broadcasts which carried to every city and farm the very words of the nominators and seconders, the votes of delegations and the stentorian tones of the chairmen. The radio listeners were on the inside for the first time. Through them the public at large had its ear to the air.

Newspapers were aided in their stories and editorials through radio. Some carried a daily ringside, or round-by-round resume of the sessions. Many people read these running accounts which were not dissimilar to the inning-by-inning baseball stories found on the sport pages.

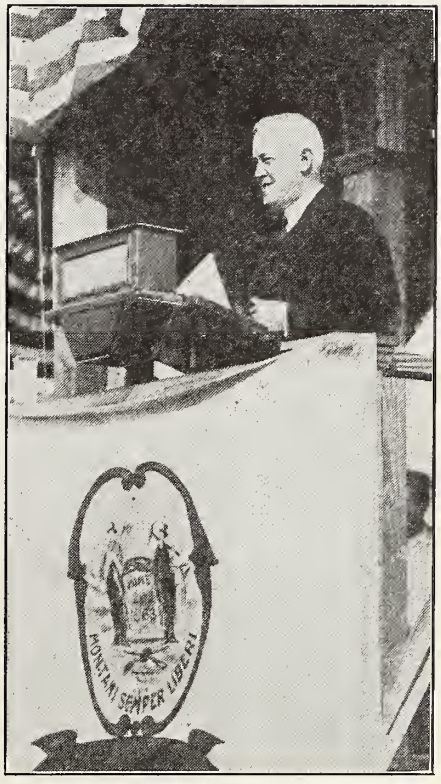
Democrats Thank Broadcasters

AT THE final session of the Democratic Convention in New York, a resolution was passed thanking the twenty broadcasting stations and the Bell System, together with their associates, for service rendered the convention and the public throughout fifteen days and nights of broadcasting. The convention so phrased the resolution as to include the thanks of the fans themselves, knowing the interest and appreciation in that quarter.

Before the campaigns are fully launched we shall see that campaign managers have laid plans for broadcasting the speeches of their candidates and auxiliary speakers, wherever arrangements can be made with broadcasting stations, and again we will tune in to hear what we shall hear.

Every fan in the country will also prepare to listen in when the polls close on November 4th. The returns will be gathered directly from precincts in all the states. It is foreseen that broadcasters will co-operate with local papers or precinct headquarters and election boards so as to carry minute-by-minute bulletins on returns. Those who do not possess sets of their own will join the crowds in front of newspaper offices where loud speakers will be active.

The presidential campaign this year is fraught with a new and exceedingly interesting question; Who will get the vote of some 25,000,000 radio fans? Undoubtedly the host of listeners will be influenced in their voting by spellbinders of each party as soon as the candidates for president and vice-president are named. The candidates themselves, will soon be on the air, voicing their platforms and aims.



John W. Davis was one of the first candidates for the presidency to take the "radio stump" last month. His voice already has been heard over several big radio stations, and he plans intensive use of radio before the polls close.

Some of those mentioned as possible candidates and others more certain to be nominated have already been heard in practically all the states of the Union. They have impressed the millions of fans one way or another, and it is the first time in political history, that as many citizens have come into contact in any way with aspirants for high national honors. To be sure, not many fans have seen the men who will be selected to stand for election in the fall, but many have heard, or will hear them speak before they vote. It is estimated that the broadcasts from the conventions at Cleveland and New York, will be carried by as many as twenty broadcasting stations and that these announcements and speeches will reach 25,000,000 fans.

President Coolidge is far better known today in radio land than any other man who entered a campaign. Hundreds of thousands of fans in many states have already heard him.

¶Coolidge and Davis Evenly Matched In Contest to Win Favor of Fans

What Will Happen?

THE question of the effect of the radio vote is especially interesting because it is new and because it may break down party lines. It is certain that voters, otherwise uninfluenced, will cast their ballots for their friends of the air whom they feel they are acquainted with better than an individual whose voice and ideas they have never heard.

Two candidates could hardly be more evenly matched over the radio than President Coolidge and John W. Davis. They are about the same height and weight, Mr. Davis perhaps being a trifle heavier and taller.

Both stand squarely up to the microphone, both are almost motionless when speaking, both speaking an ordinary conversational tone. Both talk along easily and evenly, never lacking for a word, both are deliberate, both are lawyers and of a legal turn of mind, both are men of unusual refinement of speech, both are college graduates, both are experienced speakers, both firmly believe in short speeches, and both are exceedingly careful in what they say, one having served as a governor, vice president, and president, and the other as a congressman, solicitor-general, ambassador extraordinary and minister plenipotentiary to Great Britain.

"And," adds James D. Preston, sage of the Senate press gallery and newest of radio experts, "both Mr. Coolidge and Mr. Davis have remarkably good radio voices."

Which seems to make it unanimous. Not one person in a thousand who hears President Coolidge over the radio has ever had the opportunity of seeing him, but so faithful has been the reproduction of his voice that should they ever actually get within earshot, it is reasonable to believe they would recognize him.

How Radio Converted Coolidge

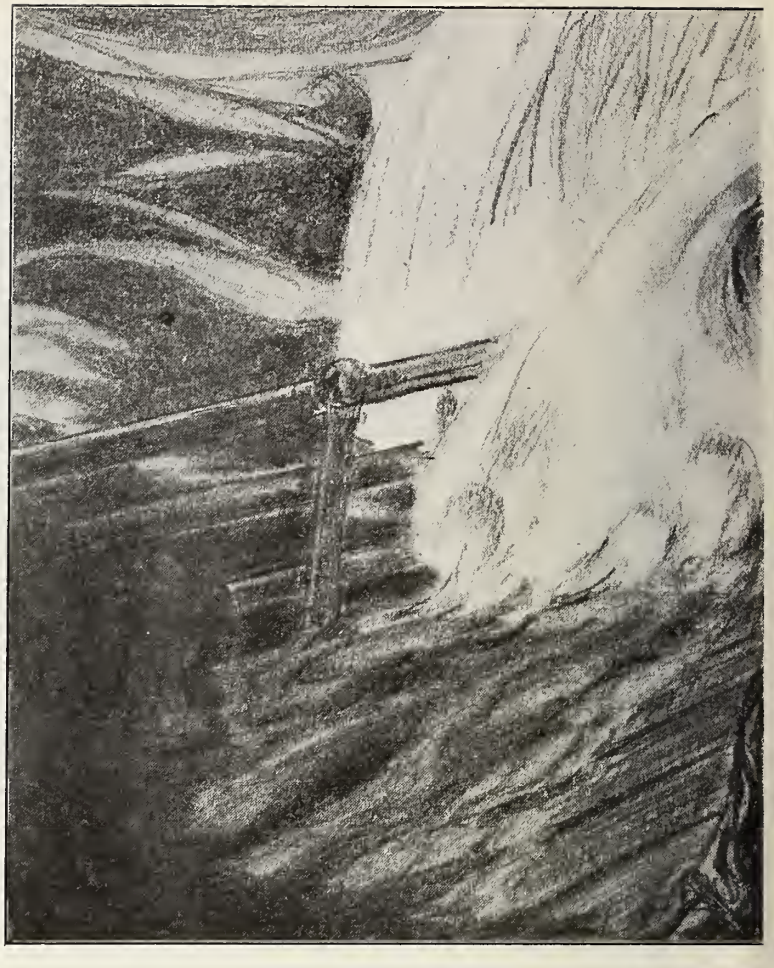
And just as the listener-in is getting better acquainted with the President, the President is becoming more and more at his ease with his newly-found friend, the microphone.

It may be remembered how for years President Roosevelt fought the automobile, but finally yielded and became a real enthusiast. Just so, it is said, President Coolidge did not warm up to the radio. After each address, however, like other popular broadcasters, he has received an avalanche of commendatory letters. These have increased in number as the President has become more at ease and really himself in the

(Continued on page 49.)

Hazardous *Adventures* as a Commercial Operator

By ARTHUR LEECH



Once outside and flattened against the deckhouse by the wind, I was ses of wind-whipped foam, towered all about us, threatening to wipe tions, was a mighty unimportant speck in the tumult. . . . . Looking

IT WAS not more than two weeks after I had started to "post up" at the "BX" station, (Bellevue-Stratford Hotel, Philadelphia, later "BS"), that I was called on to go to sea.

The fast-growing need for operators could only be supplied by encouraging amateurs and wire men to "break in" at the land stations, as there were no radio "ham factories" (telegraph schools) in those days. Examinations and licenses were unknown.

At that time I was a proper "lid" on receiving stuff where every letter counted. Sitting at home quietly piecing out press and weather reports, et cetera, I found it to be a different bit of business from having the stuff slapped directly at me thirty a minute by a Morse hound bent only on getting my OK and sine on a flock of real messages. Continental was at that time a novelty, being used only by the Navy. American Morse is at least a third faster.

On the third or fourth night of my course, Dave Heilig, station manager, was called out and left me in charge. I was so scared I could barely lift up the phones, and as I got them on I was immediately paralyzed from ears to fingers. My worst fears were realized—"NY" WAS CALLING "BX" LIKE A HOUSE AFIRE! By the time I had gotten my palsied muscles to functioning "NY" was on his fourth call, four times as mad and sending four times as fast. I was faintly slapping the key in reply when Dave returned.

"Good gosh! What's the matter?" he asked, after a look at my haggard countenance.

"Nothing," I managed to reply. "MIN," I said on the key, then to Dave, "Here, take 'em."

I handed him the phones and staggered to the roof for air.

One of the first messages gave me my second big thrill from the commercial slant. After I had reread it for the tenth time to be sure it sounded right—it was a SVC (service) and had no check, or number of words to assuage my doubts as to whether or not I really had it all—when I finally assured myself that I had been justified in OK'ing the message, I noted its contents. It advised the station manager that on the following Saturday New York would need two operators to sail to parts not mentioned. I did not take the allusion "operator" as referring to me, but after Dave had looked the SVC over, he said: "Well, Art—what say? Want to go?"

With the big chance suddenly looming up before me, I waxed weak in the knees and home and Mother seemed a lot more desirable than steamships and foreign ports. Maybe my scant fifteen years had something to do with it. However, Dave SVC'd "NY" that "Operators" Killie and Leech would report. On the way home I spent a hectic time, hot and cold in turns, one minute on a pinnacle of joy and the next in the slough of despond, and by the time I got to Camden I was well nigh gibbering. Mother was as concerned as I had been at the news, but after a conference we decided to see it through.

What a pathetic little figure I must have been, trudging aboard the Camden-Philly ferry before daylight Saturday morning, October 9, 1909, in a dense fog that symbolized perfectly what I was facing.

Meeting friend Kille as arranged, I looked him over anxiously, but vainly, for any traces of such excitement as was surging through my breast.

In New York we repaired immediately to the roof of 42 Broadway, headquarters of the United Wireless Telephone and Telegraph Company, and crawling under and over and around a host of pipes, tanks, wires and similar devices common to the attics of New York's office buildings, we shortly stood before the arbiter of our destinies in the form of H. J. Hughes, Operating Superintendent, absolutely one of the finest gentlemen I have ever met—in spite of his being an operator. H. J. H. I shall always remember as a medium-sized gent whose face was always smiling, even when he was serious. I must certainly have looked like a tender sapling to trust with the safety of an ocean-going steamer and her precious cargo of human lives. However, reassured by H. J. H.'s kindly presence, I gradually regained some measure of the last ounce of poise which had trickled out of my system as we had ascended in the elevator.

Kille, quickly assigned to a vessel, briefly took leave and passed out of my life. I was bade to stand by while H. J. H. disposed of routine duties. After an hour I began to get anxious again. Anxiety shortly turned to panic and I spent some minutes picturing my dire circumstances—with no ship, alone, penniless and forgotten in New York, a fifteen-year-old wanderer with an enormously heavy suitcase, buffeted about

Being the Second of a Series of Unusual Memoirs

Drawn for RADIO AGE by T. R. Braithwaite

appalled at the sight around me. Waves higher than I had ever imagined, topped by mas- out our little craft. The ship, which at dock had impressed me as a mass of sizeable propor- forward I saw a monster wave headed directly at us. . . . . and I thought the end had come.

by the careless crowd. Despairingly I looked into H. J. H.'s room, to see him apparently at ease as if the docket were clear. As a reminder that the most important piece of business in the world was still on the boards, I stepped in.

Hope—Then Despair!

"Heavens," said H. J. H., (or was it the other place), "we have forgotten Leech."

And by the way he looked vacantly at his list of ships I instinctively knew that I had been left out somehow. "Everything that sails today seems to be filled up."

I felt too forlorn to reply.

"Ah," said H. J. H., "here's one—but she does not sail until next Wednesday." I was so immensely relieved at having something that it was a few minutes before I started to wonder how I was to live until Wednesday with about two dollars in my jeans. H. J. H. evidently saw my predicament.

"I think," he said, "that you can live aboard, but they don't keep house in port on that line, so you will have to eat ashore."

Everything was in process of overhaul when I arrived aboard the "Seminole" at Pier 31, South Brooklyn, and a heavy, depressing smell of fresh paint mixed with the usual dock odors prevailed everywhere. To this day similar smells around a dock remind me of that day and give me a momentary fit of the blues. The wireless room, a 6x8 converted stateroom on the upper deck, was a wreck. Steamfitters had installed a new radiator and had departed leaving the usual mess. And on this detail hangs an important later development. As to furnishings, the upper berth contained the big coffin-like 1 K. W. transformer, a case of leyden jars and the helix and spark gap. A shelf over the motor generator was large enough for the tuner and a pad of message blanks. The lower berth held mattress, blanket and one pillow, but, of course, no linen. The washstand contained nary water, soap nor towels. I could not get any bed linen, but I did get a towel, some soap and a clue to a fresh water tap. The stewards informed me that the ship was out of commission and that there was nothing doing on any service before sailing day. However, the berth, linen or none, was better than a bench in the park, so I dug in for a lonesome wait.

The three days and nights before sailing I spent in cleaning up the set, copying for practise and wandering around Brooklyn. I was already so homesick that I nearly deserted ship, but I stuck it out and finally the big day arrived. As I watched the dock receding I had to admit a grand exhilaration now that the "great adventure" had commenced.

The first duty in those days was to send a "Leaving dock" "OS" (position), a practise long ago discontinued on account of the unnecessary interference caused. Listening carefully for a break in the fearful jam of stations on the air, I finally got a clear minute and with generator running I threw down the aerial switch and—lost my nerve. Having faltered for a few seconds I knew I was too late, and sure enough on throwing up the switch "NY" was working with another ship. At the next break I slammed the switch bravely and called "NY NY VJ . . . -." Back he snapped with "VJ NY Ga . . . . -," and I was into my first ship to shore communication. Outside of the key sticking every other letter and the fact that I said "1:55 *A. M.* VJ left dock" instead of "1:55 *P. M.*" I got it over. "NY" had quite a job on his hands getting me corrected, but I finally savvied and made it "1:55 P. M."

A Rude Awakening

About 7 a. m. the next morning I suddenly "came to" compactly piled up in one end of the berth. Before I could get unwound, or the ole bean to work doping out this unusual situation, my end of the berth elevated itself to the top of a perpendicular and I shot down to the foot, plus pillows, bedding and some clinging, snapping, troublesome articles which I shortly discovered to be the phones. Now thoroughly awakened, I could hear a tremendous whistling which I took to be the wind, accompanied by much splashing and running of water. Recalling a storm warning I had pieced together the night before we sailed, I gathered that this was it.

This much understood, I next turned my attention to a strange tumult raging nearer at home—somewhere between the heart and liver, to be as specific as I was able. Two guesses as to what was the trouble. Not wishing to dwell on such personal matters, I watched my chance between leaps and vigorously swung my feet out of the berth and plunked them down hard—right into my suitcase on top of the clean shirts. I then perceived that practically everything but the set had broken adrift and was mixing it merrily on the floor at each gallop of our laboring steed. A sudden lurch shot me into an upright position and into another surprise, which was that this business of standing up had to be learned all over again. Three good wallops put me where I would be safe while I formulated plans.

I had wound my arms desperately around the tuner. My efforts were fully

rewarded as this instrument accompanied us on the backward crash and I kept it close to my bosom for the complete cycle back across the washstand and return to the table. Only—we missed the table by several feet of altitude and joined ourselves freely with the motor-generator and the oil can. There we stuck. Forsaking my first love, the tuner, I firmly embraced the motor-generator and with face resting comfortably among the collector ring brushes, I thought this thing over calmly.

The disturbance in the neighborhood of my floating ribs becoming serious, I determined to return to bed. Spreading arms and legs so as to give myself a stable wheelbase, I cautiously sat up and quietly studied the strange contortions of our gallant vessel for some sign of system or sequence, but I could detect neither. I had just given it up when a heavy, regular tramping approached on the deck outside. At this sign of life aboard I felt better and with the knowledge that here at least was one person who could not only stand up but make excellent time in a predetermined direction.

But the tramping stopped outside my cabin, a firm hand seized the knob and opened the door. In rushed a large section of salty gale, mixed with a dash of spray and Captain McKenzie. Slamming the door behind him, the skipper dashed the brine from his eyes, took one look at the wreckage, burst into a flow of language that started like a prayer but wasn't, and stamped out of the room. Five minutes later Carey, the First Mate, came in and not unkindly offered to lend a hand to get matters straightened around. Shortly we had everything made fast and the room took on a business-like aspect.

"Fishing" for Signals

Carey had brought our 8 a. m. "OS," also a request from the Captain to rustle up a weather report. As I was about to reply my stomach turned end for end and did not immediately return. Carey instinctively ducked, but it was a false alarm that time and by a herculanean effort I forced my digestive organs back into place. Agreeing to have the engineers start up the dynamo—we normally only had juice during the night—Carey left, after advising me that I would feel better in bed.

Then started a session which paralleled my first siege of listening at my first set in 1907. Not a sig could I hear; not a soul could I raise, although we were but 250 miles from New York and in easy range of "AX" and "HA," Cape Hatteras. As often as I could marshal strength I continued calling "AX" and "HA" for hours, then "CQ"—general call. Hearing no response I started broadcasting my "OS," "8 A. M. VJ 210 South Hook," keeping this up steadily until without notice the juice suddenly went off.

In the forenoon I attempted the trip below to ask for power again. The wireless room was on the windward side and I soon found that I had a lot more stuff to learn about conduct in general with relation to the roll of the ship, wind direction, et cetra, nearly breaking a complete set of arms and legs in the first battle with the cabin door. Once outside and flattened against the deckhouse by the wind, I was appalled at the sight around me. Waves higher than I had ever imagined, topped by masses of wind-whipped foam, towered all about us, threatening to wipe out our little craft. The ship, which at dock had impressed me as a mass of sizeable proportions, was a mighty unimportant speck in the tumult. I was first surprised, then relieved, at the quick response of our ship to the necessities of the raging waters. Looking forward I saw a monster wave headed directly at us and I thought the end had come. But the old "Seminole" climbed that hill like a duck and in an instant we were right on top—all ready for the dizzy slide down the other side. I proceeded on my way, slowly slipping, sliding, down the deck.

For the next three days, fighting sea-

BEG YOUR PARDON!

In introducing the author of this series last month, RADIO AGE erroneously referred to him as "Arthur Lynch" instead of "Arthur Leech." Mr. Leech is a veteran operator known to thousands of fans throughout the country, and his adventures will be appreciated by those who know the true facts of the early days of radio. We hope the impression created last month will be corrected by this explanation.

sickness, homesickness and general disgust, I doggedly hammered that key by the hour, whenever I could get juice, calling "CQ" and broadcasting our latest "OS."

Then, Saturday night, (October 16, my diary says), with weather moderating, I decided something was wrong with the set, and I discovered that I had been working without a receiving ground, absolutely no soap for any distance in those pre-R. F. amplification days. You recall my allusion to the steamfitters installing a new radiator so as to furnish me with material to write about fifteen years later? My receiving ground had run to the steampipe and those gentlemen of the wrench and red lead had cut the wire and stuffed the end inside the partition while proceeding with their dirty work!

Touching the wire to the radiator, I immediately heard about eighteen sparks with different tones, sounding like the lost (and found) chord on a church organ. Making hasty connection, I heard in five minutes enough ships and stations to fill two log sheets. While rejoicing at thus solving the problem, my blood suddenly froze ice as I realized what I had been doing for the last three days and nights. I had dumbly been jamming the whole coast. I must have done especially heroic execution on the second day out when, while only 150 miles from "AX" and "HA" I had been on the key steadily during those hours when said stations were normally overtaxed clearing the flock of ships that had left New York the day before. And at night, during the freak range of the set, which might be anything. What a mess I had made of the wireless communication of the Atlantic seaboard! Appalled, I decided to remain silent on the up-trip, sneak off the ship to avoid the lynching party sure to be waiting, change my personal sine, develop a new style of sending and ask for a transfer.

Another "Faux Pas"

However, that was borrowing trouble. I still had enough for the immediate present, what with a skipper absolutely convinced that I was purely excess baggage. Next day we were to pass the "VK," S. S. "Cherokee," northbound, which was something of an event to the skippers anxious to exchange long messages regarding general conditions. I made a complete daub of this deal too, and my stock went from .00 to .0000 with the Boss. Due to a comedy of errors in which "VK" called while I had no juice, and I had juice while "VK" was off the job, in connection with real tropical static when we both had juice, we missed each other entirely. After this had been going on about a day, "VK" called me, and in response to my impassioned plea to the Chief that "VK" was calling, he forced his crew to reassemble the dynamo right in the middle of some delicate repair work. The fact that it was twenty minutes before I could answer, during which time "VK" had given up and gone off the job, meant nothing to the Chief. As my pilot light died down, my last hope went with it, for in my diary under Sunday, October 17, 1909, I wrote: "Have decided to resign. Wrote letter to Ma."

Tomorrow was another day and I felt better when we saw our first land—Turk's Island, a British possession. Although producing only one thing, salt made from evaporated sea water, and anything but beautiful in form, it was my first view of a foreign land and for a time my troubles were banished in the activities attendant upon lightering the cargo to shore. The lightermen were British negroes, a different type from our American negro, and as they worked on some kind of a piece work scale, much competition was engendered in maneuvering for a place at the ship's side.

The outstanding point of interest on my first trip was the arrival at Monte Christi the next morning. I looked over the ship's rail at the most colorful panorama I had ever seen and it remains with me to this day as a peer of my travels. The water about the ship was a transparent blue as deep as laundry bluing and as it approached shore, it shaded off to a light blue, then through all shades of green to a line of foam on a white beach of coral sand. Clumps of palms, picturesque native huts, and a deep purple background of snow-capped mountains in the distance from which the morning mists were melting in ever-changing halos of gorgeous coloring, completed the picture.

The glamor of the extended excursion from port to port among an old world atmosphere so different from what we knew at home, kept me free from worry until the day we took the aerial down looking for a loose joint that had de-

(Continued on page 60.)

Our Hall of Fame

"DOUG AND MARY" LISTENING IN

What the Broadcasters are Doing

"Husk" O'Hare Captures Radio Hearts

RADIO orchestras are many, but very few are remembered after the rheostat is turned off. On the fingers of one hand radio fans can name the orchestras that they've heard and would really like to hear again.

And if Summer fans have been tuning in on WLS, the Sears-Roebuck Station at Chicago, during the past three months, they will undoubtedly devote one of the fingers of the aforementioned hand to "Husk" O'Hare and his inimitable band of syncopators who have been broadcasting over WLS from the College Inn of the Hotel Sherman.

"Husk" prides himself that his dance orchestra is just as intriguing over the ether as it is 'midst the rattle of Chicken a la King dishes in the College Inn. To prove it he exhibits a bushel of telegrams and letters he has received since his boys began furnishing the jazz music for WLS and Chicago's dance lovers.

"It's all in taking music as an art," "Husk" explains.

"We don't play a piece unless we know it is musically perfect and able to withstand the ravages static causes. For we know if our music is good 'radio music,' it will certainly be the best there is out on the dance floor."

New Chicago Station

Chicago now has another broadcasting station operating under the call letters of WTL, located at the Webster Hotel at Webster Avenue and Lake Shore Drive, only a mile or so away from the Drake Hotel station.

The station operates on 258 meters, and uses 10 watts power. It is owned by the H. G. Saal Co., radio manufacturers.

A new and larger station is pending, the plans being nearly completed.

Washington Bishop Preaches on Radio

Washington, D. C.—Radio will shortly rank with printing as a great medium for spreading the gospel of Christianity. That is the conviction of friends of the National Episcopal Cathedral in Washington, where former President Wilson is buried and from which special services have been broadcast every Sunday afternoon at four o'clock during the last year. It is estimated that from 250,000 to 400,000 persons listen in every Sunday and the services have been picked up as far West as the Mississippi Valley.

Almost letter-perfect transcriptions of sermons are received by the Right Reverend James E. Freeman, D. D., Bishop of Washington. Hundreds of letters indicate enthusiastic appreciation of the choral services by one of the finest male choirs in the United States.

"Husk" O'Hare

Improving School by Radio

A thorough and comprehensive plan to adapt radio to the public school is now being tried out under the supervision of the research director of the Oakland, California, public schools with the assistance of KGO, popular Pacific Coast station.

From tests thus far made it is expected that through the medium of radio more voluntary attention may be obtained from a child in school.

Dr. Virgil Dickson, research director of the Oakland Public Schools, announced recently that a committee working on the radio problem is divided into two groups differing in opinions. One group believes that a lesson by radio will be limited to a message of special importance by some special speaker who is able to give it better than anybody else. This is the lecture type of lessons and will be limited to specialists.

The opinion of "group two" is that findings point to radio as a means for giving actual classroom lessons. It is their belief that the radio teacher may take the place of the classroom teacher and give the same kind of lesson; however, the regular classroom teacher will listen in and point out upon maps, globes or charts topics referred to by the radio teacher. The regular classroom teacher will also direct operations of the class and see that pupils make proper notes required by the radio instructor.

The lecture plan as advocated by group one of the committee has been tried out by broadcasting one lesson in music and another on Indian customs. Returns from various schools listening in indicate that both lessons were successful. Opinions of group two of the committee have not yet been verified, as the test lessons on geography, Shakespeare, and commercial arithmetic have not yet been fully tabulated. Under both systems the radio teacher was assisted by pupils also speaking into the microphone, creating classroom atmosphere.

What's Going On in Radio *Land*

Photo from U. and U.

Army radio operators thruout the country "listened in" for messages from Mars last month—without much success. Corp. John H. Sadler of the Signal Corps is shown at a radio station of the War Department.

Photo from Alantic Photo Service

Snuggled in a diving suit, C. A. Jackson of Philadelphia is shown being lowered into the Atlantic Ocean at Atlantic City, where he conducted the first underwater radio broadcast in History. His story was transmitted through WIP.

Mary Jane and Catherine Tompkins "did their stuff" for the ether fans of WLS recently, singing and dancing to the accompaniment of the famed "How D'ye Do Boys," Ford Rush and Glen Rowell. The Youngsters were attired for a regular performance and won many encores.

Photo from P. and A.

Senator "Bob" La Follette, third party choice for president, is making intensive use of the radio to win the voters to his cause. Here he is shown making a campaign speech before the new machine designed to synchronize voice and action. It is called the DeForest Phono-Film.

The *Sunny Side* of *Running* a *Radio Station*

By MILTON LIEBERMAN

"ABOUT the closest escape from complete annihilation our studio and my job ever had was when we held an 'amateur night.'

"It was a riot. Tracey Drake, owner of the Drake Hotel, the elevator men, and all of the guests in the hotel threatened to get out en masse or throw us out. The day was saved, however, with very small loss of life."

Jack Nelson, until recently the announcer of WGN, the Chicago Tribune radio station in the Drake Hotel, Chicago, was telling some of the highlights in the history of the famous station.

"We had announced for several days that a certain night would be set aside for amateurs," he continued. "Anybody in Chicago or whoever else might care to, could come up to the studio and 'do his stuff' before the microphone. The crush started early. With little deviation from the truth, it might be said that traffic was blocked for a half-mile down on 'Boul Mich.' Everybody who aspired fame before the microphone, from infant prodigies with a fiddle under one arm and a roll of music under the other, to elderly ladies who had tried to get into opera all their lives, but were 'never understood,' came.

Above is Jack Nelson, who until recently was announcer and musical director of WGN, the radio station on the Drake Hotel, Chicago. He is shown above composing one of his song hits.

On They Crushed

THEY mobbed the lobby; they crushed the dignified guests in elevators; they paraded down the halls; they brought essense of the stockyards to the perfumed corridors, and they found their way up here to the studio and took it like the Smith cheer-boys took the Democratic Convention.

"While guards fought them off to give me breathing room, I announced the great event to the invisible audience, and told them that, to make it interesting, they should send in their votes and the most popular entertainer would get a prize—the wonderful high silk hat of Tracey Drake's!

"Well, with a prize like that to work for, the entertainers got down to real business. Little Clarence tweeked his bow and fiddle in the fashion that his dollar-an-hour professor had taught him. Mademoiselle McCarthy, who had studied abroad from the best vocal teachers to train her for the operatic stage, shrieked her songs of love as she never did before, and the one-man orchestra pepped up the evening with an orgy of music. Telegrams and telephone calls came in like bullets from a machine gun, and the favorites were soon picked.

"Then came the time of picking out the winner and awarding Tracey Drake's silk hat. The most coveted of prizes was about to be awarded to the gasping genius, when Tracey flatly refused to give up his crowning glory.

"'S'pose I'm going to let that classy stove-pipe rest on the flat head of some ham musician? I should say not. That hat stays in the box that still has the $25 mark on it,' said Tracey.

"And so the prize was not awarded and amateur nights have been discontinued."

All in a Day's Work

Lots of funny things happen in radio studios, some of which the fan gets in on and some that he never hears about. For instance, Jack Nelson tells of the time when a dog escaped from the kennels on the roof directly above the broadcasting room and found its way in.

That time the radio audience heard more than they should have. Everyone was chasing for the hound, which was pedigreed and very valuable, and there was great fear that it would step on one of the high-tension wires in the operating room. While all this was going on, the microphone was open and Jack Nelson was announcing the evening's program.

Suddenly a terrible howl came from the power room, just next to the studio, and Nelson asked, excitedly, if the dog had been killed, or what had happened. Elliot Jenkins, one of the original owners of the station, shouted back, not knowing that the microphone was connected: "The blankety-blank-blank confounded mutt got mixed up in the furniture."

Blankety-blank-blank in themselves are innocent words, but the real speech which they hid is not the sort of thing that should be heard by children who had just turned off the bedtime stories. However, Jack's more careful now.

WGN has a humorous side, as you have seen, but it is really one of the most seriously important stations in the world. It has served its worthy purpose in entertaining listeners in all parts of the globe, and by dispensing the market reports from the Chicago Board of Trade with fresh news-items furnished by the Chicago Tribune. And its shining star, Jack Nelson, has become as necessary to his listeners as the most famous movie actor is to his fan.

Jack Leaves WGN

Jack's history reads like a book. When at Northwestern University, he wrote five plays which were acted by the "Hermit and Crowe" student men's dramatic body. His voice, now so popular with radio listeners, won him honor and distinction when the Northwestern University Glee club, of which he was president-director, was sent by the federal government to the Panama Canal zone to entertain Americans. This was the largest body of its kind ever sent. He was also an ensign in the navy during the world war.

Since this story was written, Jack has left the employ of Station WGN (formerly WDAP) for a much needed rest. Already the contest manager of RADIO AGE, Harry Aldyne, has been in receipt of numerous requests asking where Jack has gone and why, and the nature of these letters plainly tells the story of Mr. Nelson's popularity.

Jack tells us that he will again reappear on the air on or about October 27th, when he will open a brand new broadcasting station at Mooseheart, Illinois, a small town located between Aurora and Batavia, with studios both at Mooseheart and Chicago.

Composer of Song Hits

As a music composer he is nationally famous. Among the song hits credited to him are "Foolish Child," "I've Got

A Song For Sale," "After the Storm," "You Are Too Sweet For A Dream," "Carolina," and "Sleepy Head." Two new songs by him have just been placed on the market. One is "I Do" and the other, "May You Laugh In Your Dreams." The inspiration for the latter is his catchword "May you laugh in your dreams, dear listeners," with which he signs off the program each night.

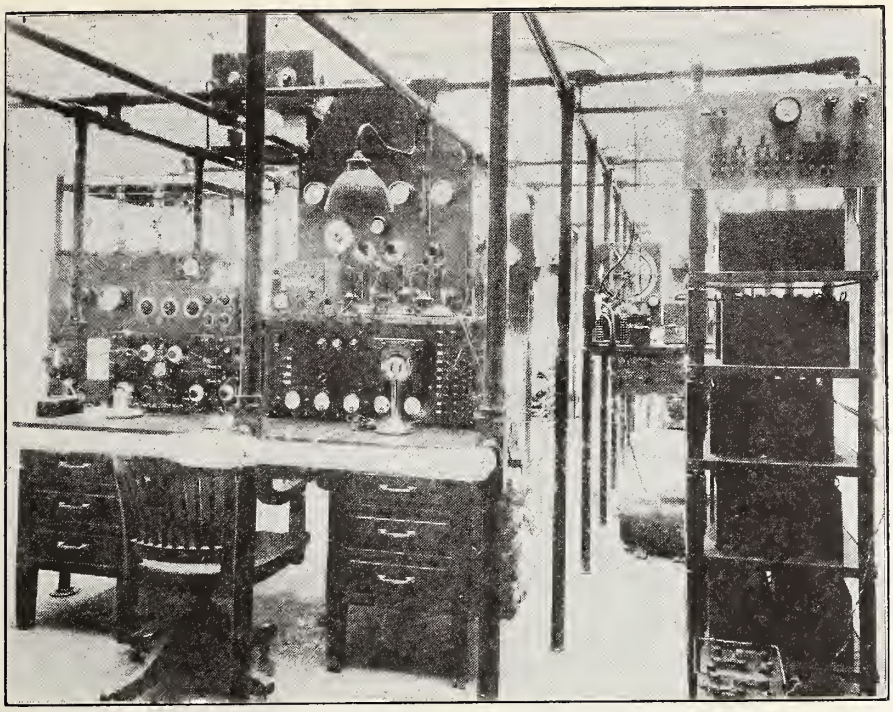
First Radio Courtship

THERE was considerable mention in the newspapers about a year ago when he married a Detroit girl as the culmination of a "radio courtship." It was said that the girl admired his voice and corresponded with him. However, she wasn't the only one. Jack received—and still receives, although he is married—more "mash" letters than Milton Sills or any other movie star. He is humorous, has a clever and interest-compelling personality, and his voice and interesting talk grips his female listeners. The reception room next to the studio has the walls covered with caricatures of himself as the desert sheik with worshipping women at his feet.

He became program director and announcer of WGN July 1, 1923, after he had been coming up to the studio to play the piano. He replaced Ralph Shugart, who had also earned for himself the title "sheik of the Drake."

The birth of the now famous station, which has made records for distant sending equaled by few other stations in the world, was in the Wrigley Building, on Michigan Boulevard, in the Spring of 1921.

Two wealthy young society men and radio fans, Elliot Jenkins and Thorne Donnelly, created amateur station 9CT. This became quite well known and they moved to larger quarters in the Drake Hotel about a year later. The station was given the call letters WDAP which it retained when it was purchased by the Chicago Board of Trade as its official station some time later. The change in ownership which gave it the present call letters, WGN, came when the Chicago Tribune moved from the Edgewater Beach hotel, where it operated a station with the Zenith Radio Corporation and came to the Drake Hotel, replacing the Board of Trade. This was only a few months ago.



Here is the control panel and generator room of WGN, the new Drake Hotel broadcasting station at Chicago. From the desk in the foreground all the mechanical details of the broadcasting are manipulated. The receiving set at the left is used fifteen minutes out of every hour to "stand by" for possible distress signals from ships on Lake Michigan.

Features of the station's regular programs are the Drake Concert Ensemble, under the direction of Henry Selinger, the Blackstone String Quintette, directed by Irving Margraff, and Jack Chapman's orchestra, in the main dining room of the Drake Hotel. Jack Nelson gives much of the regular entertaining as does Bert Davis, known as the "Clown of the Air."

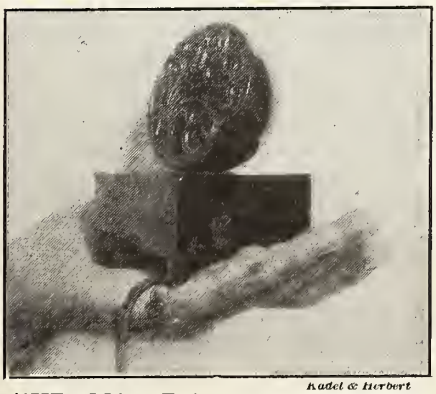
And Here's Kaney

ANOTHER famous character of the station is "Sen" Kaney, who announces part of the time. He started his career with KYW, and became so popular that the Chicago Tribune took him over while they were still at the Edgewater Beach Hotel. He stayed with them when they moved to the Drake Hotel. "Sen" is no singer, as so many of the announcers are, but he has his admirers, too. His "Well, folks, don't go to bed yet; there is more coming," has been mimicked by thousands.

Far, far down at the toe-end of South America the distance record for radio reception was created when a ship rounding Terra Del Fuego heard The Drake Hotel. The station was heard by MacMillan when he was 10 degrees from the North Pole, and has been heard on Wrangel Island, Alaska. A steamship five days West of Honolulu tuned in Jack Nelson's voice, and the steamer "Berengaria" listened to it when it was 150 miles from Cherbourg, France. A fan on the Samoan Islands also tuned in on the famous station.

Jack Nelson tells another anecdote about the station. There was a Scotchman who had come up to the studio to sing songs about his native highlands. It was calculated that many a heart covered over with the feudal plaid would beat double time after hearing his voice, but when Jack announced that they were ready for him to take the microphone, it was found that he had disappeared. A great search started for him, and fans heard through their headsets: "Paging the Scotchman, paging for Scotch."

"Would you believe it," said Jack, "that not many minutes had passed before we had Scotch—five cases of it. But the saddest part of the story is that drinking liquor is against the rules of the studio, so we had to abstain. It might interest you to know that we created another record that night—that of closing the studio early."



Kadel & Herbert

THE SMALLEST LOUD SPEAKER

What is said to be the world's smallest loud speaker is shown in the photo. It weighs seven ounces and consists of a special type of loud speaking unit in a celluloid receptacle.

Eskimos Turn Radio "Fans"

When an interesting radio program is being received in their home, Eskimo children are just as hard to keep in bed as any other children.

Discovering this in an orphanage for Eskimo children at Teller, Alaska, the matron has reported that during a recent broadcast she found several of the girls out of bed with their ears to the floor just above the loud speaker, enjoying the program.

"We have thirty-six Eskimo children here," writes E. H. Dahl, manager of the orphanage. "You cannot imagine the pleasure we get from air programs. We live at Port Clarence, the only harbor on Seward Peninsula. Only ships going into the Arctic stop at our door. They get fresh water from our creek."

How *Radio Is Taming* Temperament In *Hollywood*

Practically every motion picture star of note in Hollywood is equipped with his or her radio set. The story tells how the movie directors made radio an ally instead of the foe it first threatened to be. Above, Viola Dana, popular movie actress, is tuning in between "shots" at her studio. In the oval "Baby Peggy" Montgomery is finding she can hear the bedtime songs better in close proximity to the loud speaker. Even at that, it's quite a lot of music for one youngster to handle.

LOS ANGELES.—The Movies, the scientific world's crowning achievement until the advent of radio, have at last realized the importance of radio as an aid in filming motion picture productions. Latest reports reveal that several prominent movie directors have taken up radio as one of the prime methods of "taming" stars who are inclined to be temperamental.

Not many months ago some movie stars thought it novel to install a radio set on the "lot" or in the dressing rooms while waiting to "shoot" a picture. This piqued the directors a bit, for they wanted their charges to pay strict attention to the business of making movies and not to what happened to be flitting about the ether at the moment.

But, as many of you know, some movie stars, and especially the highly paid, temperamental ones, like to have their own way. So the directors hit a stone wall when they tried to break down the instant approval won by efficient radio sets which enabled the movie workers to pick up messages at any time and place.

Turning the Tables

SO the directors decided to make the best of the radio craze and put it to work for them, instead of letting it serve as a means of promoting animosity between actor and director.

In other words, such directors as Cecil B. De Mille, James Cruze, Tom Forman, Eric Von Stroheim and Fred Niblo, all of whom enjoy flattering reputations here in California, installed high priced radio receivers on their production lots and used them to supply "temperamental music" for their equally temperamental stars.

Instead of hiring an expensive violinist or pianist to coax tears to the eyes of a heart-broken maiden, these directors let the radio do it. They even went to the extent of paying broadcasting stations to play certain numbers at certain times of the day, when they knew a certain high-priced star would be trying to "emote" for all she was worth.

When the emoting began, the broadcasting station was tuned in, with its "End of a Perfect Day," "Souvenir," "Just A' Wearyin' for You," and other sentimental pieces ready to start a natural flow of emotion.

Then, again, radio was found to be cheaper than orchestras in furnishing the incidental music so essential to big scenes of cafes, ballrooms, theatres, and the like. Why not let the radio jazz orchestra furnish the music for the movie dancers? These high-toned orchestras were getting too expensive, anyway. So the idea of letting radio orchestras furnish the jazz was born.

They All Like Radio

THE stars who rely on radio for "temperament" are as numerous as would be expected, what with a radio in nearly every home and hotel in Hollywood and Los Angeles. "Baby Peggy" Montgomery likes to cry to soft radio music, while Viola Dana believes a radio jazz orchestra makes dancing more fun than ever. Pola Negri was one of the first to be converted to radio music; and of all the temperamental stars, she's about the most particular.

Hal Roach, director of the "Our Gang" comedies, keeps his kids quiet (when such occasions are necessary,) by letting them listen to distant broadcast programs.

Pat O'Malley, a serial star, would rather listen to a radio while filming scenes out on the Californian deserts than hear a hundred Montmarte Cafe bands.

So you see radio and the movies are already united and ready for the time when they shall be merged into one by means of "radio movies."

The girls who have risen to fame since they licked the whole police force of Cicero, Ill., single-handed, are equally famous over the ether waves. Vivian and Rosetta Duncan, shown above, are better known as "Topsy and Eva" from the musical show of the same name. Twice a week from 7:30 to 8 p. m. they may be heard from KYW singing the syncopated lullabies that made them the favorites of thousands of radio fans. Incidentally, they won RADIO AGE'S first radio popularity contest for July and August.

Endearing TOPSY *and* EVA *to Radio*

INTRODUCING OUR FIRST RADIO SWEETHEARTS

THE girls who once snubbed Mrs. Vanderbilt, licked the whole police force of Cicero, Ill., and got more square inches of space in newspapers and publicity agents' hearts than anybody else ever did, are Vivian and Rosetta Duncan, well-known to radio fans.

Vivian and Rosetta, perhaps better known as "Topsy and Eva" from their show by that name now in Chicago, have their own broadcasting studio. It is located in the Garrick Building, Chicago, and is part of the suite of rooms occupied by their own music publishing house. In addition to their other accomplishments, they are composers, and their songs are sold by their own company. Many songs other than their own are also sold by the company, which is managed by John Conrad.

KYW, the Westinghouse radiophone in Chicago, broadcasts the Duncan Sisters through a special wire from their studio. They go on the air every Wednesday and Friday from 7:30 to 8 p. m., Chicago daylight saving time, and sing many hits from their famous musical comedy and songs composed by themselves.

Among these are "Tom Boy Blues," "Some Time Ago," "Stick In The Mud," "In Sweet Onion Time," "Moonlight and You," "Keep On Dancing," and "Topsy."

Just Like Real Thing

THEY usually come up to the studio with their stage make-up on, for the show starts right after they finish broadcasting. "Topsy," or Rosetta Duncan, comes all blacked up, in her disreputable costume as the famous character from "Uncle Tom's Cabin." Their play is a parody on Harriet Beecher Stowe's classic, and for getting laughs holds the world's record.

One night the Duncan Sisters were heartbroken. They had lost their pet dog. He was sired by the famous movie hound "Strongheart," and he had run away. His name was "Cicero," a lovable name, and they did like him so! In an attempt to get him back they broadcast an appeal to all radio listeners and a great search was started all over the country, which finally resulted in his recovery.

Of course, many people wondered about the request. Maybe "Cissie" was a good dog, and all that, but they wondered why on earth the girls should want anything back with that name. For all they remembered the incident which made the Cicero police force famous. Cicero is a suburb of Chicago, and one day when the girls were auto

(*Continued on page 53.*)

"Th' Top o' The Morning," Says Bill Hay

By JUDGE L. B. STINER
Ex-Mayor of Hastings, Neb.

"Guid Nicht Tae Ye All," the signing-off message of the announcer of Westinghouse Station KFKX, Hastings, Nebraska, is known by radio fans all over the continent.

W. G. Hay, called by his friends "Bill," was born in Scotland, coming to the United States when he was twenty-two years of age. His quaint Scotch accent is recognized in his conversation and enables him to acquaint the radio public with the peculiar sweetness and charm of that dialect.

Bill came to Hastings about four years ago, and is employed as treasurer and sales manager of the piano department of the Gaston Music & Furniture Company. Since the Westinghouse Electric Company opened their broadcasting station, KFKX, Bill has been the announcer, and with very few exceptions has announced all the programs over that station.

"A Reg'lar Guy!"

Bill is a real fellow. His friends here, including all the citizens of Hastings, are unanimous in their loyal support of Bill, and can vouch for his being an exemplary young man, sober, industrious and honest. He is a veritable dynamo of human action. Aside from the duties of his position, he is leader of the choir in the First Methodist Episcopal Church in this city, which is one of the largest choirs in the State of Nebraska; he is conductor of the Hastings Lyric Glee Club, a popular and well known organization of more than twenty Hastings business men who devote a great share of their time to the musical interests of the city; and has also a large class of voice students, and many of the programs have been made up by them.

W. G. Hay

"Bill" Hay, popular announcer from KFKX, Hastings, Nebraska, is the winner of the RADIO AGE radio favorite popularity contest for the month of September, leading all other candidates—announcers as well as entertainers, by a safe margin. Strange to say, just as many votes came from Bill's admirers in the East as those nearer KFKX in the West. The accompanying article tells all about Hastings' favorite son.

He has a splendid baritone voice, and whenever an artist scheduled to appear is unable to keep his engagement, Bill fills in, and the old Scotch melodies are now familiar to the radio public. He is also connected with various local activities, like the Chamber of Commerce, and he and his wife are constantly in demand at all social functions.

Aside from all of this, he finds time to arrange programs for KFKX, and to act as announcer, which takes a great deal of his time and energy.

He has become very popular with the radio public because his clear enunciation and pronunciation makes him easily understood under all conditions. His popularity as an announcer is proven by the hundreds of letters received daily by KFKX from all parts of the continent, and without exception these letters tell of the fine impression Bill makes as an announcer, and in the part he plays in the programs.

Bill has really but two fads, or inherited "vices," he is passionately fond of golf, and he is never seen without his trusty pipe.

Two Young Ladies—

Koehne Photo

Miss Elizabeth Berry

APPLAUSE CARDS for programs recently broadcast by RADIO AGE have been received from all parts of the country. Perhaps the best programs of all, judging from the response from fans, have come from Station WLS, operated by Sears, Roebuck and Co., from the Hotel Sherman, Chicago, and WTAY, the Oak Park, Ill., station of the Pioneer Publishing Co.

Early in July, RADIO AGE decided to broadcast once a week from WTAY, adhering strictly to technical talks. This policy continued for a while, and then it was decided to broadcast a feature program once a month or oftener. The first of these programs "took the air" from WTAY on July 25, and the latest and equally successful was broadcast Tuesday evening, September 9, from WLS, Chicago.

They're All Popular

The response has been instantaneous. RADIO AGE'S young lady vocalists, Miss Tillie Thorpe, Miss Elizabeth M. Berry and Miss Anna Leeb have been deluged with requests from stations at which they have already appeared, as well as from stations who "listened in" for possible talent. Miss Thorpe has been kept busy traveling from one microphone to another ever since her debut on July 25.

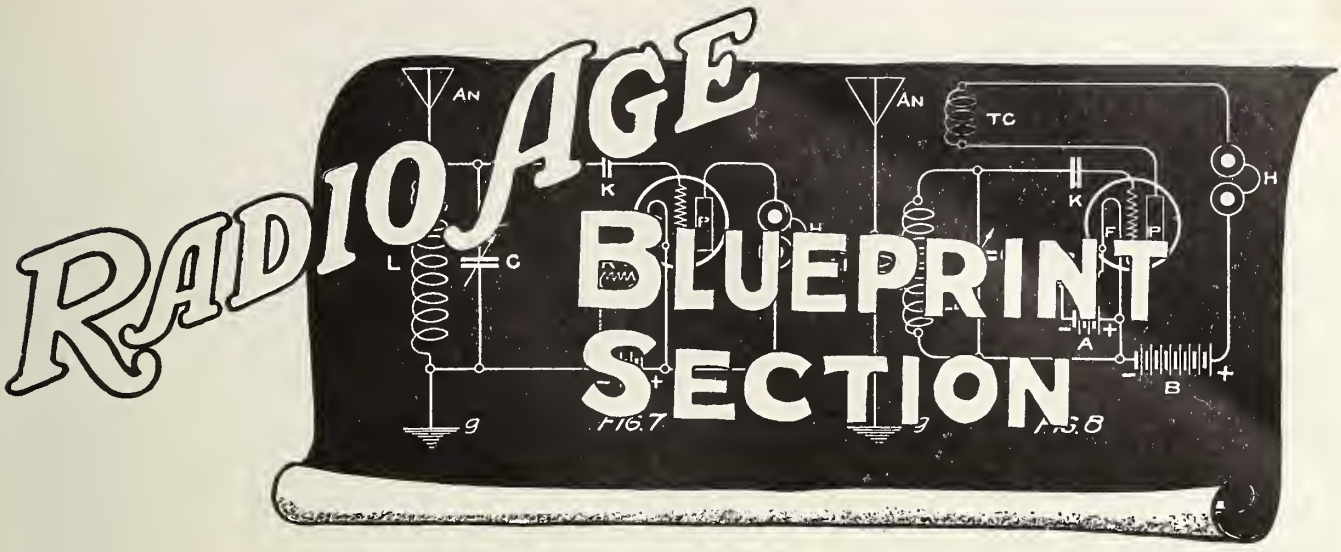
Arthur W. Hickman, a baritone of note who has had considerable experience as a church soloist in Evanston, Ill., has captured many feminine hearts with his inimitable singing of such sentimental pieces as "At Dawning." He has been accompanied at WTAY by Miss Helen Rauh and at WLS by Glen Rowell, one of the famed "How do You Do?" boys.

RADIO AGE wishes publicly to thank WLS and WTAY for the courtesies extended its artists.

—You Should Know

Photo by Drake Studio

Miss Helen Rauh



Selectivity and Tone With

A Three-Tube Neutrodyne

By JOHN B. RATHBUN

PROBABLY the most popular multi-tube circuit of the present time is the tuned radio frequency type, of which the neutrodyne is the most prominent example. In fact, the neutrodyne was one of the first radio receivers employing more than three tubes which became popular with the broadcast listener and therefore stands alone as being the representative long range circuit, at least in the minds of the average home builder. This popularity led to the development of a long series of "dynes" which bear more or less resemblance to the original neutrodyne and all of which are members of the tuned radio frequency family.

Tuned RF Arguments

In a tuned radio frequency circuit the distinguishing feature is the employment of tuned transformers (air core type) in the radio frequency stages. Each radio frequency transformer is individually tuned to wave length by means of a variable condenser connected across the secondary coil and by this means the maximum amplification or "peak" is obtained on all wavelengths within the range of the condenser and coils. Further, the tuning of the independent stages very greatly increases the selectivity, since each transformer is an additional tuning coupler which augments and corrects the selectivity of the first antenna coupler. With two stages of radio frequency amplification, we have three tuning controls, the antenna coupler condenser and the two variable condensers used in connection with the two radio transformers. Should the wave of an undesired station succeed in passing the antenna coupler, it will be eliminated in either the first or second transformer of the succeeding tuned radio transformers.

Because of the condenser effect between the grid and plate of the tube,

Clear Tone Assured by a Crystal Detector

we cannot attain maximum amplification in the radio stages unless the feedback through this capacity is offset by some external device. Starting from the antenna end of the circuit, we find that some of the radio energy will feed straight through the internal capacity of the tube without any amplification. Starting at the output or plate end of the radio stages we can see that some of the plate current is fed back to the antenna through the tube capacity and thus produces regeneration with its annoying noises and re-radiations from the aerial. When regeneration in the radio stages occurs in this way, we cannot carry the electron emission to the point required without also producing troublesome audio oscillations or squealing, and this of course limits the possible amplification.

MANY AMATEURS who have wished to work the neutrodyne circuit have been held back by the expense of the usual five tube standard set. It is for this reason that the writer has worked out a three tube neutrodyne which will give many of the advantages of the more elaborate circuit with only a slightly reduced output and range. A crystal detector is substituted for the more usual detector tube and only one stage of audio frequency amplification is employed, thus doing away with two of the tubes.

Fig. 1 is a picture diagram of the three tube neutrodyne, where it will be seen that we have two radio frequency stages, a crystal detector, and one audio stage. This will insure very good distance reception and loud speaker volume on all but the more distant stations. The crystal avoids the noises of the detector tube, thus giving a very pure natural tone that is unapproached by the standard five tube set. Further, when properly adjusted it will not squeal nor howl under any tuning conditions.

All Tubes Amplify

In Fig. 1 the two radio frequency tubes are at (T1) and (T2), the crystal detector is at (CD), and the audio tube at (T3). All tube filaments are controlled by the single rheostat (R), the resistance of which depends upon the type of tubes used, and as this carries the current for all tubes the resistance must be somewhat lower than when a single rheostat is used for each tube. It must be borne in mind that all of the tubes are amplifiers such as the UV-201A, C-301A, UV-199 or C-299 and that soft detector tubes will not give the necessary amplification.

(Continued on Page 40)

HOW TO USE RADIO AGE BLUEPRINTS

The blueprints printed in this section are so arranged as to form a complete unit with the explanatory articles when desired by the reader. For example, the center sheet consisting of pages 35, 36, 37 and 38 contains two blueprints and two pages about the Midget Reflex. Just follow this four-page sheet at the center and you will have a complete section to follow when you make the "Midget." Likewise the second center sheet, which also can be followed as one unit, is devoted to the three tube neutrodyne. The blueprints for this hookup are on pages 34 and 39, and the article on pages 33 and 40.

Blueprints appearing in future issues will be arranged in the same manner. —The Editors.

Blueprints for the Three-Tube Neutrodyne on Pages 34 and 39.

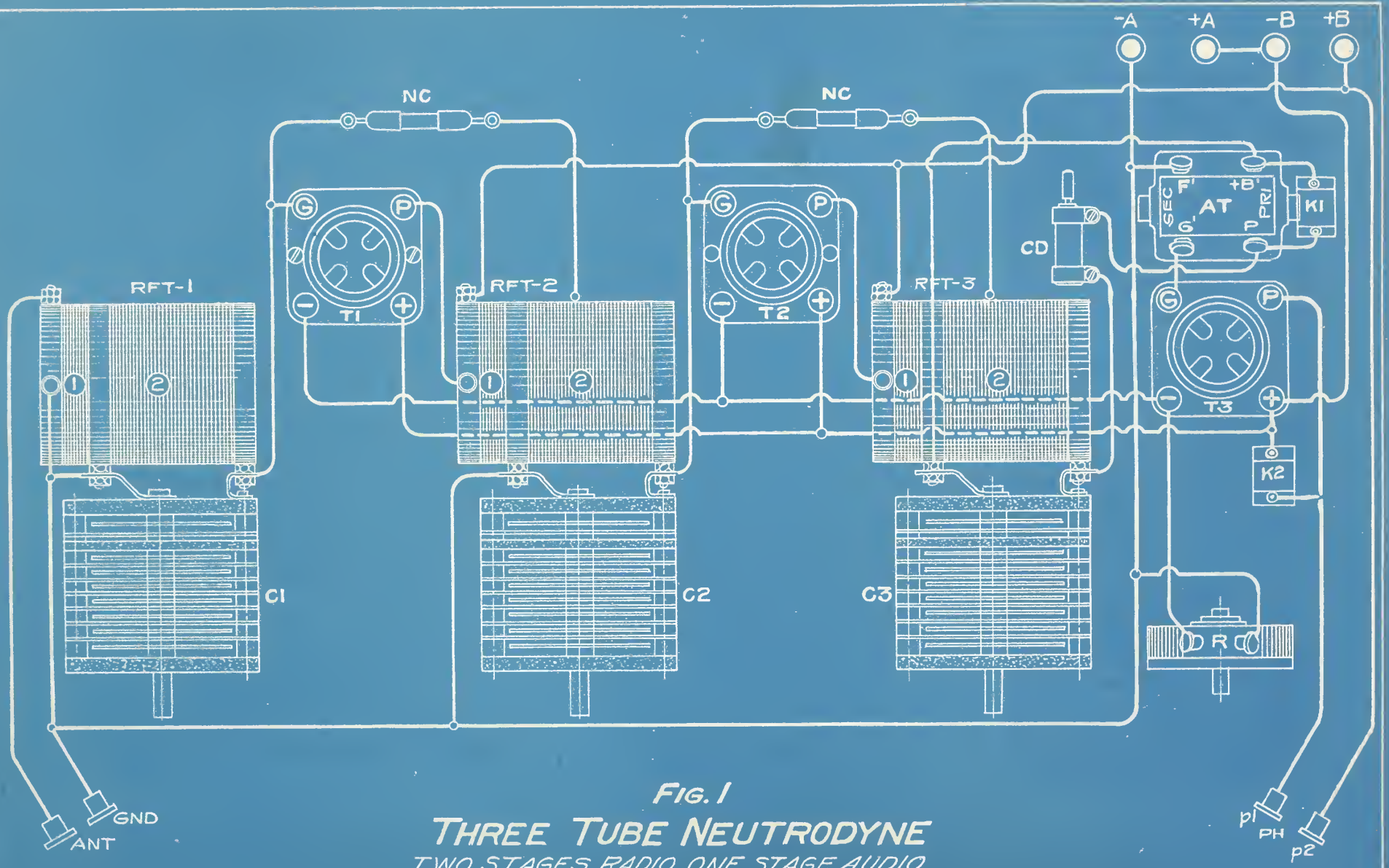


FIG. 1

THREE TUBE NEUTRODYNE

TWO STAGES RADIO, ONE STAGE AUDIO

J. B. RATHBUN
ND-204

Getting Tube Economy With

A One Control Midget Reflex

By JOHN B. RATHBUN

A Novel Hookup that Employs One Tube as a High and Low Frequency Amplifier

IT HAS been the constant endeavor of the writer to simplify the radio receiver to the point where maximum reception could be attained with a minimum of material and wiring and with the fewest possible controls.

Not only is such a receiver more practicable from the standpoint of the home builder, but it is also easier to handle and less likely to develop those annoying "bugs" which are so difficult for the novice to discover and remedy. The nearer we approach a parallel to Henry Ford's "Tin Lizzie" idea, the nearer we will come to developing the ideal all-round receiver.

Powell Crosley of The Crosley Radio Corporation has pursued this idea for years with great success and has long been acknowledged the "Ford of Radio."

Wiring complications in a circuit form the most objectionable feature of construction to the beginner and the first step in simplification should be made in reducing the number of wires. Nearly any circuit can be simplified without changing the performance, by proper arrangement of the parts, or by constructing the set so that the cabinet or supporting members are made a part of the circuit, thus doing away with the corresponding number of wires.

Thus, by using a metal cabinet instead of the more usual wood enclosure, we can make the metal cabinet take the place of all grounded connections and do away with a number of wires. At the same time the metal cabinet acts as a shield against body capacity effect and is of assistance in tuning. By similar expedients, arrived at by careful consideration before starting construction, we can make surprising economies in construction.

Simple But Efficient

FORTUNATELY, circuit simplification generally means increased effectiveness and better performance, for the smaller number of wires decrease the energy losses in the circuit, thus making the receiver more sensitive than a similar circuit with longer and more complicated wires. For a given energy input; that is, battery energy, the simpler set will show greater sensitivity and selectivity.

Probably the simplest regenerative circuits are the single circuit Ultra-Audion and the three circuit "Wizard." Both are highly efficient, cheap and easy to build, and simple to tune, and the more complicated regenerative circuits using variometers and other tuning elements have little on them except for tone quality. While regeneratives employing two or more tuning controls can be brought more closely into a condition of resonance than the Ultra-Audion type, yet the electrical losses due to the wiring are so much greater that the Ultra-Audion puts up a better performance than would be imagined from a purely theoretical standpoint.

When greater volume is required for loud speaker operation or for the amplification of weak distant stations, one or more "Audio Amplification Stages" are added behind the detector tube of the regenerative set. This increases the volume but does not materially increase the range or receiving distance.

For greater distances, or when a loop aerial is to be used in place of an outdoor aerial, we must increase the sensitivity of the set by the addition of "Radio Frequency Stages" in front of the detector tube. While R. F. amplification does not necessarily increase the volume of the signals, yet it "magnifies" the weak impulses on the aerial so that the detector tube can work on them. Adding both radio and audio amplification gives both increased distance and volume, but of course enormously increases the amount of electrical energy that must be supplied by the battery to the tubes. Tube for tube, the single tube regenerative set is more efficient in the use of current for a given result than a set having many radio and audio stages.

For marked improvement in the results, at least two stages of radio and two stages of audio amplification must be used in addition to the detector tube. Hence, when each tube is used for a single definite purpose only, we have five tubes to which we must supply filament and plate current. We now have not only an increased demand for current, but also the additional expense of the five tubes, the transformers and sockets for these stages, and a tremendous increase in the number of wires. Such a combination is not to be thought of with a "flivver" set, and if we are to obtain the equivalent of radio and audio amplification with a few tubes we must apply some other principle than outlined above.

Reflex Permits Economy

FORTUNATELY, the "Reflex" system affords a means of attaining tube economy when amplification is to be employed in addition to the usual detector function. In this type of circuit each tube acts both as a radio and audio amplifying stage, while a crystal is employed as the detector or rectifying agent. Theoretically, only half the number of tubes will be required in a reflex system for a given amplification, compared with the circuits in which each tube is used for a single purpose. The impulses from the aerial at radio frequency first go through the tubes, and then after this current is amplified, a second trip is made through the tubes for amplification at audio frequency. Only one tube would therefore be required for one stage of radio and one stage of audio amplification.

It is because of this tube economy and other resulting economies that the reflex principle has been adopted for the "flivver" radio set to be described in this article. While this is a single tube set, yet it gives results which are very nearly equivalent to more elaborate sets, arranged in the ordinary manner. A crystal detector takes the place of a detector tube and leaves the tube free for amplifying. A loud speaker can be used with local stations and in some cases the speaker has been operated with fair volume on stations 200 miles distant. The radio amplification increases the range considerably over that attained by the usual single tube regenerative while the audio amplification makes a marked improvement in the volume.

For a time I considered adopting a conventional reflex circuit, somewhat similar to the "99" circuit described in the August issue of RADIO AGE, but on further thought, it seemed possible to do away with the radio frequency transformer and hence with an additional control. Finally this saving was worked out satisfactorily. Actually, we still have a radio frequency transformer in effect, but as the fixed coupler now acts in a dual role, the expense and trouble of the independent transformer is done away with in this circuit. The wiring is simplified and we have an improvement in all around performance. Basically, this is the same thing as the "Wizard" to which a stage or radio and a stage of audio are added by the simple installation of an audio frequency transformer and a crystal detector.

Only One Control

FIG. 1 shows the simplicity of this circuit where the only tuning control is the variable condenser (C1). This is a 23 plate (0.0005 mf) vernier condenser of the standard type. The fixed coupler (L1-L2) not only acts as a tuning inductance but also as a radio frequency transformer in which the coil (L1) is the primary and coil (L2) is the secondary. Here we have a part which performs two distinct functions in the circuit and saves us from $3.00 to $5.00 in the construction of the set. The fixed coupler is attached to the variable condenser (C1)

(Continued on page 38.)

Blueprints of the Midget Reflex on Two Pages Following.

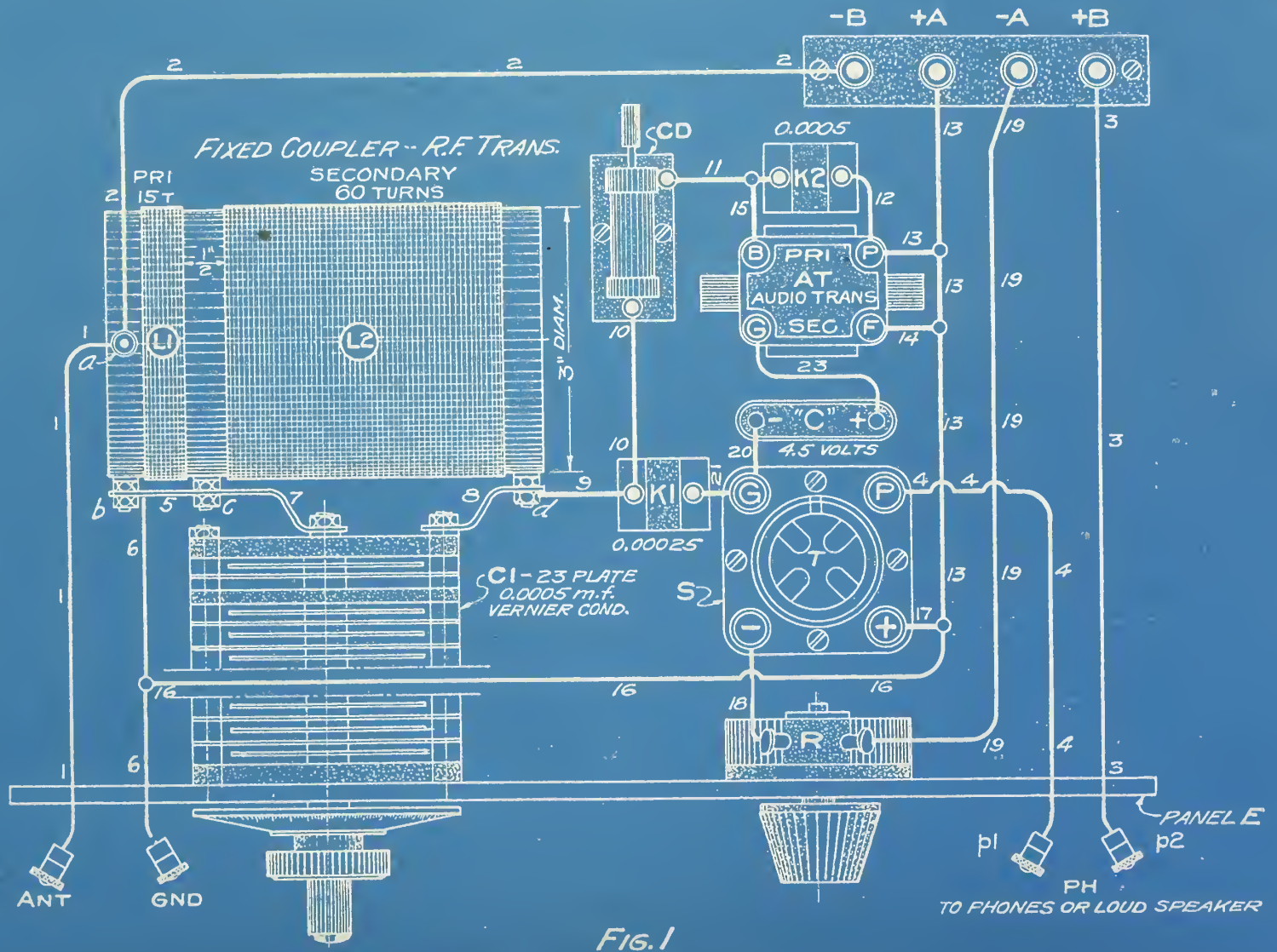


FIG. 1

MIDGET REFLEX SET

(WITHOUT RADIO FREQ. TRANSFORMERS)

WIRING DIAGRAM (PLAN VIEW ABOVE)

PATENTS PENDING

J.B. RATHBUN
RFX-112

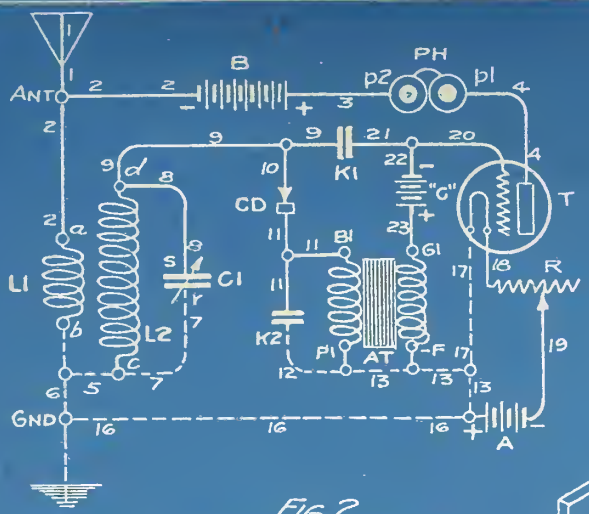


FIG. 2
SCHEMATIC DIAGRAM

NOTE!
USE ONLY A HARD AMPLIFIER TUBE SUCH AS THE UV-201A, C-301A, UV-199, C-299. SOFT DETECTOR TUBES WILL NOT FUNCTION
AUDIO TRANSFORMER (AT) RATIO IS BEST AT 5 TO 1, BUT OTHER RATIOS CAN BE USED IF DESIRED.
PLATE VOLTAGE ("B" BATTERY) TO BE FROM 67.5 TO 90 VOLTS, APPLIED BETWEEN +B AND -B.

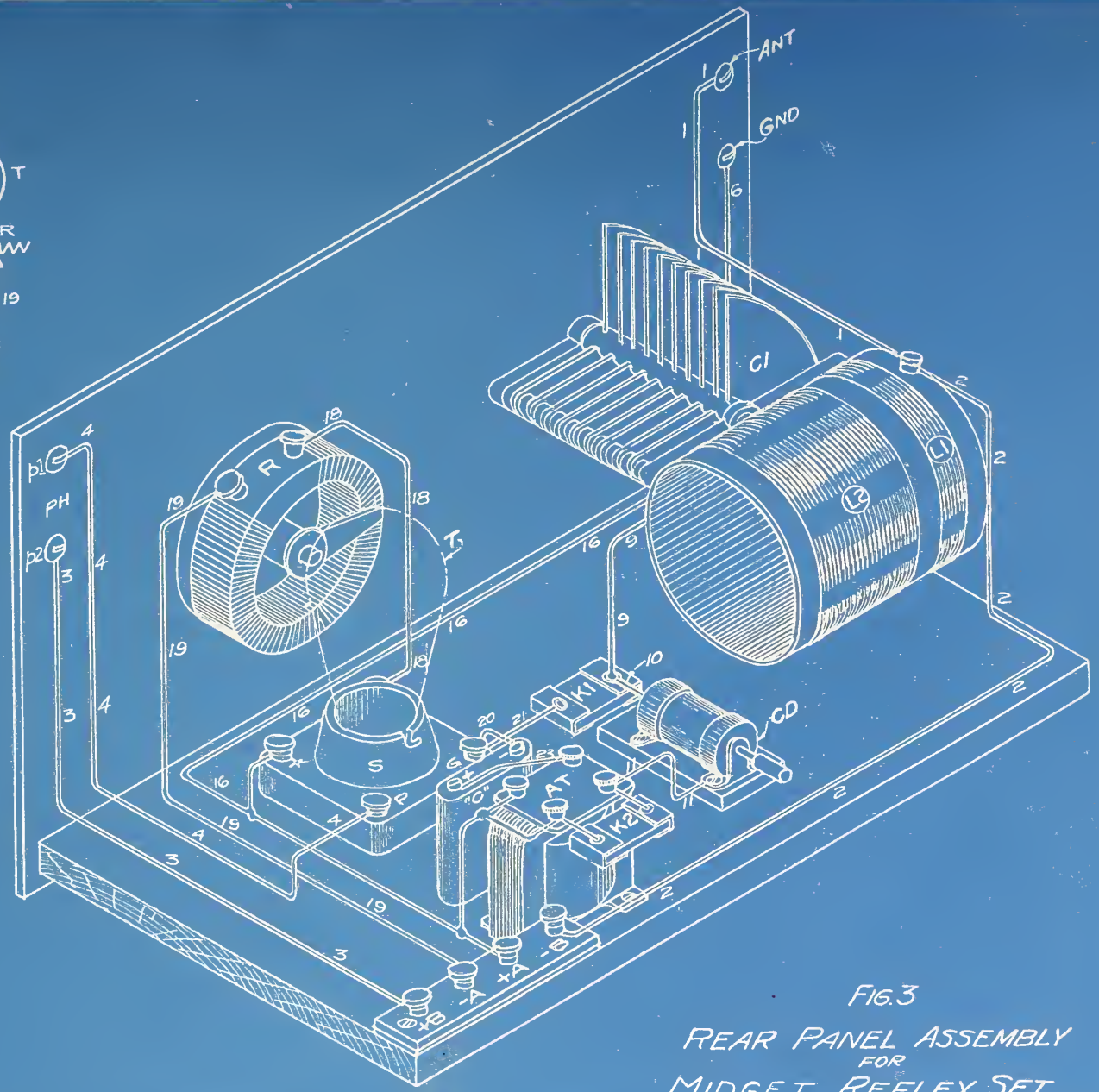


FIG. 3
REAR PANEL ASSEMBLY
FOR
MIDGET REFLEX SET

J.B. RATHBUN
RFX-112

A Midget Reflex Set

(Continued from page 35)

by means of the sheet brass brackets (7) and (8). For those used to reading electrical diagrams, the functioning of the circuit is clearly shown by the conventional diagram of Fig. 2, and as both Figs. 1 and 2 have the same lettering, the relation is easily followed.

Both the primary (L1) and the secondary (L2) are wound on the same 3" cardboard or bakelite tube and are separated from each other by 1-2" to 5-8" as shown. The primary contains 15 turns and the secondary (L2) has 60 turns, giving a ratio of four to one. If No. 26 double silk covered wire is used, the length of the tube will be about four inches. The diameter is three inches.

At (CD) we have the crystal detector.

However, we caution you not to use a common galena crystal, as this burns out quickly and does not stay in adjustment for any length of time owing to the heavy current passing through it. This detector crystal takes the place of one tube and of course requires no current.

An audio frequency transformer (AT) is used for the audio phase of the circuit, and connections must be made to the four binding posts (B-P-F-G) as shown. The fixed condenser (K2) bypasses the radio frequency component around the primary coil of the transformer. The capacity of this condenser may range from 0.0005 mf to 0.001 mf.

The fixed grid condenser (K1) is a 0.00025 mf condenser used as a stop in the grid line. The secondary (G-F) coil of the transformer acts like a leak so that an additional grid leak is not necessary. A 4.5 volt (3 cell) "C" battery is placed in series with the secondary of the transformer with its negative pole (-) toward the grid (G) of the tube as shown. This battery is effective in increasing the volume and quality of the audio component, and while it can be omitted if desired yet it adds considerably to the amplification and hence is highly desirable. Either a flashlight or standard "C" battery can be used.

A hard amplifying tube (T) must be used, such as the UV-201A, C-301A, UV-199 or C-299. This is carried in the socket (S) and is controlled by the filament rheostat (R). The resistance of (R) depends upon the type of tube and voltage of the battery. For the UV-201A and C-301A the resistance should be from 15 to 20 ohms. For the UV-199 and C-299 a resistance of from 30 to 40 ohms will be necessary. The "B" battery voltage will range from 67.5 to 90 volts for the maximum volume. The amplification at 67.5 volts is nearly as great as at 90 volts and the lower voltage is not so noisy.

Get Correct Polarity

THE head phones or loud speaker (PH) are connected at the posts (p1-p2) at the front and right of the panel (E). At the left of the panel are the antenna (Ant) and the ground posts (Gnd) respectively. The four battery posts are mounted at the rear of the set on a small piece of bakelite,—where great care must be used in connecting up the batteries so that the polarity will be exactly as shown. The plate or "B" battery is is connected to the posts (+B) and (−B) while the "A" or filament battery is connected to (+A) and (−A).

By examining Fig. 2 we see that the primary (L1) of the coupler is of the aperiodic type and carries both the impulses from the aerial and the amplified plate current. It is necessary to tune only the secondary (L2) by the variable condenser (C1). It will be seen that we tune both the grid and plate currents simultaneously by means of a single condenser. This arrangement eliminates the necessity of the two independent condensers used in the "99" Reflex and attains exactly the same results with less complication. The weak impulses from the aerial induce currents in the secondary (L2) which act on the grid of the tube through the stopping condenser (K1) Amplification takes place in the tube and the amplified plate current returns through the leads (2-2) to the primary coil (L1). The plate current now induces stronger currents in the secondary (L2) which augment those already received from the aerial, so had we have the amplified current at radio frequency, which acts on the primary (B-P) of the audio transformer (AT).

Before passing the primary of the audio transformer (AT) the current is rectified and reduced to audio frequency by the crystal detector (CD). Through (AT) the audio current acts on the grid (G) to produce audio frequency amplification in the tubes. By lifting the cat whisker off the crystal (CD) we have a straight regenerative circuit of the "Wizard" type. As soon as the cat-whisker is replaced, we have a reflex circuit and two stages of amplification.

An outdoor aerial of from 50 to 60 feet in length will prove most satisfactory for this receiver. A longer aerial will do little more toward bringing in the stations and does reduce the selectivity to such a point that it is difficult to separate stations which are operating on nearly the same wavelength. The circuit under proper conditions tunes very sharply, and is highly selective for a single control set. In regard to selectivity remember that it is seldom possible to get as close tuning with a single control as with a properly designed radio frequency set with two or three controls. However, this factor will be perfectly satisfactory under ordinary conditions with the circuit shown and is fully as selective as a large number of the more complicated sets of the regenerative or reflex types.

If the set is not properly selective on the first trial, or if the signals are weak, it may be that the primary and secondary coils (L1) and (L2) are "bucking" each other. Try the effect of reversing the ground and aerial connections at (Ant) and (Gnd); that is, connect the aerial to the ground post and the ground wire to the aerial post. If this gives no improvement, it may be that the audio transformer connections are reversed. Next try the effect of reversing the secondary winding of (AT) by connecting (G1) to the return wire (13) and the post (F1) to the positive (+) side of the (C) battery. If the audio transformer happens to be connected in such a way that the windings of (AT) oppose the windings of the coupler (L1-L2), then we will have weakened reception or even no reception at all.

Eliminating Capacities

TO ELIMINATE body capacity, the stator or stationary plates of the condenser (C) should be connected to the terminal (d) and the grid line marked (9). The rotatable plates or rotor of the condenser should be connected to (c) and (5) as shown. This is important, and on the diagram Fig. 2 the condenser stator is indicated by (S) while the totor is shown by (r).

A sheet metal cabinet or sheet metal panel (E) can be used providing certain precautions are observed. This arrangement is sometimes desirable as it shields the set against the effects of body capacity and local interference. Again, the wiring is simplified as all of the grounded connections can be made directly to the metal cabinet. While the metal cabinet is not recommended for the beginner, owing to his lack of knowledge regarding proper insulation, yet a metal shielded set will give remarkable results when built by an experienced amateur.

At points where the connections are not grounded to the cabinet, as at (Ant), (p1) and (p2), the wires and binding posts should be carried by large rubber or bakelite washers (not fiber) which afford positive insulation. Paper or fiber are not suitable as they absorb moisture. The holes in the tin walls should be considerably larger than the screws of the binding posts, say 1-2" in diameter at least. If the holes are not large or if the insulation is not perfect at this point, there will be a loss of current and volume. Secondly, the coupler (L1-L2) should be kept at least one inch away from the tin sides of the box and preferably two inches away from the ends of the coil.

In Fig. 2 all of the grounded connections or parts of the circuit formed by the metal cabinet are shown by dotted lines, and it will be seen that this grounding arrangement does away with many wires. For sets to be built on a production basis this is a very good scheme, as assembly is simplified and the cost of labor much reduced.

Fig. 3 is an isometric view of the assembly showing the relative arrangement of the parts when viewed from the rear of the panel. All parts are lettered and numbered to correspond with the lettering and numbering of the parts and wires in the two diagrams. As several of the wires are concealed in the isometric view, it is a good plan to use the diagram in Fig. 1 when making the actual connections and in laying out the wiring.

Another set of original blueprint hook-ups in November RADIO AGE.

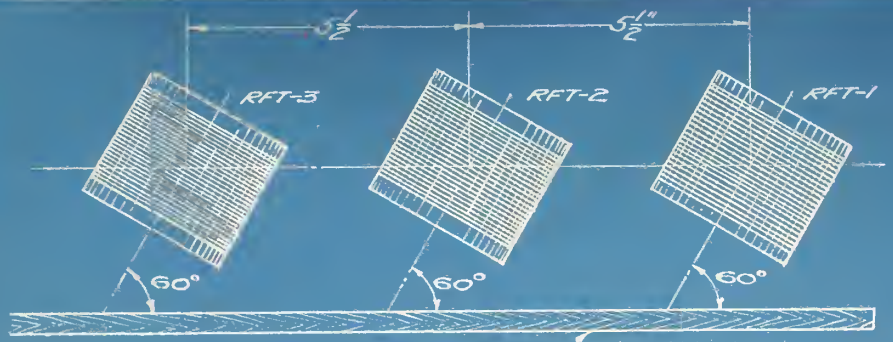


FIG. 2

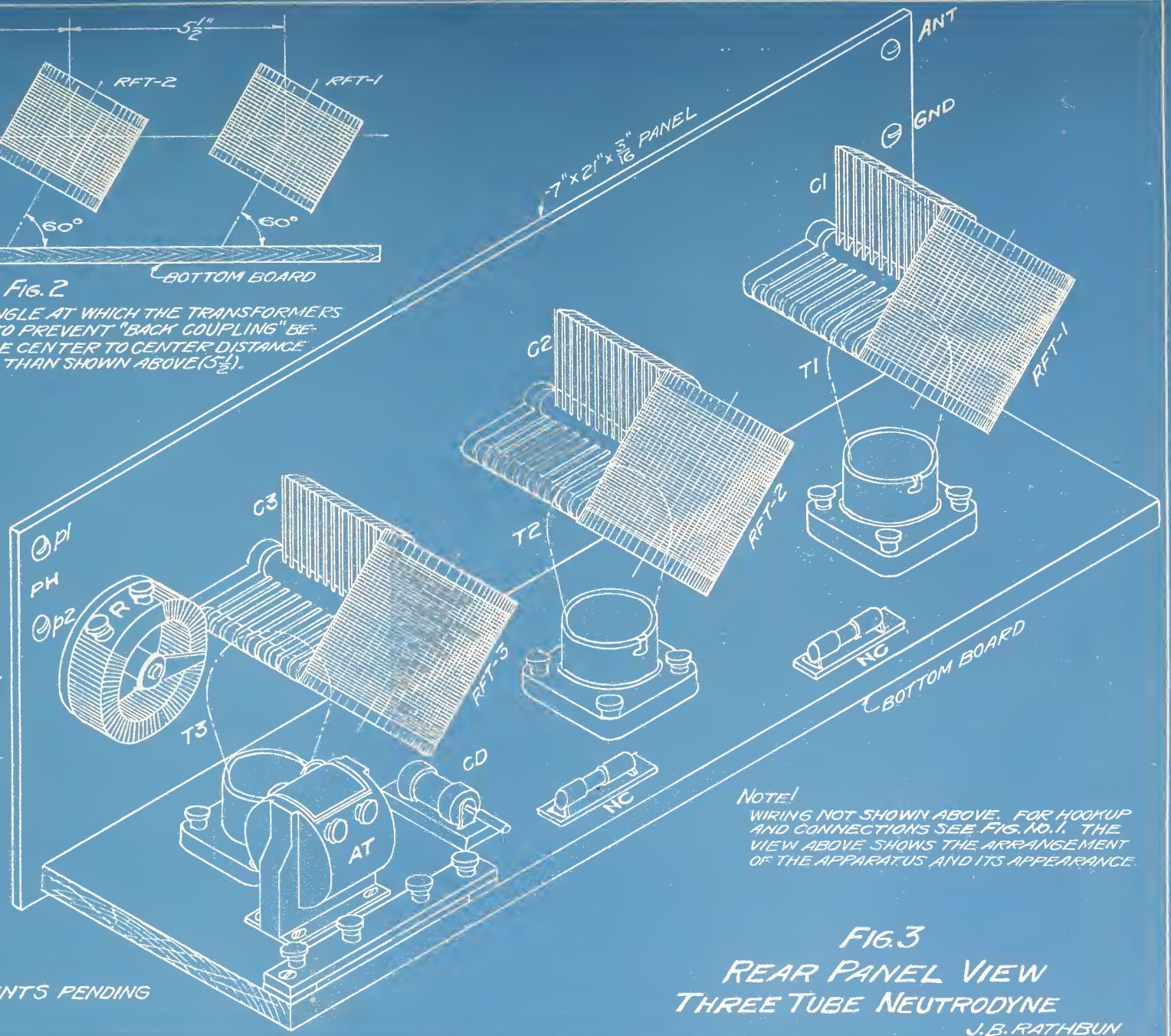
SHOWING THE ANGLE AT WHICH THE TRANSFORMERS MUST BE TURNED TO PREVENT "BACK COUPLING" BETWEEN STAGES. THE CENTER TO CENTER DISTANCE MUST NOT BE LESS THAN SHOWN ABOVE ($5\frac{1}{2}$").

NOTE!

USE ONLY HARD AMPLIFYING TUBES FOR THIS RECEIVER, SUCH AS THE UV-201A, OR THE UV-199.

PROPER AMPLIFICATION REQUIRES FULL 90 VOLTS ON OF "B" BATTERY ON THE PLT. OF TUBES.

KEEP TUBES AND SOCKETS WELL BACK OF TRANSFORMERS AS SHOWN TO PREVENT BACK COUPLING.



NOTE!

WIRING NOT SHOWN ABOVE. FOR HOOKUP AND CONNECTIONS SEE FIG. NO. 1. THE VIEW ABOVE SHOWS THE ARRANGEMENT OF THE APPARATUS AND ITS APPEARANCE.

FIG. 3

REAR PANEL VIEW

THREE TUBE NEUTRODYNE

J. B. RATHBUN

A Simple But Effective Neutrodyne

(Continued from page 33)

In the aerial circuit (ANT) we have the fixed coupler (RFT-1) with the aperiodic primary coil (1) and the secondary coil (2). The secondary (2) is tuned to wavelength by the variable condenser (C1) while the lower end of the primary (1) is grounded to the ground post (GND) and to the (-A) line. The plate output of tube (T1) is fed into the primary coil (1) of the radio frequency transformer (RFT-2) where it induces a current of higher voltage in the secondary coil (2) of RFT-2. The *outer end* of the secondary (2) is connected to the grid of the second tube (T2) where the next radio amplification takes place. The secondary of (RFT-2) is tuned to wavelength by the variable condenser (C2) which is the second control. In the same way, the output of the tube (T2) is fed into the crystal detector circuit (CD) by means of the third radio transformer (RFT-3). The crystal detector (CD) rectifies the radio current into the modulated audio frequency current.

ALL THREE units (RFT-1), (RFT-2) and (RFT-3) are standard air core radio frequency transformers commonly known as standard "Neutrodyne Transformers," and it is far better to buy these transformers ready made than to attempt making them at home. Unless properly made, such transformers will greatly reduce the effectiveness of the circuit and cause trouble in tuning. In the diagram of Fig. 1, the transformers are shown laid flat down in a horizontal position so that the connections can be more easily seen, but actually they are tilted up at an angle of about 60 degrees with the horizontal so that there will be no coupling between the adjacent stages. It is of the greatest importance that we avoid having the magnetic flux from one transformer feedback into the following transformer, hence, the arrangement must be made as in Fig. 2 where the transformers are shown tilted up at an angle of 60 degrees with the baseboard.

As shown by Fig. 3, the center to center spacing between the transformers and condensers is 5 1-2", and the transformers should not be closer than this if maximum results are to be obtained. With this spacing we can get the apparatus on a 7x18" panel without difficulty but if we consider adding a second stage of audio in the future it would be better to use a 7x21" or 7x24" panel.

Returning to Fig. 1, we see the neutralizing condensers (NC) used for neutralizing the internal capacity of the tubes. At one end they are connected to the grids (G) of the tubes while at the other end a connection is made to an intermediate tap in the secondary of the transformers. By adjusting these condensers (NC) we can completely offset the internal capacity so that maximum amplification is attained. The neutralizing condensers (NC) should be purchased ready made, and as they can be obtained at a comparatively low cost we will not enter into their construction.

Tuning Condensers

The secondary tuning condensers (C1), (C2), (C3), should be a reliable make of variable condenser. Plain condensers are used and verniers are not necessary. The majority of the commercial neutrodyne transformers on the market require a condenser having a maximum capacity of 0.00035 mf or what is commonly known as a 17 plate condenser. Usually, a 23 plate condenser is too large for this purpose, and makes the tuning unnecessarily critical and difficult. The condensers can be connected to the transformer secondaries by the brackets shown or else by wires when the transformers are of the type which are fastened to the floor.

USE THE ORIGINAL RADIO AGE BLUEPRINTS

On Pages 34 and 39 to Make This Three Tube Neutrodyne.

Another Group of Unrivaled Blueprints in November RADIO AGE.

In connecting the condensers to the secondary coil of the transformers we should take particular care to have the stater or stationary plates connected to the wire which runs to the grid of the tube, as shown in the diagram. The rotor or movable plates should be connected to (-A) and ground. If this is not followed out, then we will be sure to have trouble with body capacity. The outside turn of the secondary coil (to the right), the stator of the condenser and the grid wire must be connected together for the best results. This is clearly shown in the diagram and should be followed out carefully by the builder.

Any Ratio Possible

At (AT) we have the usual iron core audio frequency transformer for the audio stage. Almost any ratio can be used with slightly varying results. With a ratio of 3-1 or 5-1 we obtain very clear amplification with a slight decrease in volume. With a 10-1 ratio we have a somewhat greater amplification but with slightly increased distortion. A ratio of 5-1 probably is the best compromise but this is not exactly the case with all makes of transformers. In any case there will be less distortion and noise with a crystal detector circuit than when a detector tube is used, and therefore we can probably use a higher ratio with this circuit than would be permissible with a circuit employing a detector tube.

A 0.001 mf. fixed condenser (K1) is connected across the primary (P'-B') of the transformer to bypass the radio frequency component. No jacks are used for the detector and final stages, since they introduce complications into the circuit. We have only three tubes and the small additional current taken by the final tube doesn't make it practical to introduce jacks at this point. A fixed bypass condenser (K2) bypasses the radio current across the phones and "B" battery. The value of this condenser is not critical and may range from 0.0025 mf. to 0.006 mf.

Battery and Voltages

TO produce the maximum range and volume, we will require a 90 volt "B" battery for supplying the plate current. This is connected between the (-B) and (+B) battery binding posts. The audio amplification will be made somewhat greater if we introduce a 4.5 volt "C" battery between the secondary transformer post (G') and the grid (G) of the tube (T3). Full details of this arrangement were shown on Data sheets JJ-9-25 and JJ-9-26 of the September RADIO AGE. The installation in Fig. 1 of data sheet JJ-9-26 shows the installation exactly as it would be made. Be sure that the negative (-) post is connected to the (G) post of the socket.

After the circuit has been wired up according to the diagram in Fig. 1, with the apparatus located as in the isometric view of Fig. 3, we can connect the batteries, insert the tubes, and then make the neutralizing adjustments. With the tubes lighted up to normal brilliancy we can tune in some local station by means of the variable condensers until we obtain maximum volume. Now note the position of the dials on the condensers, and after loosening the dial, set the screws and turn them until the same number on each dial comes exactly opposite to its stationary pointer. This will save much time in tuning, as we are now able to get all three condensers in exact agreement by turning to the same number on each dial.

With everything running at full pitch, remove the first radio tube (T1) from its socket and place a piece of paper across the "A" battery contacts so that the tube will not light when replaced in the socket. With this tube in place, but not lighted, see if you still hear the local station with the rest of the tubes at normal brilliancy. If you do, then adjust the first neutralizing condenser (NC) until you can no longer hear the signals. With this accomplished, take tube (T2) out of its socket, place a piece of paper across the battery springs as before, so that the filament of tube (T2) will not light. With the other tubes burning, try again to see if any signals are being heard through the capacity of the dead tube. If signals are still heard with (T2) dark, adjust the second neutralizing condenser (NC) until signals cease or are reduced to a minimum.

The set is now only partly neutralized at best and further adjustments of the neutralizers (NC) will probably be necessary until the best tone and volume, and the best all around reception is had. There should be no squealing or howling and the "tweet-tweet" of the carrier wave should be very faint when tuning into a station.

Watch for a new Rathbun hookup in November RADIO AGE.

RADIOTORIALS

THE CANDIDATES who can convince the radio voters are the ones who will win," is the universal prediction of campaign managers on the eve of nation-wide elections, at which a President, governors and representatives will be chosen by the people.

They are not far from the truth. The exit of blah in the political life of the American people can be largely attributed to the influence of radio and the promotion of clean politics that it has effected. All three of the leading candidates for the Presidency of the United States have acknowledged the importance radio will play in the days preceding election day. No greater tribute to radio's importance as a national necessity could be paid.

American citizens do not need to be reminded that they are tired of the misleading power of the spoken word as it comes from the not too trustworthy mouths of unscrupulous politicians. Too often have ignorant voters been swayed to the wrong cause because they believed oratory, gestures and personalities, instead of the facts they should convey.

Radio has opened a new era in politics, for it puts its stress on the spoken word alone and not the gesticulations that accompany it. Some politicians would be apt to disregard radio as a campaign aid for this reason alone—but the convincing argument of "But look at the millions of people you can reach through radio," makes up for the lack of vision. No candidate for public office is going to pass up a chance to be heard by everyone, illiterate or learned—whom he could never possibly reach by the printed word or personal contact.

So the campaign which is now rounding into its final weeks will be a campaign of issues, and *facts*, and not of personalities. It will be a campaign of *truth*, because truth alone will stand up after all the tinsel of oratory and deception has been removed. The unseen listeners will turn their dials and listen in, and no politician or over-confident candidate, no matter what his telepathic powers, will be able to tell what those countless voters are thinking of until the polls have closed and the ballots counted.

Politics is just one of the many ways radio is being used to *serve* the people. Government watchfulness will prevent its being used as a political tool for selfish propagandists. An instrument of national good such as radio is becoming cannot afford to become the chattel of one man. Radio must remain as it is today—a medium through which public opinion may run freely, be dissected and digested wisely by the voting public. Then radio will have attained its maximum of efficiency; it will have become the world's greatest means of entertainment as well as a nation's safeguard against an illiterate and misinformed body of citizens.

While on the subject of political campaigns, it may be well to remind radio voters that they look up the position of their candidates as they stand on radio issues, before deciding to vote one way or the other. This pertains especially to candidates for governor, state and national representatives and senators, who will be called upon this Winter to decide issues affecting the future of radio in this country.

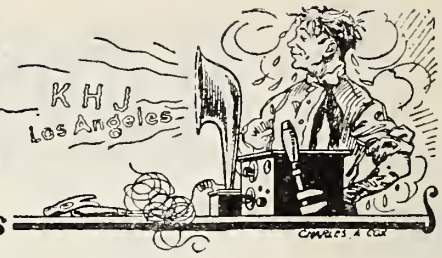
AFTER studying radio conditions in foreign lands, and particularly in the countries of Western Europe, it is only natural that we lean back and sigh with a relief possible only to an American citizen who is proud of his own country. Other nations may boast of the heights they have reached with radio, but none can approach anywhere near the dizzy altitudes reached by this miraculous industry in America. But most of all, disregarding commercial and inventive arguments, the outstanding reason for pride in American radio conditions lies in its freedom from paternalistic government control. The slight government watchfulness over American radio is a blessing compared to the strict restrictions placed on the industry abroad. Some foreigners wonder why people do not take to radio so enthusiastically in Europe. They need look no farther than their government's statutes against radio—the laws that place a financial burden on every owner of a receiving set and every broadcasting station, as well as limiting the number of broadcasters. America, with its nearly 700 stations, as well as hundreds of wireless amateurs, is enjoying a radio freedom that is nearly unlimited. With these thoughts in mind, those Americans closely connected with radio should appreciate what their government is doing for them, and not rise up in protest the minute Congress takes steps to clear the congested ether by adjusting broadcasting conditions.

AS THE veil of Summer static is being slowly removed, the fans who deserted radio during the warm months are brushing up their sets and looking forward to long Winter nights in gleeful search of elusive "DX" stations. Those thousands of fans who saw it through during the Summer will stick to their guns, of course, but their joy in tuning in distant stations will be all the more fruitful, for they have the advantage of a season of difficult tuning.

It is with pleasure that RADIO AGE welcomes into the fold any new members of the receiving fraternity, and we know that once they learn what set is best adapted to their needs, their evenings will be pleasant ones. And it is with pleasure that we offer all the technical and editorial resources of RADIO AGE toward aiding any prospective fans who would like to get established in America's fast-growing colony of listeners-in.

WELL, ONCE more Mars has slipped through our hands. More than any other time, Radio was called upon last month to establish communication with the "nearest" planet, which hovered only 35,000,000 miles away to give us a chance to "do our stuff." We believe—and personally, only—that the American public expects a little too much of radio so soon in its career. Remember, radio is an infant industry, and communication with distant planets is a thing that requires time and study, as well as patience. All we ask is that earthly mortals wait a few more decades and then perhaps radio will have become far enough advanced to permit inter-planetary communication.

Pick-ups and Hook-ups by our Readers



The material appearing under the title "Pickups and Hookups by Our Readers" in RADIO AGE, is contributed by our readers. It is a department wherein our readers exchange views on various circuits and the construction and operation thereof. Many times our readers disagree on technical points, and it should be understood that RADIO AGE is not responsible for the views presented herein by contributors, but publishes the letters and drawings merely as a means of permitting the fans to know what the other fellow is doing and thinking.

THE coming months promise to have a lot in store for the Dial Twisters. After a brief resumé of the Summer months, it looks as though Old Man Static didn't have very much effect on the reception outside of few short weeks that put a blanket on all kinds of reception.

With the approach of the clear, cold nights, some unbelievable records will be established with the simplest of receivers.

The average tendency seems to be towards the use of "Dynes," but there are a great many who are continuing to stick to the old circuits and are making numerous improvements on them. Personally, we believe, you have to hand it to the old stand-bys for pulling in the signals. Of course, we all know that these new circuits (and there are plenty of them) are improvements on the standard ones.

We get hundreds of circuits that are hopelessly scrambled, asking that we tell the writer if it is practical and if it wouldn't work better than Johnny Jones' if he made certain improvements and then after redrawing the circuit we find it to be one of the old regulars that has been used for years and is still in use.

As a suggestion in tuning for DX, be patient. Oftentimes you may come on a station that is fading badly, and you will be unfortunate to hear him on the point where he is the faintest. HOLD HIM, and you will in nine cases out of ten hear the station come back and sound like local stuff. This fading isn't the fault of your receiver, as is often thought the case; it is due to atmospheric conditions and cannot be overcome at the receiving end.

RADIO AGE,
Gentlemen:

I am sending a more complete description of my set. Many fans have asked if the primary condenser is necessary. For those bothered with local interference of near-by stations, the condenser is very helpful. However, if not, a fixed condenser of .001 mfd. is satisfactory. The other fixed condensers in the diagram are needed but the capacity is determined by the parts you use.

CONTRIBUTORS

William Weightman — **Kenneth Glass**

and Two Other Dial Twisters

DIAL TWISTERS

Name	Address	Circuit
Wilber Milnor	196 16th Ave., San Francisco, Cal.	Three Circuit
George Blood	2962 Bewick Ave., Detroit, Mich.	Not Stated
Oswald Faubel	Parma, Ohio	Not Stated
Merle Hough	545 Rose St., Springfield, Ohio	Not Stated
Ralph Lewis Link	Kirksville, Mo.	Baby Het
Dick Redding	505 Pine St., Lexington, Ill.	Atwater-Kent
Franklin Troutman	11304 Cotes Ave., Cleveland, Ohio	Not Stated
Clair McCormick	% Jensen Mercantile Co., Ewen, Mich.	Crosley
Albert C. Westphal	1667 Palmetto St., Brooklyn, N. Y.	Three Circuit
C. B. Hines	703 Central Bank Building, Memphis, Tenn.	Baby Het

Here are the most important points to be remembered.

(A) Space the apparatus well and keep the leads as short as possible. Do not run wiring too close. The panel I use is 28" by 8".

(B). Use number 12 or 14 bus bar wire in hooking up the set. Solder all connections well.

(C). Most of the tuning is done by the secondary condenser. Regeneration is controlled by the plate variometer. A 23 plate condenser is most advisable in the secondary circuit.

WILLIAM WEIGHTMAN.
Middletown, Ind.

A FEW BOUQUETS

"Your new blueprint section is one of the best magazine features I have ever seen. They are certainly worth keeping and will make a fine collection of hookups if you continue them. Keep it up—they need no improvement."

(Signed) J. S. Moore,
Kansas City, Mo.

"Boys—! You've got me this time! I always liked your great magazine—your Pickups Page is great. It was your blueprint section that made me a subscriber when I saw them in the September issue.

"Enclosed please find my subscription to cover cost of RADIO AGE for one year and also the copy of your AUNAL. I have read them all but yours is the best published. Your Pickups and Hookups Section is well worth a subscription alone. Start mine with the October issue."

Very truly,
(Signed) Michael J. Renehan,
New York City, N. Y.

RADIO AGE,
Gentlemen:

Since you published my hookup in RADIO AGE, I have received more requests for information than I have time or stamps to answer, so I am relying on you to give the fans the information they desire.

The hookup as published was slightly incorrect, as I control regeneration only with the condenser and not a tickler.

1. The coil consists of 70 turns of number 26 D. C. C. wire on 3 inch cardboard tube, and is tapped at 0, 20, and 70 turns. A double slide tuning coil will work very satisfactorily, in fact, it will give you a larger wave length band.

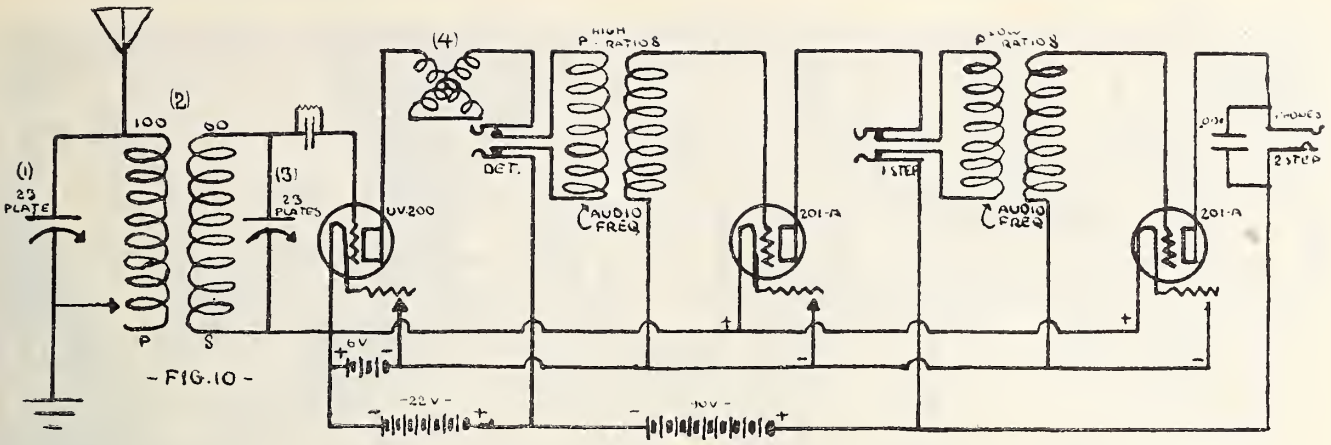
2. Condensers. The condenser in the plate is of the plain type and has 23 plates. Very little tuning is done with this condenser.

The secondary condenser is a 13 plate venier type. Careful adjustment of this condenser is necessary as it is the main tuning control.

3. Tube. The tube used in this set is either the UV-200 or the C-300.

I have no special panel arrangement as my set is experimental; however, when wiring, be sure and keep the grid and plate leads short and at right angles. Connecting the condensers as shown will keep down body capacity.

I got the idea of the circuit several years ago from a hookup which suggested the alternate of the two slide tuning coil or spider web.



- FIG. 10 -

No. (1) ACTS AS WAVE TRAP AND VERNIER - INTERFERENCE ELIMINATOR.

No. (3) VERY CRITICAL.

No. (4) CONTROLS REGENERATION.

Believing your magazine better every issue,

I remain,

KENNETH GLASS.

144 S. Mt. Vernon,
Uniontown, Pa.

The following letter shows that all the Dial Twisters are not old fellows. Look what a 15 year old DT can do:

RADIO AGE,

Gentlemen:

I have read 'most every issue of RADIO AGE from cover to cover. I am 15 years old and have been interested in radio for about 3 years. I have a single tube, three-circuit receiver, consisting of a ten turn aperiodic primary, tuned secondary and tickler coil with an 11-plate condenser across the secondary. I think my list ought to admit me to the Loyal Order of Dial Twisters.

KPO, KLX, KLS, KGO, KZM, KHJ, KFI, KGG, KGW, CFCN, KZN, KFSG, KWG, KFBK, KOW, CJCA, KFAU, KFBC, KEAC, KLZ, KDKA, WHB, WBC.

All of the above stations have been confirmed, and I have another list twice as long that has not been confirmed.

Sincerely yours,

WILBER MILNOR.

196 16th Ave.,
San Francisco, Calif.

George Blood seems to regard summer static as a minor detail in the reception of distant stations. Guess there isn't such a thing over in Michigan because Chicago appears to be the place where Old Man Static comes to spend his vacation. On some nights the air in Chi[illegible]o sounds like a series of train wre[illegible] combined with fireworks.

R[illegible]IO AGE,

G[illegible]lemen:

I am sending you my list of stations heard, in response to you request for reports on mid-Summer reception. All the stations were heard on a one tube set, using a C-301a tube.

KDKA, KFGZ, KFIX, KFKX, KFNF, KSD, KYW, NAA, WABD, WABN, WBAH, WABP, WBAV, WABN, WBAH, WBBR, WBZ, WCAE, WCAP, WCAY, WCBD, WCBU, WCK, WDAF, WDAR, WDBL, WEAF, WEAN, WEAD, WEB, WEBH, WEBJ, WFAA, WGI, WGN, WGR, WGY, WHA, WHAA, WHAM, WHAS, SHAZ, WHB, WHK, WHN, WHO, WJAX, WJZ, WKAA, WLAG, WLS, WLW, WMAQ, WMC, WMH, WNAC, WOAG, WOAW, WOC, WOO, WOR, WOS, WQJ, WRC, WSAI, WSB, WTAB, WTAM, WTAS, WTAY, WWI, 2XBH. Our locals KOP, WCX, and WWJ on July 5, 14, 22, 24, 25, 26, 27 and 29.

All of the above were received on a single wire antenna about 20 ft. high at the ends and 15 ft. high in the center, where it is intersected by a tree. It is about 50 ft. long.

Hoping this will win me a DT button, I remain,

Yours till the trees bark,

GEO. BLOOD.

2962 Bewick Ave.,
Detroit, Mich.

The following Dial Twisters ought to publish a "Calls Heard" book all of their own. They take the prize on pulling down 200 stations, which isn't an easy job when you consider the drag that Old Man Static has in keeping you from running up a list of "out of towners."

RADIO AGE,

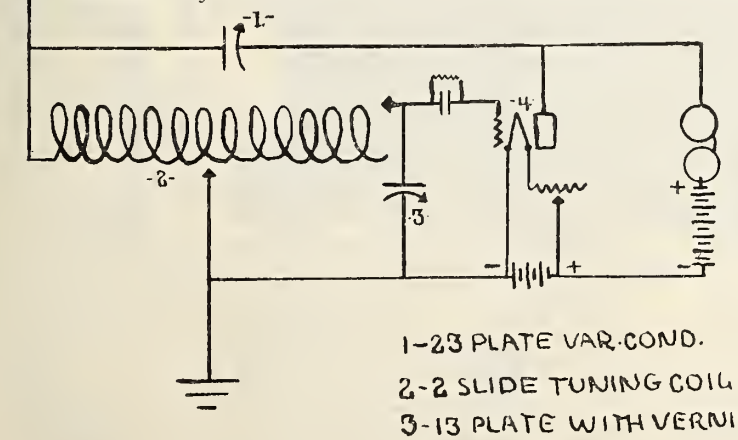
Gentlemen:

I enjoy your magazine more than any other on the market. We get our quarter's worth of things that interest us, and not all advertisements. I take great interest in trying to beat the records sent to your "Pickups" page. Some I can smash, others I cannot touch—yet. I have experimented with many different hookups but have found the Flewelling super has them all beat for volume and distance. I have received exactly 200 stations on one tube. Ths list would be too long so will give them by states.

Ala. 3; Ark. 1; Cal. 6; Colo. 2; Conn. 1; D. of C., 2; Ga. 6; Ill. 20; Ind. 5; Iowa 11; Kans. 6; Ky. 1; La. 1; Maine 0; Mass. 8; Mich. 5; Mo. 13; Neb. 5; N. J. 6; N. Y. 16; N. Car. 1; N. Dak. 1; Ohio 13; Okla. 3; Ore. 1; Pa. 17; R. I. 3; S. Dak. 2; Tenn. 3; Tex. 3; Va. 1; Wis. 5; Canada 13; Cuba 2; Mexico 1. Could pick up CYL almost every Sunday night during the winter. I have picked up KGO three times during July and my reception has been confirmed.

(Continued on next page)

A diagram of the receiver used by Kenneth Glass in his DX work. This receiver is very similar to the Reinartz Audio Regenerator, since it uses the feedback condenser and aperiodic antenna idea in the same way.



1-23 PLATE VAR. COND.

2-2 SLIDE TUNING COIL.

3-13 PLATE WITH VERNIER

4-UV201-A

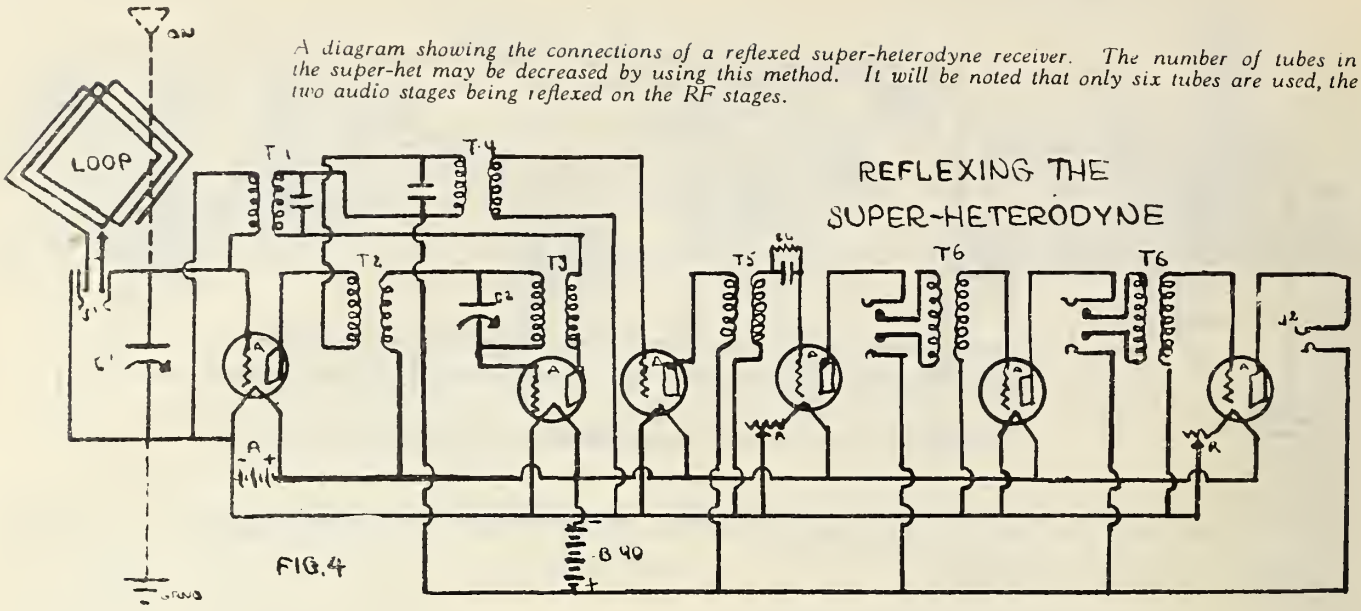


FIG. 4

A diagram showing the connections of a reflexed super-heterodyne receiver. The number of tubes in the super-het may be decreased by using this method. It will be noted that only six tubes are used, the two audio stages being reflexed on the RF stages.

When static got too bad last night, I used a loop aerial and picked up WGY, WBZ and WGN with surprising volume. WGY is 425 miles. WBZ is 475 miles and WGN is 310 miles from our place.

OSWALD FAUBEL.
Parma, Ohio.

RADIO AGE,
Gentlemen:

The June number of RADIO AGE was my first copy of your magazine. I can't see how I could ever do without your many radio helps. I am sending my hookup and the stations I have heard.

CFCA, CHBC, CJSC, CKAC, CKCK, CFCF, CYB, CYL, KDKA, KDPM, KFDY, KFEL, KFDB, KFAF, KFEX, KFIB, KFNF, KFIL, KFKB, KFI, KFKX, KGW, KHJ, KOP, KPO, KSD, KLX, KYW, KLZ, KFGZ, WAAP, WAAM, WAAW, WABM, WBAH, WBAK, WBL, WBAN, WBAP, WBAV, WBAY, WBZ, WCAD, WCAE, WCAL, WCAH, WCAR, WCAP, WCAS, WCAY, WCBD, WCK, WCX, WDAF, WDAH, WDAJ, WDAL, WDAP, WDAR, WDAT, WEAA, WEAA, WEAB, WEAD, WEAF, WEAG, WEAM, WEAN, WEAO, WEAP, WEAY, WEBH, WEW, WFAA, WFAN, WFAF, WFAS, WFI, WGAW, WGAZ, WGF, WGN, WGM, WGI, WGR, WGY, WHA, WHAC, WHAF, WHAH, WHAK, WHAM, WHAS, WHAZ, WHG, WHK, WHN, WIAO, WIP, WIAS, WJAD, WJAK, WJAM, WJAR, WJAS, WJAX, WJAZ, WJZ, WKAN, WKAF, WKAQ, WKAA, WLAG, WLAJ, WLAK, WLAL, WLAN, WLS, WLW, WMAF, WMAH, WMAJ, WMAK, WMAQ, WMC, WNAC, WNAP, WNAJ, WNAP, WNAV, WOAC, WOAI, WOAV, WOAN, WOAW, WOC, WOF, WOI, WNAN, WOO WOQ, WOR, WOS, WPAB, WPAD, WPAL, WPAH, WPAK, WQAM, WRAL, WRAV, WRC, WRL, WRM, WRK, WSAI, WSB, WSY, WTAM, WTAG, WTAS, WWI, WWJ, WWAE, 6KW, WHO, KGO, KQV, KFOA, WTAY. 4ST, 5PX, 5LJ, 8DC, 8CDL, 8PO, 8BCD, 9CE. Canada) 9DES, 9WJ, 8CE, 5RK, 8WX

As ever,
MERLE D HOUGH
545 Rose St.,
Springfield, Ohio.

Reflexing the Super-Het

By An Experimental Dial Twister

RADIO AGE,
Gentlemen:

The ambition of all radio fans is to build an efficient receiver possessing selectivity, volume and range at the least expense, and to aid those that wish to go to the trouble and expense of building a six-tube set, I am offering the following:

First I wish to say that this set eliminates two of the eight tubes, which reduces the operation cost 25 per cent, and also eliminates the troublesome unit of the potentiometer, leaving only two controls.

By looking at the diagram, the average fan will notice this circuit employs one detector, two reflexed stages of radio frequency, 2nd detector or second harmonic principal, and two stages of audio frequency amplification.

T-3 transformer acts as an oscillator by virtue of being in the plate circuit and eliminates the necessity of employing an inductance coil as oscillator which frequently is the seat of distorted reception.

The tuning of the primary of this transformer by a variable condenser permits placing the circuit in absolute resonance with the incoming signal.

All transformers are wrapped on the same size forms, with the exception of audio which should be of the best manufactured type.

In making the forms the following is the simplest method.

Purchase a piece of bakelite 2″x20″, saw it into ten pieces 2″ by 2″ drill 5 1-8 inch holes as per Fig. 1. Secure five pieces of wood about as thick as a lead pencil and 1 1-4″ long, (Fig. 6). Screw a piece of bakelite on each end through center holes and attach two small size binding posts through other holes as per Fig. 7. Now start winding all in the same direction as per specification.

Attach one end of wire to small binding post, then wrap primary and fasten end to binding post to the end of form. Cover primary with one layer of empire cloth or some other insulating material. Then wrap secondary directly on top. If a little care is exercised in wrapping, sufficient room will be permitted for all turns.

Transformers, when mounted in the set, must set at right angles to each other to prevent inductive relations. Fig. 4 shows simple and easy layout for wiring.

Figs. 8 and 9 show the cabinet and panel layout. Stations over 500 miles away are heard in the Summer time on the horn, using only the loop. Which shows that when using an outside aerial in cool weather, reception up to 2,500 miles may be had.

I trust that I may hear from the fans who try this circuit. I can only offer as a suggestion that when wiring the

(Continued on page 46)

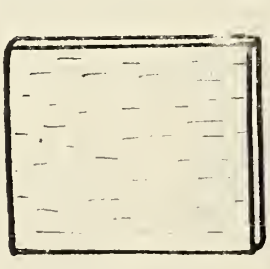


FIGURE 5

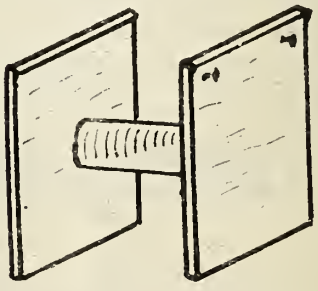


FIGURE 7

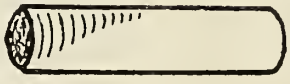


FIGURE 6

Send For This Sensational Radio Bargain Book-FREE

Order Direct From This Page! Save About One-half! Compare our prices with others. Only highest grade nationally known GUARANTEED parts. OUR GUARANTEE PROTECTS YOU. Money cheerfully refunded if you are not satisfied. Be sure to write your order and state prices plainly. Send post office or express money order or bank draft for total amount to insure prompt shipment. ALL PRICES ON THIS PAGE INCLUDE SHIPPING CHARGES RIGHT TO YOUR DOOR. Refer to any bank or commercial agency regarding our reliability. If your favorite circuit is shown here, order direct from this ad. No skill required to build your own radio with Randolph parts, Panels are all drilled. Instructions are simple and complete. Everything comes ready to assemble. Order direct! All shipping charges prepaid.

Complete Parts for Two-Stage Amplifier

May Be Used in Connection With Any Receiving Set

1 7x9 or any standard Bakelite Panel.
1 Thordarson or Columbia High-ratio Transformer.
1 Thordarson or Columbia Low-ratio Transformer.
2 Bakelite Rheostats.
2 Bakelite Sockets.
2 2-circuit Jacks.
1 1-circuit Jack.
1 Baseboard.
9 Binding Posts.

$10.90

Diagram and Instructions for wiring.

COMPLETE PARTS FOR 3 AND 5-TUBE NEUTRODYNE RECEIVING SET

Genuine Hazeltine Licensed Fada, Freed-Eiseman, or other Genuine Licensed Parts

PARTS FOR 5-TUBE SET:

1 7x28x⅜ Drilled Panel.
2 All American or Columbia Audio Transformers.
3 4" Bakelite Dials.
3 Filament Control Jacks.
1 Vernier Rheostat—30-ohm.
1 Plain Rheostat—6-ohm.
1 strip Bakelite, 6x1x⅜.
8 Binding Posts.
1 Grid Leak and Condenser.
2 Bakelite Sockets.
1 .001 Condenser.
1 Dubilier By-Pass Condenser.
3-Gang Bakelite Socket.
35 feet Hook-up Wire.
1 Wave Control Neutroformer.
2 R. F. Neutroformers
1 Baseboard.
2 Neutrodons
3 Bezels.

5-TUBE SET $43.75

Complete blue-prints and working diagrams and instructions.

PRICE—3-Tube Set, $26.45

OUR CATALOG IS FILLED WITH Bargains Like These

CONDENSERS

23-plate plain Cond'n'r, $1.29
23-plate Vernier Cond'r 2.59

RHEOSTATS and POTENTIOMETERS

Bakelite Rheos't, 6-ohm .38
Bakelite " 30-ohm .59
Bakelite Vernier Rheos't 1.15
Bakelite Potentiometer, 200 ohm 59

TRANSFORMERS

Randolph Special, 6 to 1, 2.16; 3½ to 1 . . 1.89
Sinclair Special, 6 to 1, 2.55; 3½ to 1 . . . . 2.24

TUBE SOCKETS & DIALS

4" Hygrade Dial 29
Bakelite Socket 28
Weston Plug 75

VARIOMETERS

Moulded Variometer . . . 2.39
Bakelite moulded 3.45

HEADFONES

Randolph Special, 2200 ohms 2.45
Blue Bird Special 3.95

LOUD SPEAKERS

American Bell 3.95
With adjustable loud speaker unit 6.95

COUPLERS and COILS

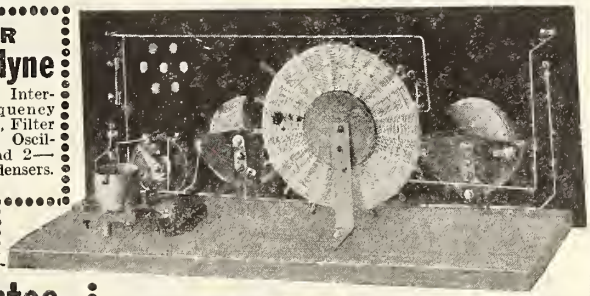
180° Variocouplers 95
Reinartz Coils 1.25
Electric Soldering Iron. 1.29
Cockaday Coil 1.65
Three-Circuit Tuner . . . 2.95
Ambassador Coils 2.95

SUPER Heterodyne

Containing 3 Intermediate Frequency Transformers, Filter Transformer, Oscillator Coil and 2—1 M. F. Condensers.

$19.75

with Audio frequency Trans. $26.65



COMPLETE PARTS FOR 3-TUBE COCKADAY RECEIVING SET

1 Cockaday Coil.
2 23-plate Hy-Grade Cond.
1 Bakelite Rheostat, 30-ohm.
1 Bakelite Rheostat, 6-ohm.
3 Bakelite Sockets.
1 high ratio Columbia or All-American Transformer.
1 Single Circuit Jack.
1 low ratio Columbia or All-American Transformer.
2 Double Circuit Jacks.
2 3" Bakelite Dials.
1 Grid Leak and Mica Cond.
7 Switch Points, 2 stops.
1 Bakelite Binding Post Strip.
8 Binding Posts.
1 7x21x⅜" Drilled Bakelite Panel.
3 Bezels.
1 Baseboard.

3-TUBE SET $19.95

Complete blue-prints and wiring diagrams.
1-Tube Set. $10.45

Our Guarantee

Every article exactly as represented. Every article is tested before shipping. Complete satisfaction guaranteed or money will be cheerfully refunded.

PARTS FOR ONE-TUBE REINARTZ RECEIVING SET

1 7x18 Bakelite Panel.
1 Vernier Bakelite Rheo.
1 Bakelite Socket.
1 23-plate Lo-loss Var. Cond.
1 11-plate Lo-loss Var. Cond.
2 Bakelite Dials.
1 Genuine Rheinartz Coil.
2 doz. Switch Points and Stops.
3 Switch Levers.
25 feet Busbar Wire.
1 Freshman Grid Leak and Condenser.
1 Baseboard.
9 Binding Posts.

1-TUBE SET $10.45

Blue-print and Complete Instructions.
3-Tube Set. $17.55

Complete Parts for ACME 4-TUBE REFLEX

3 Acme A-2 Transformers
1 Acme R-2 Transformer
1 Acme R-3 Transformer
1 Acme R-4 Transformer
4 Bakelite Tube Sockets
1 Duplex or Bremer-Tulley Lo-loss 23-plate Condenser.
7 Frost Potentiometer-Rheostat.
1 .00025 Fixed Condenser with grid leak mounting.
1 .0025 Fixed Condenser.
2 .002 Fixed Condensers.
1 .005 Fixed Condenser.
1 RW Crystal Detector.
8 Binding Bosts.
1 3" Bakelite Dial.
1 2-circuit Phone Jack.
1 length Spaghetti.
25' No. 14 Hook-up Wire.
1 50,000-ohm Grid Leak.
1 "C" Battery.
1 7x21x⅜" Bakelite Panel—drilled,
1 Baseboard.

Complete set blue-prints and instructions for wiring.

4-Tube Set $39.85

1-Tube Set. $17.45

COMPLETE PARTS FOR 8-TUBE SUPER-HETERODYNE

1 23-plate Lo-loss Vernier Bremer Tully or Duplex Condenser.
1 23-plate Lo-loss Vernier Bremer-Tully or Duplex Condenser.
1 400-ohm Frost Potentiometer.
2 6-ohm Rheostats.
2 30-ohm Bakelite Rheostats.
1 .00025 Fixed Condenser.
4 .002 Condensers.
1 .006 Condenser.
1 Bakelite Terminal Strip for Binding Posts.
1 Multicolucord Cable for connecting batteries.
1 1-Meg. Leak.
2 4" Bakelite Dials.
1 Single Circuit Jack.
2 2-Circuit Jacks.
8 x 35 Baseboard.
35 ft. Busbar Wire.
1 8x36x⅜" Dr'ld. Bak. Pan.
8 Bakelite Sockets.
7 Binding Posts.
1 Filter Transformer
1 Oscillator Coupler.
1 "C" Battery.
1 Battery Switch.
3 All-American or Columbia Long-wave Transformers.
2 All-American or Columbia Audio Transformers.

Instructions, blue-prints and complete layout.

$59.75

RANDOLPH RADIO CORPORATION

159 N. Union Ave. Dept. 58 Chicago, Illinois

FREE

BIG MONEY-SAVING RADIO CATALOG

containing a thousand bargains of everything on radio—parts, supplies, complete parts for sets, complete sets, etc., also a mine of very latest information on all different circuits, complete list of broadcasting stations, and other valuable, up-to-the-minute radio data. Send your name and address on a card or letter. We will send catalog free.

Free Service Department

Our radio engineers will help you solve all your radio problems, and furnish up-to-date information on set construction, operation and improvement. This service is free to our customers.

set, be sure to keep your leads as short as possible, and you will no doubt be surprised at the results in distance and volume this receiver will give.

Yours for improved radio,

"A DIAL TWISTER."

[Name on request to Editor.]

Specifications

T-1—Low Frequency—Primary, 150 Turns No. 36 Scc Wire; Secondary 600 Turns No. 36 Scc Wire.

T-2, T-4, F-5—High Fre.—Primary 220 Turns No. 36 Scc Wire; Secondary 1100 Turns No. 36 Scc Wire.

T-3—Oscillator—Primary 80 Turns No. 36 Scc Wire; Secondary 150 Turns No. 36 Scc Wire.

C-1, C-2—.0005 or 23 Plate Variable Condensers (low loss type).

G. L.—.00025 dielectric condenser, "Turn-it" Grid Leak 1 1-2 Meg.

J-1—3 Double Circuit Jacks.

J-2—1 Single Circuit Jack.

T-6—2 audio transformers ratio 5 to 1.

R—2 rheostats 20 Ohm.

O—Filament switch.

A—6—U. V. 199 Tubes.

Loop—Box Type—15 turns Electric Lamp Cord—18" Diameter.

Fixed Condensers—.0005 on Sec. of T-1, .05 on Pri. of T-4.

Panel—18"x7".

2 Vernier Dials.

Cabinet 30"x7" Supplies room for batteries.

In the following letter we have some data, as to what the Baby Heterodyne will do in the Summer-time.

RADIO AGE,

Gentlemen:

I have a list of stations received from July 25 to August 1. I think it is a good list for Summer reception. Enclosed is a self-addressed envelope for an answer. The list is as follows:

WOC, WOS, WOAW, WOI, KSD, WHB, WHAA, WDAF, WCAE, WHO, WMAQ, WEB, WOQ, KFNF, WSAI, WLS, WEBH, LWL, KDKA, WEAF, WFAA, WSB, WBAP, WQJ, WIAH, WTAY, WTG, KFFV, WTAS, WCAL, WCAP, KFKB, KFKX, KYW, WHAS, WMC, WTAM, WJAX, WGY.

I am using the Baby Heterodyne in the February issue of RADIO AGE. I think this list entitles me to a Dial Twister's Pin.

RALPH LEWIS LINK.

Kirksville, Mo.

Dick Redding of Lexington, Ill., has a five-tube Atwater-Kent and seems very lucky in being able to keep the phones on with five tubes lit and stand the Summer static. However, by his report it looks as though Old Man Static was licked.

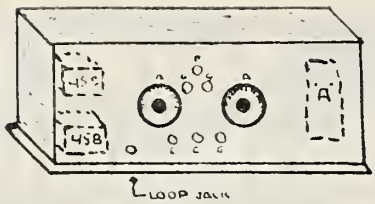
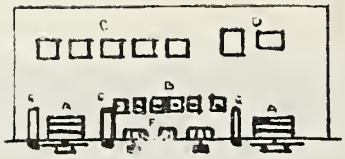


Figure 9 [above] The panel layout of the reflexed super-heterodyne receiver as described by one of our Dial Twisters.

Figure 8. (Below) The apparatus should be arranged on the mounting board and the panel as illustrated. The letters have the following significance: A-23 plate condenser, B-6 UV 199 sockets, C-Radio Reflex Transformers, D-Audio frequency transformer, E-Jacks, F-Filament Switch, G-Rheostats.



RADIO AGE,

I think that your magazine is the best radio publication on the market, and I think the Pickups Department is the best department in it.

I have a five-tube Atwater-Kent Radio set, and here is the list of the stations I have received since last January:

WHAS, KSD, KYW, WLS, WMAQ, WGN, WQJ, WCBD, WEBH, WOC, KDKA, WBZ, WWJ, WHB, WMC, WBAA, WCK, WMH, WOS, WGY, WHO, WHAZ, WDAF, WLW, WTAS, WJAN, WTAM, WTAY, WGR, WCAE, WDAR, WCX, WOAW, WBAP, WOR, WHAA, WAAF, WOO, WEAF, WAAD, WKY, WLAG, WOI, WOQ, WRC, WRM, WSAI, KFKX, WJAZ, WDAP KHJ.

I hope you will send me one of your famous "Dial Twister" Buttons.

Yours very truly,

DICK REDDING.

505 N. Pine Street,

Lexington, Ill.

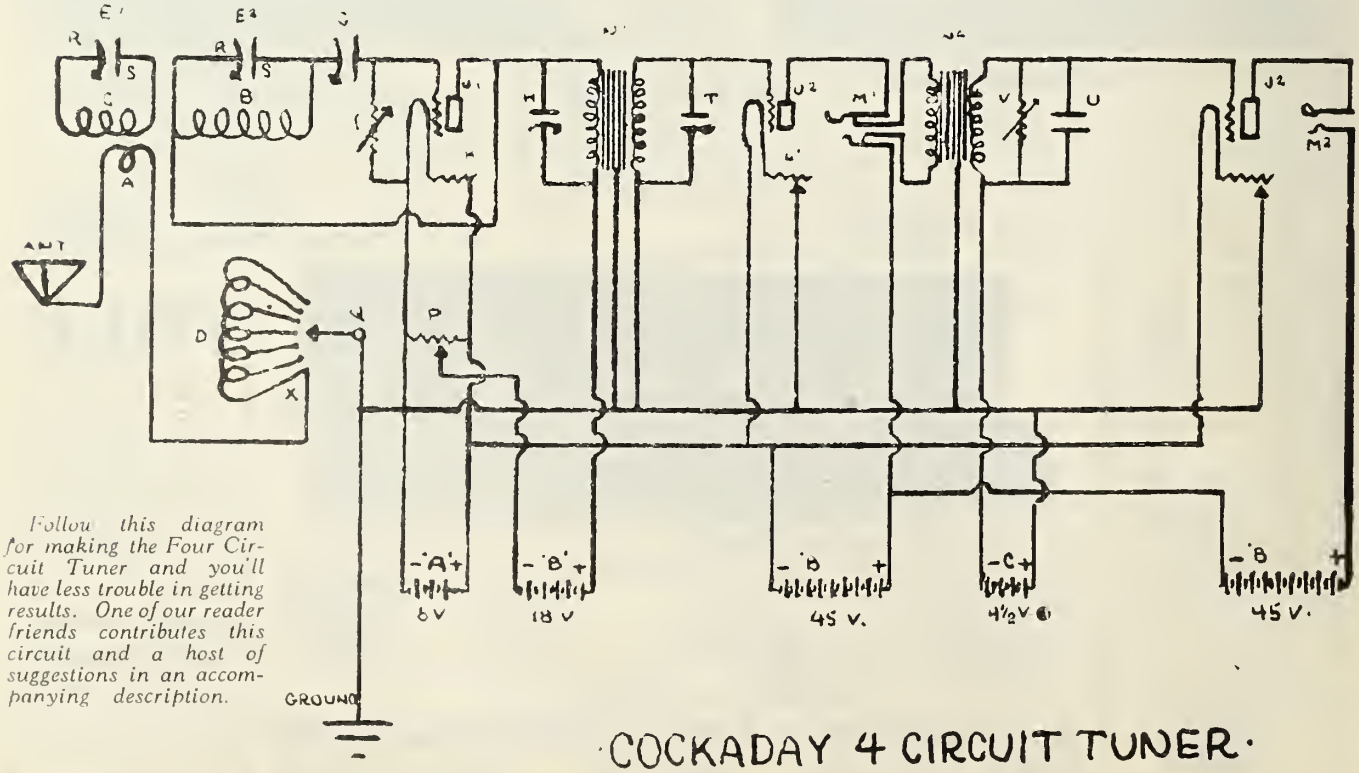
THE COCKADAY FOUR CIRCUIT TUNER

The following information on the Cockaday four circuit tuner was submitted by a reader in order that RADIO AGE might relieve him of the hundreds of inquiries received in regard to the circuit. We feel that by printing this information, it will at the same time help many other fans now using the Cockaday circuit.

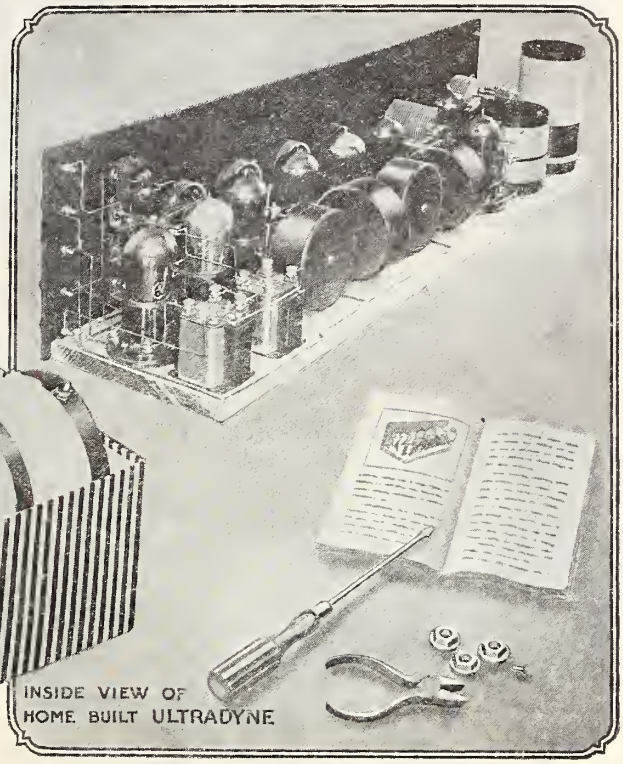
The first thing to heed in the construction of the set is the use of good apparatus. Make all connections correctly and as near perfect as possible. In purchasing of the coils, those mounted or wound on very thin hard rubber or bakelite are most preferable.

Watch the condensers, as they play a large part in the efficiency of the receiver. Particular attention should be paid to the "low loss" condensers now on the market, which sell at the same price as those of the "moulded mud" type.

(Continued on page 54)



Follow this diagram for making the Four Circuit Tuner and you'll have less trouble in getting results. One of our reader friends contributes this circuit and a host of suggestions in an accompanying description.



$26.00 ULTRADYNE KIT

Now, the famous Ultradyne Receiver has been so simplified that anyone can successfully build it with the Ultradyne Kit.

This Kit includes all the special parts required to build the Ultradyne, designed by R. E. Lacault, the inventor—1 Type "A" Ultraformer, 3 Type "B" Ultraformers, 1 Tuning Coil, 1 Oscillator Coil, 4 Matched Fixed Condensers.

The Ultradyne incorporates the new "Modulation System"—a decided departure from the detector arrangement of radio reception, used in all other Super-Heterodynes. This "Modulation System" is the latest development of R. E. Lacault, A. M. I. R. E., Consulting Engineer of this company and formerly Radio Research Engineer with the French Radio Research Laboratories.

Even Super-Heterodyne Engineers marvel at Ultradyne performance—its unusual selectivity and great range on the loud speaker.

There is no greater receiver! Now you can build it yourself.

Write for descriptive folder

R E L

To protect the public, all genuine Ultraformers bear Mr. Lacault's personal monogram seal (R. E. L.) and are guaranteed so long as this seal remains unbroken.

Send for 32-page illustrated book, giving latest authentic instructions on drilling, wiring, assembling and tuning 6 and 8 tube Ultradyne receivers.

50c

ULTRADYNE
The Improved
SUPER-HETERODYNE

PHENIX RADIO CORP.

3-9 Beekman Street **New York**

WITH THE MANUFACTURERS

Grebe Synchrophase Receiver

Followers of radio development have become more or less accustomed to the advances in design and performance which have heretofore characterized each new Grebe Radio Receiver. However, it is doubtful whether any great number have anticipated such radical

departures in design as distinguish the new Grebe "Synchrophase" from the usual type of radio receiver. The changed external appearance is due mainly to the new type of dials, rotating in horizontal plane, projecting through ornamental gold-covered escutcheons. These plates in combination with mahogany toned bakelite panel and dark mahogany cabinet present a very pleasing appearance.

The original Grebe Tangent Wheel Verniers have been elaborated with similar escutcheon guide plates. No dial-twisting motion remains, the coarse tuning of the dial and hair's-breadth vernier action both being horizontal.

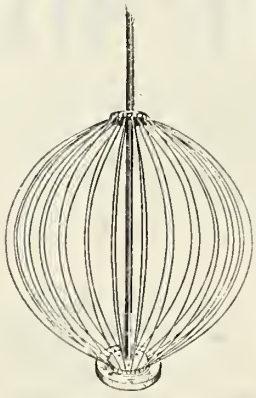
Binocular Coils in combination with (Straight-Line-Frequency) condensers constitute the backbone of the tuned stages. These Binocular Coils are entirely devoid of external field, shutting out the bothersome effects of powerful currents usually experienced with single cylindrical coils when operating a receiver close to a broadcasting station. These coils contribute largely to the extreme selectivity and stability of operation found in the Synchrophase receiver.

Non Directional Aerial

While great strides have been made in the radio field within the past two years, one of the outstanding features for 1924 is the perfection of the Non-Directional Aerial. Many enthusiastic radio fans who have been discouraged at times, owing to their inability to pick up certain stations, will be greatly encouraged from now on due to the fact that with this Non Directional Aerial the most distant stations can be picked up one after another depending, of course, upon the power of the receiving set used.

It matters not in what position a wire has to be to best pick up a message—the Portable Globe Aerial has a wire in that position and several more very similar.

Those who have tried it out are most enthusiastic. Even during the Summer months the Portable Globe Aerial worked remarkably well, and one particular instance is recorded where on a very

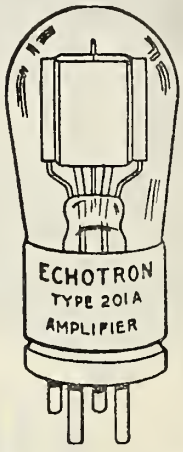


A view of the non-directional aerial when opened

severe, hot, electric stormy night by merely turning the dial an individual in St. Louis was able to pick up in quick succession San Antonio, Davenport, Atlanta and Pittsburgh.

New Vacuum Tube Makes Debut

A new wrinkle has lately been added to the construction of vacuum tubes that are used in radio work. The familiar tip on the end of the tube is absent. This fact has a considerable value to all radio fans.



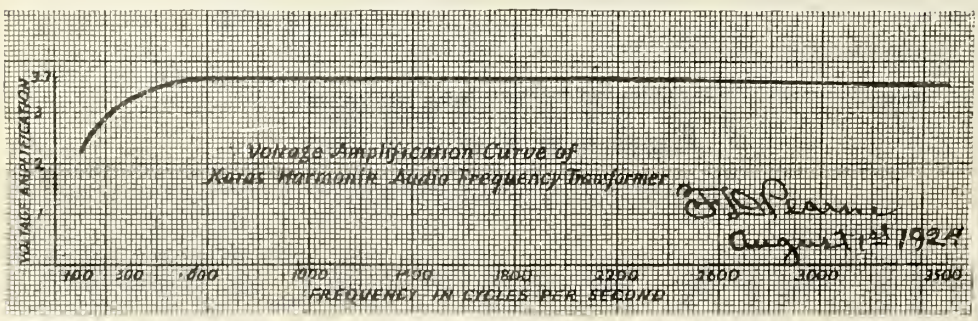
In the earlier type of tubes a tip of glass was left on the end of the globe. This was due to the fact that in pumping the air from the globe a glass tube was fastened to an opening on the surface of the globe. This glass tube was connected by means of a rubber hose to the pump.

When the air from the tube was exhausted the glass tube was melted off in a gas flame, thereby sealing the tube. Part of the glass tube always remained and formed a sharp pointed tip that protruded from the most prominent part of the surface of the globe.

This tip is very easily broken off by a blow that would prove harmless to any other part of the instrument. A very light touch with a screw-driver or other tool when working in the set is often sufficient to break off the tip and allow air to enter and destroy the tube.

In the newer type of tubes the globe is evacuated from the bottom. The tip is then located beneath the metal socket of the tube and is out of sight and out of the way.

A new tube, called the Echotron, has been introduced that embodies the tipless feature as well as other improvements. The tube is of the 201-A type with a standard base and consumes but a quarter of an ampere of current at five volts and is used on a six volt storage battery.



The above chart is the voltage amplification curve obtained by Frank D. Pearne, Technical Editor of RADIO AGE, with the new Karas Harmonik Audio frequency amplifying transformer. Note how straight the curve is over the entire band of frequencies from 1000 to 3500 cycles, the band of frequencies covered by the average modulated signals from a broadcasting station. The transformer was approved in this test by the RADIO AGE Institute.

Pfanstiehl Model 7

The Pfanstiehl Radio Co., Highland Park, Ill., are placing on the market their new "Model 7" five-tube receiver, which is one of the best developed and simplified sets ever produced. It embodies the Non-Oscillating system perfected by Carl Pfanstiehl. Another feature is the station-finder on the panel which enables one to locate any station desired, so long as the wave length is known

Now Come the Radio Politicians

(Continued from page 21.)

at first difficult experience of addressing unseen audiences.

Mr. Davis will travel considerably, probably going to every section of the country. Thus more people will meet him face to face, but he has already indicated that he will avail himself freely of the radio, both en route and at his home at Locust Valley, New York. He declares radio has completely transformed campaign methods, and has even gone so far as to counsel, perhaps for the benefit of his colleagues in the campaign, those who broadcast. His advice is simple and to the point, "Speak slowly, speak distinctly, and don't shout."

No 20 Minute Speech for "Bob"

ALTHOUGH a comparatively unknown quantity to the radio public, Senator La Follette will be heard frequently. As a movie star he would be a knockout, and doubtless as a radio speaker he will also prove a big drawing card. However, like Hiram Johnson, there will be much that is picturesque in his manner of speaking that must be seen as well as heard.

It is a foregone conclusion that he will not follow the warning of Mr. Davis that no political speech should be longer than twenty minutes. Twenty minutes, indeed! What does twenty minutes mean to this seasoned leader of Senate filibusters, a fighter who has spoken continuously, all day and all night and more, later, if necessary? Some years ago, in his effort to defeat the Aldrich-Vreeland currency bill, Senator La Follette talked for nineteen hours.

Senator La Follette is as different in action from Mr. Coolidge or Mr. Davis as day is from night. He is almost explosive. He shoots out his left hand in a way that Jack Dempsey might envy, he claps his hands together like pistol shots, he crouches, he jerks out his words, he shakes his marvelous head and hair violently, and he is all over the place.

Jewell Has Unique Line

One of the most unique and attractive lines of radio products ever offered has been placed on sale by the Jewell Electrical Instrument Co. of Chicago. After an exhaustive study of the radio and electrical field, several new articles have been put on the market. They include a radio test set, equipped for the taking of vacuum tube characteristics, voltage and miscellaneous tests.

A New Rathbun Hookup in November Radio Age.

Eliminating Radio Frequency Losses

By FRANK D. PEARNE

NO DOUBT the time will soon come when all this talk about poor reception of distant broadcast programs will cease and the fans will begin to realize that although atmospheric conditions are not the best, it is still possible to get programs from distant stations if they will only pay attention to the little things which, while they do not mean so much in the Winter time, when the conditions are ideal for DX work they do make a world of difference under adverse weather conditions. With our powerful local stations, almost any kind of a set may be thrown together and fairly good reception obtained, but the user will never realize the fact that he is too easily satisfied and has missed much of the pleasure to which he would be entitled were he to carefully consider the small things which are generally overlooked and which mean so much when weather conditions are at their worst.

In order to ascertain what could be done in the hot Summer months with a receiving set which was built in a scientific way and which was carefully constructed with the idea of eliminating all the small losses which many manufacturers consider too trivial, the writer started out to find what it was all about.

HAVING recently heard a lecture by Carl Pfanstiehl on this very subject, and learning that the Pfanstiehl Radio Co. was building sets which embodied some of the principles mentioned in his lecture, the Pfanstiehl Model 7 receiver was selected to prove or disprove the issue.

This receiver employs five UV-201-A tubes, two of which are used as radio frequency amplifiers, one as a detector and two as audio frequency amplifiers. All inductances and radio frequency transformers were made of specially constructed spider web coils similar to those indicated in Mr. Pfanstiehl's lecture and which from the nature of their construction were said to so concentrate the electro-magnetic and electro-static fields that interference of any kind from these two sources was entirely eliminated. That is, these fields were so concentrated that no stray lines of force could extend from one coil to another. With this arrangement and the method of wiring which was employed, it was claimed that it was impossible to make this receiver oscillate, thus doing away with all howling and squealing and the danger of causing interference with other receiving sets located nearby.

The plate circuit of the detector tube was supplied with 45 volts and the plate circuits of the amplifiers, both radio and audio, were operated at 90 volts. The filament circuit was supplied with a 6 volt storage battery, having a capacity of 120 ampere hours. The filament current of each tube was .25 ampere making a total discharge of 1 1-4 amperes to aupply all the tubes. A logging chart was engraved upon the front of the panel, which directed the operator just where to turn the dials to receive any given wave length. The aerial used in the test consisted of 120 feet of Shinn braided aerial cable about 3 feet from the roof, connected to the set by approximately 60 feet of lead-in wire. The ground was obtained by a 15 foot lead to the radiator. This aerial arrangement, while entirely too long for ordinary good Summer reception, might be considered fairly good for long distance reception when the weather conditions were right, and was used principally to make the test a hard one, so far as selectivity was concerned.

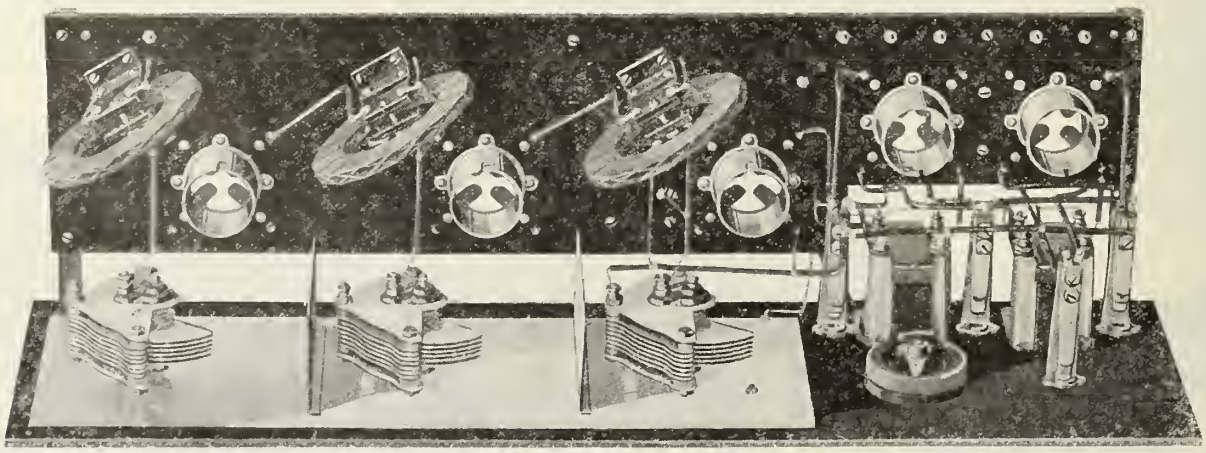
THUS prepared to find out just what a carefully constructed receiver would do as compared to others which were built in the ordinary way, and with a grim determination to see just what difference one might find with many of the little leaks eliminated, a thorough test was made.

This test was made at Chicago, Ill., and was carried on from June 1 until August 20, during which time almost all conceivable kinds of weather conditions occurred, with the exception of extreme cold. Naturally, at times static was very bad, but even when at its worst it was often possible to get stations more than 1,000 miles away on the loud speaker, which, were it not for the slam-bang of static, would lead one to believe that it was a local station coming in; and in fact Schenectady, New York, was often mistaken for Zion, Ill., until the announcement was made. New York City, Troy, N. Y., Fort Worth and Dallas, Texas, were, when the set was properly tuned, brought in with considerable volume at times when it was impossible to get them on the three circuit regenerative set with which the comparison was made.

As the Pfanstiehl set was non-oscillating, no sound other than that of the signals was heard, and by consulting the chart and moving the dials to the wave length indicated, the stations could be picked up immediately without any howling or squealing or any other sound except that caused by static.

THE selectivity was excellent, considering the long aerial used at this time of the year and many stations such as Davenport, Ia., Des Moines, Ia., and WEAF of New York were picked up occasionally through the local broadcasting which was going on at the same time. Several other types of receivers were compared, all stations first being located by the Model 7 and then the other sets switched on. Whenever it was possible to pick the stations up on the other sets, the reception was not so good, bearing out the fact that the little things are of far more importance than one would suspect and if in the construction of a set, one will take the trouble to prevent all the little leaks and losses, he will be very well repaid by greatly improved reception.

(Continued on page 52)

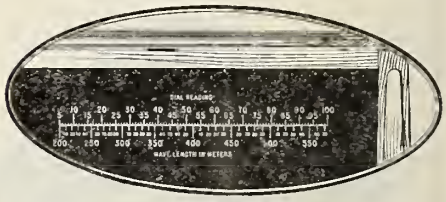


A top elevation of the new Pfanstiehl receiver which embodies a new principle in construction to offset the oscillations usually present in radio frequency receivers of the tuned type. Note the method of placing the coils to counter any stray inductance. It is claimed that this is only possible with a coil of the spider-web type

The Radio Frequency Problem

(Continued from page 50)

Radio engineers have been perfecting tuned radio frequency amplification. This circuit has stimulated the effects of the best engineers becauseit offers so much. It fulfills the demands of those who want a high degree of selectivity,



The chart or station-finder gives the wavelength for the various degrees on the tuning dials.

distance and volume, and who desire to avoid reradiation. It has, in fact, but one defect; a supposed inherent tendency of the tubes to oscillate. These oscillations make themselves known as squeals, howls and distortion, and defeat the high degree of amplification obtained.

Until recently it was assumed that these oscillations were unavoidable, and therefore all efforts were made to choke them down or to compensate for them. To this end resistances were used, then the potentiometer and finally and most successful of all, neutralizing condensers. All these devices do two things; they cut down efficiency and they require expert adjustment.

Carl Pfanstiehl has attacked the problem from a new and different point of view. Instead of assuming that these oscillations are inherent in the circuit, he has traced the disturbing oscillations to their various sources, ascertained exactly how they are generated, and built up a system which altogether avoids producing them.

These oscillations are generally supposed to be due to capacity effects between the elements of the tube. Pfanstiehl doubted this commonly accepted belief. Such small surfaces were insufficient to explain the oscillations, and such a theory did not seem reasonable in view of which he had deemed in his laboratory about electrostatic and electromagnetic fields at high frequencies. He set himself to the task of tracing to their sources, with delicate measuring instruments, all oscillations generated. Tube capacities proved to be significant, but electromagnetic and electrostatic coupling developed an important hearing on the subject.

The Pfanstiehl non-oscillating system shows that the capacity effects inside the audion tube are not sufficient to produce oscillations in a properly designed tuned radio frequency circuit, on the present wave lengths used for broadcasting. It analyzes the generation of oscillations into two kinds; those due to electromagnetic coupling and those due to electrostatic effects. In other words, this system does not aim to neutralize, or choke down undesired oscillations after they have arisen, but to avoid generating them.

Have You Met Our Radio Sweethearts?

(Continued from page 31)

riding they got into a friendly squabble with the cops of that town. As a result, little "Topsy" came out with a broken rib, nose and minor other bruises and hurts which laid her up for some time. Suit for damages and counter suits came up later which filled the newspapers of the country. The Cicero police force said they wanted her restrained, for she had nearly disabled one of their cops, a 225-pounder. And "Topsy" tips the scales at about 110! So that's why the radio fans wondered why she wanted the dog "Cicero" back.

There is another interesting story about the girls, regarding the time they upset all precedent which governs the society of royalty and near-royalty in England. It was the time they played the game "snubbing Mrs. Vanderbilt." They had been invited to Mrs. Vanderbilt's home in London by the Prince of Wales, a guest of hers, and they came —with all their song and mischief along. The King of Spain and the Duke of York were there also. They went up in the music room and sang songs, played the piano, and told the Prince how to put pep into his music.

THEN the dinner bell called them. and it called and called but without much result. The guests were impatient, as was Mrs. Vanderbilt, who was much more so, for the girls were not only delaying the "eats" but they were occupying their beloved Prince! But Topsy and Eva sort of liked it up in the music room, and the Prince came to like it too, so he made the suggestion that the guests should rather come up there to eat! My, what a hub-bub that did cause. The society ladies and gentlemen never heard of such a thing, and they branded it scandalous. But they did come, after all.

Radio has played a very important part in the lives of Vivian and Rosetta Duncan, and even helped make their show the tremendous success that it is; so they feel that they owe it a debt. When they go to New York, which they will late in October, they are going to have another studio there from which the Westinghouse Company will again broadcast their songs, as they did through their station KYW in Chicago.

KYW will rebroadcast the music, so Chicago and the West will have a chance to hear them.

Pickups

By Our Readers

(Continued from page 46.)

The grid leak and grid condensers are common places to experience trouble when poor ones are used. Many times the average builder, when soldering the leads on the condensers, allows the flux to run in between the metal or mica separators, making them practically useless.

Make all connections as short and direct as possible. Always avoid running the grid and plate leads parallel to each other. Also mount transformers at right angles.

Use tube sockets of low loss such as porcelain and mount them on a hard rubber or bakelite strip. The transformers may be mounted directly beneath the tubes.

The plate voltage of the tube is given as 18 volts. However, the voltage will have to be adjusted to suit the characteristics of the particular tube. It is advisable to use a separate B battery for the detector tube, connected as shown in diagram, B, to center arm of potentiometer, B+ to B+, on first audio transformer.

The C battery has a maximum voltage of about 4 1-2 volts. This also will have to be varied according to the plate voltage.

This hook-up may be used with either C-199 or UV-199 tubes, by omitting the potentiometer and connecting the B− of the detector B battery to the A+ and connecting the B− of the first 45 volt B battery to the B+ of the detector B battery, and substituting the 6 ohm rheostat for a 25 ohm rheostat. However, dry cell tubes will not deliver the volume that may be obtained from the larger tubes.

As to the antenna, ordinarily a single wire 100 ft. long, seven strand copper, 40 or 50 ft. high, exclusive of the lead-in, will give excellent results. The antenna may be supported at each end by strain insulators brought down through a lead-in insulator. Try to make the antenna all one wire so as to avoid connections.

When soldering, take your time and make a good clean job of it, clean your joints well and use as little paste as possible. It is not advisable to use spaghetti; it's good to look at and that's all. Pull it off your old set and notice. the difference. Of course, in the instance where one wire crosses another it will be found necessary to use some form of insulation.

If you wish to use push-pull amplification, be careful or you will "bust a speaker," especially on stations within 500 miles.

LEGEND

A. A single turn of bus wire around coil C, 1-4 of an inch from beginning of winding, running in same direction as wire in coil.

B. Secondary winding, 65 turns, No. 18 D. S. C.

C. Reaction stabilizer winding, 34 turns No. 18, D. S. C.

D. Antenna tuning coil, double bank wound, 43 turns of No. 18, D. S. C. mounted at right angles to coils B and C.

The above coils may be purchased wound on thin bakelite, made for the 4 circuit tuners.

E-I, E-2. .0005 mfd. vernier variable condenser, low loss.

F. Variable grid lead, 1-4 to 10 meg.

G. Variable grid condenser .0005 mfd.

J-I C-300 or UV 200 vacuum tube.

J-2 C-301A or UV 201A vacuum tube.

K6-. ohm vernier type rheostat.

L-I, L-2. 25 ohm rheostat.

M-1. Double circuit jack.

M-2. Single circuit jack.

N-1, N-2. Audio frequency transformers, preferably of low ratio. Mount directly under tubes to have short leads.

9. 400 ohm potentiometer.

Q. Switch arm.

R. Rotary plates of condensers.

S. Stationary plates of condensers.

T. Mica fixed condenser .0005 mfd.

U. Mica fixed condenser .00025 mfd.

V. A Resistance, 25,000 to 200,000 ohms.

X. Starting of bank wound coil, or end on which taps are close together.

In the following letter, the writer shows how, by inserting a loading coil in the antenna, he was able to get many more stations than he did before. The use of small coils in the antenna circuit has hindered many from getting the stations on the higher wave lengths.

RADIO AGE,
Gentlemen:

After reading your magazine for several months, I decided to contribute my list of stations received. Looking over my list, I feel that it's not so bad when one considers that Summer shortens your range and static occasionally prevents DX reception.

At first my set would not work right. I could not tune above 390 meters, but I built a loading coil, and now I get them all.

KFKX comes in like a local some nights. The rest of the list is:

WTAM, WJAZ, WHK, KDKA, WHAZ, WBZ, KFKX, WTAS, WLW, WGY, WTAX, WDAP, WGY, WEAM, WDAR, WDAF, KYW, WLAQ, WTAY, WCK, WSAI, WCAD, WEAF, WCAE, WCX, WWJ, WTAZ, KOP, WOC, WEBH, WQJ, WOS, WSB, WLS, WHN, WOAR, KSD, WCAY, WEAN, WNAC.

Some of these stations were heard during the month of June, but I have heard many of them since then.

Very truly yours,
FRANKLIN TROUTMAN.
11304 Cotes Ave.,
Cleveland, Ohio.

Many of the letters contain reports for months at a time. The following shows what a DT did in one night. By the looks of things, Old Man Static doesn't rate very high in Michigan. Anyway, read this:

RADIO AGE,
Gentlemen:

I have been a subscriber to RADIO AGE for a little over a year,

(Continued on page 57.)

CONSTRUCTION NOTES (S-10-20)

SOLDERING AND CONNECTIONS

PURPOSE OF SOLDERING. Wherever possible, wires should be soldered to each other and to the connection posts of the apparatus which they connect. This not only insures a tight joint which will not rattle loose, but also a clean joint in which the contacting surfaces cannot become corroded or oxidized by the air. Wires simply twisted together without soldering soon become coated with a film of oxide or "rust," and as this film is a non-conductor of electricity, the film increases the resistance of the joint or may even cause an open circuit. Soldering is of particular necessity in portable sets where jarring and vibration are likely to cause loose screw terminals or loosened wires.

At points where wire connects to another wire, solder should always be used. At binding posts it is sometimes a question as to whether soldering is desirable, especially if the wires are to be disconnected frequently at these points, but for safety's sake soldering is always better. In extreme cases, it is the practice of many very particular experimenters to solder the lugs of the tubes (prongs) to the socket springs, but while this is advantageous from an electrical standpoint, we do not recommend the practice for beginners. This makes the tubes difficult to remove, and unless one is skilled in handling the soldering copper, damage to the tube is likely to result.

It is good practice, however, to solder the wires to the terminals of rheostats and potentiometers, and where there is not much likelihood of the wires being disturbed, to the four socket posts as well. After the connections to the aerial and ground binding posts have been well tightened up, a drop of solder at this point will prevent the connections from jarring open, and in addition will prevent the screws from turning when the aerial and ground wires are being attached to the set.

The wire connections to the phone jacks must always be soldered under all conditions, care being taken not to use any more solder than absolutely necessary at this point. By lumps of solder on the jacks, the use of acid flux at this point or small pellets gathering under the springs will cause a lot of trouble that is very difficult to locate.

WHAT TO AVOID. The small fixed condensers and grid leaks used in various parts of the circuit are easily damaged by excessive heat applied by the soldering copper, and great care should be taken to prevent the heat from traveling along the wire and into these parts. The heat of the iron will cause the paraffin to run out of the condensers or will cause the grid leaks to pack and change their value. The same precautions should be taken in soldering wires to parts that are already soldered, for it is an easy matter to unsolder the first joints and cause all sorts of trouble. To prevent the heat from travelling along the wire into points where heat is not desired, lay the corner of a damp cloth on the wire between the joint being soldered and the part to be protected. Be careful not to have the cloth so wet that it will drip and destroy the insulation.

Another thing to observe in soldering is the "flux" or soldering cleaners used to clean the surfaces of the metal. Soldering acids and a great many of the soldering pastes should be avoided, since they never completely dry out after soldering ,and therefore often result in annoying short circuits and noisy operation. Rosin is the best flux and will not cause short circuits, but as the rosin is an excellent insulator, care should be taken not to get it in between contact points or between parts which are supposed to be in electrical contact. In soldering jacks, the rosin must he kept from flowing into the jack contacts.

COMPILED BY
J. B. RATHBUN

CONSTRUCTION NOTES (S-10-21)

SOLDERING AND CONNECTIONS

When a soldering acid is used on parts which are closely spaced, the acid is likely to cause a short circuit as before explained, and still further causes a continuous crackling, snapping noise like a good dose of old fashioned static. This noise can be distinguished from static by disconnecting the aerial and ground wires. If the noise now still goes on you can be quite sure that the acid is still damp and is generating current at each of the joints like a series of small batteries. A pair of wires soldered together and wet with acid forms a small "couple" or battery which is capable of generating enough current to make an awful noise in the headset. Eventually the wires will become so corroded that they will break off or introduce unnecessary resistance into the circuit.

FLUX. Rosin core solder, which is a hollow wire of solder with rosin in the central hole, is very convenient and is used by practically all large telephone manufacturing companies, in their assembling departments. It is rather difficult to handle at first, but one soon gets the knack of handling it. The joints to be soldered must be made quite hot by means of the soldering copper before the rosin will flow freely into all the crevices.

There are a number of rosin solutions on the market which are very good and which make it easy for the beginner to spread the flux uniformly over the surfaces. The rosin is dissolved in alcohol, acetone or other non-acid solvent and there is no danger of causing short circuits as with acid and certain soldering pastes.

THE SOLDERING COPPER. The common soldering copper is so common that an extended description seems unnecessary. Generally it consists of a cylindrical copper bolt with a pointed end which is provided with an iron wire shank and a wooden handle. The electrical soldering irons are much more convenient, as they remain hot continuously as long as they are in use without the necessity of stopping work while the copper is being heated over the gas as with the old simple tool.

For radio work a small iron with a sharp point is the most desirable, as it is necessary to work in small spaces. The great objection to a very small iron of the common type is that it cools off rapidly and must be reheated at very frequent intervals. The point should preferably be of a sharp chisel point type, sharp along the edge and with an edge about one-quarter inch wide. The point must be filed off and sandpapered bright and clean before using, and then heated quite hot and "tinned" by rubbing it into flux and solder alternately. The point must always be provided with a bright clean coat of solder, or soldering cannot be properly performed. Should this coat of tin be burned off, then the end of the copper should be filed or scraped and the tinning operation should be repeated.

When the copper is accidentally overheated by heating it to a red heat, it will no longer hold its tin coating and must be given a treatment. Plunge the copper into cold water while it is still red hot, and then hammer the end thoroughly with a steel hammer while cold to readjust the fibers. After hammering, the copper will be found to take its tinning as before. If the iron is burned so bad that there are deep pits in the end, then it must be filed into shape with a coarse file before attempting to do any soldering.

A hot iron, held at just the temperature where a play of colors starts to run across its surface, must be had if soldering is to be properly performed. The solder must be heated so that it becomes thin and runs freely into all openings on the parts to be joined. Cold pasty solder forms a poor weak joint, and you must he careful that the copper is not allowed to cool down to the point where the solder has a mussy granular appearance.

COMPILED BY
J. B. RATHBUN

(Continued from page 55.)

and I find, as have thousands of others, that this magazine is just the dope for a radio "nut."

I have been particularly interested in your Dial Twisters, as I haven't had a list which I considered long enough to warrant your attention.

On the night of July 1st, from 9:15 until 12:00 midnight, I received the following: WWAE, WWJ, WCX, KYW, WRC, WLW, WHB, WEBH, WLS, KDKA, WOAW, WQJ, WTAF, KFKX, WMC, WFAA, WCAY.

The reception was perfect and so loud that persons several blocks away heard the music distinctly, through the loud speaker.

I am using a Crosley Trirdyn receiver on a 150 foot L-type aerial.

I consider this somewhat of a record for Summer reception, as the weather conditions have been anything but favorable for radio.

I am located at a point midway between Duluth, Minn., and Marquette, Mich.

The Crosley Trirdyn receiver is in my estimation the most easily operated and the loudest receiver for the price on the market.

This may or may not reach the printed page, but you have my list.

Does this warrant a D. T.?

Very truly yours,
CLAIR McCORMICK.
% Jenson Mercantile Co.,
Ewen, Mich.

Albert Westphal's letter will make those that live in out-of-town locations appreciate it. By this time we all know what the location surrounding the receiving set means to reception.

Considering the noise and sparking of the electric line, combined with a power house located a block away, Mr. Westphal hands in a very good list

RADIO AGE,
Gentlemen:

As a candidate for the Royal Order of Dial Twisters, I would like to submit the following:

KDKA, KYW, WAAM, WBAP, WBAY, WBBR, WBS, WBT, WBZ, WEAF, WDAP, WDAR, WEAF, WFAF, WCJ, WCY, WGR, WHAZ, WHN, WIP, WJAX, WJY, WJX, WJZ, WMAC, WMAF, WMAK, WOC, WOO, WOR, WOAO, WRW, WSAI, WTAM, WWJ, WWI .

Please note that I live in a block where there are elevated and surface lines in front of my house. A power house is a block away. I use an indoor aerial about 40 ft. long, bending several times.

My set is a single circuit three tube receiver as described in the Consolidated Call Book.

Not so bad, eh?

Respectfully submitted,
ALBERT C. WESTPHAL.
1667 Palmetto St.,
Brooklyn, New York.

RADIO AGE,
Gentlemen:

I have built the Baby Heterodyne as modified by A. F. Van Louven, of Los Angeles, using coils wound like

Pfanstiehl, two low loss condensers and W. D. 11 tube.

To my amazement the set worked right off the reel, giving wonderful volume on our local station. I have also heard three or four out-of-town stations four or five hundred miles distant with the best volume I have ever heard on a one-tube set, and that in the month of August. The set is easy to tune. I agree with Mr. Van Louven that it is a wonder, and I want to thank Mr. Rathbun for giving us the hook-up. See if you can't induce Mr. Rathbun to work out one or two more stages on this set for the average man who only wants two or three tubes. I am sure he can do it, notwithstanding his opposition to W. D. 11 tubes.

With thanks to the best magazine published, I am,

Very respectfully,
C. E. HINES.

703 Central Bank Bldg.,
Memphis, Tenn.

The PICKUPS SECTION with the coming months promises to be one of the greatest features of RADIO AGE. So come on, all you "space annihilators" and make up for all the trouble Old Man Static has caused you.

Our goal this Winter is DISTANCE—get that? DX!

Hang a card up in front of your set with "DX" painted on it, and every time you put the "cans" on, think of the million and one stations that you are going to receive. Keep an accurate list and don't forget to send them in.

The Pickups department is growing fast and we're waiting for your lists. LET'S GO, GANG!—THE PICKUPS EDITOR.

Zenith With Radio Stores

A deal of considerable importance to dealers in the New York metropolitan area was consummated recently, whereby the Radio Stores Corporation, of 218-222 West 34th Street, New York City, have secured a jobbing franchise from the Zenith Radio Corporation, of Chicago, through the Eastern Office, located at 1269 Broadway, New York City.

Mr. Gross, when interviewed, stated: "We have been endeavoring for some time to become jobbers of Zenith products, having become convinced that Zenith is one of the best selling radio lines obtainable.

Who's Who In The *Radio Industry*

Various men of importance in the radio industry will be reviewed from month to month in this newly created department of RADIO AGE. Material for this department is solicited from corporations and manufacturers who have in their personnel men of prominence and who deserve publicity for some accomplishment or work which benefits the radio field as a whole.

The "Early Bird" in Radio Caught the Business

Plodding the heat-baked pavements of Chicago during the hot summer days of 1922 when radio dealers were few, far between and equally far from optimistic, due to the terriffic slump that had hit radio at that time, was a man who had a vision to spur him on.

Robert Himmel

This man was then representing certain radio manufacturers. But that Summer, while he disposed of optimism in large lots, he sold goods in small parcels.

Today this same man heads a large radio house, which he personally founded that same Fall. And all because he foresaw and believed in the tremendous possibilities in radio and was not to be sidetracked by temporary unfavorable conditions.

He is Robert Himmel, president and general manager of Hudson-Ross at Chicago. In the short space of two years his company has become a recognized national factor in the radio distributing field.

"Quality Goods" Only

A stout believer in quality products backed by national advertising, he conceived the plan of creating a wholesale organization that would take the goods of reliable radio manufacturers who advertise, and by proper merchandising place these goods in the hands of progressive dealers to be sold to the public.

Instead of treating radio as a side-line, this organization would handle nothing but radio. Moreover, it would sell to dealers only.

He advocated that dealers buy well-advertised lines, lines that the public knew, and the dealers quickly disposed of what they purchased. They "turned over" their investments with speed, and as they grew and succeeded, Hudson-Ross expanded with them. "Turnover" is Mr. Himmel's explanation of his success.

Soon Mr. Himmel found it necessary to have more space, and to add to his force. He multiplied the size of his stocks to be able always promptly to accommodate his customers. Again and again was it necessary to enlarge the offices, the warehouse space, and stocks and the organization, until today, at the original address—the firm of Hudson-Ross occupies quarters fifty times the size of the first office.

The slogan of Hudson-Ross is "Legitimate Merchandise—Legitimately Merchandised."

"Radio Is Universal Entertainer," Says Powel Crosley, Jr.

The development of low-price dreceiving sets capable of good all-year-round reception, as evidenced by the excellent equipment of this character now on the market, has placed the man of small means virtually on the same plane as the rich man, insofar as opportunity for enjoying life is concerned, Powel Crosley, Jr., one of the leading radio manufacturers of the United States, declared recently.

"I look forward to the time when radio will be regarded as an indispensable source of home entertainment," said Mr. Crosley. "Modern man cannot live without diversion—and how can he obtain as unfailing a variety of entertainment, day in and day out, and at such a small investment, as he now secures through radio?

"To the family of sufficient means to enjoy the opera, the theater and other forms of entertainment at will, radio offers an additional source of diversion, information and culture, brought directly to the home," Mr. Crosley pointed out. "But to the family of moderate circumstances, to whom the more costly forms of entertainment come as a luxury, radio indeed is a universal source of entertainment.

"The city dweller, when he comes home oppressed with the care and routine of his life in office or factory, requires amusement of the sort which will divert his mind from the daily grind of activities. Radio has come to him as manna from the heavens.

"I consider that radio satisfies a definite spiritual need of the people, and that it is destined to have a profound effect on the life of the modern man. It will go far toward allaying the restlessness and discontent that is largely a product of overwrought nerves, insufficiently rested by amusement and mental diversion."

Hazardous Adventures As a Young Operator

(Continued from page 24.)

veloped an annoying swing in received signals. The aerial had been up for three years and was badly corroded and oxidized, and when Carey and I started to lower the after end, the cable stuck in the block, despite vigorous prayerful remarks made by Carey at the aftermast. Carey gave a wrathful yank on the flimsy leads and—what follows sounds like slapstick, but it is gospel truth—one of the leads broke off, came snaking down around us, and the end, an ugly snare of seven sharp, salty, smoke-covered barbs, caught right in Carey's nose and stayed there. With the wire still holding fast, and gouging at every little movement until the blood spurted all over, there was no comedy apparent at the moment. Carey's bellow brought help, and the doctor was quickly on the job, but, believe me, we had one hard time getting that wire out of Carey's nose and the old beak was fearfully lacerated when the delicate job was done.

The Fall of China

We left the calm waters of some port during breakfast, for a short run to the next stop. The meal had been served in calm weather style, with complete china and silver service, and of course without the racks which in rough weather persuade the stuff to stay on the tables. We steamed into a heavy swell, which struck us square on the beam for a few minutes, which was a disastrous thing for it to do to a ship all rigged out for fair weather. After one little, harmless roll, the "Seminole" laid right over flat on her starboard side just once. There was the grandest crash in all time from the pantry and only a slightly lesser one from the dining room itself, where the tables were stripped as clear as they had been before they were set. The principal comedians were some of the ship's officers sitting at the head of the thwartship tables. These young men were the glad recipients of ten complete covers, consisting of everything but the linen. Along with the china and cutlery came at least one portion of everything on the menu from grapefruit to coffee, and if there is anything that detracts from the dignity of a natty, gold-laced white uniform, it is several plates of oatmeal and half a dozen soft-boiled eggs spread thickly from shoulders to lap.

My interest in communications of all kinds, as well as wireless, let me in on a little comic opera which is far more amusing today than it was at the time it was being staged.

One day I found myself pursued by two native sleuths in the inconspicuous garb of white army uniforms loaded with yards of glistening gold braid. Upon discovery, these actors went through an amusing scene to convince me that they were not interested in me, and if I had started in their direction they might have retreated. But I made the tactical blunder of trying to cut through an alley and beat it back to the ship,

which bucked up their waning courage immensely. Assisted by several score of spectators, I was quickly rounded up. A slight hint of resistance on my part brought a show of sword play from the two braves and a yell of expectation from the audience. I suffered myself to be led to the Commandante's office. A lengthy speech in Spanish was delivered to me by an officer in a carriage starter's uniform. I attempted to explain that I did not understand Spanish, but at every interruption the orator folded his arms and waited, my captors drew their swords and the whole assembly arose in horrified protest. Finally an American merchant was sent for, and he explained (after I had tried to kiss him for joy) that a revolution was on and that my similar actions in several towns had excited suspicion. I was before the council to explain why I should not be executed as a rebel agent bent on destroying the Government's communication systems.

Adopting "Safety First"

My American friend advised me to get the Captain of the ship at once! I refused. This must have aroused the suspicions of the American himself, as he looked at me curiously for a moment. However, he agreed with the high moguls to be responsible for anything that I might do to the Government, and interpreted to me an order from the council to the effect that I was to go to the ship and never set foot ashore again. I did go ashore in Santo Domingo city, but on the way back I had another shock that kept me within running distance of the ship the rest of the time we were in the island. A dusky citizen speaking very good English approached me and asked if I had any small arms and ammunition to sell at a good price. To me this bird was one of the same gang that had me corralled before, probably trying me out on some more revolutionary bait. I did not even wait to say "No"—I yelled from a distance of about 100 feet, all the time making fast progress to the dear old "Seminole."

The trip back was uneventful. Arrived in New York after a beautiful northbound passage, I was on the fence about resigning, and by the time I was again ascending in the elevator to see dear H. J. H., with all the grief behind me as experience, I was a little ashamed of the boyish letter I had written Mother from Monte Christi.

He looked up and—smiled broadly. "Why, hello, Leech," he said cheerily.

"Hello," I responded in a smallish voice.

"How'd you make out?" he asked. I thought briefly of the million times a night that I had burned up the air with my "OS" and could only grin in reply.

"Guess you did fine," he returned approvingly. "We got your 'OS' every night."

"So did San Francisco, I'll bet," I thought. But I only said, very discreetly: "Yes, sir."

[In the November RADIO AGE Mr. Leech will narrate his thrilling adventures as an "Op" to Jamaica on the Steamers "Admiral Schley" and "Admiral Farragut."]

Rheostats: How They Affect Audibility

(Continued from page 7.)

tube, but most of them are useful when a low-voltage tube is in use. The fact that none of the curves shows the secondary peak of audibility of the UV 200 being reached by either of the rheostats, is not the fault of the rheostats. It is due to the failure of the ordinary "A" battery to supply the necessary voltage to reach the peak. The radio fan will have little if any interest in this secondary peak—what he wants is the high spot. The valley between the peaks is interesting, however, for it represents the "hissing point" which occurs at about 5.25 volts.

Mr. Hoyt goes on to say that the rheostat should not be blamed for all of the troubles that interfere with good audibility. The battery may be at fault. This is particularly true in the case of the WD 11 and WD 12 types, which operate on one dry cell. A dry cell is supposed to deliver 1.5 volts, but after a very short period of use, it drops considerably below that value. Mr. Hoyt advises using two No. 6 dry cells in parallel, or multiple, with these tubes. It is hoped the proportion of beginners who connect the batteries in series, thus doubling the voltage and burning out the tube, will become less and less as the fundamentals of electricity become more generally known.

The Wire Rheostat

HIS final analysis is rather hard on a device that all of us have used, and that some of us still buy and will continue buying, perhaps, for use with the non-critical tubes in amplifiers—namely, the wire rheostat. It has the great advantage, from the point of view of the fan with little money, of costing fifty cents or a dollar less than the newer devices that give finer control. Mr. Hoyt says of it: "We see that wire rheostats have their entire regulation range confined to within about three-fourths of a turn, with the additional disadvantage of depending on a slider which passes from convolution to convolution of the resistance wire, in contact at all times with two or three surface wires, while four-fifths or more of the total resistance represented by these surface turns is on that part of the convolution not available to the slider's regulation."

He did not mention the fact that some wire rheostats have a vernier control in which a separate glider reaches every point of several turns of wire. If he had done so, perhaps he would have mentioned also the fact that this wire sometimes wears out or burns off.

If anyone wishes to take exception to Mr. Hoyt's point of view on any of these matters, he has the physicist's permission. Mr. Hoyt has given us the diagram of his testing circuit so that anyone may make the same tests that he made or any others that the experimenter may wish to make. Neither he nor I is in the business of selling radio apparatus.

Another article by Armstrong Perry next month.

"Blazing the Trail" for Beginners

(Continued from page 8)

But do not expect them to last that long if you sit up every night until 3 a. m. And by all means do not forget to turn off the current when you are through operating. Many a man has used up a new set of batteries in short order because he forgot to turn off his rheostats or circuit switch.

14. *How do I know when my "A" batteries need replacing?*

You can quickly detect the fact by the gradual decrease of volume. This can be overcome for a time by turning up your rheostats until you have finally cut out all the rheostat's resistance and are using the full voltage of your batteries. If the volume continues to decrease after you have done this, you will know that it is time to buy a new set of "A" batteries.

15. *Will a storage "A" increase the efficiency of my set?*

The current from a storage battery will not give you any better reception than the *same* current from a dry battery. The advantage of a storage battery is that it eliminates the expense of battery replacement and always gives full voltage on your tubes, assuring uniform reception. The use of a storage battery is more convenient and economical when you have electric current in the house so that you can charge it yourself. The current cost of charging is very low.

16. *How long should "B" batteries last?*

The life of your "B" Batteries depends upon the way you use your set. A conservative estimate, considering average use, would be six months. The life of a "B" battery depends first and foremost on the size of that battery. Remember the voltage of a battery is no indication whatever of its ampere-hour capacity. Desired voltage is obtained by connecting up a number of cells, each cell producing 1 1-2 volts, no more, no less. That cell may be a large one or a small one. The voltage is still 1 1-2. A 45-volt battery is composed of 30 cells and the life of any battery depends on how large these cells are.

17. *How am I to know when my "B" batteries need replacing?*

You may test them with a voltmeter, or better yet, test any 22 1-2 v. battery with a 25 or 50 volt electric light bulb. Place its base on one terminal of the battery and connect the side of it by wire to the other terminal. If the filament burns red, the battery is satisfactory. Run down "B" batteries sometimes create a noise similar to "static," but it is difficult to decide whether such noise is due to the batteries or outside causes.

18. *Will the use of storage batteries improve the operation of my set?*

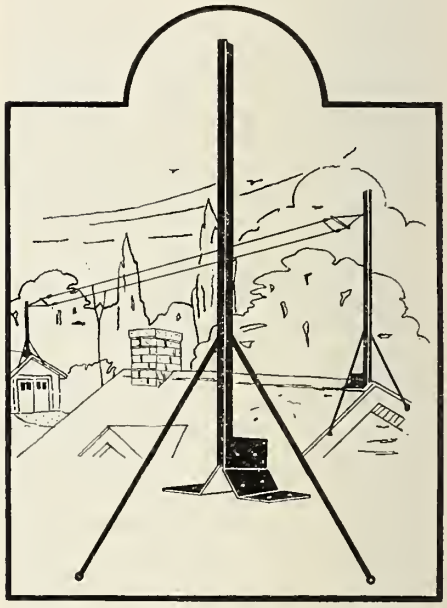
With the proper voltage applied to the plate circuit of your set, it makes no difference whatever whether this voltage comes from dry batteries or storage batteries, but an advantage lies with the storage battery in that it enables you to keep your voltage entirely

up to par always. If you use your set so much that you have to replace "B" batteries frequently, you might find it desirable to invest in storage "B" batteries which can be recharged with the same charger you would use for storage "A" battery.

19. *Is it possible that a tube will fail to fun tion as a Detector or Amplifier although the filament will light up?*

Yes. If you suspect that one of your tubes is not functioning properly, test it out by trying one tube after another as detector and noting the difference, if any. If any one of your tubes seems to operate properly in one socket and fails to operate in any other socket, then look for your trouble either in the socket or in the adapter. See that a clean and perfect contact is made between the pins and springs.

(Continued in November Radio Age)



The New Kraco Aerial Mast

Radio fans will be interested in learning that their troubles of erecting outside radio aerial masts are over. This change was brought about by the new Kraco all-steel adjustable aerial mast that is now being made and distributed by the Kedmont Mfg. Co., Chicago.

Your Radio Troubles Ended for 30c in Stamps

If you are constructing a receiving set and need diagrams that will produce perfect results, RADIO AGE can help you by return mail.

We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed hookups to be found in these issues. Select the ones you want and enclose 30 cents in stamps for each desired.

May, 1922
—How to make a simple Crystal Set for $6.

September, 1922
—How to make a Regenerative Set at a low cost.

October, 1922
—How to make a Tube Unit for $23 to $37.
—How to make an Audio Frequency Amplifying Transformer.

November, 1922
—Design of a portable short-wave radio wavemeter.

May, 1923
—How to make a portable Reinartz set for summer use.

June, 1923
—How to build the new Kaufman receiver.
—What about your antenna?

December, 1923
—Building the Haynes Receiver.
—Combined Amplifier and Loud Speaker.
—A selective Crystal Receiver.

January, 1924
—Tuning Out Interference—Wave Traps—Eliminators —Filters.
—A Junior Super-Heterodyne.
—Push-Pull Amplifier.
—Rosenbloom Circuit.

February, 1924
—How to make a battery charger.
—Single Tube Heterodyne.
—Adding two audio stages to selective receiver which began as a crystal set.
—Superdyne receiver.

March, 1924
—An Eight-Tube Super-Heterodyne.
—A simple, low loss tuner.
—A Tuned Radio Frequency Amplifier.
—Simple Reflex Set.

April, 1924
—An Efficient Super-Heterodyne (fully illustrated).
—A Ten-Dollar Receiver.
—Anti-Body Capacity Hookups.
—Reflexing the Three-Circuit Tuner.
—Index and first two installments of Radio Age Data Sheets.

May, 1924
—Construction of a Simple Portable Set.
—Radio Panels.
—Third Installment of Radio Age Data Sheets.

June, 1924
—Important Factors in Constructing a Super-Heterodyne.
—A Universal Amplifier.
—A Sure Fire Reflex Set.
—Adding Radio and Audio to Baby Heterodyne.
—Radio Age Data Sheets.

July, 1924
—A Portable Tuned Impedance Reflex.
—Operating Detector Tube by Grid Bias.
—A Three-Tube Wizard Circuit.
—Data Sheets.

August, 1924
—Breaking Into Radio Without a Diagram.
—The English 4-Element Tube.
—Filtered Heterodyne Audio Stages.
—An Audio Amplifier Without an "A" Battery
—Data Sheets.

September, 1924
—How Careful Mounting Will Improve Reception.
—One Tuning Control for Hair's Breadth Selectivity.
—Four Pages of Real Blueprints of a New Baby Heterodyne and an Aperiodic Variometer Set.
—Data Sheets.

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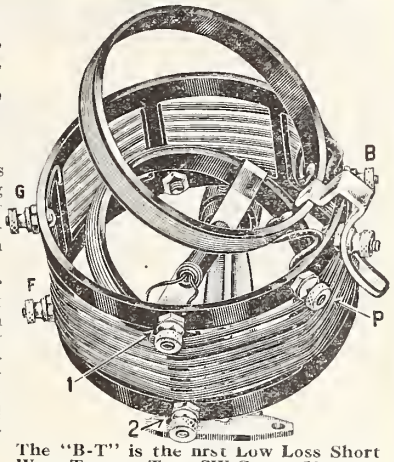

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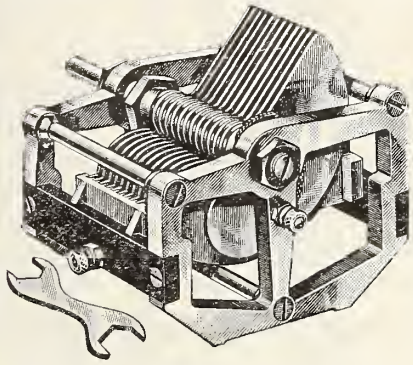

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Corrected List of U. S. Broadcasting Stations

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh	326
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270
KDPT	Southern Electrical Co.	San Diego, Calif.	244
KDYL	Telegram Publishing Co.	Salt Lake City, Utah	360
KDYM	Savoy Theatre	San Diego, Calif.	244
KDYQ	Oregon Institute of Technology	Partland, Oreg.	360
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZE	Rhodes Department Store	Seattle, Wash.	270
KDZI	Electric Supply Co.	Wenatchee, Wash.	360
KDZR	Bellingham Publishing Co.	Bellingham, Wash.	261
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	360
KFAE	State College of Washingtoa	Pullman, Wash.	330
KFAF	Western Radio Corporation	Denver, Colo.	278
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif.	280
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280
KFAY	W. J. Virgin	Medford, Oreg.	283
KFBB	F. A. Buttrey & Co.	Hnvre, Moat.	360
KFBC	W. K. Azbill	San Diego, Calif.	278
KFBE	Reuben H. Horn	San Luis Obispo, Calif.	242
KFBG	First Presbyterian Church	Tacoma, Wash.	360
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and the Chronicle News	Trinidad, Colo.	360
KFBU	The Cathedral (Bishop N. S. Thomas)	Laramie, Wyo.	283
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFCF	Frank A. Moore	Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)	Billings, Mont.	360
KFCL	Leslie E. Rice	Los Angeles, Cal.	236
KFCP	Ralph W. Flygare	Ogden, Utah	360
KFCV	Fred Mahnfeyl Jr.	Houston, Texas	360
KFCZ	Omaha Central High School	Omaha, Nehr.	258
KFDD	St. Michaels Cathedral	Boise, Idaho	232
KFDH	University of Arizona	Tuscon, Ariz.	368
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	360
KFDR	Bullocks' Hardware & Sporting Goods (Roh. G. Bullock)	York, Nebr.	360
KFDX	First Baptist Church	Shreveport, La.	360
KFDY	South Dakota State College of Agriculture and Mechanics Arts	Brookings, S. Dak.	360
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank Co.	Portland, Oreg.	360
KFEL	Winner Radio Corp.	Denver, Colo.	254
KFEQ	Screggin & Compaay Bank	Oak, Nebr.	268
KFER	Auto Electric Service Co.	Fort Dodge, Iowa	231
KFEV	Radio Electric Shop	Dauglas, Wyo.	263
KFEX	Augsburg Seminary	Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Miaing and Concentrating Co.	Kellogg, Idaho	360
KFEZ	Asso. Engr. Societies of St. Louis	St. Louis, Mo.	248
KFFB	Jenkins Furniture Ca.	Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.	Pendleton, Oreg.	360
KFFP	First Baptist Church	Moberly, Mo.	266
KFFR	Nevada State Journal (Jim Kirk)	Sparks, Nev.	226
KFFV	Graceland College	Lamoni, Iowa	280
KFFX	McGraw Co.	Omaha, Nebr.	278
KFFY	Pineus & Murpby	Alexandria, La.	275
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	273
KFGL	Arliagton Garago	Arlington, Oreg.	234
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFGX	First Presbyterian Church	Orange, Tex.	250
KFGZ	Emmanuel Missionary College	Berrien Springs, Mich.	268
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHD	Utz Electric Shop Co.	St. Joseiih, Mo.	226
KFHH	Ambrose A. McCue	Neah Bay, Wash.	283
KFHJ	Fallon & Co.	Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.	Seattle, Wash.	270
KFI	Earle C. Anthony (Inc.)	Los Angeles, Calif.	469
KFID	Ross Arbuckle's Garage	Iola, Kans.	246
KFIF	Benson Polytechnic Institute	Portland, Oregon	360
KFIL	Windisch Electric Farm Equipment Co.	Louisburg, Kans.	234
KFIO	North Centrnl High School	Spokane, Wash.	252
KFIQ	First Methodist Church	Yakima, Wash.	242
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIV	V. H. Broyles	Pittsburgh, Kans.	240
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huelsman	Fon Du Lac, Wis.	273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	Seattle Post Iatelligencer	Seattle, Wash.	233
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	252
KFJI	Liberty Theatre (E. F. Marsh)	Astoria, Oreg.	252
KFJK	Delano Radio and Electric Co.	Bristow, Okla.	233
KFJL	Hardsacg Manufacturing Ca.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	229
KFJQ	Valley Radio, Div. of Elec. Constr. Co.	Grand Forks, N. D.	280
KFJR	Ashley C. Dixoa & Son	Stevensville, Mont. (near)	258
KFJX	Iowa State Teacher's College	Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	248
KFJZ	Texas Natioual Guard, One hundred and twelfth Cavalry	Fort Worth Texas	254
KFKA	Colorado State Teachers College	Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association	Milford, Kans.	286
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark.	224
KFKV	F. F. Gray	Butte, Mont.	283
KFKX	Westinghouse Electric & Manufacturing Co.	Hastiags, Nehr.	286
KFKZ	Nassour Bros. Radio Co.	Colorado Springs, Colo.	234
KFLA	Abner R. Willson	Butte, Mont.	283
KFLB	Signal Electric Manufacturing Co.	Menominee, Mich.	248
KFLD	Paul E. Greenlaw	Franklinton, La.	234
KFLE	National Educntional Service	Deaver, Colo.	268
KFLG	Bizzell Rndio Shop	Little Rock, Ark.	261
KFLR	University of New Mexico	Alhuquerque, New Mexico	254
KFLU	Rio Grande Radio Supply House	San Benito, Texas	236
KFLV	Rev. A. T. Frykman	Rockford, Ill.	229
KFLW	Missoula Electric Supply Co.	Missoula, Mont.	234
KFLX	George Roy Clough	Galvestoa, Tex.	240
KFLY	Fargo Radio Supply Co.	Fargo, N. Dak.	231
KFLZ	Atlantic Automobile Co.	Atlantic, Ia.	273
KFMQ	University of Arkansas	Fayetteville, Ark.	263
KFMR	Morningside College	Sioux City, Iowa	261
KFMT	Dr. George W. Young	Minneapolis, Minn.	231
KFMW	M. G. Sateren	Houghton, Mich.	266
KFMX	Carleton College	Northfield, Minn.	283
KFNF	Heary Field Seed Co.	Shenandoah, Iowa	266
KFNG	Wooten's Radio Shop	Coldwater, Miss.	254
KFNJ	Warrensburg Electric Shop	Warrensburg, Mo.	234
KFNL	Radio Broadcast Ass'n.	Paso Robles, Calif.	240
KFNV	L. A. Drake Battery and Radio Supply Shop	Santa Rosa, Calif.	234
KFNX	Peabody Radio Service	Peabody, Kansas	240
KFNY	Montana Phonograpb Co.	Helena, Montana	261
KFNZ	Royal Radio Company	Burlingame, Calif.	231
KFOC	First Christian Church	Whittier, Calif.	236
KFOD	Vern Peters	Wallace, Idaho	224
KFOJ	Moberly High School Radio Club	Moberly, Missouri	246
KFOL	Leslie M. Schafbush	Marengo, Iowa	234
KFON	Echophone Radio Shop	Long Beach, Calif.	234
KFOO	Latter Day Saints University	Salt Lake City, Utah	261
KFOQ	Ora William Chancellor	Galveston, Texas	240
KFOR	David City Tire & Electric Co.	David City, Nebraska	226
KFOT	College Hill Radio Club	Wichita, Kansas	231
KFOX	Board of Education, Technical High School	Omaha, Nebraska	248
KFOY	Beacon Radio Service	St. Paul, Minn.	226
KFOZ	Leon Hudson Real Estate Co.	Fort Smith, Ark.	233
KFPB	Edwin J. Brown	Seattle, Wash.	224
KFPG	Garretson and Dennis	Los Angeles, Calif.	238
KFPH	Harold Chas. Mailander	Salt Lake City, Utah	242
KFPL	C. C. Baxter	Duhlin, Texas	242
KFPM	The New Furniture Co.	Greenville, Texas	242
KFPN	Missouri National Guard	Jefferson City, Mo.	242
KFPO	Colorado National Guard	Denver, Colo.	231
KFPP	G. & G. Radio & Electric Shop	Olympia, Washington	236
KFPQ	Clifford M. Esler	Denison, Texas	231
KFPR	Los Angeles Co. Forestry Dept.	Los Angeles, Calif.	231
KFPS	Carter A. Ross Motor Service Co.	Casper, Wyo.	242
KFPV	Heintz & Kablmoos, Inc.	San Francisco, Calif.	236
KFPW	St. Johns M. E. Church S.	Carterville, Mo.	268
KFPY	Symons Investment Co.	Spokane, Wash.	283
KFPX	First Presbyterian Church	Pine Bluff, Ark.	242
KFQA	The Principia	St. Louis, Mo.	261
KFQB	The Searchlight Publishing Co.	Fort Worth, Tex.	254
KFQC	Kidd Brothers Radio Shop	Taft, Calif.	227
KFQD	Chovin Supply Co.	Anchorage, Alaska	280
KFQE	Dickenson-Henry Radio Laboratories	Colorado Springs, Colo.	224
KFQG	Southern Calif. Radio Ass'n.	Los Angeles, Calif.	226
KFQH	Albert Sherman	Hillsbourgh, Cal.	231
KFQI	The Thos. H. Ince Corp.	Culver City, Calif.	234
KFQJ	Harbour-Longmire Company	Oklahoma City, Okla.	236
KFQK	Democrat Leader	Fayette, Mo.	236
KFQL	Oklahoma Free State Fair Assa.	Muskogee, Okla.	252
KFQR	Walter LaFayette Ellis	Oklahoma City, Okla.	250
KFQS	Dickenson-Henry Radio Laboratories	Manitou, Colo.	246
KFQT	Texas National Guard	Deaison, Texas	252
KFQU	W. Riker	Holy City, Calif.	234
KFQV	Omaha Grain Exchange (Portable)	Omaha, Nebr.	231
KFQW	C. F. Knierim	North Bend, Wasb.	248
KFQX	Alfred M. Hubbard	Seattle, Wash.	233
KFSG	Angelus Temple	Los Angeles, Calif.	278
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service	Portland, Oreg.	360
KGO	General Electric Co.	Oakland, Calif.	312
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach	360
KGW	Portland Morning Oregoaian	Portland, Oreg.	492
KGY	St. Martias College (Reb. Sebastian Ruth)	Lacy, Wash.	258
KHJ	Times-Mirror Co.	Los Angeles, Calif.	395
KHQ	Louis Wasmor	Seattle, Wash.	360
KJQ	C. O. Gould	Stockton, Calif.	360
KJR	Northwest Radio Service Co.	Seattle, Wash.	270
KJS	Bible Institute of Los Angeles	Los Angeles, Calif.	360
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	360
KLX	Tribune Publishing Co.	Oakland, Calif.	509
KLZ	Reynolds Radio Co.	Denver, Colo.	283
KMJ	San Joaquin Light & Power Corp.	Fresao, Calif.	273
KMO	Love Electric Co.	Tacoma, Wash.	360
KNT	Grays Harbor Radio Co. (Walter Hemrich)	Aberdeen, Wnsh.	263
KNX	Electric Lighting Supply Co.	Los Angcles, Calif.	360
KOB	New Mexico College of Agricultnre & Mechanic Arts.	State College, N. Mex.	360
KOP	Detroit Police Department	Detroit, Mich.	286
KPO	Hale Bros.	San Francisco, Calif.	423
KQP	Apple City Radio Club	Hood River, Oreg.	360
KQV	Douhleday-Hill Electric Co.	Pittsburgh, Pa.	360
KQW	Charles D. Herrold	San Jose, Calif.	360
KRE	V C Battery & Electric Co.	Berkoley, Calif.	278
KSD	Post Dispatch (Pulitzer Pub. Ca.)	St. Louis, Mo.	546
KTW	First Presbyterian Church	Senttle, Wash.	360
KUO	Examiner Printing Co.	San Francisco, Calif.	360
KUY	Coast Radio Co.	El Monte, Calif.	256
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	360
KYQ	Electric Shop	Honolulu, Hawaii	270
KYW	Westingbouse Electric & Mfg. Co.	Chicago, Ill.	536
KZM	Preston D. Allen	Oakland, Calif.	360
KZN	Cope and Johnson Co.	Salt Lake City, Utah	268
WAAB	Valdemar Jensen	New Orleans, La.	268
WAAC	Tulane University	New Orleans, La.	360
WAAD	Ohio Mechanics Institute	Cincinnati, Ohia	360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	286
WAAK	Gimbel Brothers	Milwaukee, Wis.	280
WAAM	I. R. Nelson Co.	Newark, N. J.	263
WAAN	University of Missouri	Columbia, Mo.	254
WAAW	Omaha Grain Exchange	Omaha, Nebr.	286
WABB	Harrisburg Sporting Goods Co.	Harrisburg, Pa.	266
WABD	Parker High School	Dayton, Ohio	283
WABE	Young Men's Christian Association	Washington, D. C.	283
WABG	Arnold Edwards Piano Co.	Jacksonville, Fla.	248
WABH	Lake Shore Tire Co.	Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co.	Bangor, Me.	240
WABL	Connecticut Agricultural College	Storrs, Cnnn.	283
WABM	F. E. Doherty Automotive and Radio Equipment Co.	Saginaw, Mich.	251
WABN	Ott Radio, Inc.	LaCrosse, Wis.	244
WABO	Lake Avenue Baptist Church	Rochester, N. Y.	252
WABP	Robert F. Weinig	Dover, Ohio	266
WABQ	Haverford College, Radio Club	Haverford, Pa.	261
WABR	Scott High School, N. W. B. Foley	Toledo, Ohio	270
WABT	Holiday-Hal, Radio Engineers	Washington, Pa.	252
WABU	Victor Talking Machine Co.	Camden, N. J.	226
WABW	College of Wooster	Wooster, Ohio	234
WABX	Henry B. Joy	Mt. Clemens, Mich.	270
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	263
WBAA	Purdue University	W. Lafayette, Ind.	283
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAN	Wireless Phone Corp.	Paterson, N. J.	244
WBAO	James Millikin University	Decatur, Ill.	360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.	Columbus, Ohio	390
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.	New York, N. Y.	492
WBBA	Newark Radio Laboratories	Newark, Ohio	240
WBBD	Barbey Battery Service	Reading, Pa.	234
WBBE	Alfred R. Marcy	Syracuse, N. Y.	246
WBBG	Irving Vermilya	Mattapoisctt, Mass.	240
WBBH	J. Irving Bell	Port Huroa, Mich.	246
WBBJ	Neal Electric Co., P. E. Neal	West Palm Beach, Fla.	258
WBBL	Grace Covenant Presbyterian Church	Richmoad, Va.	283
WBBM	Frank Atlass Produce Co.	Lincoln, Ill.	225
WBBN	Blake, A. B.	Wilmington, N. C.	275
WBBR	Peoples Pulpit Asso.	Rossville, N. Y.	244
WBBT	Lloyd Brothers	Philadelphia, Pa.	234
WBBU	Jenks Motor Sales Co.	Monmouth, Ill.	224
WBBV	Johnstown Radio Co.	Johnstown, Pa.	248
WBBW	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washingtoa Light Infantry Co. "B" 118tb Inf.	Charleston, S. C.	268
WBBZ	Noble B. Watson	Iadianapolis, Ind.	227
WBL	T & H Radio Co.	Anthony, Kans.	254
WBR	Pennsylvania State Police	Butler, Pa.	286
WBS	D. W. May, Inc.	Newark, N. J.	360
WBT	Southern Radio Corp.	Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co.	Springfield, Mass.	337
WCAD	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa.	462
WCAG	Clyde R. Randall	New Orleans, La.	268
WCAH	Entrekin Electric Co.	Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University	University Place, Nehr.	283
WCAK	Alfred P. Daniel	Houston, Texas	263
WCAL	St. Olaf College	Northfield, Minn.	360
WCAO	Sanders & Stayman Co.	Baltimore, Md.	360
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C.	469
WCAR	Alamo Radio Electric Co.	San Antonio, Tex.	360
WCAT	South Dakota State School of Mines	Rapid City, S. Dak.	240
WCAU	Durham & Co.	Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co.	Little Rock, Ark.	360
WCAX	University of Vermont	Burlington, Vt.	360
WCAY	Milwaukee Civic Broadcasting Station	Milwaukee, Wis.	226
WCAY	The Milwaukee Civic Broadcasting Assn., Inc.	Milwaukee, Wis.	266
WCAZ	Carthage Collego	Carthage, Ill.	246
WCBA	Charles W. Heimbach	Allentown, Pa.	280
WCBC	University of Michigan	Ann Arbor, Mich.	280
WCBD	Wilbur G. Voliva	Zion, Ill.	345
WCBE	Uhalt Radio Co.	New Orleans, La.	263
WCBF	Paul J. Miller	Pittsburgh, Pa.	236
WCBG	Howard S. Williams (Portable)	Pascagoula, Miss.	236
WCBI	Nicoll, Duncan & Rush	Bemis, Tennessee	226
WCBJ	J. C. Maus	Jennings, Louisiana	244

WCBK	E. Richard Hall	St. Petersburg, Fla.	266
WCBL	Northern Radio Mfg. Co.	Houlton, Me.	280
WCBM	Charles Swarz	Baltimore, Md.	229
WCBN	James P. Boland	Ft. Benj. Harrison, Ind.	266
WCBO	The Radio Shop, Inc.	Memphis, Tenn.	250
WCBQ	First Baptist Church	Nashville, Tenn.	236
WCBR	University of Mississippi	near Oxford, Miss.	242
WCBS	Charles H. Meester (Portable Station)	Providence, R. I.	246
WCBT	Clark University, Collegiate Dept.	Worcester, Mass.	238
WCBU	Arnold Wireless Supply Co.	Arnold, Pa.	254
WCBV	Tullahoma Radio Club	Tullahoma, Tenn.	252
WCBW	George P. Rankin, Jr., and Maitland Solomon	Macon, Ga.	226
WCBX	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	233
WCBY	The Forks Electrical Shop	Buck Hill Falls, Pa.	268
WCBZ	Coppotelli Bros. Music House	Chicago Heights, Ill.	248
WCK	Stix, Baer & Fuller Dry Goods Co.	St. Louis, Mo.	360
WCX	Detroit Free Press	Detroit, Mich.	517
WDAE	Tampa Daily Times	Tampa, Fla.	360
WDAF	Kansas City Star	Kansas City, Mo.	411
WDAG	J. Laurence Martin	Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South)	El Paso, Tex.	268
WDAK	The Courant	Hartford, Conn.	261
WDAR	Lit Brothers	Philadelphia, Pa.	395
WDAS	Samuel A. Waite	Worcester, Mass.	360
WDAU	Sloeum Kilburn	New Bedford, Mass.	360
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	244
WDBA	Fred Ray	Columbus, Ga.	236
WDBB	A. H. White & Co., Inc.	Taunton, Mass.	229
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WDBD	Herman Edwin Burns	Martinsburg, W. Va.	268
WDBE	Gilham-Schoen Electric Co.	Atlanta, Ga.	252
WDBF	Robert G. Phillips	Youngstown, Ohio	246
WDBH	C. T. Scherer Co.	Worcester, Mass.	268
WDBI	Radio Specialty Co.	St. Petersburg, Fla.	226
WDBJ	Richardson Wayland Electric Corp.	Roanoke, Va.	229
WDBK	M. F. Broz Radio Co.	Cleveland, Ohio	248
WDBL	Wisc. Dept. of Markets	Stevens Point, Wis.	278
WDBN	Electric Light & Power Co.	Bangor, Me.	252
WDBO	Rollins College Inc.	Winter Park, Fla.	240
WDBP	Superior State Normal School	Superior, Wis.	261
WDBQ	Morton Radio Supply Co.	Salem, N. J.	234
WDBR	Tremont Temple Baptist Church	Boston, Mass.	256
WDBS	S. M. K. Radio Corp.	Dayton, Ohio	283
WDBT	Taylor's Book Store	Hattiesburg, Miss.	236
WDBU	Somerset Radio Co.	Skowhegan, Maine	258
WDBV	The Quimby Enterprises, The Strand Theatre	Fort Wayne, Ind.	258
WDBW	The Radio Democrat	Columbia, Tenn.	268
WDBY	North Shore Congregational Church	Chicago, Ill.	258
WDM	Church of the Covenant	Washington, D. C.	234
WDZ	James L. Bush	Tuscola, Ill., Star Store Bldg.	278
WEAA	F. D. Fallain	Flint, Mich.	280
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	492
WEAH	Wichita Board of Trade	Wichita, Kans.	244
WEAI	Cornell University	Ithaca, N. Y.	286
WEAJ	University of South Dakota	Vermillion, S. Dak.	283
WEAM	Borough of Nortb Plainfield (W. Gibson Buttfield)	North Plainfield, N. J	252
WEAN	Shepard Co.	Providence, R. I.	270
WEAO	Ohio State University	Columbus, Ohio	360
WEAP	Mobile Radio Co.	Mobile, Ala.	360
WEAR	The Evening News Publishing Co.	Baltimore, Md.	261
WEAU	Davidson Bros. Co.	Sioux City, Iowa	275
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Texas	360
WEB	Benwood Co.	St. Louis, Mo.	273
WEBC	Walter Cecil Bridges	Superior, Wis.	242
WEBD	Electrical Equipment and Service Co.	Anderson, Ind.	246
WEBE	Roy W. Waller	Cambridge, Ohio	248
WEBH	Zenith-Edgewater Beacb Broadcasting Station	Chicago, Ill.	380
WEBI	Walter H. Gibbons	Salisbury, Md.	242
WEBJ	Third Avenue Railway Co.	New York, N. Y.	273
WEV	Hurlburt-Still Electrical Co.	Houston, Texas	360
WEW	St. Louis University	St. Louis, Mo.	261
WFAA	Dallas News & Dallas Journal	Dallas, Texas	476
WFAB	Carl F. Woese	Syracuse, N. Y.	234
WFAH	Electric Supply Co.	Port Arthur, Texas	236
WFAM	Times Publishing Co.	St. Cloud, Minn.	360
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn.	360
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr.	275
WFBB	Eureka College	Eureka, Ill.	240
WFBG	The Wm. F. Gable Co.	Altoona, Pa.	261
WFBH	Concourse Radio Corporation	New York, N. Y.	273
WFBW	Ainsworth-Gates Radio Co.	Cincinnati, Ohio	309
WFI	Strawbridge & Clothier	Philadelphia, Pa.	395
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa.	248
WGAN	Cecil E. Lloyd	Pensacola, Fla.	360
WGAQ	Glenwood Radio Corp. (W. G. Patterson)	Shreveport, La.	252
WGAW	Ernest G. Albright	Altoona, Pa.	261
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGI	American Radio & Research Corp.	Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett	Philadelphia, Pa.	360
WGN	The Tribune Co.	Chicago, Ill.	270
WGR	Federal Telephone & Telegrapb Co.	Buffalo, N. Y.	319
WGY	General Electric Co.	Schenectady, N. Y.	380
WHA	University of Wisconsin	Madison, Wis.	360
WHAA	State University of Iowa	Iowa City, Iowa	484
WHAD	Marquette University	Milwaukee, Wis.	280
WHAG	University of Cincinnati	Cincinnati, Ohio	222
WHAH	Hafer Supply Co.	Joplin, Mo.	283
WHAK	Roberts Hardware Co.	Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y.	283
WHAP	Otta & Kuhns	Decatur, Ill.	360
WHAR	Paramount Radio & Electric Co. (W. H. A. Pulus)	Atlantic City, N. J.	231
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	380
WHB	Sweeney School Co.	Kansas City, Mo.	411
WHK	Radiovox Co. (Warren R. Cox)	Cleveland, Ohio	360
WHN	George Schuhel	New York, N. Y.	360
WHO	Bankers Life Company	Des Moines, Iowa	526
WIAB	Joslyn Automobile Co.	Rockford, Ill.	252
WIAC	Galveston Tribune	Galveston, Texas	360
WIAD	Howard R. Miller	Philadelphia, Pa.	254
WIAH	Continental Radio & Mfg. Co.	Newton, Iowa	258
WIAK	Journal-Stockman Co.	Omaha, Nebr.	278
WIAO	School of Engineering of Milwaukee	Milwaukee, Wis.	246
WIAQ	Chronicle Publishing Co.	Marion, Ind.	226
WIAS	Home Electric Co.	Burlington, Iowa	283
WIAT	Leon T. Noel	Tarkio, Mo.	360
WIAU	American Trust & Savings Bank	Le Mars, Iowa	360
WIAY	Woodward & Lothrop	Washington, D. C.	273
WIK	K. & L. Electric Co. (Herbert F. Kelso and Hunter J. Lohman)	McKeesport, Pa.	234
WIL	Continental Electric Supply Co.	Washington, D. C.	360
WIP	Gimbel Brothers	Philadelphia, Pa.	509
WJAB	American Electric Co.	Lincoln, Neb.	229
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	360
WJAG	Norfolk Daily News	Norfolk, Nebr.	283
WJAK	Clifford L. White	Greentown, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAN	Peoria Star	Peoria, Ill.	280
WJAQ	Capper Publications	Topeka, Kans.	360
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	250
WJAX	Union Trust Co.	Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	448
WJD	Richard H. Howe	Granville, Ohio	229
WJY	R. C. A.	New York, N. Y.	405
WJZ	R. C. A.	New York, N. Y.	455
WKAA	H. F. Parr	Cedar Rapids, Iowa	268
WKDA	Chas. Looff (Crescent Park)	East Providence, R. I.	240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Texas	360
WKAN	United Battery Service Co.	Montgomery, Ala.	226
WKAP	Dutee W. Flint	Cranston, R. I.	360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	360
WKAR	Michigan Agriculture College	East Lansing, Mich.	280
WKAS	L. E. Lines Music Co.	Springfield, Mo.	360
WKAV	Laconia Radio Club	Laconia, N. H.	254
WKBF	Dutee Wilcox Flint	Cranston, Rhode Island	286
WKY	WKY Radio Shop	Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn.	417
WLAH	Samuel Woodworth	Syracuse, N. Y.	234
WLAL	Naylor Electrical Co.	Tulsa, Okla.	360
WLAP	Wm. V. Jordan	Louisville, Ky.	286
WLAQ	Arthur E. Shilling	Kalamazoo, Mich.	283
WLAV	Electric Shop	Pensacola, Fla.	254
WLAW	Police Dept., City of New York	New York, N. Y.	360
WLAX	Putnam Electric Co. (Greeneastle Community Broadcasting Station)	Greencastle, Ind.	231
WLB	University of Minnesota	Minneapolis, Minn.	360
WLBL	Wisconsin State Dept. of Markets	Stevenspoint, Wis.	278
WLS	Sears, Roebuck & Co.	Chicago, Ill.	345
WLW	Crosley Manufacturing Co.	Cincinnati, Ohio	423
WMAC	J. Edw. Page (Olive B. Meredith)	Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	360
WMAH	General Supply Co.	Lincoln, Nebr.	254
WMAK	Norton Laboratories	Lockport, N. Y.	273
WMAL	Trenton Hardware Co.	Trenton, N. J.	256
WMAN	First Baptist Church	Columbus, Ohio	286
WMAP	Utility Battery Service	Easton, Pa.	246
WMAQ	Chicago Daily News	Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute	Auburn, Ala.	250
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	280
WMAZ	Mercer University	Macon, Ga.	261
WMC	"Commercial Appeal" (Commercial Publishing Co.)	Memphis, Tenn.	500
WMH	Precision Equipment Co.	Cincinnati, Ohio	248
WMU	Doubleday-Hill Electric Co.	Washington, D. C.	261
WNAC	Shepard Stores	Boston, Mass.	278
WNAD	University of Oklahoma	Norman, Okla.	360
WNAL	Omaha Central High School	Omaha, Nebr.	258
WNAM	Ideal Apparatus Co.	Evansville, Ind.	360
WNAP	Wittenberg College	Springfield, Ohio	231
WNAR	First Christian Church	Butler, Mo.	231
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa.	360
WNAW	Peninsular Radio Club (Henry Kunzmann)	Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNYC	Dept. of Plant and Structures	New York, N. Y.	526
WOAA	Dr. Walter Hardy	Ardmore, Okla.	360
WOAC	Maus Radio Co.	Lima, Ohio	266
WOAD	Friday Battery & Electric Corp.	Sigourney, Iowa	360
WOAE	Midland College	Fremont, Nebr.	280
WOAF	Tyler Commercial College	Tyler, Texas	360
WOAG	Apollo Theater (Belvidere Amusement Co.)	Belvidere, Ill.	224
WOAH	Palmetto Radio Corp.	Charleston, S. C.	360
WOAI	Southern Equipment Co.	San Antonio, Texas	385
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	360
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	360
WOAQ	Portsmouth Kiwanis Club	Portsmouth, Va.	360
WOAR	Lundskow, Henry P.	Kenosha, Wis.	229
WOAT	Boyd M. Hamp	Wilmington, Del.	360
WOAV	Pennsylvania National Guard, 2d Battalion, 112th Infantry	Erie, Pa.	242
WOAW	Woodmen of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOI	Iowa State College	Ames, Iowa	360
WOO	John Wanamaker	Philadelphia, Pa.	509
WOQ	Western Radio Co.	Kansas City, Mo.	360
WOR	L. Bamberger & Co.	Newark, N. J.	405
WOS	Missouri State Marketing Bureau	Jofferson City, Mo.	441
WPAB	Pennsylvania State College	State College, Pa.	283
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	360
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College	Agricultural College, N. D.	283
WPAL	Superior Radio & Telephone Equipment Co.	Columbus, Ohio	286
WPAM	Auerbacb and Guettel	Topeka, Kan.	275
WPAP	Theodore D. Phillips	Winchester, Ky.	360
WPAR	Ward Battery and RadioCo.	Beloit, Kans.	236
WPAU	Concordia College	Moorhead, Minn.	286
WPAZ	John R. Kocb (Dr.)	Charleston, W. Va.	273
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	360
WQAC	E. B. Gish	Amarillo, Texas	234
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275
WQAF	Sandusky Register	Sandusky, Ohio	240
WQAL	Coles County Telephone & Telegraph Co.	Mattoon, Ill.	258
WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	360
WQAQ	Abilene Daily Reporter (West Texas Radio Co.)	Abilene, Texas	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAX	Radio Equipment Company	Peoria, Ill.	248
WQJ	Calumet Baking Powder—Rainbow Gardens Station	Chicago, Ill.	448
WRAF	The Radio Club (Inc.)	Laporte, Ind.	224
WRAL	Northern States Power Co.	St. Croix Falls, Wis.	248
WRAM	Lombard College	Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	236
WRAO	Radio Service Co.	St. Louis, Mo.	360
WRAV	Antioch College	Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRBC	Imanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corporation of America	Washington, D. C.	469
WRH	Chicago Herald & Examiner	Chicago, Ill.	536
WRK	Doron Bros. Electric Co.	Hamilton, Ohio	360
WRL	Union College	Schenectady, N. Y.	360
WRM	University of Illinois	Urbana, Ill.	360
WRR	City of Dallas (police and fire signal department)	Dallas, Texas	360
WRW	Tarrytown Radio Research Laboratory (Koenig Bros.)	Tarrytown, N. Y.	273
WSAB	Southeast Missouri State Teachers College	Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural College	Clemson College, S. C.	360
WSAD	J. A. Foster Co.	Providence, R. I.	261
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	309
WSAJ	Grove City College	Grove City, Pa.	259
WSAN	Allentown Radio Club	Allentown, Pa.	229
WSAP	Seventh Day Adventist Church	New York, N. Y.	263
WSAR	Doughty & Welch Electrical Co.	Fall River, Mass.	254
WSAU	Camp Marienfeld	Chesham, N. H.	229
WSAX	Chicago Radio Laboratory	Chicago, Ill.	268
WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	233
WSAZ	Chas. Electric Shop	Pomeroy, Ohio	258
WSB	Atlanta Journal	Athanta, Ga.	429
WSL	J. & M. Electric Co.	Utica, N. Y.	273
WSY	Alabama Power Co.	Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAF	Louis J. Gallo	New Orleans, La.	242
WTAG	Kern Music Co.	Providence, R. I.	258
WTAH	Carmen Ferro	Belvelere, Ill.	236
WTAJ	The Radio Shop	Portland, Me.	230
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gordon & Son	Osseo, Wis.	220
WTAR	Reliance Eectric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	286
WTAT	Edison Electric Illuminating Co.	Boston, Mass. (portable)	244
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	360
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	242
WTAW	Agricultural & Mechanical College of Texas	College Station, Texa	280
WTAX	Williams Hardwnre Co.	Streator, Ill.	231
WTAY	Oak Leaves Broadcasting Station	Oak Park, Ill.	283
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTG	Kansas State Agricultural Collegc	Manhattan, Kans.	273
WTL	H. G. Saal Co., Webster Hotel	Chicago, Ill.	258
WWAB	Hoenig, Swern & Co (John Rasmussen)	Trenton, N. J.	229
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	Alamo Dance Hall, L. J. Crowley	Joliet, Ill.	227
WWAO	Michigan College of Mines	Houghton, Mich.	244
WWJ	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	517
WWL	Loyola University	New Orleans, La.	260
WYAM	Electrical Equipment Co.	Miami, Fla.	283
WYAW	Catholic University	Washington, D. C.	236

"The Perfect Amplifier:" Something every DX fan needs—In November RADIO AGE

The Radio Age POPULARITY CONTEST

By Harry Aldyne

ON ANOTHER page you will find a story about the winners of the July-August division of the Radio Favorite Popularity Contest conducted by RADIO AGE. To none other than the inimitable Duncan Sisters, ("Topsy and Eva") Chicago's radio sweethearts, goes the credit of cornering the most votes for that period.

In the November RADIO AGE, you will be introduced to the favorite receiving the greatest number of votes for the October contest.

Bill Hay, popular announcer from KFKX, Hastings, Neb., took first honors for the September contest. His life story will be found on page 32 of this issue.

It is interesting to note that while the Duncan Sisters got off to a flying start in July and August, Bill Hay and Lamkin Kay led them in the grand total for September.

This month the mischievous girls have fallen slightly below the leading positions. For, as Brutus said, "Not that I love Caesar less, but that I love Rome more." But the fans in back of Vivian and Rosetta Duncan will have their opportunity to restore them to favor again with their votes this month.

So don't forget to send in your coupon for your radio favorites. Those who have not made use of their coupons from back numbers of RADIO AGE since July are entitled to use them all at any time. You can vote as many times as you have coupons.

HOW THEY STAND FOR OCTOBER

Name	Classification	Where Heard
Bill Hay	Announcer	KFKX Hastings, Neb.
H. W. Arlin	Announcer	KDKA Pittsburgh, Pa.
Kari Bonawitz	Organist	WIP Philadelphia, Pa.
Jack Nelson	Announcer	WGN Chicago
Harry M. Snodgrass	Entertainer	WOS Jefferson City, Mo.
Lamkin Kay	Announcer	WSB Atlanta, Ga.
E. W. Tyson	Announcer	WWJ Detroit
Nicholis B. Harris	Entertainer	KFI Los Angeles, Calif.
Hired Hand	Announcer	WBAP Fort Worth, Tex.
Bert Davis	Entertainer	WGN Chicago

October contest closes October 15.
November contest closes November 15.
December contest closes December 15.

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Radio Age, Inc.,
500 North Dearborn Street,
Chicago

Gentlemen: Please enter my subscription for RADIO AGE, the Magazine of the Hour, for one year, beginning with your next issue, for which I enclose $2.50.

Name.....

Street Address.....

City.....

State.....

☐ If RADIO AGE for one year and RADIO AGE ANNUAL are desired at special price of $3, mark cross here. Price of Annual alone is $1.00 postpaid.

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POPULARITY CONTEST COUPON

Harry Aldyne,
Contest Editor,
RADIO AGE,
500 N. Dearborn St., Chicago.

I wish to cast my vote for:

Name of favorite.....

Classification.....

Station.....

Date heard.....

Name (optional).....

Address (optional).....

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RADIO JOBS

If you want to turn your knowledge of radio into dollars, insert an ad in the classified section of RADIO AGE at 10 cents a word. You will find that manufacturers and radio dealers are looking for radio men like you.

RADIO CIRCUITS

SPECIAL FOR OCTOBER

The Reinartz Radio Booklet, by Frank D. Pearne, fully illustrated, and RADIO AGE, for $2.50. Price of booklet alone is 50c. Send check, currency or money order to RADIO AGE, 500 N. Dearborn Street, Chicago.

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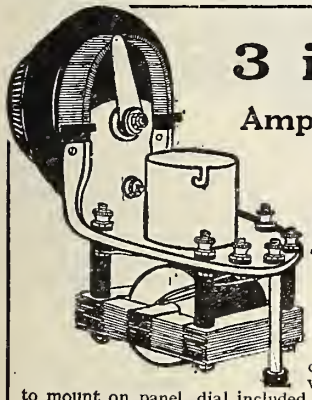

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$2.00 PER SET Postpaid

NOTE: Manufacturers! Send in your blue prints for quotations on any inductance requirements you may have. No order too large.

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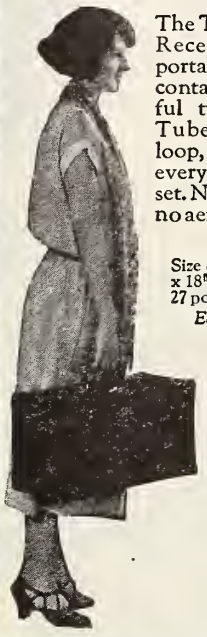
1331 N. Wells St. Dept. RA10 Chicago

Telmaco Acme Receiver

The Ideal Receiver for all Seasons



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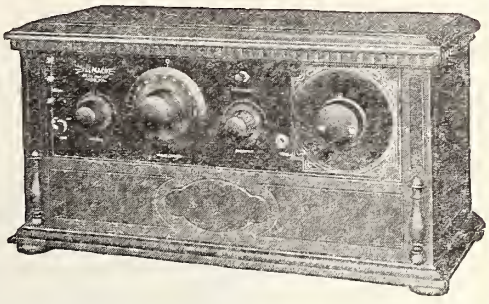
Size of Case 8" x 10" x 18". Weighs only 27 pounds complete. *Easily Carried.*



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securing selectivity, distance and volume with minimum battery consumption.

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Radio Division

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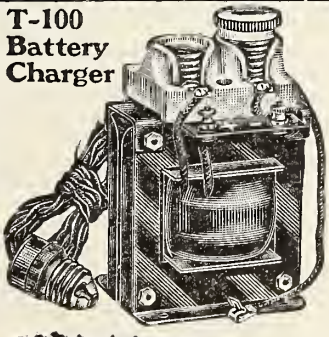


The Best and Lowest Priced on the Market

This battery charger operates on 110 volt, 60 cycle, A. C. circuit, charging a 6 volt battery at a 2 ampere rate. Standard 2 ampere charging tube is used. The T-100 is the lowest priced first-class charger on the market. Large numbers now in use have proved entirely satisfactory. No vibrating parts to get out of order. Absolutely noiseless in operation. Furnished with plug and cord for lamp socket. Battery leads marked. Fuse protects charger from accidental short circuit of 110 volt leads. Fully guaranteed.

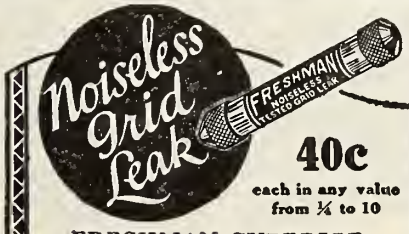
Price complete, with 2 ampere tube, $12.00

Radio Division

TELMACO

Quality Radio Exclusively

TELEPHONE MAINTENANCE CO.
20 So. Wells St., Dept. C Chicago, Ill.



40c

each in any value from ¼ to 10

FRESHMAN SUPERIOR

You can depend upon them to remain accurate at all times

Made of high resistance material impregnated throughout (not coated paper). Unaffected by climatic conditions. Will not deteriorate. Clamped between solid knurled ferrules assuring rigid construction and firm contact at all times.

At your dealer's, otherwise send purchase price and you will be supplied postpaid.

Chas. Freshman Co., Inc., 106–7th Ave., N. Y.

JUST SEND A POSTCARD YOU GET absolutely free—the A-K "Library of Latest Radio Literature," written by foremost radio authorities. Contains HUNDREDS of valuable wiring diagrams, HOOK-UPS, illustrations, articles, data, etc.

EXPLAINS in clear, understandable language the popular new circuits: reflex, neutrodyne, phasiform, "nameless," super-heterodyne, etc., and how to build sets. Covers long and short wave amplification, push-pull and audio amplifiers. Latest information on multitudes of other radio subjects. **LOG BOOK INCLUDED FREE.** Also our latest Radio Catalog featuring NATIONALLY ADVERTISED lines at attractive savings. Write today—offer limited. Address

ATWOOD-KING, Inc.
Dept. P-10163 W. Washington St., Chicago

ATWOOD KING INC.

Department of RADIO ENGINEERING

Radio Age Institute Tests

Look for the Approval Seal

The above approval seal will be furnished free of charge by RADIO AGE, and any article bearing this seal has been approved by the Institute Laboratory.

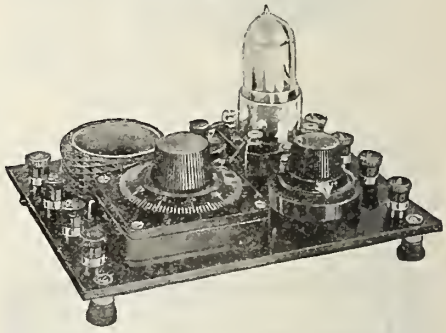
We will be pleased to receive and test any materials that are offered on the market and give them our endorsement where they meet all Institute tests. Send materials to RADIO AGE INSTITUTE, 504 N. Dearborn St., Chicago.

The following radio accessories have successfully passed RADIO AGE INSTITUTE tests for awards in October, 1924.

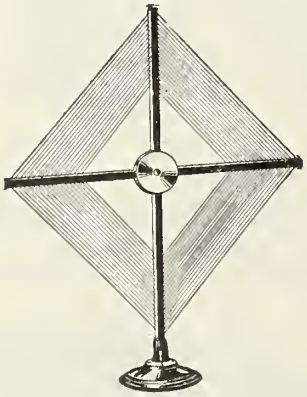
Test No. 7. The Pfanstiehl receiver, Model 7, which embodies a new principle in radio frequency amplification. The receiver is of the tuned type, and does not oscillate or radiate. One of its exceptional features is the station finder, which is really a calibration chart engraved on the panel. Made by the Pfanstiehl Radio Company, of Highland Park, Ill. Tested and approved by Frank D. Pearne, for RADIO AGE Institute.

Test No. 9. The Karas Harmonik Audio Frequency amplifying transformer. Especially designed for broadcasting frequencies. This transformer gives an exceptionally good curve which covers the range of audio frequencies commonly in use at broadcasting stations, and will give good amplification with a minimum of distortion. The transformer is larger in size than the average transformer, and is well constructed throughout. An all ratio winding is used, the actual ratio being in the vicinity of about 4 to 1. Manufactured and sold by the Karas Electric Company, Chicago, Illinois. Tested and approved by the RADIO AGE Institute.

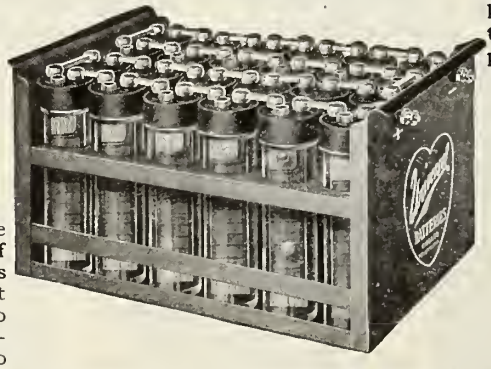
Test No. 11. The Filkostat Lightning Arrester. Well made, and is guaranteed to stand up under the severest strain. Constructed so that short circuits are not possible. Tested and approved by RADIO AGE Institute. Made by the DX Instrument Company, Harrisburg, Pa.



Test No. 12. The International Babydyne Receiver, manufactured by the A. & T. Radio Co., Danvers, Mass. A receiver of good construction and a good circuit, assembled with simplicity as its keynote. Capable of satisfactory selectivity and substantial range. Tested and proved by the RADIO AGE Institute.



Test No. 8. The Red Seal Collapsible Loop Aerial, No. 2580. The loop is of rigid construction throughout, and is thoroughly durable in spite of the fact that the average collapsible loop is so frail. The loop is mounted on an engraved scale, which can be referred to in finding stations once they have been logged. Special base provision for connections to set. Sufficient wire is wound on this loop to cover all the broadcast wave lengths with a good 23 plate condenser (.0005 Mf). Tested and approved by the RADIO AGE Institute.



Test No. 10. Universal B Battery, type RB, 48 volts. Manufactured by the Universal Battery Company, 3410 S. LaSalle St., Chicago, Illinois. Durably and well constructed, and of excellent design electrically. Tested and approved by the RADIO AGE Institute.

Test No. 13. The Burgess B Battery, 22½ volt type. Of good construction and excellent life. Provision made for plate voltage variation so that it is adaptable to any tube. Tested and approved by the RADIO AGE Institute. Made by the Burgess Battery Company, Madison, Wis.

ANNOUNCING
The New Pfanstiehl Model 7

Embodying the Pfanstiehl Non-Oscillating System of Tuned Radio Frequency

The Last Word in Simplicity

The Station-Finder Eliminates All Guess-Work in Tuning

Frank D. Pearne, Noted Radio Expert, Reports the Following Test:

"AFTER testing hundreds of radio sets, I decided upon the Pfanstiehl Model 7 for my own personal use, and I can recommend it because it produced the most satisfactory results I have yet attained with any set.

The test was carried on during all conceivable kinds of weather, but even when static was at its worst it was possible to get stations more than 1,000 miles away on the loud speaker, with all the volume of a local station.

As the Pfanstiehl Model 7 is Non-Oscillating, no sound other than signals was heard. The selectivity was excellent and many long distance stations were picked up when local broadcasting was going on at the same time, only a few miles away.

Several other types of receivers were compared with the Model 7, and whenever it was possible to pick up the same stations with other receivers, the reception was not so good."

The Pfanstiehl Non-Oscillating System.

RADIO FREQUENCY has had one serious obstacle to overcome; it has heretofore generated oscillations which caused howls, squeals and other disturbing noises, if not suppressed. Formerly these oscillations were considered as inevitable and were suppressed more or less effectively with resistances, potentiometers, neutralizing condensers, etc.

Pfanstiehl believed these oscillations could be avoided and traced them to their sources. Through his new system of controlling and shaping electro-magnetic and electrostatic fields, no disturbing oscillations are generated in the Pfanstiehl Model 7 Receiver. No neutralizing or adjusting is therefore necessary. In consequence a new simplicity of operation is attained. The effect of no misdirected fields is to give a new purity of tone and a new efficiency which is reflected in great distance and volume.

A simple station-finder at the right of the panel tells you exactly at what number to set the dials for the station you want to receive.

Manufactured by

THE PFANSTIEHL RADIO CO.

Highland Park, Ill.

Chicago, Office:

1001 W. Washington Blvd. **Tel. Haymarket 8010**

DEALER'S COUPON

You are invited to write for description of the Pfanstiehl Model 7.

Name.....

Dealer or Jobber.....

Send this coupon to Pfanstiehl Radio Co., Highland Park, Ill.

The PONY EXPRESS OF TODAY

DISTANCE covered in record time while all the world wondered. News received in one part of the country only a few weeks after it was sent from another. That was the pony express.

Today, news, messages, entertainment—all are instantly brought from all over the land right to your home by the Pony Express of the air—Crosley Radio Receivers. New York hears California. Florida listens to Hawaii. Canada converses with Mexico. North Dakota keeps in close touch with the MacMillan expedition at the North Pole. Such are the daily performances of Crosley Receivers as told by hundreds of unsolicited letters from happy users.

At bringing in distant stations in a clear, enjoyable manner, Crosley Instruments, each in its own class have proven themselves unexcelled. Yet they are the lowest priced radio receivers ever offered.

For satisfactory results, real radio value, you can't beat a Crosley.

Listen In On a Crosley Before You Buy.

For Sale By Good Dealers Everywhere.

The Crosley Radio Corporation

POWEL CROSLEY, JR., President

1063 Alfred St. Cincinnati, O.

CROSLEY

Better-Cost Less

Radio Products

CROSLEY TRIRDYN 3R3—$65.00

The Trirdyn 3R3 incorporating radio frequency amplification, regeneration, reflex and additional audio frequency amplification will, with only three tubes, give performance equal to the customary four and five tube set. ¶ Will easily tune through local broadcasting to bring in long distant stations on the loud speaker.

Other Crosleys each a leader in its line

One tube Crosley 50. The regenerative set with which Leonard Weeks of Minot, N. D., kept in almost daily touch with the MacMillan Expedition at the North Pole. Money cannot buy better radio value.....$14.50

Two tube Crosley 51. The little wonder regenerative set that in just 24 days became the biggest selling radio receiver in the world. Represents wonderful radio value.....$ .50

Three tube Crosley 52. This regenerative set consists of regenerative detector and two stages of audio frequency amplification. Gives loud speaker volume on distant stations under practically all conditions.....$30.00

Prices as Given Are Without Accessories

All Crosley Regenerative Receivers licensed under Armstrong U. S. Pat. 1113149

The Crosley Radio Corporation owns and operates Broadcasting Station W L W

MAIL THIS COUPON TODAY

The Crosley Radio Corporation,
1063 Alfred St., Cincinnati, O.

Gentlemen: Please mail me free of charge your complete catalog of Crosley instruments and parts together with booklet entitled "The Simplicity of Radio"

Name _____

Address _____

RADIO AGE

ngazine *of the* Hour

In This Issue

Blueprints of a Single Tube Loop Set and a Capacity Feed-back Receiver.

Pickups and Hookups by Readers; Prize "Static-busters."

Radio for the Beginner.

Five New Hookups for the Set Builder.

Eight-Page Section of Studio-Land Features.

Price 25 cents

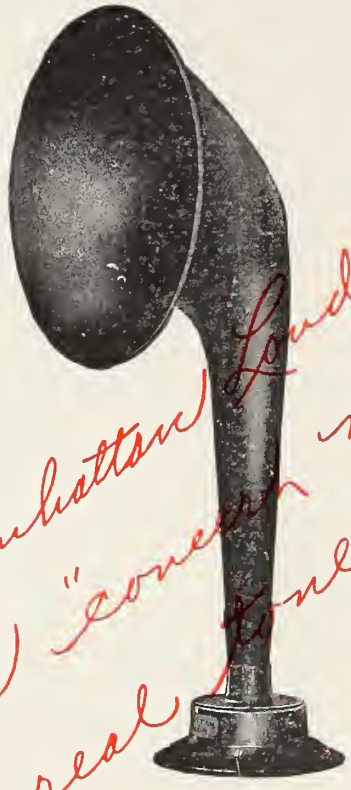
NOVEMBER 1924

Let Our Hookups Be Your Guide

Blueprint Section Every Month

MANHATTAN
ELECTRICAL SUPPLY CO., INC.

MAKERS OF THE FAMOUS



The Manhattan Loud Speaker with its "cone" modulator gives real tone quality.

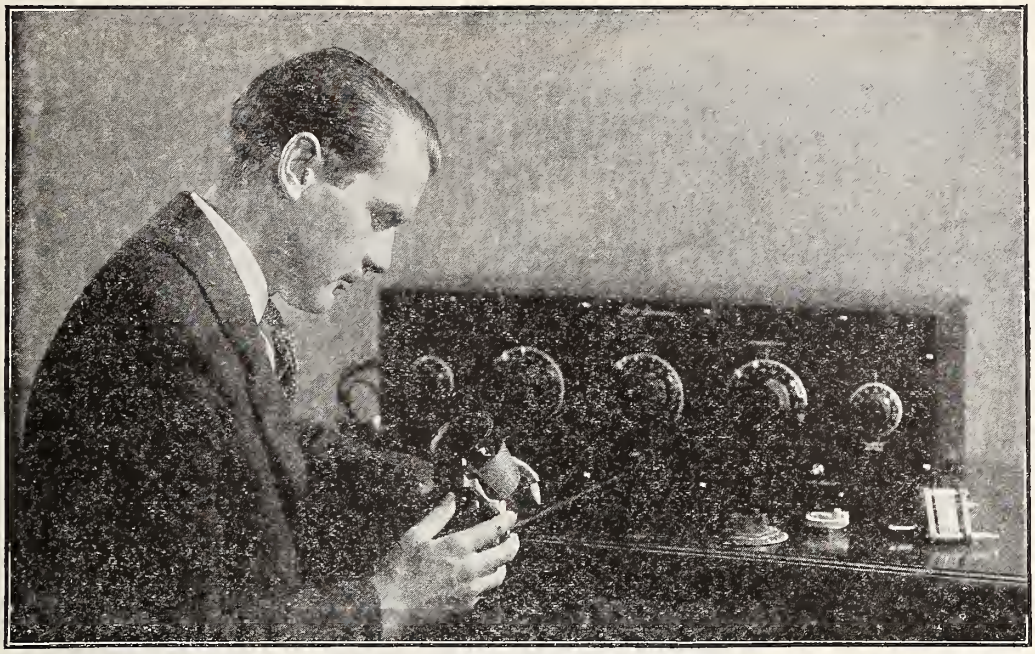
Manhattan Junior $10
LOUD SPEAKER

Oldest and Largest Distributors of

Radio WORLD WIDE WIRELESS **Corporation** of America

114 SO. WELLS ST., CHICAGO

NEW YORK ST. LOUIS SAN FRANCISCO



How I Earn $100.00 a Week as a Radio Expert

A year ago I was mighty blue and discouraged. It seemed to me that I would never be more than a low-paid bank clerk. Of course I had a small increase in salary every now and then, but I knew that pretty soon I would reach my limit and there would be no further advancement for me. What future had I to look forward to? Where would I be in five years? I became restless and discouraged and began to look around for some other opportunity.

It was then that I discovered that the demand is for *trained* men, that the opportunities are all for men who can do some one thing better than anything else. There were wonderful opportunities for men who were experts or specialists—but I was..... a clerk. How I regretted then that I hadn't prepared myself for some definite career!

I Wanted to Marry

The thing that made me more restless at that time than anything else was the fact that Marian and I were—that is, we wanted to be married. But we both knew that we couldn't possibly get along on my small salary. If only there was something I could do that would bring me a larger salary!

It was just about the time that everyone became so interested in radio. Our whole town became radio-mad, and of course what was happening in our town was happening all over the country—all over the world. I managed to save up enough to buy a receiving set and I was never quite so happy as when I was trying to tune in on stations.

The thing fascinated me. Playing with air waves! Bringing melodies and messages out of the sky! I was never so interested in anything before.

Marian was the first to sense the great opportunity. "Why don't you become a radio expert?" she said. "You like it, and I am sure there must be a big demand for men who understand it. It's a new field and there's plenty of room for wide-awake men."

"But—but I'm not trained!" The thought excited me. To be a radio expert! To find my future in this fascinating new field! "I don't know anything about it, Marian," I said. "I wish I did, though."

"Well, why don't you find out about it" she retorted. "You can't learn about radio just by listening in to the concerts. Why don't you take a course?"

But we found out that most courses were expensive or that they would interfere with my other work. We were about discouraged when I discovered that through the National Radio Institute it is possible to become a radio expert by studying right at home in spare time. I told Marian about it and she was elated. "Send off for information, at once—today!" she exclaimed.

Advances Quickly to $100 a Week

I did, and the following day received an important booklet, "Rich Rewards in Radio" telling all about radio opportunities and how to become an expert in any particular phase of the work.

Here was my opportunity at last!

I began to study in all my spare time. It was the most interesting and absorbing study I had ever made. The secret of the radio revealed to me! Day by day I became more skilled and deft until I was able to take apart receiving sets and put them together again as though I were playing with a toy. It was fun! In a month I was able to take a position as lineman at a bigger salary than I was getting at the bank. This was wonderful experience for me, and I kept right on with my studies. It wasn't long before I qualified for a position as radio engineer at a salary of $100.00 a week! That is what I am earning now, though I expect to make more soon. It seems to me almost too good to be true, after all those years as a low-paid clerk in a bank. And Marian, who will soon be my bride, keeps saying, "I told you so!"

As a radio expert I can tell you that there is a tremendous demand for men who can build, sell and install radio sets, who can design, test, repair. Men are needed as engineers and executives, all over the world. The opportunities are limitless, and if you like radio there is no reason why you cannot qualify for one of these positions by studying in your spare time at home as I did.

The National Radio Institute offers an absolutely complete course which prepares you for the Government First Class Commercial License and for the bigger-paying jobs in Radio. The Director, E. R. Haas, will be glad to send you all details of their marvelous new method of practical instruction, including information concerning the Free Employment Service which secures positions for National Radio Institute graduates. Everyone interested should have this information. *It's free*, and this coupon will bring it to you. I advise you to send it off today. Radio is a new and interesting field, and it offers you more money than you probably ever dreamed possible!

Important

Those who mail the coupon *at once* will also receive details of Special Short Time Reduced Rate. Do it now.

National Radio Institute, Dept. 53 LA.
Washington, D. C.

I am interested in radio and would like to find out whether or not I am suited for a radio career. Please send me, without the slightest obligation, your interesting free book called "Rich Rewards in Radio." Also full details concerning your special Short Time offer.

Name.....

Address..... Age.....

City..... State.....

RADIO AGE
The Magazine of the Hour
Established March, 1922
WITH WHICH IS COMBINED RADIO TOPICS

Volume 3 *November, 1924* *Number 11*

CONTENTS

Radio Age is published monthly by
RADIO AGE, Inc.
Member: Audit Bureau of Circulations.

Publication Office, Mount Morris, Ill.
Chicago Office, 500 N. Dearborn St.

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Final Advertising forms close on the 20th of the 2nd month preceding date of issue

Issued monthly. Vol. 3, No. 11. Subscription price, $2.50 a year.
Application made for transfer of second class entry from the post office at Chicago, Illinois, to the post office at Mount Morris, Illinois

A Chat With the Editor

IN A recent advertising campaign in which this magazine sought to impress prospective advertisers with the fact that RADIO AGE carried 80 per cent more advertising in October than in the previous month, it was emphasized that *"Reader Interest Tells in the Long Run."*

"Reader interest" is a term applied to a certain confidence which a publication inspires in the minds of its readers—confidence in its editorial contents and in its advertising columns. This confidence is always accompanied by an actual interest in the subjects discussed and an approval of the manner in which those subjects are presented.

Now we want to tell you why we emphasize "reader interest" in our recent advertising. We based our statement that it wins in the long run on the fact that we have proved it in less than three years of hammering away at one editorial principle which we considered radiologically sound. That policy was and is embraced in the determination to give our readers each month the best technical information and the best technical draughtsmanship in the radio publication field.

Readers who read our articles in the Spring of 1922 are still reading them and writing us their approval.

They have greeted our eight-page blueprint section with surprise and delight. They are enthusiastic followers of our "Pick-ups and Hook-ups By Readers" department. These letters come from every state, from all Canadian provinces, from England and from countries even more remote. We acknowledge them by direct mail but hereby wish to express our appreciation to all these friends as a group. We also are showing our good will in return by continuing to keep the volume and quality of technical radio up to our old standard.

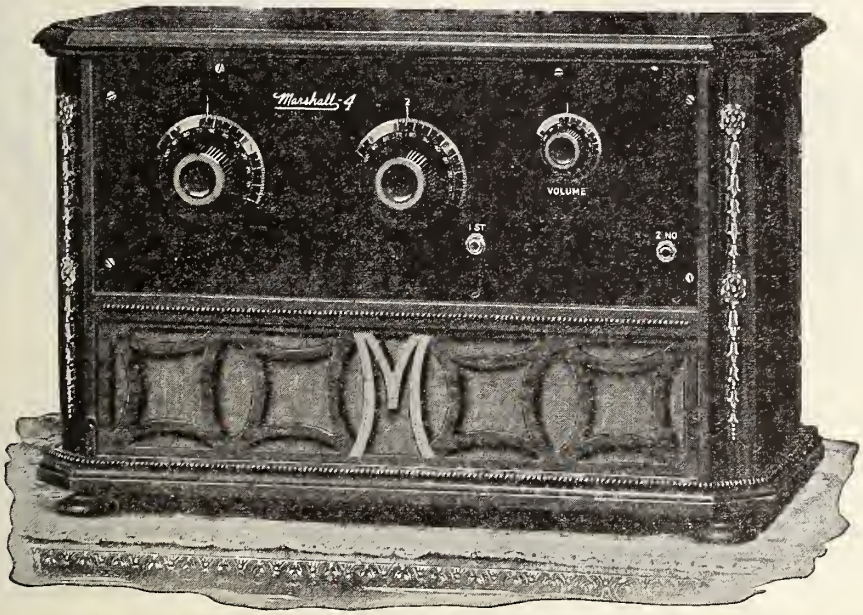
Advertisers have forced us to 80 pages in this issue. Please notice that we have not reduced the number of pages of pictures and information to "make room" for more pages of advertising. On the contrary, we have increased the editorial content considerably.

Frederick Smith

Editor of RADIO AGE.

Marshall 3-4 and 5 Tube Sets

The Greatest Advance yet made in RADIO



Receiver and Loud Speaker in Combination Cabinet of Solid mahogany

This Beautiful Marshall 4 Tube Non-Oscillating Receiver *Complete with all accessories*

only $5.00 DOWN

WRITE TODAY for full particulars of this most exceptional offer. Marshall Sets embody the very latest improvements known to radio. The wonderful new principle involved is proving the sensation of the 1924-25 radio season. Zero Coupling—the problem which radio engineers have been working on for years—has at last been solved. As a result, the Marshall has no need for neutralizing condensers or other make-shift methods of avoiding internal oscillations which invariably reduce efficiency. The Marshall Tuned Radio Frequency Receiver brings to radio a new degree of musical quality. Its selectivity will delight the experienced radio operator. Yet it is so easy to tune that the novice will handle it like an expert.

Easy Monthly Payments—2 Weeks Free Trial

This is the remarkable offer we are prepared to make you! Two weeks to prove that the outfit you select is everything we have said for it. If it doesn't make good our claims, back it comes, and your deposit will be cheerfully refunded. But if it fulfills all your expectations, you may pay for it in easy monthly installments. You don't risk a cent when ordering from us. You *must* be satisfied, or we don't do business. Is it any wonder that radio buyers the country over are rushing to take advantage of such an offer? If YOU are interested, figure on getting your order in early, while prompt shipment can be made. Everyone predicts a serious shortage of radio supplies this season. Send for full particulars today.

Beautiful Solid Mahogany Combination

Compare the beautiful Combination Cabinet, pictured above, with the usual radio box and horn. Here the receiver and Loud Speaker are contained in a single handsome cabinet. Or, if you prefer, we also have the Receiver in a separate cabinet of the same design. These cabinets are the work of a master designer—fashioned of solid mahogany. They will harmonize with the furnishings of the finest homes. In spite of the extra value, these Marshall sets are surprisingly low in price. Compare them with others which sell for cash. Then remember you can order a Marshall outfit on two weeks' free trial and pay for it on very easy terms.

Complete Outfits If Desired

In buying from Marshall, you have the choice of a set complete with all accessories, or the set alone. You have choice of dry cell or storage battery outfits. Unless you already own the accessories, you can buy them from us at less-than-market prices, with your set, on easy terms. Your outfit will come all ready to set up and operate within a few minutes,—saving time and trouble—and saving money, too.

MARSHALL RADIO PRODUCTS, INC.
Marshall Blvd. and 19th Street, Dept. 58-98 Chicago

Send Coupon for Special Offer!

If you have any idea of buying a radio set this year, don't let this chance slip by. Our terms and liberal guarantees have set a new pace in the radio business. The low prices we will make you on a 3, 4, or 5 tube Marshall set will surprise you. A letter, postcard, or just coupon will do. But send it today.

We also have a most favorable offer for radio dealers. Write.

Marshall Radio Products, Inc.
Marshall Blvd. and 19th St., Dept. 58-98 Chicago

Please send me your special offer price, terms and full description of Marshall Radio Outfits. Though I may change my mind on receiving your proposition, my preference now is for a:

------3 Tube ------4 Tube ------5 Tube (Please check)

Name ----------

Address ----------

ALL-AMERICAN

now brings you

DISTANCE, VOLUME AND QUALITY with *ONE TUBE*

Self-Tuned Radio Frequency Transformers —Wound to Suit the Tube

OUT of a year of many experiments and numerous failures to achieve in a practical instrument the theoretical possibilities of broad-tuned Radio Frequency Amplifiers, has come a simple but far-reaching discovery. Radio Frequency Transformers can and must be *adapted to the characteristics of the particular vacuum tube* whose grid voltage they supply. That truth—with All-American scientific research and All-American precision manufacturing—has made radio history.

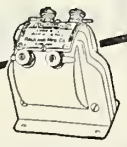
SELF-TUNED RADIO FREQUENCY TRANSFORMERS *have arrived*—and All-American, naturally enough, has brought them. Never before has an instrument been built which will amplify so effectively, over the entire radiocast range, as will the new All-American Types R-199 and R-201A. Together with the new Type R-140 All-American Universal Coupler, they have made possible a *new standard of efficiency* in Radio Frequency and Reflex receivers.

As an example of this, we offer ALL-AMAX JUNIOR (1 Tube) and ALL-AMAX SENIOR (3 Tube). Both are *All-American-coupled throughout*, and both exemplify the new standard of performance.

Build an ALL-AMAX—using the complete panel scheme and wiring plan shown in your KEY BOOK—and you will never go back to an ordinary reflex set. Distance and power are yours!

All-Americans—Precision-Made for Reliability

Sold by all the Better Dealers



Audio Frequency Transformers
"All-American for Reliability"

Ratio 3 to 1 . . . . . R-12, $4.50
Ratio 5 to 1 . . . . . R-21, 4.75
Ratio 10 to 1 . . . . . R-13, 4.75

Built by Precision Methods in a Modern Plant, All-American Audios are Unsurpassed at any price for Quality Reproduction and Dependable Service.

Long Wave Transformer

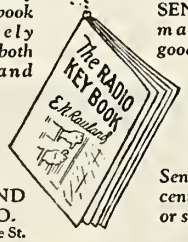
For High Amplification and no distortion of side bands at 4,000 to 20,000 meters (75 to 15 Kilocycles) . . R-110, $6.00

Power Transformers

For *Tone Quality* in a Third Stage, or for Loud Volume with Clearness.

Input Type R-20, $6.00
Output Type R-31, 6.00

An absolutely new kind of book—immensely valuable to both beginner and expert.



ALL-AMAX JUNIOR *and* SENIOR; *also many other good hook-ups.*

Sent for 10 cents, coin or stamps.

RAULAND MFG. CO.
2680 Coyne St.
CHICAGO
Pioneers in the Industry

ALL-AMERICAN
TRADE MARK

Radio Frequency Transformers
"Self-Tuned—Suited to the Tube"

Effectively amplifying all Frequencies within the Radiocast Range.

For "199" Tubes R-199, $5.00
For "201A" Tubes R-201A, 5.00

10,000 Meter Transformer

It gives superior results in beat reception, filtering out a 30 Kilocycle Frequency with high selectivity and no side-band distortion R-120, $6.00

Radio Frequency Coupler
(Oscillator Coupler.)

A uniform output at 150 to 650 meters . . R-130, $5.00

Universal Coupler

Sets a new standard of efficiency as an antenna coupler. As a radio frequency transformer in tuned stages it is unsurpassed R-140, $4.00

Largest Selling Transformers in the World

RADIOTORIALS

THE third national radio conference, called by Herbert Hoover, Secretary of Commerce, has passed into history, and the great army of fans undoubtedly are familiar with the steps that are to be taken in the progress of radio during the next year.

A perusual of Secretary Hoover's opening address before the conference leaves no doubt regarding his attitude toward the radio industry as a whole. The complaints of hundreds of small stations during the last few months, to the effect that they were faced with extinction to make way for super stations, seem to be groundless. Mr. Hoover makes it clear that he does not wish to stifle progress in any direction, and that nothing must be done that will interfere with the programs of local stations, on which so many millions of people depend.

Secretary Hoover realizes that efforts are being made by several corporations to install powerful stations with power up to 5,000 watts, which in turn would make it impossible to hear any small station which happened to have the misfortune to broadcast at the same time. From the Secretary's attitude, and from the opinons of the members of the conference who directly represent the radio public, it seems unlikely that permission will be given for the establishment of powerful stations whose operation would tend to monopolize the air eventually.

Mr. Hoover does advocate however, the national interconnection of radio stations. Whether this is to be done by super stations or by inter-connection of local stations, he does not definitely say, leaving that point to the discretion of the conference. But he does assert the need for a sort of associated press of the air, which could be subscribed to by broadcasting stations and depended upon to furnish programs of suitable excellence, as well as arrange events of national importance.

Mr. Hoover is unqualifiedly in favor of interconnection of radio stations. He emphasizes the need of a system of program directing that will take programs out of the amateur class and put them on the high plane that they deserve. But, again, he does not say who should do this. Surely, not the government; surely, not one company, for that would be monopoly. Who, then? Perhaps the conference will decide. Perhaps the conference will form from its own personnel a force of sufficient dependability and ability to furnish nation-wide programs.

Mr. Hoover's entire speech assumes that the local station will continue to exist. That is good news for the "DX" hound. But he insists some plan must be worked out whereby this same local, and perhaps small station shall be able to broadcast events of national importance and interest. In so doing he opens the way to propositions of large corporations who would have to handle this huge system of interconnection. They will be the only ones who can afford to do this, if the Government will not do it. And if a few related corporations take over radio interconnection, the small station probably will lose its individuality. But only the conference will decide that.

Mr. Hoover is right when he says radio will die of its own confusion unless it has stringent rules of conduct to which all elements adhere. He is right when he says radio must be an instrument of service if it is to succeed. All we ask is that it be allowed to serve everyone, and not a *few:* that its destiny be entrusted to those who really love radio—not those who love the money in it.

THE New York broadcasting fraternity is in the throes of a restless discussion over the question of paying broadcast artists. Small stations who have thrived on free entertainers are beginning to furrow their brows with worry over what will happen if they have to buy their performers' services. And members of the Actors' Equity and other professional unions are beginning to see in radio a new commercial field to conquer. Perhaps so. The ether has been peaceful enough because of the absence of selfish squabbles such as characterize the Actors' Equity. Without salaries to worry about, the broadcasters have been able to assume a lofty position and choose entertainment that they believed was the best. The minute they start paying for it if they have to do so, they may pick the cheapest. It is only human nature for individuals seeking to cut expenses to purchase that whch is low-priced and which will pass as the real thing. It will happen to the broadcasters, for they have no tangible income from their stations, and paying money for artists is hard unless there is some return. No, New York is needlessly alarmed. Radio entertainment is good enough now. When we want the professionals we'll ask for them.

RADIO'S great tribute was paid at the New York "Radio World's Fair." The large body of fans never realized what a husky youngster their hobby had developed into until they visited that show and crowded their way to the manufacturers' booths. Radio sets and parts heretofore undreamed of were there. The men who brought about this perfection were there, too. But after all is said and done, there were no radical changes. True, radio sets have developed to a great extent. There have been improvements, but none which would confuse the radio fan of a year ago. The sets are more simplified, their beauty enhanced, and their parts more durable, but their principle is not far removed. The outstanding feature of the receivers in the 1924 radio show seems to be excellence rather than radical change. Fans want quality—tone—selectivity. They realize it will be a few years before radio again changes its shell, and in the meanwhile they want sets that will give them what they want to hear when they want it, and with as much natural reproduction of one as is scientifically possible. There are many such sets today. They are the symbol of the continued excellence of quality that has characterized radio manufacturing for the last twelve months.

(Photo C. Drake Studio)

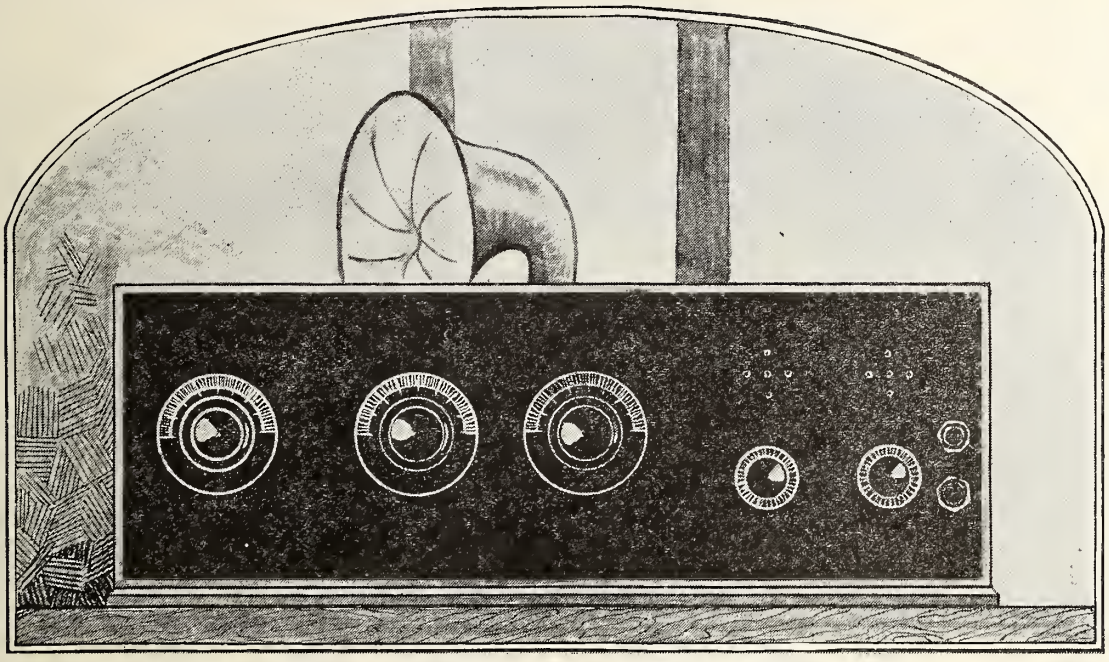
Miss Rosemary Hughes is known to nearly every radio fan in the country because of her consistent performances at scores of stations during the past few months. Miss Hughes has an alluring soprano voice, and her rendering of popular and semi-classical favorites has put her in demand wherever she goes. Because of her success over the radiophone she is said to be considering a liberal vaudeville offer. At the left is Bert Davis, "The Clown of the Air," who can "sing more crazy stories than you ever heard before." He is scheduled to make a nation wide tour of radio stations this Winter, and he is also to be featured on RADIO AGE programs over Chicago stations.

RADIO AGE
The Magazine of the Hour

M. B. Smith
Business Manager

A Monthly Publication Devoted to Practical Radio

Frederick A. Smith
Editor



A *Three-Tube* LOW LOSS *Regenerator*

A RECEIVER THAT TUNES DX LIKE A SUPER-HET

By FELIX ANDERSON

IT has always been the policy of the members of the technical staff of RADIO AGE to promote the development and interest in the low loss type of receivers, and in nearly every description of receivers in past issues, the reader has probably noticed that this lesson has been particularly stressed. At the risk of becoming tiresome, the writer has drummed this message over and over again, with the natural result that many letters of gratitude and satisfaction have been received from people who benefited by following this low loss policy in constructing their radio sets.

In the March, 1924, issue was printed our first actual description of a real low loss radio receiver, that really deserved the name for its design. Acting in the capacity of official question-answerer of the technical staff of RADIO AGE, the writer has had the privilege of noting the interest and results which this description created, and since March it has been a pleasure to note the increasing demand for more information along the low loss line.

If you will refer to that number, you will find several initial lessons or requisites that must be followed in the course of constructing a receiver that is really and truly low loss.

It may be well to refresh the mind of the reader on this subject, since the major points of that article may not have been duly considered at that time. Taking up these requirements, we find that there are at least three factors of tremendous importance which must be observed. Listing them they are as follows:

1. *A good secondary circuit, with a low loss coil and an electrically and mechanically near as perfect variable condenser.*

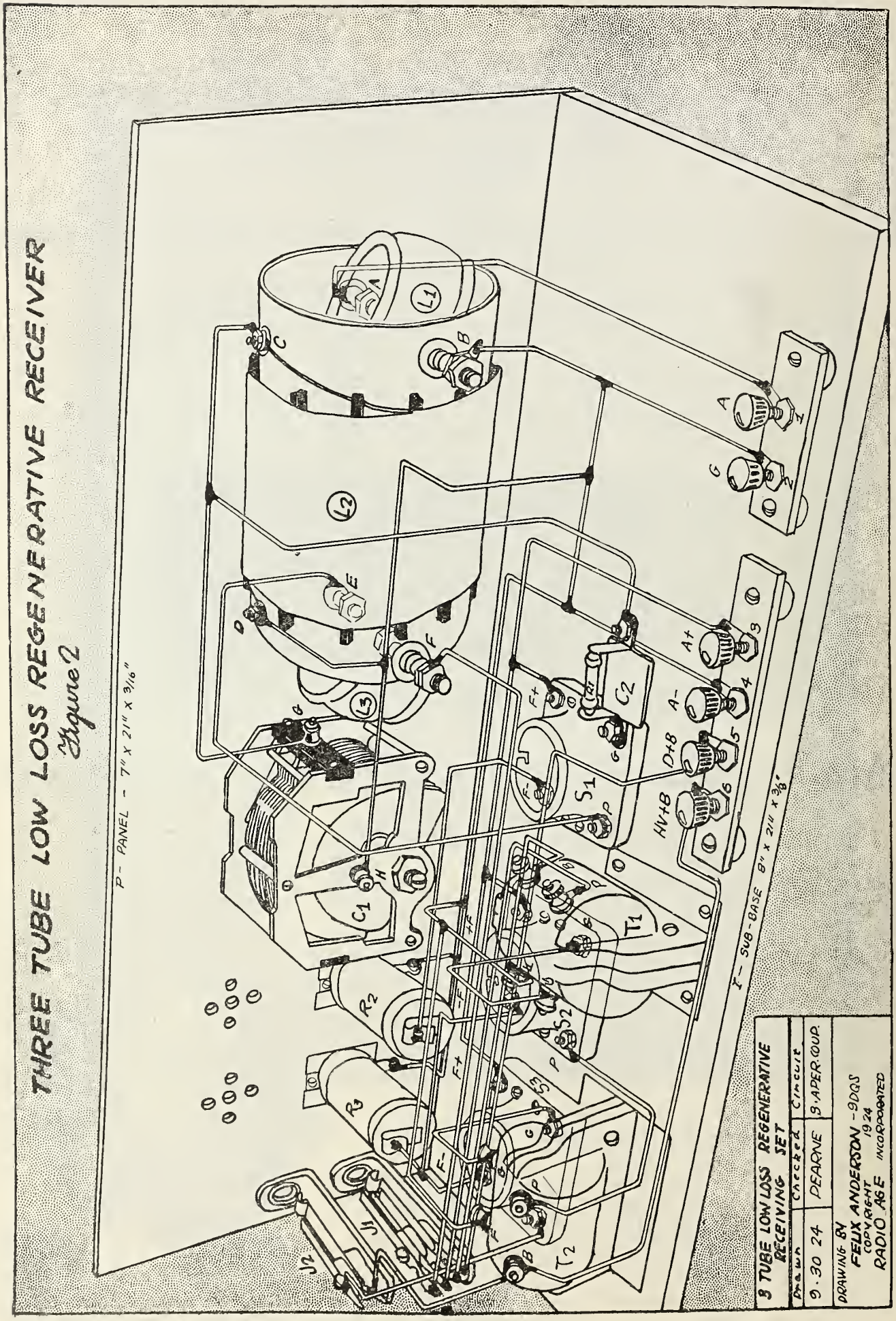
2. *A properly adjusted grid leak and a good detector tube.*

3. *A well chosen list of accessory units such as tube sockets, rheostat, and fixed condensers.*

THE secondary circuit consists of a coil and condenser in series which form the tuning unit of the receiver, and which must necessarily be good if sharp tuning is desired. The coil must be free of both actual ohmic resistance and high frequency resistance as possible, and must be so constructed that it has the least amount of distributed capacity possible.

The condenser should be one of the low loss type, having a grounded rotor, and should be sturdily made with regard to both insulation and plate construction so that it may be calibrated in terms of wavelength in conjunction with the coil you are going to use. A condenser poor in a mechanical way will cause wobbling of the plates, and this destroys the accuracy of the logging possibilities of the receiver.

The grid leak is next in importance, as well as the choice of a good detector tube. The tube is, of course, more or less of a gamble, since you cannot tell whether it will detect as well as another tube of the same type, but the grid leak should at least be so constructed that it


THREE TUBE LOW LOSS REGENERATIVE RECEIVER
Figure 2
P- PANEL - 7" X 21" X 3/16"
L1
L2
C1
C2
S1
S2
T1
T2
R2
R3
J1
J2
A+
A-
D+B
HV+B
F+
F-
1- SUB-BASE 8" X 21" X 3/8"
3 TUBE LOW LOSS REGENERATIVE RECEIVING SET
Drawn 9.30.24
Checked DEARNE
Circuit 3 AMPER. GUP.
DRAWING BY FELIX ANDERSON - 9DQS
COPYRIGHT 1924
RADIO AGE INCORPORATED

will be free of noises, and so that it will not change in resistance with the weather. Since the June, 1924, issue covers that subject so thoroughly, I will not discuss this unit at any greater length. Suffice it to say that it is important, and if you lack knowledge on this matter, it would certainly be a wise move, regardless of what kind of a set you operate, to stock yourself with the knowledge of this small but important part of your radio set.

The other accessories such as the tube socket are not so great a problem, since the average tube socket on the market is now usually low loss. However, tar paper and composition sockets should be avoided, as should paper or other makeshift fixed condensers.

In the March, 1924, issue, the writer discussed these features of a receiver from A to Z, and while the subject is still of great interest, it is regretted that space does not permit us to again discuss the relative importance of these units in more detail. If further information is desired in regard to the foregoing, it can be obtained from that number. It is somewhat of a joy to note that the specifications for the condenser and coils of the receiver in that description are just now beginning to appear on the radio market, and by the looks of things, that type of apparatus construction will probably stay with us for a long while.

Three Tubes Instead of One

IN the opinion of the writer, an all-around receiver for the broadcast listener should have tubes and amplification enough to permit the use of a loud speaker. The low loss set of the March issue employed only one tube. So many requests were received for additional circuits showing two more and even four more tubes that it was quite a surprise. The receiver in the following description is ideal in that respect. Further, the ideal broadcast receiver should be easy to tune, and we find that only two actual working hands are necessary in the operation of the receiver to be described. Like a super-heterodyne, we have two dials, the secondary control being the condenser, and the tickler control which corresponds to the oscillator dial on the super-het. With the super-heterodyne, we usually have a potentiometer which requires an occasional touch, and on this low loss set we must make an infrequent adjustment of the antenna coupling to get the best results. The logging operation is the same—two dial readings; viz.: the secondary and the tickler readings being logged, and used.

Constructing the Set

PROBABLY the most important unit of the set is the tuning coupler, which must be made carefully and intelligently if results are to be obtained. Low loss couplers adaptable to the circuit are now on the market, and if the constructor so desires, they may be purchased instead of being home-made. The condenser, of next importance, can be purchased from any supply house, the low loss 23 plate, all plate vernier type, being the type to be obtained. Reference to the advertising pages of RADIO AGE will disclose some of unusual merit.

Tackling the problem of the coupler, we will need two rotors, of either wood or bakelite. Refering to Figure 2, these are the forms upon which L_1 and L_2 are wound. In addition to these rotors, you will need a thin cardboard tube, which has been lightly varnished with a thin coating of spar varnish after having previously been oven dried.

The size of the cardboard tube will depend upon the size of the rotor balls which you purchase, and since it is easiest to get cardboard tubing of the proper size, to use with the rotors, get the rotors first and then match them with the proper size tube. The matching should be done with the idea in mind of allowing from 1-4 to not more than 3-8 inch coupling space between the rotor ball and the cardboard tube. Bakelite tubing may be used but it is harder to work with.

After the above material has been procured, cut yourself a dozen bakelite strips, from an old panel and plane their edges square. These strips should be just as long as the tube you are using (the tube being about 6 inches long to start with). Glue the strips you have cut, firmly with their edges to the tube, then set the form aside to dry. When the glue has hardened you are ready to wind your secondary coil.

Incidentally, the size of the bakelite strips is not important, so long as the outside diameter of the coil L_2 does not exceed $4\frac{3}{4}$ inches. The entire length of the coil as a whole may be determined after the coil has been wound. If the coil L_2 is $3\frac{1}{2}$ to $3\frac{1}{4}$ inches, outside diameter, 55 turns of wire, space wound should be used. If from $3\frac{3}{4}$ to 4 inches from one side of the winding to the other, only 45 turns are necessary, and if the entire coil diameter is so great as to be over $4\frac{3}{4}$ inches from one side of L_2 to the other, only 40 turns will be necessary. The coil is space wound, to offset distributed capacity. By space winding, it is meant that the wires are not wound closely alongside of each other, the wires being separated from one another by a small air space about three quarters as wide as the diameter of the wire itself. It is because of this method of winding

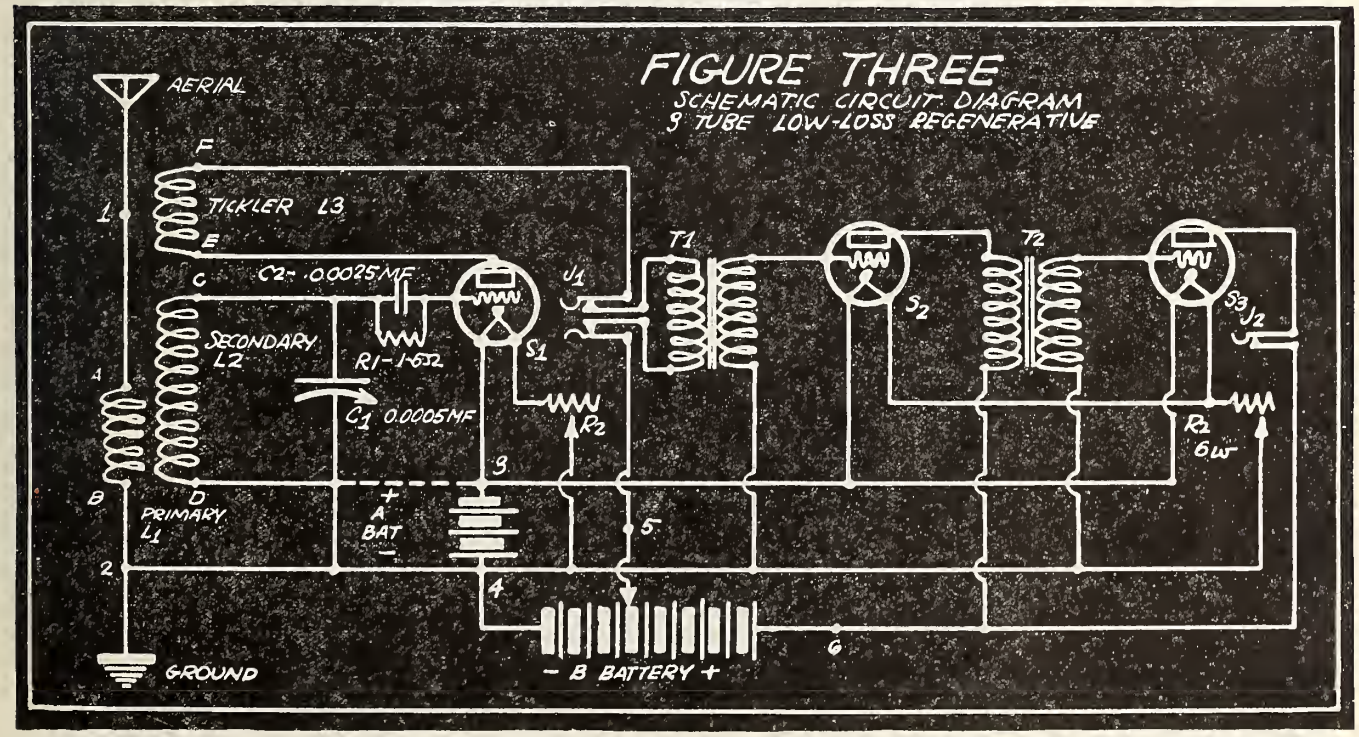


Figure 3. A circuit diagram of the low loss receiver described in the accompanying article by Mr. Anderson. The connections for the ground may be made either positive or negative, as indicated by the dotted line at points 3 and 4.

that the coils will vary in length, as will the actual length of the tuner itself.

After the coil L_2 has been wound the points for the holes of the rotor shafts may be determined. Drill your holes so that they clear the coil L_2 with about a good ½ inch clearance.

BY following the proportions in Figure 4, you can get a general idea of how the coil should look when finished. The entire unit is mounted on the panel with two collars threaded and supplied with screws at both ends—one end for the coil and one for the panel. Figure 2 shows the connections for the coil, as does Figure 3. A and B may be reversed if hand capacity effect is noticed without impairing the effectiveness of the set. C and D are the grid and filament ends of the coil which are connected to the rotary and stationary plates of the 23 plate variable condenser. E and F are the connections of the tickler coil for plate and jack connections.

These may also be reversed, if the set fails to oscillate. The coils themselves should have the following number of turns as determined by a few preliminary experiments: L_1 should be wound with 20 turns of number 18 DCC wire with 9 turns on each side of the shaft. L_2, should be wound as mentioned just preious, with the same size of wire, and L_3 the tickler, should be wound with 35 turns to start. If your antenna is a long one, coil L_1 should be decreased to about 12 turns. The final number of tickler turns should be determined by setting the coil L_1 at maximum, and then turning condenser C_1 to full setting.

The tickler coil should then be set at maximum (maximum is when all coils are in parallel setting and all windings run in the same direction), and turns should be removed until the set barely oscillates at that setting.

General Notes

The audio frequency transformers should be of good make with a ratio of not over 5 to 1 for maximum clearness. The ratio of these transformers is left to the choice of the constructor, who may desire louder signals over clearness, the choice of which lies in the purchase of either a low or high ratio transformer. High ratios distort and give louder signals but low ratios give cleaner signals with less volume.

A vernier rheostat should be used at R_2 while an ordinary type may be used at R_3. R_3 controls both audio tubes. The battery connections are made at the rear of the set, as are the antenna and ground, as indicated. No. B- post is shown, since this connection should be made to the +A of the filament battery.

The set tunes in the same manner as the single circuit regenerative, except it is very much sharper.

It is not a malignant squealer, since the ratio of antenna coupling to the grid coil is very small, and only little energy getsthrough. Theproper ratio of tickler coil also is one reason for its being easily controlled with respect to regeneration, since by employing a correct number of turns on the tickler the set does not spill over so easily.

Figure 1 is a front panel view of the set, which was drawn to scale from the working model.

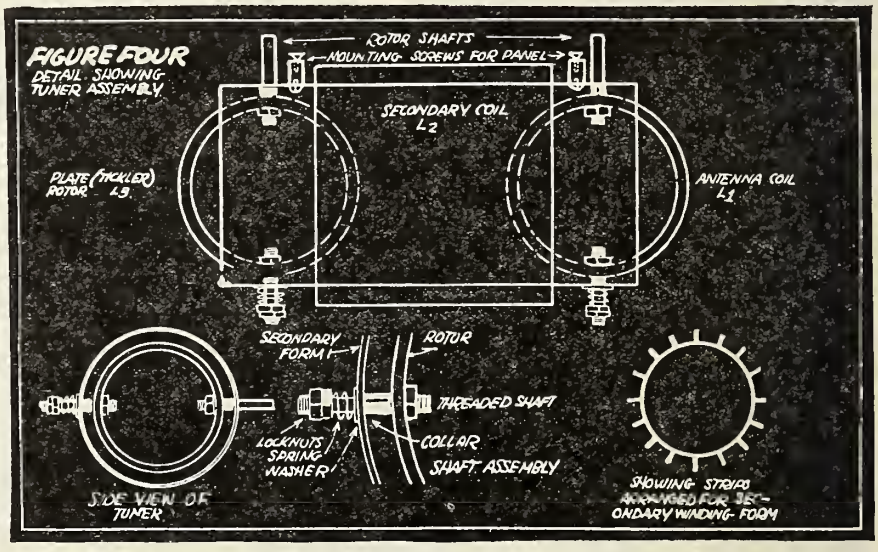


Figure 4. Details of the coupler are shown in the accompanying sketch. The top view shows the complete assembly of the coupler; the bottom left, a side view. The center bottom gives the details of the shaft and tension mounting, while the lower right gives an idea as to how the bakelite strips are fastened radially to the tube.

Low Loss Design for Efficient Reception

By KENDALL NORTH

THE ambition of the broadcast listener of today is to have a receiving set that will operate a loud speaker and one that will reach out and get the distant stations. However, in the purchase or construction of the receiver he overlooks the value that low loss design has to do with his set.

How many times have you visited a fellow listener's station whose set consisted of a lot of bell wire wound on a Quaker Oats box and more wire strung here and there and leading to every place but what seemed the right place? Then you began to wonder why he was getting better results than you were with your more expensive set. However, your friend, in building his set, has eliminated a good many losses that are so troublesome to an efficient receiver.

The present tendency seems to be to get amplification regardless of tuner efficiency. The loss of 5 per cent in a condenser or a coil cannot be detected by the human ear, but when ten or fifteen per cent is added to this by bad connections or dielectric loss, a noticeable effect may be distinguished on distant stations. This will also apply to local stations.

There are two methods of tuning the secondary of a receiving set. First, by a variable condenser and second by a variometer.

WHEN a set is constructed to tune from 75 meters to 375, the capacity tuned secondary is used. This might be termed employment of a variable condenser and coil.

When a condenser is connected across the secondary coil, the voltage is lowered. Regardless of this, the losses due to the distributed capacity of the variometer or coil are greater than the losses that will be found in a good condenser, and as a result they more than make up for the decrease in voltage caused by the condenser itself.

If you are building a coil with a capacity of 300 meters, wind the coil for 300 meters and not for 600. When you wish to tune the set to 300 meters, you will have what is known as dead end. This is known as the unused part of the coil.

It has been found that an ordinary paper tube, providing it is free from moisture, is far superior to the expensive material found in some expensive sets, such as the heavily varnished tubes that are sold on appearance and not for actual operation.

The secondary plays an important part in the receiving set and it is necessary when purchasing one that you obtain one of low loss. Of all the condensers on the market, there are about six makes that have really low loss. These condensers do not sell for any more than the ordinary so called moulded mud brand. That is the kind that has enough moulding in the back and front to mould a socket for a vacuum tube. You can readily see that here again arises the problem of insulation in an electric field.

How Careful Design Helps in Mastering the 3-CIRCUIT TUNER

By BRAINARD FOOTE

Degree of Coupling Between Aerial and the Secondary Circuit Fixes Set's Efficiency

WITHOUT any doubt, the simple and reliable one tube receiving set of today is the three-circuit tuner, with its untuned antenna coupling coil, the secondary coil tuned by a variable condenser and the tickler coil for controlling its sensitivity. Yet it is true enough that results are widely different—the very same set acting far differently when used in different situations.

Lack of uniformity in reception is largely a matter of differences in the aerials to which otherwise similar receiving sets are connected. Especially is this inequality likely to occur with the three-circuit tuner, simply because the antenna part of the set is not tunable. There is always a fixed amount of coupling existing between the antenna and the tuned secondary, and whether the aerial be immense in its dimensions or a mere indoor wire strung along the picture molding, the coupling is not variable.

Naturally, a large antenna is going to pick up many times the energy from broadcasting stations that is within the grasp of a little one, and hence the distance and the strength of signals received will be widely different. Therefore the results anyone may expect with his three-circuit receiver depend to no little extent upon the degree of coupling between the aerial and the secondary circuit.

How Much Coupling?

It is quite easy for any listener to judge, merely from the way in which stations are received, whether the coupling in his set is too much, just about right, or not enough. The selectivity is a good criterion. For instance, if WNYC can be heard faintly through broadcasting from WEAF, one may be quite sure that there is a little too much energy being transferred from the aerial to the secondary. When this condition exists, signals are received with plenty of "kick," but great difficulty is met in endeavoring to tune in a distant station whose wavelength is not many meters away from a local station.

ON the other hand, if stations within ten or fifteen miles do not come in with much volume, and at the same time are exceedingly difficult to tune to the precisely correct "spot" on the dial, it is a certainty that there isn't quite enough coupling or quite enough energy being transferred to the secondary coil to insure really satisfactory reception. In cases where volume is good from all of the locals, and yet there is sufficient selectivity to tune in distant points such as WGY, WIP, WDAR, etc., without too serious interference from neighboring broadcasters, the listener has the coupling just about as it should be.

With a large aerial, say a wire 100 to 150 feet long, including the lead-in, and which is fairly well elevated from trees and buildings, eight to twelve turns on the antenna coupling coil usually provide all the coupling that is necessary. As the aerial becomes smaller, it is necessary to use a larger primary coil, and with an over-all antenna length of 75 feet or so, fifteen to twenty turns may be employed.

When it comes to indoor aerials, however, it doesn't help much to go over 20 turns for the primary, and the best practice is to include the aerial right in the secondary circuit, so that the aerial as well as the grid coil is resonant to the received wavelength. This takes advantage of every bit of available energy that the aerial can get hold of, and when this is done the distance and the volume that can be obtained with a tiny insignificant looking aerial is surprising.

How to Change Coupling

In Fig. 2 is given the ordinary three-circuit arrangement. When the aerial lead is connected to point No. 1, the most common type of circuit is obtained. The aerial is then coupled to the secondary through a separate primary coil, the most desirable method where the aerial is of good size. However, if the aerial is very small, the amount of energy change-over from the separate primary isn't great enough. In that case, the aerial lead may be connected to point No. 2, which is the center point of the secondary coil. Half of the secondary coil is then acting as a primary winding also, and the antenna circuit is completed through the connecting lead "X," whereby the positive side of the filament is grounded.

AND with a very tiny aerial, fifteen to thirty feet long, perhaps, or with a set of capacitive aerials, which are very successful for indoor work, the aerial lead goes to point No. 3, where the entire secondary is also the primary coil. Maximum coupling is thereby had, and the capacity of the antenna supplements that of the secondary tuning condenser. In this latter case, any alteration in the capacity of the aerial exerts a strong tuning effect upon the set, so that a capacitive aerial or an indoor wire should be erected where persons passing by cannot come closer than two feet to the aerial or the aerial lead

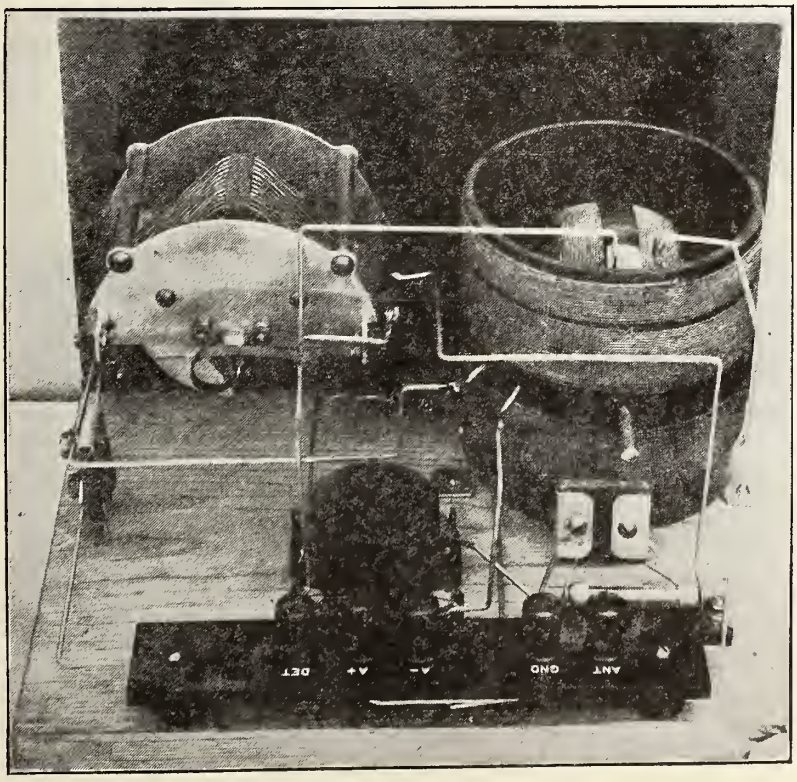


Fig. 1—Home-made, but simple and satisfactory. The secondary coil is split in two, the primary coupling coil located on top, and the tickler coil placed in the middle, inside the tubing.

When the separate small primary coil is employed, the antenna is quite independent, however.

Any listener having trouble in reception with such a three-circuit set would do well to solder three little copper lugs to points 1, 2 and 3 and try connecting the aerial lead to each one with a clip. As a matter of fact, it is of considerable advantage to have a coupling adjustment for any single tube receiver, or with such a receiver used in conjunction with a two stage audio amplifier. While taps and switches are not considered to be especially efficient, points 1, 2 and 3 might be connected to a set of three switch points for easy selection of the best coupling arrangement, provided the switch points are so placed that the leads from points 2 and 3 are very short.

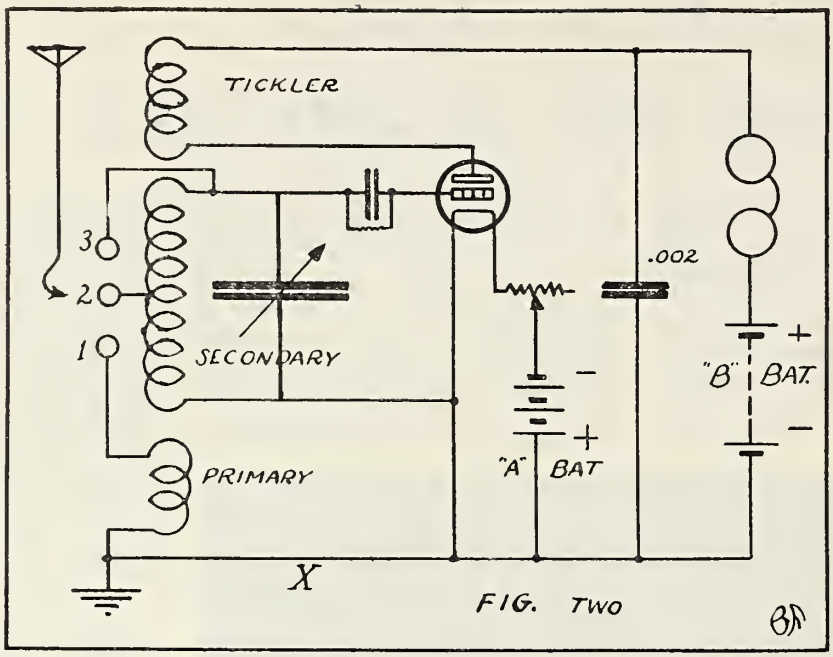


Fig. 2—The popular three-circuit tuner plus coupling adjustments, to adapt the receiver to aerials of varying proportions. Small aerials require more coupling, and vice versa.

A distinct advantage in this scheme lies in one's ability to alter the coupling to suit varying conditions. When a local station is wanted with lots of volume, use point 2 or perhaps 3 to get it, so long as there isn't interference from some other station to be encountered. But when a weaker and more distant broadcast program is desired, use less coupling to get rid of the local interference.

In Fig. 3 is shown the front panel view of a typical three-circuit tuner, one for which the coils may be home-made. At the left is the dial for adjustment of regeneration—the tickler control. Next, at the lower center, is the rheostat knob, while at the right may be seen another larger dial for moving the tuning condenser. Binding posts at the right are for the phones, and the small knob beneath the condenser dial is a vernier control for the condenser.

The Coupler

The rear view of the same set is given in Fig. 1. The coupler is made with coils of No. 20 double covered wire wound on a piece of high grade insulating tubing measuring 4 inches long and 4 inches in diameter. The secondary coil is put on in two sections, 46 turns in all, with 23 turns to a section. A space of about one-half inch is allowed between halves to provide room for the passage of the 1-4 in. shaft, which controls the tickler coil. The halves of the secondary are wound in the same direction, so as to make up a continuous coil of 46 turns when the inner ends are soldered together. Ends of the secondary are held tightly by pushing them through small holes drilled in the tubing. Actual connections to them are made inside.

A 15 turn primary coil is wound at one end of the secondary, with a gap of about one-eighth of an inch. This winding serves for ordinary purposes with the average antenna, but the aerial may be connected as in Fig. 2 if this be found necessary. The tickler coil is wound on a rotor of similar high grade insulating material measuring approximately 3½ inches in diameter and having winding spaces about ⅝ inch in width. The tickler must also be wound in two sections because of the curvature of the rotor ball on which it is placed. The halves are started at the outer edges, and wound so as to make a continuous uni-directional coil when the inside ends are soldered together.

TWO 1½ inch lengths of ¼ inch diameter brass rod form the shafts for the rotor. These should make a forced fit in the rotor and should be tried in the rotor before the latter is purchased. Two holes at exactly opposite points on the tubing, and in the center of the space left between the halves of the secondary coil, are drilled for the shafts, using a ¼ inch drill. A small rat-tail file is then used to slightly enlarge the hole so that it fits snugly but without binding. Fiber washers or short lengths of fiber tubing maintain the rotor ball in the center of the tubing. Flexible wire forms the connections to the ends of the tickler coil, and two brass brackets or angles serve to mount the coupler to a wooden baseboard.

The Assembly

Other parts required are a 7x10 inch panel, 7x10 inch baseboard, socket, rheostat, .002 phone condenser, .00001 or .00025 grid condenser, 2 megohm grid leak, .0005 mfds. variable condenser with vernier attachment, strip of panel material for a binding post panel inside the set, 6 feet of bus bar for connections, necessary dials and 7 binding posts. The tuning condenser chosen should be of some reliable make, with a minimum of insulating material and having the rotor plates grounded to the frame. The fixed plates should be shielded by an end plate from hand capacity effects.

Connections are given in Fig. 2. Rosin-core solder should be employed rather than plain solder and acid flux as the latter is too likely to institute corrosion at the joints. The photographs tell well enough where the parts are located, and holes for mounting the rheostat and

(Turn to page 75)

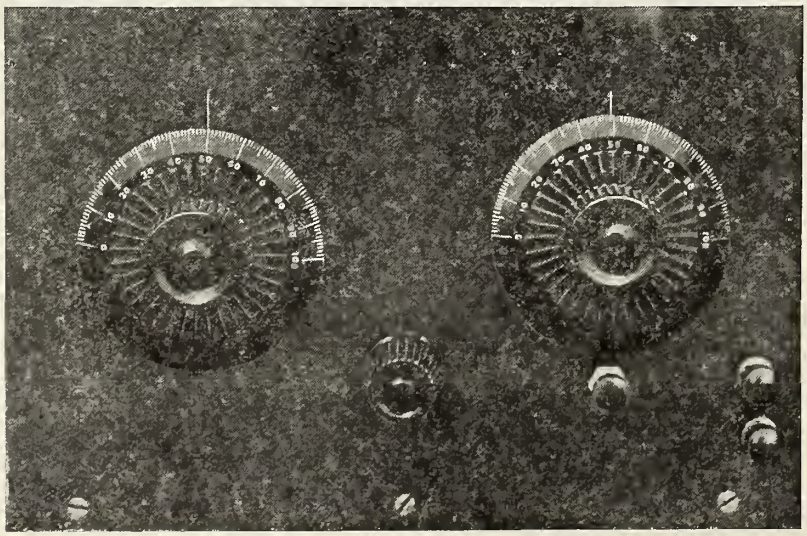


Fig. 3—A simple three-circuit set, front view. The rheostat knob is in the center, regeneration and tuning controls at left and right respectively, and phone binding posts at the extreme right.

Overcoming Obstacles in the Construction and Operation of a Super-Het

By ROSCOE BUNDY

One must not expect a super-heterodyne to do its best the first time it is operated. Like neutrodynes or other multi-tube sets, several weeks of painstaking adjustment are necessary before maximum efficiency is attained.

WHILE a great many super-heterodyne hookups have been shown in the various radio publications during the past few months, yet there has been very little data published regarding the actual construction from an analytical standpoint. This is undoubtedly the reason for the many failures with the "Het" and is also responsible for the prevailing opinion among certain groups of builders that the eight-tube super-heterodyne offers little more than the five-tube neutrodyne.

To have a simple hookup diagram is not sufficient for the beginner in building a multi-tube receiver. He must also have a knowledge of the remedies to be applied when his circuit goes wrong, and must be told what to do and what not to do in the actual construction.

We had the same conditions when the neutrodyne first appeared upon the scene, and before the true significance of "neutralization" was brought home to the novice. The same group that are now so bitterly assailing the super-heterodyne were the very fellows who were knocking the neutrodyne six months ago. Let it be said that neither the neutrodyne nor the super-heterodyne is a circuit which we can hook up in an evening and then expect to get maximum performance on the first twirl of the dials. Both circuits require careful adjustment and experience in tuning before they develop their full capacity for range and volume. With care and attention to details the super-het can be made to live up to its reputation in every particular.

Precautions to Observe

In the first place, we must not fail to remember that the super-heterodyne is a special form of radio frequency circuit, and that many of the precautions observed with the short wave R. F. receivers must also be observed with the "het." We must insure against feed-backs between the radio stages and use every means to suppress free oscillations in the R. F. tubes. This, however, is a simpler matter with the heterodyne than with the straight radio frequency or reflex circuits.

PRIMARILY the super-heterodyne is intended for use with loop aerials, and if it is desired to operate the circuit on an outdoor flat-top aerial we must observe certain precautions. The very sensitivity of the circuit causes it to pick up much noise and interference with the outdoor aerial unless the set is very loosely coupled. The outdoor aerial is more inclined toward picking up noises than it is signals, and while fainter and more distant stations can be picked up by an outdoor flat top from a standpoint, yet the increased interference also imparted to the aerial usually more than overcomes the benefits thus obtained.

For this reason we must provide an extremely loose coupling between the primary and secondary circuits, a coupling that often involves as much as six to eighteen inches between the primary and secondary. The standard vario-coupler is seldom suited for this purpose unless there is sufficient distance between the rotor and stator to insure against the least degree of electrostatic coupling. Selectivity with this circuit is attained only when we can introduce comparatively great losses in the input.

Loop aerials, being strongly directional, afford a means of eliminating undesired stations and noises by simply turning the loop in the direction of the desired signals. In this way, waves lying to either side of the loop plane are greatly weakened and can be more readily tuned out by the normal controls of the set. Actually, the loop is used as the third control of the super-heterodyne and is nearly as effective in tuning as the primary and oscillator condensers. This applies particularly where there is much local interference from nearby broadcasting stations.

For the best results, the loop aerial must have a very low electrical resistance, and this is one reason why great distance is never obtained with the ordinary commercial loops wound with small gauge solid wire. Heavy lamp cord of No. 18 to No. 16 gauge is the smallest conductor advised, and excellent results are obtained with heavy ignition cable. In such cases, the increased diameter of the stranded conductor gives a greater presented area than a solid wire, and as it is the superficial area rather than the cross-sectional area which rules in high frequency work, the lamp cord or ignition cable gives stronger signals and a much higher degree of selectivity.

To Get More Selectivity

ADDITIONAL selectivity may be had by applying the wave trap idea to the loop; that is, by installing an absorption circuit within the main turns. From six to ten turns of wire are wound just within the outer turns of the main loop, and the ends of this inner coil are connected to the terminals of a 23 plate vernier condenser. By adjusting this condenser we can effectively short circuit any undesired waves, thus reducing the lead on the main tuning units and reducing interference. This adds one more control, it is true, but it frequently becomes necessary under certain conditions.

When an outdoor aerial is used, it is of course necessary to ground the lower end of the primary, and also the (—A) connection. Even with a loop it may also be necessary to ground the (—A) under certain conditions when the loop may be acting both as a loop and as an antenna at the same time. When the set does nothing but squeal without amplifying the incoming signals it is a good plan to

(Turn to next page)

ground the (—A) as an experiment, and the same is true when body capacity is much in evidence or when the set is not properly selective.

Much of the trouble experienced with body capacity or from weakened signals due to feed-backs between stages, can be avoided by grounding the metal shells of the radio frequency transformers, or by connecting the metal casings to the (—A) line, which is much the same thing. This is not an invariable remedy with all transformers, but it is frequently of great assistance.

Shielding the Set

Ordinarily, shielding the interior of a radio receiver is not to be recommended, owing to the losses that may be introduced, but in the super-heterodyne it is frequently necessary to reduce body capacity and to increase the selectivity. Every wire and every coil inside the cabinet acts as a small untuned antenna in picking up stray waves unless shielded by a complete enclosure of grounded metal plates, and where there is much local interference we cannot attain perfect selectivity unless we ground the local waves before they induce uncontrollable currents in the wiring and coils. This means grounded metal shields on the front, back and ends of the cabinet when there are many nearby broadcasting stations.

Grounded metal shields are also often necessary between the oscillator tube and the first radio frequency tube to prevent direct feed-backs between the plates of the tubes. However, it is best to avoid this by changing the arrangement of the tubes where possible, but in certain cases the shield is the only solution. Grounded shields, forming partitions between the various tubes of the radio frequency stages are sometimes of advantage, but in most cases had better be omitted. At this point the shields absorb an unusual amount of energy, and unless body capacity is much in evidence it is better to allow a small feed-back to take place rather than to suffer losses in the stages.

FOR the maximum results with the super-heterodyne we must use storage battery tubes for all stages, the C-301A or the UV-201A being the best for this purpose. Dry cell tubes do not provide much energy, particularly in the audio frequency stages, and while such tubes as the UV-199 or the C-299 may give fairly good results in a circuit designed for them, yet the 0.25 ampere tubes give much the greater amplification. At present it is considered the best practice to dispense with the soft gas filled detector tubes (UV-200 or C-300) owing to the great amount of "A" battery current taken, and also for the reason that the soft detectors must be worked with a positive bias on their grids, thus causing an excessive demand on the "B" battery.

Many heterodyne circuits have fallen down on the job simply for the reason that their owners did not appreciate the fact that all tubes are not uniform, and that certain tubes out of a lot are better oscillators than others. In fact, the lack of uniformity in the characteristics of the tubes has been one of the greatest troubles experienced in the heterodyne circuit. It is only by changing the relative positions of the tubes in the sockets that we can determine which is the best oscillator of the lot and which tubes are the best in the radio stages. There will be found one combination at which the best results are obtained, and in many cases, one particular tube in the oscillator circuit will give twice the volume and range as certain of the other tubes. Before condemning a hookup, try a complete transposition of the tubes.

BEFORE we attain our ideal in the heterodyne we must be able to obtain matched tubes from the dealer or else lay in a sufficient surplus from which to make a choice. Special oscillator tubes should be marketed which have proved by test that they are specially fitted for this service, thus relieving the buyer of the necessity of sorting out tubes and of purchasing more tubes than are actually required Of course, the five-watt tubes (UV-202) and the Western Electric amplifiers are wonderful oscillators and audio amplifiers, but they take so much "A" battery and "B" battery current that their use is practically prohibitive in the ordinary set, and we may as well put this idea out of mind at the beginning.

When all eight tubes are of the hard amplifier type (UV-201A) we can use a high plate voltage on all of the tubes. In everyday practice it is the custom to use 45 volts on the plates of the detectors and 90 volts with the amplifiers, radio frequency, and audio frequency tubes alike. This gives excellent results so far as reception is concerned, but leads to an excessive demand for "B" battery current. A better arrangement is to use 45 volts on the plates of the detector and radio frequency amplifiers with 9 volts on the oscillator and audio frequency tubes. The radio frequency amplification is nearly as great at 45 volts as at 90 volts and much less plate current is used. When we have eight tubes in a circuit, the "B" battery problem becomes a very important factor in the operating expense and we must therefore observe every precaution which will reduce the demand on these batteries.

An independent rheostat for each tube is not desirable, although we frequently see this arrangement specified on hookup

(Continued on page 72)

A rear view of a novel neutrodyne receiver constructed by a well known Eastern amateur radio builder, which shows some unusual feats of engineering skill. Note the method of off-setting magnetic coupling between the neutroformers, and the simplified arrangement of the receiver as a whole. The panel is shielded carefully from stray capacity effects, which may be introduced while operating.

The March of Radio in Other Lands

How *John Bull* is

PAYING THE RADIO PIPER

By FREDERICK SMITH

ENGLAND is several strides ahead of other European countries in the development of the broadcasting art. The enthusiastic radio fan in London will tell you that the British Isles will soon become leaders of the world in home radio activities. In fact, some Englishmen told me that they believed English broadcasting methods and organization were even now superior to those of the United States.

Yet, there are only sixteen broadcasting stations throughout the British Isles. Some are scarcely started and others are still to establish continuous operation. When we remember that New York City alone has sixteen active and powerful stations, it makes one stop to question the English radio man who talks of the advance made by the magicians of the microphone in the land of John Bull.

When you begin to ask questions, you get interesting information. First, broadcasting in the British Isles is controlled by the British Broadcasting Company. No broadcasting is permitted by independents. This arrangement has been termed a monoply, but the B. B. C. denies the charge, basing its denial on the argument that any radio manufacturer may become a member of the broadcasting company by taking up a share of its stock at one pound a share. After becoming a company stockholder, the radio manufacturer has the privilege of assisting in the operation and development of the broadcasting system in the British Isles.

THE number of stations operated by the B. B. C. is rigidly restricted by the Postmaster-General. With their love of abbreviations, the English call him the "P. G."

B. B. C. and P. G. work hand in hand. B. B. C. pays P. G. a fee of fifty pounds per annum for each station. The government then undertakes to prevent, so far as is possible, the sale of foreign-made radio goods in the Isles. That, presumably, helps the manufacturing members of the B. B. C. by giving them almost absolute protection against competition of imported merchandise. Whether such a restriction on the full and free use of radio equipment is a wise program in the long run is a question that time will answer.

A license to the British Broadcasting Company was issued on the 18th of January, 1923. It will be observed that radio in the United States had been in full stride for one year when the license was granted in England.

American radio followers, whether interested in radio as a trade or an as art, will find the kernel of the English broadcasting situation in the following provisions of the scheme adopted:

"(a) A Company (called the British Broadcasting Company) to be formed among British manufacturers of wireless apparatus. Any such manufacturer to be entitled to join the Company on subscribing for one or more one pound shares and on paying a deposit of 50 pounds and entering into an agreement in the form approved by the Postmaster-General.

"(b) The Company to establish eight broadcasting stations and to provide a regular service to the reasonable satisfaction of the Postmaster-General. The Company to pay a royalty of 50 pounds per annum in respect of each station.

"(c) The Postoffice to issue broadcast receiving licenses at a fee of 10 shillings (about $2.25) a year containing a condition that the sets used and certain parts (viz., valves, valve amplifiers, head telephones and loud speakers), must bear a standard mark—'B. B. C.—Type approved by the Postmaster-General.'

"(d) The Post Office to pay the Company a sum equal to one-half the license fees received in respect of broadcast and experimental receiving licenses.

"(e) The sets sold by members of the company, as a condition of bearing the 'B. B. C.' mark, to be British made; to carry a payment to the company in accordance with a tariff approved by the Postmaster-General, and to require the Postmaster-General's approval of the type of set, such approval being confined to securing that the apparatus would not be likely to cause radiation from the receiving aerial. The tariff payments on apparatus, which were required by the Postmaster-General, could, in certain circumstances, be reduced by him after consultation with the Company.

"(f) No advertising or paid matter to be broadcast and only such news as is obtained from news agencies approved by the Postmaster-General.

"(g) The Company not to pay dividends at a higher rate than 7 1-2 per cent per annum.

"(h) An undertaking to be given that requisite capital would be subscribed, that the service would be continued throughout the period of the license, and that any deficit would be met. Six firms undertook these responsibilities and were given the right each to nominate a director, two additional directors being nominated by the remaining firms who might take up shares, and an independent chairman being appointed by the six firms."

Under the foregoing conditions broadcasting and broadcast reception were undertaken. Some changes have been made as to details, but as a whole

C. A. Lewis, shown above in a restful moment, is the "bedtime story man" of England. He is known to thousands of children for his typically British way of telling stories. His popularity, however, does not approach that which is enjoyed by similar entertainers in America.

England is fast realizing the importance of radio in modern education. Special classes have been formed in several public schools, where crystal sets have been introduced for the young pupils. The photograph above shows a group of grade school students being introduced to the intricacies of radio reception at one of the London schools. The radio idea is fast spreading throughout the British Isles, it is said.

the English are working along on the basis outlined.

I PAID two visits to the British Broadcasting Company's main offices in London and the American radio fan will appreciate with what interest I sought to learn how radio was prospering under restrictions which to Americans are little less than amazing.

I found the officials of the B. B. C. cordial, courteous, alert and intensely enthusiastic. When they told me of English radio success and named their sixteen stations I remembered that Americans abroad are often regarded as braggarts; so I refrained from mentioning the fact that in our country we have upwards of 600 broadcasting stations.

But it was not necessary to tell my English friends about our great number of stations. They knew it. They had that very fact in mind when they made the assertion that they thought their broadcasting system was preferable to ours. They preferred their own system for the reason (as they presented it) that the Americans had so many stations there was confusion and trouble. They also referred to the freedom with which Americans were permitted to choose sets of any make or type and they did not appear to approve of this liberty.

Of course, the licensing of receiving sets is necessary in order to make sure that the radio fan is not using an American or other foreign set or equipment. As a matter of fact, the government has seen fit to revoke its rule against use of foreign receivers and apparatus; but this means little, as there is a sort of gentlemen's agreement throughout the British Isles that only British equipment will be used.

Frankly, I was disappointed at not finding some of our excellent radio equipment on sale in cities like London. I believe it would do the cause of English radio a substantial good if the restrictions were broken down and the fans were permitted to make use of whatever material best suited their fancy or their purse.

It seems to me that England is making the mistake that Germany made; that is in trying to make a protected industry of a trade that is universal in all of its main appeals. I am of the opinion that we have in America about all the government assistance we need in promoting the industry here. What is needed in the United States, above all else, is an awakening of Congress to an appreciation of the need for proper financing of the departments which are trying to guide radio to even greater prosperity and popularity than it enjoys today.

OUR broadcasters do not have to join a company in order to get a license to build and operate a station. Our broadcast listeners do not have to pay a license fee in order to operate their receiving sets. This is truly a land of the free so far as radio is concerned.

There is an international element in radio transmission and reception that makes English radio more attractive and picturesque than our own. Various peoples, speaking various languages, struggle with the English that is broad cast from England and English fans wrestle with the strange tongues that speak to them from the continent.

A letter received by one of the "uncles" of 2LO, the main London station of the British Broadcasting Company, illustrates the point. The letter was written by a little Spanish girl. It was addressed to "Caractacus" whose real name is C. A. Lewis, and who entertains the children with stories by way of radio. The letter follows:

"Dear Uncle Craktykuss—I am staying in Londres con my auntie, and I am leven yeers of old, but my familia are in Madrid, where I live. I like Ingland, but the sun is not to shine and the cold comes much. I have listened on the wires, and I like you very, very much and the other gentlemans too. Are you pretty? Your voice is. I can nearly spike Inglish well. Have you seen a bull fite. I not have, but wen I am old I will, I send you much kiss. Adois con muchos abrazos, su amiga,

Carmencita Lopez y. Fernandez.

A later article in RADIO AGE will tell of broadcasting in Belgium, where there is but one station.

Answering the Demand for

A *SELECTIVE* CIRCUIT

By FRANK D. PEARNE

AS THE science of radio progresses, the cry for selectivity in receiving sets becomes louder and louder each day. Bringing in the distant stations is a comparatively easy matter with some of the receiving sets in use today, but try to do it with three or four local stations thundering away and see what the results are.

On a good cold night, with the air clear and the local stations quiet, it is no trick to pick up the distant stations with almost any kind of a good tuning unit, but the crying need of the present is a receiver that will reach out and get them when the locals are all busy and pass through them without interference. Such reception would be ideal and no doubt the time will come in the near future when it will not only be possible, but receivers of this type will be very common.

Looking back to a few short years ago, a fan who was fortunate enough to hear California stations on an exceptionally good night for reception, would hardly dare to mention it to his friends for fear of being laughed at. Today if he does not show these stations on his log, the laugh is on him.

SO MUCH for the rapid development of this fascinating science to date, but what may we expect in the near future? Distance now being an accomplished fact, the next serious subject is selectivity and the elimination of static interference. Just as distance was annihilated, so will be the interference of undesired stations and static.

There are many sets now on the market which show great selectivity, proving that we are moving in the right direction. Another very important improvement will be a set which is entirely controlled by one dial. Some of the good selective receivers now in use are capable of very sharp tuning, making it possible to get distant stations through considerable interference; but they usually have so many controls that it takes some time to get the proper adjustment. The set shown in the accompanying drawings is of foreign origin, being used quite extensively in Australia. While the desirable points before mentioned have not all been realized, its selective characteristics are such that it rates much higher in this respect than the ordinary three circuit regenerative set so commonly used in this country. It also has the advantage of greater signal strength.

Construction of Parts

It will be noted that the primary inductance consists of the stator winding of a vario-coupler, with the secondary wound upon its rotor. Very few of the couplers now on the market will be found to have the required number of turns, and for this reason it is suggested that the coupler purchased for this set be one which has a long tube for the primary winding. To make room for the special winding, this tube should be about five inches long, but if one of this length cannot be obtained a shorter one will do. This will mean that the size of the wire specified will have to be reduced so that one hundred turns may be wound on it. This coil to be correct should contain 100 turns of No. 22 double silk insulated copper wire, but if a shorter tube is used it may be wound with the same number of turns of No. 24 wire, although this will increase the resistance somewhat.

In constructing these parts, eliminate all guesswork for efficiency.

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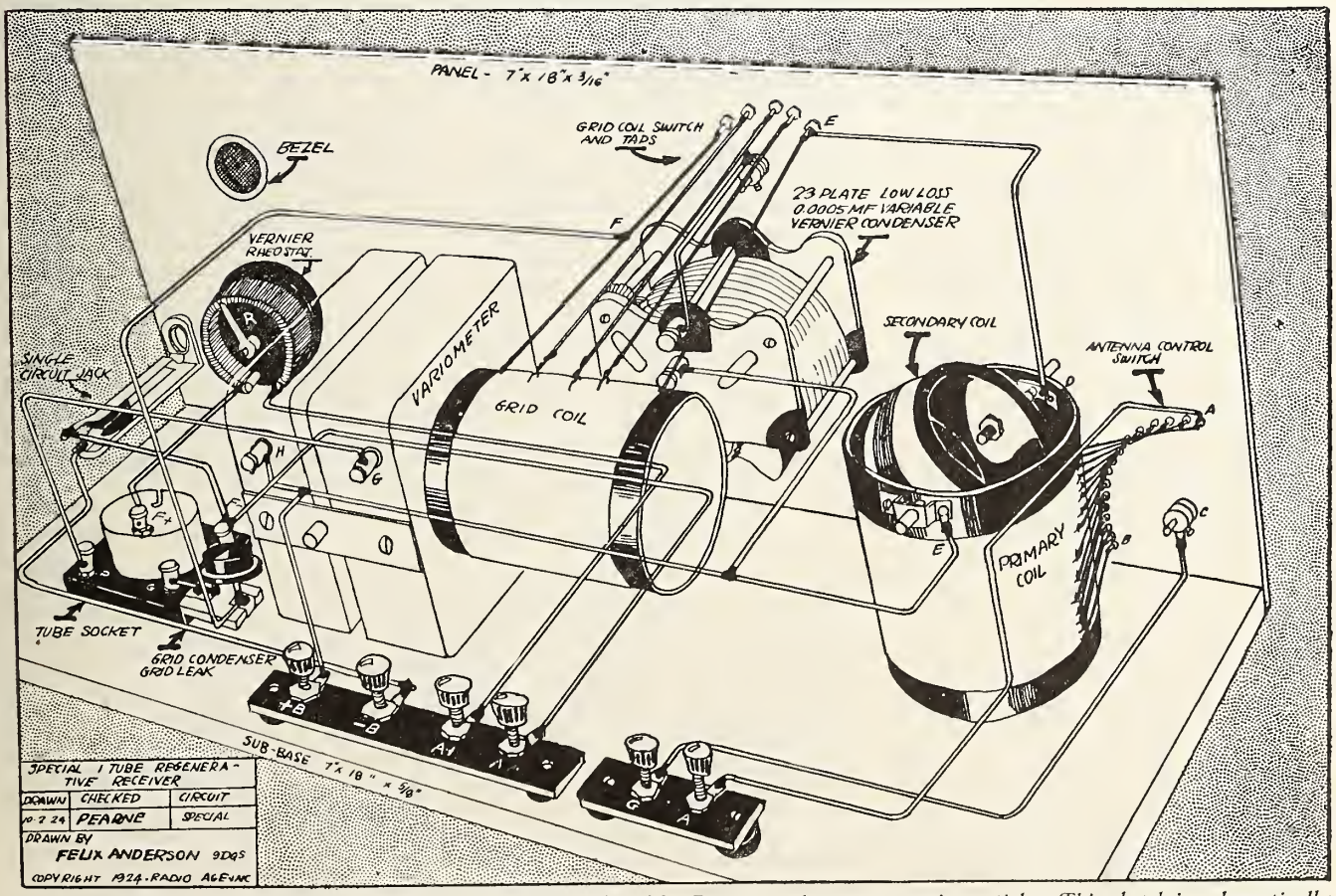

An isometeric projection of the selective receiver described by Mr. Pearne in the accompanying article. This sketch is schematically diagramed in Figure 2. and may be used as a wiring plan if Figure 2 puzzles. The variometer is set back slightly so the grid coil will clear the condenser.

OF COURSE, the original winding of the coupler is taken off and at the beginning of the new winding, the starting end of the wire is anchored in the same manner as that which was removed. Taps are brought out at the 5th, 9th, 12th, 15th, 19th, 24th, 28th, 32nd, 47th, 53rd, 58th, 68th, 78th, 88th, and at the final end of the winding which is the 100th turn. These taps are made by twisting a loop in the wire at the proper turn, leaving them about 6 inches long.

These turns should be twisted up tightly against the tube, so that the winding may be drawn up tight enough to hold its position. The final end of the wire is anchored to the tube in the same manner as that of the starting end. One thing to be carefully watched during the winding is to see that in twisting the loops used for taps that the insulation is not impaired so that a short circuit will occur between the base of the tap and the adjacent turn. This is the reason for using double insulated wire.

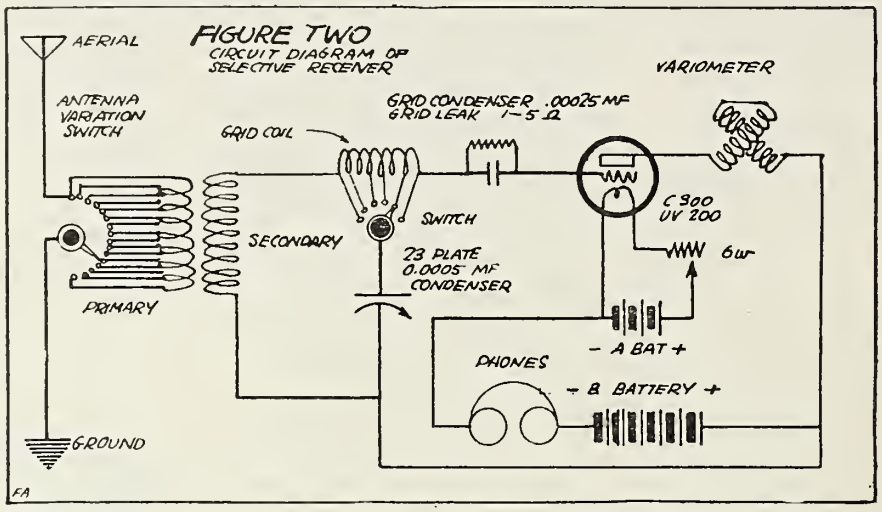

Figure 2. A schematic sketch diagram of the circuit, illustrating the principle of the circuit. Notice the peculiar position of the phones and B battery in the circuit. While a UV 200 or C 300 tube is indicated, any of the standard dry cell tubes may be used with equal results.

The great number of taps used, while perhaps a little inconvenient in the construction, will give a very close variation in the antenna adjustment on the short waves, and will also give a good variation on the longer ones. If it is found that a closer adjustment is required for the short waves, it can easily be supplied by connecting a variable condenser between the switch lever and the ground. For giving a better adjustment for the long waves, it can be connected across the two outside terminals of the coil. This may seem like "splitting hairs" to some of the fans, but we must bear in mind the fact that we are building a good set which is to accomplish something more than the ordinary and therefore too much attention cannot be paid to details.

A switch may be arranged to make it possible to switch the connections of the condenser into the ground circuit or across the outside terminals as desired. The rotor ball of the coupler will also have to be rewound, as it will only be a miracle if one having the correct number of turns is found. There should be about 3-4 of an inch winding space on each side of the ball to accommodate the winding. The correct winding should be 25 turns of No. 22 double silk insulated wire on each side. If the winding space is too small for this number of turns, the size of the wire and not the number of turns should be reduced. This can probably be done with No. 24, or No. 26 wire.

ALWAYS remember, however, that the resistance should always be kept as low as possible and the smaller the wire, the higher will be the resistance. In winding the rotor, the two coils must form one continuous winding, and it will be found that the winding will have to be done from the outside edge of the ball, up the sloping sides toward the center. This will mean that in order that the two coils shall furnish a continuous winding in one direction when completed, the winding, because it must be done from the outside toward the center, will be in the opposite direction. The two coils are to be connected together in the center.

If these coils oppose each other, the set will not work, and it is suggested that one investigate the winding of the rotor before the wire is stripped from it.

In selecting the variometer, the ordinary wooden type will best serve the purpose because the extra inductance is to be mounted on one side of it in such a manner that the rotor ball will partially enter it and the coil can be much easier fastened to the wooden type than to any of the standard bakelite variometers.

Select a variometer which is wound with No. 22 wire. Others will work, but we want to keep all windings as close to the original specifications as possible. This special inductance is a coil wound upon a cardboard or bakelite tube 5 inches long and 3 1-2 inches in diameter. A space of 1-2 inch should be allowed on the end of the tube before the winding begins to make allowance for mounting it on the side of the variometer. This coil is also wound with No. 22 double silk insulated wire and contains 70 turns. Taps are brought out every 10th turn, which will give the coil two ends and six taps. Anchor these ends by means of two small holes punched or drilled through the tube, about 1-4 of an inch apart and in line with the winding.

Special attention must be paid to the direction of the winding, as it must be in the opposite direction to that of the variometer. The set will function no matter which direction the winding takes, but it will work better if the coil and variometer windings are opposed. This should be carefully studied to decide which side of the variometer it is to be mounted on and then calculate the direction of winding accordingly. The actual mounting of the tube to the side of the variometer may be accomcomplished in several ways, the best being to cut out a ring from a piece of wood one-fourth of an inch thick, the outside diameter being just large enough to fit in the tube and the inside diameter large enough to allow the rotor to pass through it. This ring is glued (not tacked) to the side of the variometer and the tube glued to it.

The use of tacks is bad, because they may pass through the side of the variometer and short-circuit some of the turns. The ring may be easily cut out with a jig saw, or if one does not wish to go to this trouble, the tube may be fastened in place by means of sealing wax; but this is not recommended if one expects to move the set around from place to place. This method of coupling the grid and plate circuits has not been adopted in this country, probably for the reason that it has not been known. But it certainly adds much to the value of the set. The connections of the phone and plate battery circuits are peculiar and one might think at first that something is wrong with the drawing, but they must be followed out to the letter. The phones are to be connected between the negative filament and the negative plate battery terminals. It is suggested that the 23 plate condenser be of the low loss type, as we are working for efficiency and every little prevention against loss will help in the final results.

Following the Circuit

Without the refinements mentioned before, such as the switching arrangement for the extra condenser, the circuit may be traced as follows: from the aerial binding post to the top turn of the variocoupler stator and through the switch and contacts to the ground. One end of the rotor is connected to one terminal of the inductance which is attached to the variometer and the other end of this inductance is connected through the grid condenser to the grid binding post on the socket. The six taps from this coil are connected to six switch contacts.

The switch lever, which makes contact with these taps, is connected to

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Getting Distortionless *Reception*

A PERFECT AMPLIFIER FOR AUDIO FREQUENCY WORK

An Unusual Article

By L. R. Felder

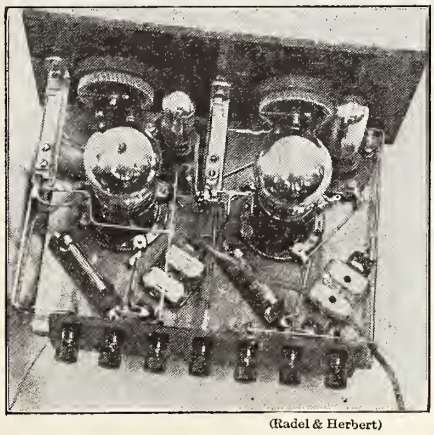
IT IS indeed very interesting to observe how, as the months pass by, the attention of the entire radio public drifts from one thing to another in the matter of radio reception. Not so long ago, I remember a very large proportion of the radio population were satisfied with their little crystal receivers.

Suddenly the bulb came into prominence. The vacuum tube was in existence all this time, but the radio public had not yet reached the tube stage. When this time came, they were satisfied with the single tube set which gave them several times the signal possibilities of the crystal set. Then followed various stages of evolution, bringing the one and two stage audio frequency amplifier, the stage in which the wave trap was employed for securing selectivity, that in which radio frequency stages were used for securing selectivity, and so on. From the point of view of selective reception, we are at present in the superheterodyne stage. The promising thing about this shifting of attention is that it is progressive; the attention of the radio public shifts always to the better things.

The quality of reception does not depend entirely on the receiver, of course. If the broadcast transmitting station does not send out perfect material the best receiving set will not make the quality perfect. But as they have developed today, broadcast transmitting stations are considerably better than most receivers. The really good broadcast stations transmit very excellent material. It therefore remains with the receiver to reproduce this good quality transmission into good quality reception.

And to date the weak point in the radio receiver has been the audio frequency amplifier. While transformer coupled amplifiers give quite good results, they are not perfect. They have the very big advantage that they give considerably more amplification than any other type of amplifier. But for those fastidious people who really desire *distortionless* reception, another type of amplifier must be employed, for iron core transformers inherently have a distorting tendency, even though it may not be very great.

AS a result, the resistance coupled amplifier is beginning to come into favor. The resistance coupled amplifier is no new invention, though there may be some who would exploit it as such. Those who have been in the radio game for some years back know that resistance coupled amplification was in use during the war as radio frequency amplifiers at long wave lengths. It is now coming into its own as an audio frequency amplifier and the principles underlying its operation are exactly the same as those underlying the operation of the radio frequency amplifier.



(Radel & Herbert)

Above is a new type of resistance coupled amplifier that permits operation on low "B" battery voltage. It has just been perfected by J. W. Marshall of Philadelphia. Note the diode tubes which are used as resistances.

The resistance coupled amplifier is the *perfect amplifier*; that is, when the amplifier is properly designed and built. It will be instructive to review briefly the principles of the resistance coupled amplifier to see why it is the perfect amplifier, after which the design constants of a suitable type of resistance amplifier will be given.

An amplifier always includes a vacuum tube, for it is the tube itself that does the amplifying. We must have some unit across which our amplified voltage appears and which transmits this amplified voltage to the succeeding tube or to the phones or loudspeaker. This unit is called the coupling unit. Thus in Figure 1 we have the very familiar circuit of the one stage audio frequency transformer amplifier. The vacuum tube amplifies the voltage which is impressed on its grid. This amplified voltage appears across the transformer primary and secondary and is transmitted to the succeeding tube or loud speaker by the transformer secondary.

In the same way a resistance coupled amplifier employs a coupling unit, only in this case the coupling unit is a resistance instead of a transformer. In Fig. 2 we show a vacuum tube with a simple resistance R in its plate circuit. Suppose an audio frequency voltage is applied to the grid of the tube. The tube will amplify this voltage because of its amplifying properties, and this amplified voltage will be developed within the tube itself. But we are not interested in the voltage inside of the tube; we are interested in securing this voltage outside of the tube where we can use it. If the plate were open circuited, we would have nothing to draw our voltage from. There is a voltage developed in the armature but there is nothing in the generator circuit across which a voltage is secured. If a resistance is placed in the generator and the circuit is closed, a current will flow through it and there will be a voltage drop across it which may be used.

However, we are not merely interested in securing a voltage across this plate coupling resistance; we are primarily interested in securing a maximum amplified voltage across it, so that our signal will be loudest. The magnitude of voltage secured across R of Fig. 2 depends upon the value of this resistance compared to the tube resistance. The reason for this will be apparent from this simple analogy of the direct current generator of Fig. 3, in which is shown a generator and a resistance in series with it. Suppose this resistance is extremely small; let us say a short circuit on the

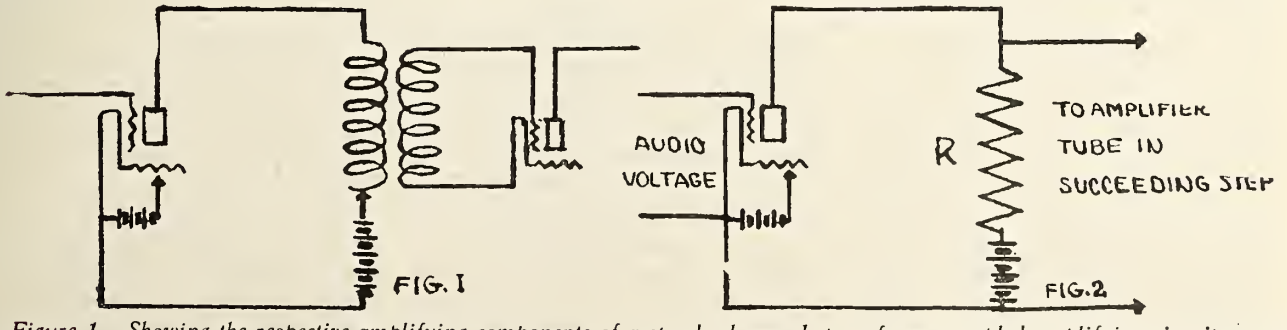


Figure 1. Showing the respective amplifying components of a standard cascade transformer coupled amplifying circuit as compared with the resistance coupled type of Figure 2. The resistance R in Figure 2 substitutes for the primary and secondary windings of the audio transformer shown in the first illustration.

generator. Since the external resistance is a short circuit, there can be no voltage drop across it, because all of the voltage drop is taken up by the resistance of the generator. Thus there appears no voltage outside of the generator. This conclusion is well known by all. Now suppose that the external resistance of the generator circuit is just smaller than the generator resistance itself. Then the entire voltage developed by the generator is divided between the generator resistance and the external resistance, and since the external resistance is less than the generator resistance, it requires a smaller voltage across it to drive the given current through the circuit. Thus we will have voltage developed across the external resistance, but it will be small. Now suppose finally that the external resistance is very much greater than the generator resistance. The generated voltage has to divide itself between the generator resistance and external resistance. But since the external resistance is so very much greater than the generator resistance most of the voltage will appear across the external resistance and only a small part will be across the generator resistance. Thus most of the generated voltage appears now outside of the generator where it can be used.

The Resistance Amplifier

EXACTLY the same principle applies to the resistance coupled amplifier. The grid voltage is amplified inside of the tube and the amplified voltage inside of the tube sends a current through the tube and plate resistance R, Fig. 2. If R is small compared to the tube resistance, most of the amplified voltage will be consumed inside of the tube itself and very little will appear outside where we can use it for working a loud speaker. Like the generator, although there is a voltage generated or developed inside of the tube, we are not able to avail ourselves of it because our circuit is not right. If R is made very much higher than the tube resistance, however, only a very small part of the voltage developed inside of the tube will be consumed by the tube itself, for most of it is required to drive current through the must higher external resistance R, and thus the amplified voltage is available across the resistance R. Thus the first important principle in the design of a resistance coupled amplifier is that the external coupling resistance must be very great compared to the internal resistance of the tube. In practice a value for R is chosen which is about 5 times that of the tube resistance.

Now, what is there about the resistance amplifier which makes it such a perfect amplifier? Suppose the resistance R is 100,000 ohms. Its resistance will be 100,000 ohms whether we measure it at 10 cycles or 10,000 cycles. The tube resistance is the same whether we measure it at 10 cycles or 10,000 cycles, assuming a given plate and grid voltage and filament current. No matter what the frequency is which we are amplifying, whether it is the low notes of a bass or the high ones of a coloratura soprano, the resistances remain the same, and therefore the amplification remains the same. Thus the resistance amplifies all frequencies alike.

The plate resistances R are the coupling resistances across which the amplified voltages appear and which transfer these voltages to the succeeding tubes. As explained before, these resistances must be high compared to the tube resistance. The voltage which appears across these resistances is applied to the grid of the following amplifier tube through a stopping condenser. This stopping condenser serves the purpose of preventing the positive voltage of the plate battery from getting on the grid of the amplifier tube. Any condenser which will stop the plate battery voltage from getting on the grid will not do. For the amplified audio frequency voltage which appears across R is applied to the following grid through the condenser C, which has a reactance depending upon the frequency. If the condenser is too small, it will have a very high reactance and a large part of the audio frequency voltage will be consumed across the condenser and will not be applied to the grid therefore, thus causing a loss in amplification. The condenser should therefore be large enough to prevent any appreciable loss of audio voltage.

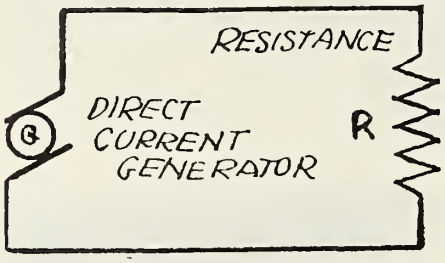


Figure 3. A simple analogy of the principle of the resistance coupled amplifier. By properly applying the most efficient value of resistance across the generator terminals, the greatest current is effected across R.

The grids of the amplifier tubes are biased with a "C" battery through a grid leak "r". The biasing potential has the effect of producing first distortionless amplification because it enables working the vacuum tube on the straight portion of its characteristic curve, and, second, it helps battery economy, for it limits the plate current. This is accomplished without any loss of amplification.

Values to Consider

IN the actual construction of a two stage resistance coupled amplifier, the following values will be found to be the best. The vacuum tubes now obtainable, such as the C-301 A, UV199 and so on, all have approximately 20,000 ohms resistance. The plate coupling resistance should therefore be about 100,000 ohms. The resistances come in standards values such as 48,000 ohms, 96,000 ohms. The 96,000 ohm unit is entirely satisfactory. The resistance does not change in value and most important of all it is quiet and will not develop noise as some others do. The stopping condenser should be at least 1 microfarad, and should be capable of withstanding the full amount of the "B" battery potential. If higher values of condensers are available, say 2 microfarads, they should be used, as then the reactive drop across the condenser will be still less and practically all of the amplified voltage will be impressed on the grid of the succeeding tube. The usual type of grid leak employed in all receiver construction may be used here, and the value should be much greater than the plate coupling resistance. It should be not less than 1-2 megohm. 1-2 to 1 megohm will be found satisfactory. As to the biasing potential on the grids, this depends upon the plate voltage used. If 110 volts are used on the plates of the larger tubes such as the C-301A 7 to 9 volts will be found necessary. In case smaller voltages are used the grid bias should be reduced proportionately.

A resistance amplifier constructed along the above lines, using the given constants, will function properly without any trouble. Approximately the full amplification of the tube will be secured. This is less than that secured by audio frequency transformer coupled amplifiers, for the reason that in the latter case the transformers themselves amplify considerably due to their step up ratio. For this reason it will be found that it will take about three stages of resistance coupling amplification to equal the volume output of two stages of audio frequency transformer amplification. There will not be a very great difference in cost, for two good audio transformers cost about as much as the additional tube and the coupling resistances together.

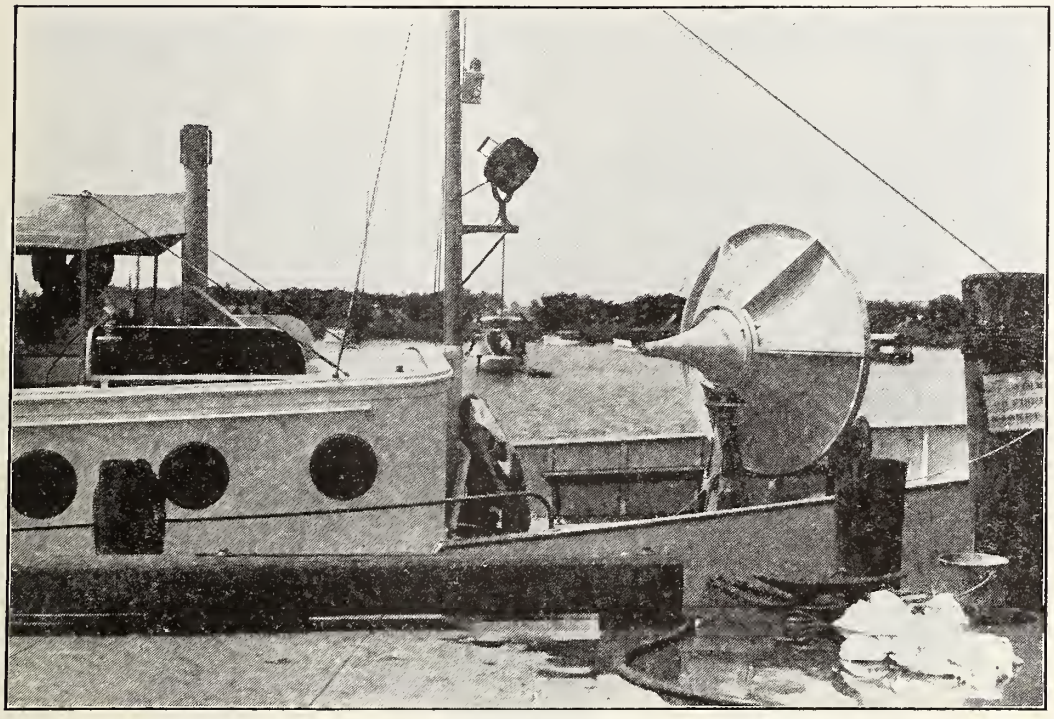
In constructing a three stage or even two stage resistance coupled amplifier, the following refinement will be found to contribute to securing good quality. As everyone knows, the loud speaker is a source of weakness in every receiver. It is as much responsible for distortion as any other element in radio broadcasting. One of the things tending to increase this distortion is the presence of direct current through the loud speaker magnet windings. The direct current produces saturation and distortion results.

Inasmuch as the plate potential of a resistance coupled amplifier has to be applied to the plates through an extremely high resistance, it will be evident the entire plate potential will not be effective. It will be found necessary to employ high plate batteries from 110 volts to 150 volts in order to secure the desired amplification. This is because the high plate resistance takes most of the "B" battery drop. The life of the plate batteries will be much greater than in any other type of set for the drain on it will be exceedingly small.

The disadvantage of using such high "B" battery voltages may be overcome in another type of distortionless amplifier of which not so much is heard; namely the reactance coupled amplifier. When properly constructed this is practically as distortion free as the resistance amplifier, and details of this will be given in a later paper.

Uniting VOICE *and* ACTION

By ARMSTRONG PERRY



At the right is a coast guard patrol boat equipped with a loud speaker that carries orders, announcements and entertainment to thousands assembled on the Potomac to witness a water pageant.

Synchronization of Sound and Action Must be Perfect or the Most Serious Event will Become a Farce—Eastern Man Has Device to Annul Divorce of Voice and Action

AFTER the phonograph had made it possible to hear a distant or even a deceased person, but not to see him, and after the motion picture had made it possible to see a distant person but not to hear him, thus divorcing voice and action, inventors turned their attention to the problem of producing a device that would make it possible to see and to hear at the same time any person whose voice and action had been recorded.

There was a near-success when someone devised a system whereby a motion picture projector in the rear of a theater could be connected mechanically with a phonograph in the front of the house. With a new film and a perfect start, these "talking movies" ran along smoothly, barring accidents; but after the inevitable breaks in the film had occurred, after the leader and tail-piece had been damaged by long use and emergency repairs had been made by operators of various degrees of skill, the voice and the action began going their separate ways without regard for co-operation. The most serious tragedy became a comedy, because a word fitly spoken so often came at a time when the mouth that was supposed to be speaking it was otherwise engaged.

After several attempts to make the movies talk had been abandoned, radio broadcasting appeared, making it possible for any number of audiences to hear a speaker at a distance while he was speaking, but not to see him. C. A. Hoxie then brought out his Pallophotophone, and Dr. DeForest his Phonofilms, which show to an audience a man in motion and let it hear what he said, but not at the time he makes his motions and does the speaking. With these systems, motion and sound must first be recorded and then reproduced, and this is true also of DeForest's latest system, which uses his thermophone and photographic process.

Pictures by the Author

A New Method

C. F. JENKINS promised something better; namely: that he would make it possible to transmit actual scenes by radio, right while they were taking place. This, combined with broadcasting, would make a radio fan a witness of the distant scene while it was being enacted. Mr. Jenkins already is transmitting still pictures and, in laboratory tests over short distances, motions of the hand and other small objects. Although some physicists say that his ultimate goal is unobtainable, the lay mind remains open to conviction. In the meantime the race to be the first to show the world and make it hear persons who are somewhere else goes merrily on.

Among those who are working on the problem is Marcus C. Hopkins of the Hopkins Laboratories in Washington, D. C. Mr. Hopkins worked with Eastman and Edison in years gone by. He understands the operations of light, sound and radio so far as they have been determined. It was his amplifier, mounted on the roof of Keith's Theater during Shrine Week in the National Capital, that projected speech and music brought in by radio from various parts of the country so that it was heard distinctly and with satisfying quality above the roar of the city's traffic as far away as the corner of K Street and Connecticut Avenue, half-a-mile away. In a quiet rural district this loud speaker has been heard over distances of from two to five

miles. Its secret is that it maintains the true form of the sound wave and sends it forth in such fashion that it is not dissipated as sound waves are when projected from poorly designed horns. The United States Coast Guard used one of these loud speakers in controlling river traffic on the Potomac and giving announcements during Shrine Week. It carried like a fog horn, though with a much more pleasing tone.

Mr. Hopkins has invented a synchronizer which, connected between a phonograph and a motion picture camera or projector, insures the perfect coordination of record and film, either when they are being made or when they are being projected. It has an application to radio also.

This synchronizer includes a rheostat of about 27 points with a total resistance of about 80 ohms. The rheostat is operated by the motion picture machine and controls the motor that runs the machine. Motion picture cameras and projectors usually have detachable handles, used only when the machines are operated by hand. When a projector or camera is operated by an electric motor, a practice common in the case of the projector, the handle may be detached and a universal shaft attached in its place, connecting the motion-picture apparatus with the rheostat of the synchronizer.

How It Works

THE synchronizer rheostat has a commutator. To this is applied a brush, operated by the motor of the phonograph. As the brush advances it cuts out resistance, and if retarded it adds resistance.

The motion-picture machine, the synchronizer and the phonograph being connected, the apparatus is started by placing the phonograph needle on a certain point, previously marked at the beginning of the record, and turning on the motor.

The moment the phonograph motor starts, it turns the brush ahead on the commutator of the rheostat, cuts out resistance and sets in operation the motor of the motion-picture machine. When the motor of the picture machine starts, it turns the commutator of the synchronizer. When the moving picture and the speech that accompanies it are perfectly synchronized, the rheostat commutator and the brush go around together, the brush remaining constantly on one segment of the commutator. When the motion-picture machine tends to move more rapidly than the phonograph, the commutator is advanced so that the brush makes a contact with a segment behind the one with which it has been traveling. This adds resistance and retards the motion-picture motor. When the phonograph tends to exceed the speed of the motion-picture motor, it advances the brush and accelerates the motor. The phonograph can be speeded up or down and the synchronizer will keep the motion-picture machine accurately with it.

The greatest variation in synchronization observed in the many tests that have been made is but twelve degrees on the commutator, which represents half of a picture on the film. As there are sixteen separate photographs to each foot of film, and each foot of film passes the projecting lens in one second, this variation is by one-thirty-second of a second between voice and action as observed by the audience. Four times that amount of time is required to make an impression on the retina of the eye, so the synchronization is perfect for all practical purposes.

If anything goes wrong, such as an interruption of the electric current, a device on the commutator automatically lifts the brush and stops the picture motor, which cannot be started again until the operator replaces the brush on the commutator.

The rheostat of the synchronizer works in conjunction with that which is a part of the equipment of the motion-picture projector. If resistance is increased or diminished by adjusting the latter, the synchronizer automatically adjusts its resistance to meet the new condition.

Its Limitations Seen

PHONOGRAPH speech and music at its ordinary volume is useless in modern auditoriums where motion pictures are shown, and Mr. Hopkins has not developed his synchronizer with the idea of shooting sound out of the motion-picture booth. His horn has an electrical device at the small end that is operated through electron tubes. With a radio set it is a loud-speaker; with a phonograph it is an amplifier of the energy transferred from the motor through the record to the needle and diaphragm. The horn can be placed on the stage, the tubes and batteries at any convenient place, and the whole sound amplifying system operated in perfect synchronization with the motion-picture machine through the device in the booth. Electrical connections can be made through an ordinary pair of telephone or bell wires. The picture machine and the phonograph can be started from the stage. The synchronizer requires no more space than the phonograph motor. It can be assembled with the phonograph in the same cabinet. The universal shaft makes it unnecessary to line up the phonograph with the motion-picture machine. All that is necessary is that they shall be somewhere near each other. The connection can be made in a second.

M. L. Hopkins, noted inventor of Washington, D. C., is shown above. He has just perfected a synchronizer which, after being connected between a phonograph and a movie camera, insures coordination of voice and actual vision.

The day when we shall both see and hear what is going on at a distance, while it is happening, may be yet far off. Experts who admit its possibility have made predictions placing it from ten to twenty years in the future, although no one can tell how soon it may come. The next best thing is to see and hear, simultaneously, some interesting event that has been recorded as it was transpiring. The Hopkins synchronizer makes this possible.

The Hoxie and DeForest systems of photographing sound on motion-picture film, at the same time action is being recorded on the same film, appear to have some advantages over the Hopkins synchronizer. They have disadvantages also. Special apparatus for recording and reproducing is required, whereas the Hopkins device utilizes standard apparatus that is already in use throughout the world. It has yet to be demonstrated that the tiny mirrors and the lamps used in recording sound photographically will take in the complex sounds that, for example, help to make a baseball game enjoyable. Sensitive microphone pick-ups, connected by wires to amplifying apparatus located at any convenient point, and through that to a phonograph record cutter synchronized with a moving-picture camera that was filming the scene, probably would give better results. Phonograph records we know can be broadcast by radio. If motion pictures ever can be transmitted and received by radio, synchronized phonograph records can go through the ether with them.

While a presidential candidate is making a speech before a visible audience, and the same speech is being sent broadcast to an invisible audience, a motion-picture camera and a synchronized phonograph recorder can catch every tone and gesture to be reproduced later.

IN THE recording of history, this synchronizer may play a highly important part. Desirable as it may be for everyone to keep himself in touch with the events of the day, it is even more important that truly great occasions should be preserved in visible and audible form for the generations that are to follow. Written history, inaccurate as it often has been, has guided all who have striven to lead humanity upward. History recorded in such fashion that it can be repeated before the eyes of future leaders, as vividly as when it occurred, with all the movements, sounds and even colors that characterized the event when it took its place in the annals of Mankind, will make an impression that could not be produced by books, still pictures or any other medium of the age that is passing.

The Best Intermediate TRANSFORMERS FOR YOUR SUPER

By McMurdo Silver

TWO YEARS ago there was practically no information available to the public on the super-heterodyne receiving system other than that given in textbooks, and that of a purely theoretical nature. Then suddenly the super rushed in to its well-deserved and ever-increasing popularity and with it rushed many manufacturers, all eager and intent upon producing equipment suitable for super-heterodyne use with the least possible delay, in order that they might take advantage of the phenomenal business in this field.

The result was nothing more than what might be expected—the adaption—and in many cases an extremely crude adaption—of existing equipment which could be made with existing manufacturing facilities into a form believed to be suitable for super use. This was most noticeable in the case of the intermediate frequency transformers and the oscillator couplers marketed and heralded as being perfection themselves; given into the hands of radio enthusiasts by the Almighty himself.

To deal with the oscillator coupler at this moment would be futile, since its requirements have already been gone over in the public press. Therefore, let us suffice it to say that it should be small and compact, suitable for use with any standard tube to produce with the minimum of in-put power a uniform output from which harmonics have been suppressed as far as possible.

The Heart of the System

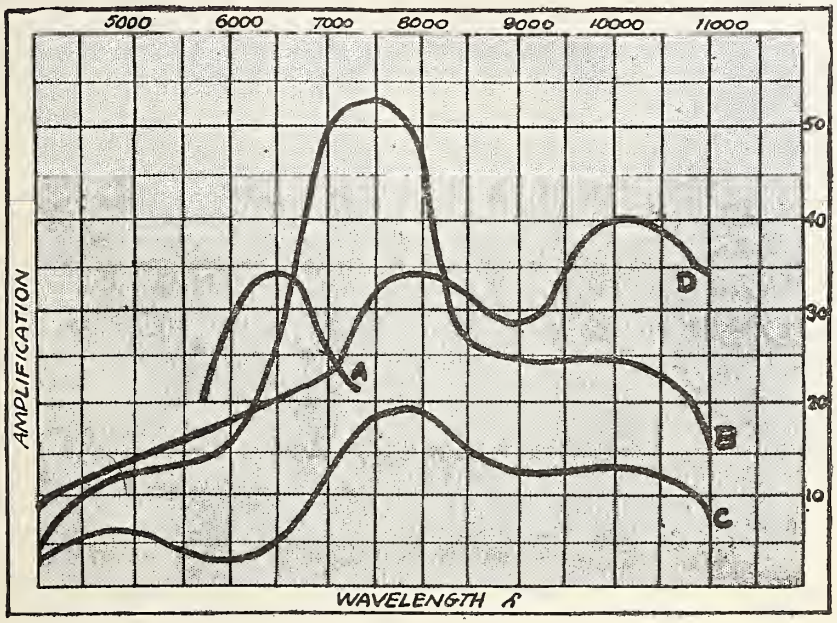
IT is not so simple with intermediate frequency transformers, for the intermediate amplifier of the super-heterodyne is the heart of the system, and like all important things, has provoked extensive controversy on the most suitable method of effecting the desired amplification. Yet we still read advertisements of manufacturers who believe themselves to be in the pre-super days, advertising intermediate transformers covering wave length ranges of a few thousand to twenty or twenty-five thousand meters, apparently blissfully unaware that this is not required for a good super amplifier.

And in the case of practically no transformer are any figures given as to the approximate voltage amplification that may be obtained per stage with it, in conjunction with different tubes and with varying numbers of stages. Little mention is made of the best peak of the iron core transformers, as apparently there is a desire not to admit the fact that the transformers have such a thing as peaks. And as for stability, the manufacturers who mention how negative the tube grids used with their transformers may be run without oscillation—well, they may be numbered upon the fingers of one hand.

The writer is not here concerned with air core intermediate transformers, for it is generally accepted by authorities that iron core transformers operating at comparatively long waves are very much more satisfactory under practical operating conditions than air core transformers with their attendant difficulties; difficulty of peaking stages at the same wave length, poor stability, poor selectivity when not peaked, and poor voltage amplification as compared with good iron core transformers.

Good Amplification

What is desired in the intermediate amplifier, and consequently in the intermediate transformers, is good amplification, selectivity sufficient to eliminate unwanted signals, yet not to distort speech, and stability when cascaded. Just what may be expected from three standard transformers may be seen by referring to the curves in the accompanying figure. Curve C represents a widely advertised 30 KC transformer. It will be noticed that the amplification obtained is quite poor—only about equivalent to what may be expected from standard air core transformers, and that its best operating point is at 7500 meters or 40 KC as against the 30 KC or 10,000 meters advertised for it. This is an unsatisfactory type of transformer, since it has no very sharp hump, and the amplification obtained is not good. Its great advantage is its extreme stability.



The voltage amplification curves on three standard intermediate frequency transformers. Curve B shows a decided peak, between seven and eight thousand meters. The voltage amplification factor is 53 at that wave length.

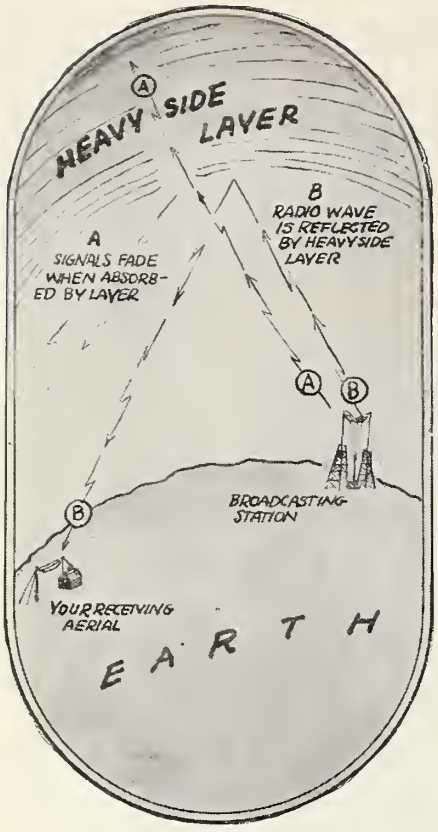
CURVE D illustrates another transformer for which no peak is advertised. It is interesting to note that it has two peaks, one at about 38 KC, the other at 30 KC, probably due to the step-up ratio employed. The amplification here is quite good, the disadvantage being the double peak and the tendency of the higher peak to drop off slowly into the audio frequency range. This would mean that the system would amplify a good deal of noise which would have to be eliminated by the use of an excessively sharp filter which would in turn effect the quality of reproduction on broadcast signals.

The ideal transformers curve is that shown at B, which operates at about 40 KC. The top of this curve is comparatively flat and it is evident that it embraces a wide enough band so that it will transmit undistorted speech; yet it is not too sharp. This transformer, despite the fact that it is the best of the lot from the viewpoint of selectivity, gives better amplification than any of the other types.

What Tubes Give

These three curves were taken between UV 201-A tubes at 45 volts plate potential. Curve A, the same transformer as B, indicates what may be expected with UV 199 tubes. The amplification has dropped off considerably and the frequency has arisen so that the peak is at 45 KC.

If all transformer manufacturers would publish figures such as these, which are at best of a comparative nature, the fan would have no difficulty in determining just which transformer was best suited to his particular requirements.



It is supposed that a "Heavy-side layer" as illustrated in the diagram above is responsible for the fading of signals, as well as their propagation along the surface of the earth. When this layer absorbs signals, we have fading.

Opening the LESSONS FOR

By EDMUND

THE business of answering questions for radio beginners is indeed a difficult task for any radio man whether he is an expert or not. In order to give a correct and specific answer to a question, it is really necessary to know just how much about radio the questioner knows, in order that the query may be made plain and without an excess of explanation leading up to the actual answer to the problem asked.

Invariably, when a question is asked by an absolute greenhorn in radio, the one answering the person must give him a general idea of the rudiments of radio, with regard to various branches of the art; its development and its present standing. Theories must be expounded in order to make the beginner understand the question he is asking. All of which, we are sure, is a tiring and hopeless task, when one considers the tremendous influx of new radio bugs into the game.

In order to do our part to alleviate this "radio question—asking game," we are publishing a series of questions dealing with the beginner's viewpoint of radio. Those who find themselves innoculated with the "radio fever" should arm themselves with the knowledge of the answers to the questions printed in this department from time to time, in order to keep from incurring the wrath and ill-treatment of not-too-courteous radio men who have just about talked themselves to death answering questions similar to the ones we are answering herewith.

The answers are brief but complete, and are reliable and accurate. The first thirty-five of these questions were published in the October issue, and should be referred to before reading the following.

What is it that keeps you from hearing every station that is transmitting when you listen in on your radio set; how are the stations kept separate?

Every station broadcasting sends out signals on a certain wave length allotted by the Department of Commerce. This wave length can be compared to a number in common telephone work. In telephony when you call for a certain number, the proper connections must be made before you can talk or hear the party you wish to call. Similarly in radio, you must make the proper adjustments in your receiver so that it will respond to certain number of waves or cycles per second. When you tune or adjust your receiver, it will (if it is a good set) respond to one wave length only. In this manner you can select the station you want by knowing the wave of that station, and tuning your receiver to that wave. When the adjustment is properly made, the set is said to be "tuned" to the station or in "resonance."

What instruments are used to determine the wave length of the receiver I am using; how do you make a unit that has this power of selecting or responding to certain waves?

The simplest way to explain the pheonomena of tuning or resonance can be made by reference to Figure 2. In this illustration you have what is called a "simple oscillatory circuit." This circuit is made up of nothing more than a coil of a certain number of turns of wire and a condenser. Either the coil or condenser should be variable or both. When the coil (shown as a fixed number of turns) is shunted across the terminals of a variable condenser, this unit has the property of being able to respond to certain frequencies or wave lengths. By changing the position of the plates in the variable condenser, you change the tune or wave length of the circuit. The more condenser plate area you use, the higher the wave length will be and the lower the frequency. When the two terminals of the condenser are connected to some detecting apparatus (an apparatus that makes it possible to hear radio waves) and the oscillatory circuit is coupled to an antenna with another coil, you can select certain waves or frequencies with this oscillatory circuit, and deliver the one you select to the detecting apparatus for changing into sound waves.

Can a tube filament be damaged in any other way than through "burning out"?

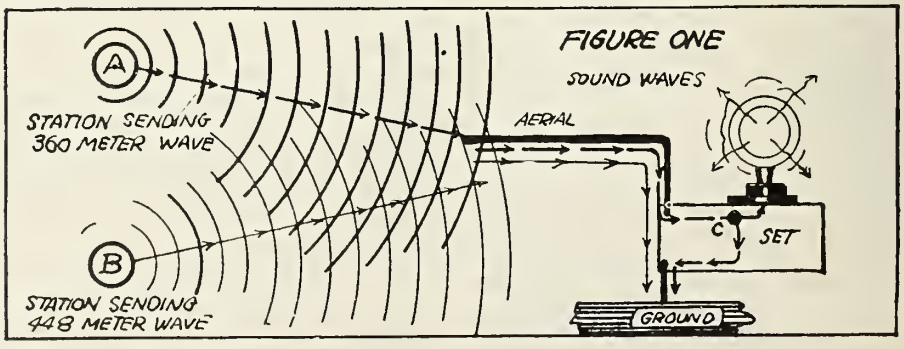
Yes. Filaments are sometimes broken by jar through careless handling. The manufacturer does not accept responsibility for such breakage.

Can I tell anything about the quality of the tube by the color of the glass?

No. In the process of manufacturing, the tubes seem to take on different colors. This is no indication whatever of the quality of the tube. Some are silver, others are a mottled blue and brown and others are a reddish color.

Can some tubes be used only with storage batteries and other tubes only with dry batteries?

Any tube can be used with any source of current. The expression "dry battery tube" refers to tubes like WD-12 and UV-199, which consume such a low rate of current that they may be economically used with dry cells. The same tubes are frequently used with storage batteries, although you must be careful to apply only the voltage specified for that particular type of tube. The



When the set as shown is tuned to Station A, the signals from that station enter the detector C and are changed to sound waves. Waves from Station B pass through the set unchanged, and go off to the ground without being converted into sound, because the set is not in resonance with that frequency.

Door to Radio

THE BEGINNER

H. EITEL

only reason that tubes like UV-200 and 201-A are not used with dry cells is that their current consumption is so high that dry cells used with them would last only a very short time.

Are the so-called "storage battery tubes" superior to the "dry battery tubes"?

Yes, from the point of view of reliability, clarity, and volume.

How long should a tube last?

This is a question that no one can answer. Tubes sometimes give service for years, but in such cases they have been operated with extreme care and intelligence.

Do not burn your tubes any brighter than is necessary. The most sensitive point of most tubes is considerably below the maximum point of brilliancy. To burn the tube brighter than this does *not* improve results, but it *does* decrease the life of the tube, because it boils the electrons off the filament. If you have done this by giving the tube an overcharge, burn it at a low heat for ten to twenty minutes, or longer if necessary, and you may very likely be able to bring electrons from inside the filament to its surface, and therefore restore it.

Tuning and Interference.

What makes my set howl?

First, are you sure that the howling complained of is within your own set? Have you learned to distinguish the howling of an oscillating tube in your own set and the howling that comes from the neighboring radio set?

The only howling noise that can come from your own set is due to the oscillation of one or more of your tubes. If you have a regenerative set you may be advancing the regeneration dial too far from the zero point. Be careful about this. Remember that the oscillation of your tubes not only prevents your hearing anything but it sets up an interference very disagreeable to your neighbors. The point of greatest sensitivity and volume comes before you reach the oscillating point. Learn from experience how far you can go in turning your regeneration dial.

What can I do to overcome howls and whistles that are not caused by the oscillation of my own tubes?

The only thing you can do is first to learn the proper tuning yourself and then teach your neighbor how to tune his set properly. Inter-set interference is one of the biggest problems in the radio world today. It is receiving the combined attention of the world's greatest radio experts. If regenerative sets were prohibited unless a stage of radio frequency or at least a periodic primary plus a secondary were used, such interferences would soon be nil. Until then we must depend on the radio public being educated to tune their sets without disturbing their neighbors. After all when you think of the wonderful things that radio has accomplished you should not let a few little squeals spoil the enjoyment you can get out of it.

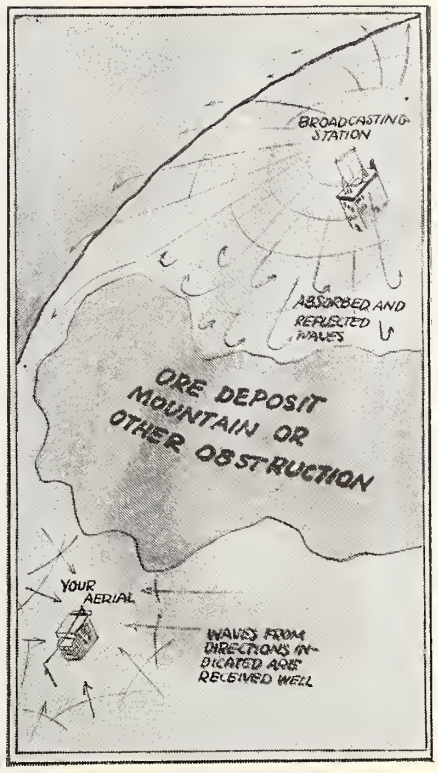
What can I do to eliminate interference from code stations?

There is absolutely no set that will tune out all codes.

There are still some commercial code stations and ships using wave lengths within the broadcasting band. The Government radio authorities are dealing with this subject as rapidly as they can. In a short time it will undoubtedly be done away with.

At certain settings I get a disagreeable humming, buzzing noise, or a noise that sounds like a spark-set operator holding down his key. What can I do to eliminate it?

Unfortunately nothing. Keep away for the time being from a wave length on which this interference is trouble-



Many beginners are at a loss to know why it is sometimes impossible to receive stations from certain directions. The illustration offers one explanation of this difficulty.

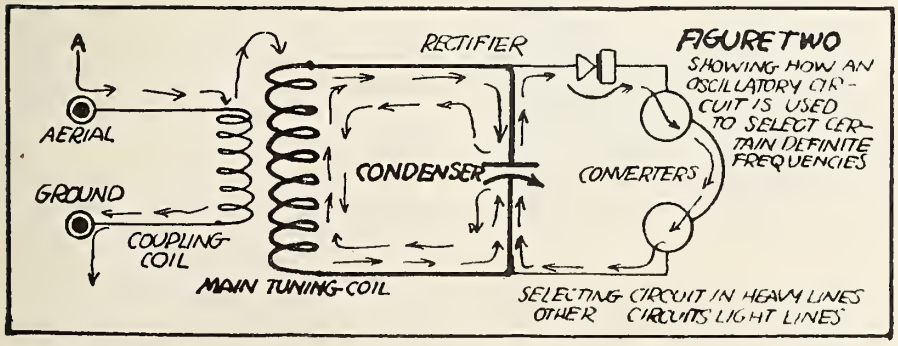
some. You may be close to a high-power transmission line. You may have a leaky transformer in your vicinity. If there are any electric motors in your neighborhood the interference may come from them. A "static" machine in a physician's office blocks away may be responsible. Even some fault in the electric wiring of our own home may set up what is known as the "60 cycle hum" or "A. C. Hum."

At what range should I be able to receive satisfactorily on a loud speaker?

So many things enter into this subject that it is impossible to give any definite answer. Broadcasting stations vary in power from 50 watts to 1000 watts. Many of the smaller stations are not expected to reach out more than a distance of a few miles. Remember, too, that atmospheric conditions, which are not fully understood even by expert engineers, will sometimes prevent your receiving a station that you get very easily at other times. These matters are being given a great deal of attention by the Government Radio authorities.

The U. S. Government once sent a corps of engineers to see if they could determine why operators in Duluth, Minnesota, were unable to receive broadcasting from the Twin Cities, only 150 miles away. The experts of the Westinghouse Electric Manufacturing Company spent a great deal of time trying to determine why operators in Milwaukee could not get powerful KYW station in Chicago, only 80 miles away. There was a time when a commercial stations in Cincinnati could not reach

(Turn to page 77)



The secondary or oscillatory circuit is the part of the set which accomplishes the action of selecting the desired stations. The impulse or wave is transferred to the main tuning coil by induction and surges back and forth as indicated in the circuit shown in black. The current of a pulsating direct nature is converted by the phones to mechanical enegy.

Adventures with the Sinister Death Ray

The Invisible MENACE

How a Streak of Ethereal Conceit and A Jealous Plot were Exposed by a Radio Sleuth

By FRANK HONEYWELL

That night, at the appointed time, the charge in the birdhouse exploded. Mr. Wellman was thrown from the south end of the porch by the impact . . . the birdhouse was "blown to smithereens" and several windows in the Wellman residence were shattered.

CHAPTER I.

"CHRISTOPHER CATWHISKER! What's that?"

Sidney Cash was alone in the house, tuning, tuning, tuning. He had listened to several numbers which to him were tiresome radio programs and was now trying to find something in the air to afford him relief from his loneliness. His father and his mother had gone to the opera and he had been left alone to receive a long distance telephone call relative to an out-of-town real estate deal in which the family was interested.

The call had come and Sid had taken the message. But it was too late for him to think of going out for any evening entertainment; so he sought to enliven the monotony of the pulseless night by magic twists of the dials and knobs of his radio.

What had startled him was a single sentence announcing a news bulletin from one of the local metropolitan newspaper broadcasting stations; and in that sentence was the name of his prospective grandfather-in-law, sometimes spoken of, perhaps inaccurately, as a multimillionaire.

"Sensational attempt to blackmail Arthur P. Wellman, wealthy resident of Glen Forest," the announcer "headlined."

SID had stumbled onto this sensation and held to it carefully. The broadcaster continued:

"About a week ago a millionaire resident of Glen Forest, a suburb of this city, received a letter demanding from him $100,000 and threatening him with death if he failed to comply with the demand. This millionaire is Arthur P. Wellman, former member of the legislature and until his retirement about a year ago a leading figure in the rubber industry. The letter read in part as follows:

"'One hundred thousand dollars is a large demand, and we do not expect you to pay it without some education on the subject. Our first lesson will be given at 7 o'clock on Tuesday night of next week. A violent explosion will then take place in your garden, and you will not be able to determine its source. We merely wish to prove to you that we can cause a deadly explosion at any point —in the air, in your house, in your garage. After you have witnessed a few

demonstrations of our power, you will realize the truth of our assertion that we can cause an explosion in your body and blow you to atoms.

" 'You will have three weeks in which to get $100,000 in $100 bills together. Another letter will follow, telling you how to deliver the money to us.

The First Warning

" 'On Wednesday night, at 22 minutes and 31 seconds after 9, a second explosion will occur 15 feet in the air and 100 feet from your house. If you will take the trouble to station yourself at the south end of your front porch, you will witness the explosion at precisely the time and place here indicated.'

"That is the end of the letter," continued the broadcaster. "It is signed with the initials 'R. D.'

"Tonight was the Tuesday night set for the first explosion. It took place as per schedule and was also seen by Wellman's grandson, Harry Raymond, 16 years old. It hollowed out a crater-like hole twelve feet in diameter in the garden.

"Read the TIMES tomorrow morning. This newspaper will carry complete story and pictures of this remarkable affair."

Sid released a long pent-up breath.

"That is Ruth's grandfather, and the boy who saw the explosion is her brother," flashed through his mind.

Five minutes later he succeeded in getting Ruth on the telephone. Yes, she knew all about it. She lived only a block from her grandfather and had been over there and seen the blackmail letter and the hole in the ground.

"What do you say to my laying off work tomorrow and seeing what I can do toward solving the mystery?" the young man asked. "I had some experience in investigation work in France, you know."

"That would be fine," she replied. "I'm sure grandfather would like it."

A little retrospection is here needful. Sidney Cash had not forgotten his radio amateur days, although they were now memories of several years past. He had met "in the ether" the girl he was about to marry. She lived about a mile from his home. His friend, Hugh Dodge, had arranged the introduction by radio, and it was handled by radio in every respect. The two boys were then college chums.

Several months later their education was interrupted by the World War, and after the armistice Sid finished his college course, meanwhile keeping up his courtship with the unwavering hopefulness of youth. Hugh was buried in France, the victim of an "accident" in the air service. Sid felt certain that his friend's death was due to a treacherous shot in the air by a comrade, Lawrence Vickers, who was known to be a jealous rival of Hugh, but the suspicion could not be proved. Vickers lived in the city several miles from the Dodge home.

Sid was now struggling for a start in life, planning to be married as soon as that start was satisfactory to him and to Ruth. He was somewhat embarrassed and perhaps a little handicapped by the fact that Ruth's grandfather had indicated that he might disinherit her or will her a comparatively insignificant legacy if she insisted on marrying a man with only a moderate business outlook. However, the aged millionaire had indicated no personal dislike for young Cash, except for the fact that the latter held only a clerical position in an insurance office.

CHAPTER II

The Bird-House Clew

NEXT morning Sid obtained leave of absence from his employer by telephone and then went with Ruth to her grandfather's home. Mr. Wellman, who was in his seventies and had lost a good deal of the vigor of youth, exhibited unwonted animation at the proposal of his granddaughter's fiancé to help him in his nerve-straining quandary, and received the young man more graciously than he had ever received him before.

Sid examined the letter and the hole in the ground. Then he returned to the front porch, speculatively taking the position at the South end which was suggested in the blackmail missive.

"Mother of Vinegar" he exclaimed suddenly, for the idea that came to him was funny enough to revive some of the facetiousness of younger years.

"What is it, Sidney?" inquired Ruth, who stood near, making a wry face at his sour expression.

"See that bird house there?" returned the young investigator. "How far is it from the house?"

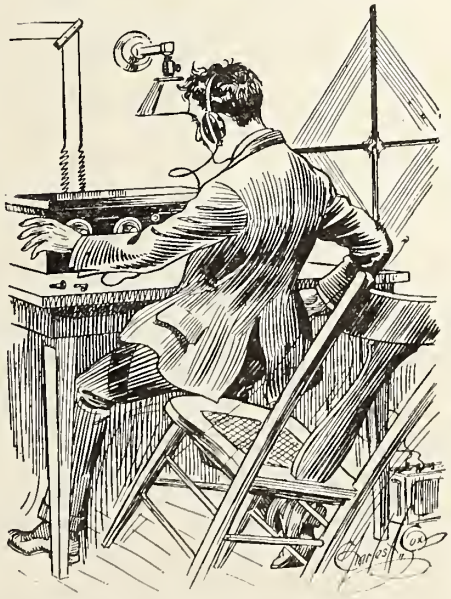
"About a hundred feet," the girl replied.

"Yes, and how high up on that pole is it?"

"Twelve feet."

"No, fifteen. Is there a ladder here? Yes, there's one out by the garage. I'm going to peep into that bird house."

Three minutes later he had set the ladder up against the sturdy, well-anchored pole "foundation" of the bird house and was ascending it rapidly. Young Harry and his grandfather now appeared on the scene and watched the proceeding, eagerly on the part of the boy, curiously on the part of the man.



"Christopher Catwhisker! What's that?" he ejaculated. What had startled him was a single sentence announcing a news bulletin from one of the local metropolitan stations; and in that sentence was the name of his prospective grandfather-in-law, sometimes spoken of as a multi-millionaire.

The Mysterious Package

Arrived at the top of the ladder, Sid reached one hand into the bird house and, after a little feeling about, brought out a tin can four inches deep and three inches in diameter and labeled "baking powder." Then he descended to the ground.

"Did you know that was up there?" he asked, addressing all present.

All denied such knowledge.

"Well, I haven't opened it yet, but I bet I can tell you what is in it—not baking powder but plain melnite. See if I'm not right."

He took the lid off the can, and, sure enough, his divination was correct. It was half full of a fine white solid familiar to the ammunition manufacturers of the recent war. Mr. Wellman looked as if ready to hand his prospective grandson-in-law a legacy ante-mortem.

"I'm going to solve this mystery," the young man declared. "Harry, do you want to help me?"

"You bet," replied the boy.

"This is a radio mystery pure and simple," continued Sid. "You're a radio fan with an elaborate outfit of your own; that's the reason I pick you. Now, I'm going to put this explosive back where I found it. That bird house will be blown to smithereens at 22 minutes and 31 seconds after 9 o'clock tonight."

He ascended the ladder again and replaced the can in the house on the pole.

"Now, Hal," he said after returning to the ground; "I want to have a long talk with you."

NUMEROUS radio principles and apparatus were discussed at length and another radio fan, living several miles distant in the city, was taken into confidence and his co-operation enlisted.

Sid, knowing that the explosion was caused by some form of a radio frequency oscillation, set himself to the task of designing a receiver that would respond to a low frequency. His knowledge of radio very easily assumed that to make a receiver capable of receiving a frequency of some several million cycles would be impossible; but the happy thought of resorting to listening for odd harmonics of the main wave occurred to him, and a good deal of the time not spent in actual sleuthing was utilized in developing a receiver that would tune to a lowest possible wavelength.

His plans bore fruit, for several days after his initial experiments he chanced to stray upon the third plus harmonic of a 15,000,000-cycle signal, and keeping his receiver trained upon this frequency, he was surprised to find that his headphones were growing terrifically hot, —in fact, too uncomfortable to wear. This he compensated for by placing resistances in series with the headset, which had several thousands ohms resistance.

(Turn to next page)

That night at the appointed time, the charge in the bird house exploded. Mr. Wellman was thrown from the south end of the porch by the impact. The bird house was indeed "blown to smithereens," and several windows in the Wellman residence were shattered.

Getting 5,000,000 Cycles

But Sid, Hal, and radio fan No. 3 were not present. They at that moment were enjoying thrills of much deeper import. Each was intently, eagerly, delicately tuning, tuning, tuning, with a specially made multi-wave tuner, for a suspected harmonic of a 5,000,000 cycle frequency and adjusting radio compasses for maximum readings.

Soon after the explosion Hal called Sid on the telephone. Caution advised him not to use the radio.

"I got it," he said.

"What did you get?" Sid inquired.

"Ninetv degrees and 13 minutes."

"Good. I got mine, too—101 degrees, 27 minutes, and 3 seconds. But my relay burnt out."

"So did mine."

A little later Elmer Creesman called Cash on the telephone and announced:

"I got 156 degrees, 24 minutes and 8 seconds. It burnt out my relay."

Immediately thereafter Sid busied himself at a table with pencil, compass, and simple draftsman's tools, and when he had finished his task he had before him a carefully prepared diagram that caused him to feel warranted in assuming the self-confidence of a "geometric prophet."

"I'll land that fellow as sure as shootin'," he told himself.

CHAPTER III

"Ray Diablo"

THINGS moved less rapidly after these events, but there was no lack of thrills up to the very time of the solution of the mystery. The young radio expert and his two boy assistants became exceedingly mysterious in their plans and actions.

Sid had a very clear and definite course in view, but he refused to divulge it to any but those actually working on his scheme, with one sentimental exception. He did not even take Mr. Wellman into his confidence, and he gave Ruth the lesson of her life in "holding her tongue." Girl-like, she could hardly keep the secret, so "stupendous" did it seem to her. Sid told her all, but impressed on her the danger of letting a hint of it leak out, and she proved herself equal to the occasion.

"If this should get into the newspapers, our scheme would be blown as high as Betelguese," he said. "I don't want the papers, nor even the police, to know what we found in that bird house."

He cautioned every person familiar with any detail of the affair not yet given to the public to "keep his mouth shut." This was inelegant language, but it was forceful and there was no mistake as to its meaning. There were two servants in the house, a man and a woman, and Sid's instruction regarding them was that any suspicions they might have should be dispelled, if possible, by a studied manner and attitude of dissimulation.

The "$100,000 night" arrived. The miniature dirigible was filled with gas. Below it was suspended a cabinet of light, thin wood, in which was boxed the propelling and steering mechanism. In front was a two-blade aluminum propeller and at the rear end was a cross-plane rudder.

"Let it be generally understood that you are scared," the "radio detective" said to the aged millionaire, who obediently adopted the policy. The newspapers carried a story to the effect that he was thinking seriously of paying the price set on his life. Sid took unto himself the task of handling the newspaper reporters, and he did it very successfully.

The Second Warning

Two days after the explosion in the bird house another letter and a parcel post package were received by Mr. Wellman. The letter renewed the threat to cause an explosion in his bedroom if the final orders with reference to the $100,000 demand were not carried out in detail. In part this letter said:

"In this package you will find a watermelon-shaped balloon, with a strong, heavy cord attached to it underneath. At the mouth of the balloon you will find an opening with an automatically closing escape valve. Fill the balloon with gas generated with hydrochloric acid and scrap zinc. After it is filled, tie a package containing $100,000 in $100 bills to the cord and at exactly midnight of August 7 release the balloon in your yard. Do not try to examine the mechanism of the balloon, as you may injure some of the operating parts, and that would be fatal to you.

"Your failure to carry out these instructions will result in an explosion in your bedroom, and if that does not kill you, another explosion will take place in your body, blowing you to atoms.

"Yours fatally,

"Ray Diablo."

SID read this letter and examined the balloon. He then made two mental notes regarding them.

"Dirigible balloon four feet long," was note Number One.

"His egotism has caused him to expose to me clue Number Two," was his second mental note. "My first clue was in the location of that can of powder in the bird house. Egotism caused him to give that away. More egotism in that signature—'Ray Diablo'—diabolical ray—death ray."

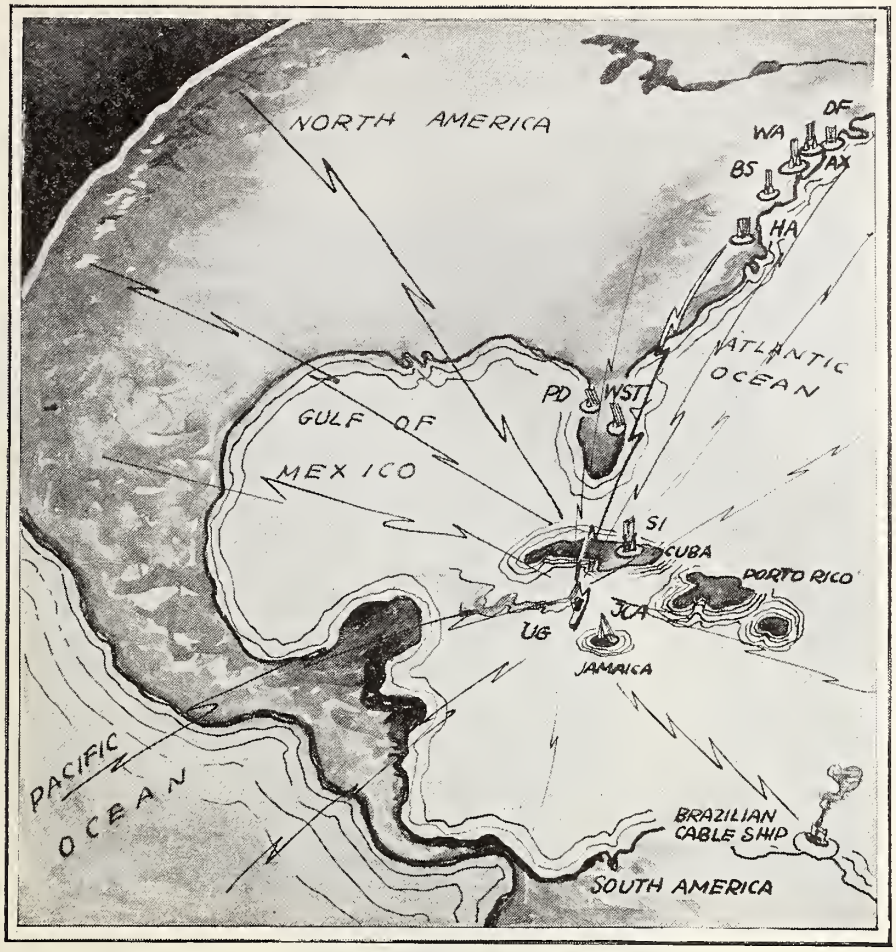
Sixteen days elapsed with much taking place in the meanwhile, measured in degrees of importance, but with much time resting heavily on the investigators' hands. Sid had taken an indefinite vacation. By means of the compass readings he had taken with Hal and Elmer Creesman, they located the house from which the death ray was sent on the night of the explosion in the bird house. A little inquiry in the neighborhood resulted in information that there was an elaborate radio outfit on the second floor of that building. Four days before the date when Mr. Wellman was ordered to send $100,000 up in the air by balloon, another letter came, warning him that unless he complied with the money demand at the stipulated midnight hour, an explosion would take place in his bedroom at 1 a.m. next following, and that a portion of that side of the house would be blown out.

Sid then ordered that the two servants be sent away and Mr. Wellman's room was searched. A long, slender can of melnite was found in one of the hollow posts of his bed. This explosive was taken home by the "radio detective" and secreted in a safe place.

At last the "$100,000 night" arrived. The silken bag of the miniature dirigible was filled with gas. Below this bag was suspended a cabinet of light, thin wood, in which doubtless was boxed the propelling and steering mechanism, as well as storage batteries for power. In front was a two-blade aluminum propeller, and at the rear end was a cross-plane rudder. An incandescent searchlight on the prow indicated lighting possibilities.

A dummy package was tied to the rope, and all was ready. Sid gave instructions to his two assistants, Hal and Elmer. They were to be at their receiving stations when the balloon went up and were to remain there, keeping record of the wave that moved the balloon and directed its course, as well as the duration of that wave and its compass reading. The purpose of this was to make doubly sure of the source of the ingenious villainy under investigation.

(*Turn to page 61*)



The Steamship "Schley," steaming off the coast of Jamaica, carried on communication with stations indicated by the towers in the photo-diagram above. A log of the stations: AX, Atlantic City; HA, Hatteras; UG, Schley; DF, Coney Island; PD, Tampa; WST, Miami; SI, Guantanamo, Cuba; JCA, Jamaica; WA, Waldorf Astoria; BS, Philadelphia.

"Brass-Pounding"

Along the Atlantic Coast

Part III: Reminiscences of an Old Operator

By ARTHUR LEECH

MY Jamaica-Philadelphia voyages, plus three special trips farther south to Panama and Colombia, covered a period from November, 1909, to May, 1911. This run, like that of the "Seminole," was an outside route, i. e., one on which most of the wireless work was a standing contest against distance, all U. S. shore stations being out of range and workable only at night on "freaks." It was our business to study these freak conditions to determine if possible some regularity about them, on which we could base our informal communication schedules.

A trip or two on a run would show up the consistent performers among the land stations, and ship and shore operators possessed an uncanny faculty of slipping through great wads of "OS" (ships' positions) and messages on these "regular" freaks.

An experienced "op" possesses a "feel" of the situation hard to explain to the novice. To passengers who would stop to condole with me, as they thought marooned in a tiny cabin with an inanimate chunk of hard rubber clamped on each ear, I would try to picture the situation as it really was. To me, placing on the receivers always seemed like clairvoyantly reducing our half of the earth (at least) to a hemispherical relief map, upon any part of which I could at will place my finger. Every dot and dash in the phones was immediately recognized and understood. The tone of a land station's spark, coupled with the style of the operator's fist, served to identify every signal. A stranger on the air was immediately discerned and placed either by his station sign, or, before the International Call Books were issued, by a direct question by one of the regulars.

All this prelude so that the reader will understand that the "op" sits in on another world in which little is hidden and everything highly comprehensible; that the snappy operations are all clearly deduced when traffic is slipped through a jam of signals to a certain station, with a possible shift to another station where more favorable conditions obtain; assisted perhaps by a few friendly dots and dashes from an interested listener five hundred or a thousand miles in another direction, fully as awake to the situation as the principals themselves. And, of course, our only detectors were crystal or electrolytic. Tubes were known to us only experimentally—even when I left the sea in 1916.

A "Rapid Relay" Man

ONE class of work which energetic operators could do when within easy day range of the land stations—usually the first or last day out—was what I always termed "rapid relay" work. A mass of ships leaving or concentrating on a port like New York create an unimaginable jam, and the ships just barely in range have little chance to be heard at the land stations whose high aerials are flooded with signals from a hundred sending sets. Being young at the game and full of pep, and on the "UG," ("Schley"), having a 120-cycle spark set easy to hear over the coarse 60-cycle notes of the mob, I was a favorite central station during these conditions. About which, more later.

* * * * *

At home after my first trip, the all-compelling reasons for my intention to resign faded and only the glamorous details were to the fore. I was somewhat chagrined at my childish weakness. Upon leaving Philly for New York to make my second trip, however, I was again threatened with a severe case of chilled pedal extremities, and aboard the "Seminole" with sailing about due I had a bad attack of the homesick blues and was much in mind of deserting ship and rushing back to Mother.

My deliberations were rudely interrupted by the sudden inrush of a messenger escorting my relief and bearing glad tidings of my transfer to the "Admiral Schley," lately laid up in New York and sailing in half an hour for Philadelphia to run regularly between the latter port and Jamaica. Hearing of the opening at the last minute, dear old H. J. Hughes, Operating Superintendent, had dispatched a messenger with positive instructions to get to the "Seminole" before she sailed.

A nervous ride to New York and a mad run to the Battery, and I found myself aboard my new home just as the lines slid over the dock's edge. In those days the law did not require that an operator be aboard and it was strictly up to that gent to be aboard of his own accord or he was simply left behind. The new job looked good. The "Schley" was a modern, white, yacht-like steamer and the wireless quarters of two rooms

were palatial—comparatively. The set was a duplicate of the "Seminole's," but the name plate on the generator said "120 cycles," which stirred up mild excitement that was considerably heightened by a few dashes on the spark with the aerial disconnected, disclosing a wonderful smoothness to the spark that informed me I had a history maker of a sending set. My conclusions on this were quickly corroborated. I found the "UG" a marked ship, being one of only two or three in existence with a high (!!) frequency spark.

Then began my real participation in the commercial game. The ensuing Winter was a record breaker for bad weather and I was dutifully sick every time we passed Hatteras, both up and down, for several months. This condition interfered somewhat with my wireless ambitions, but as I conquered ole mal de mer, my last reason for a threatened bolt from the business disappeared and I became a confirmed *young* salt.

I found rapid relay work almost as interesting as the long distance stuff. True, there was not that feeling of triumph embraced in the mastery of space consumated when one had completed a satisfactory two-way communication over a thousand or two miles, but there was some delight in surveying a foot-high pile of business which had been handled. To make it worth the effort, problem enough existed in extracting the stuff from the terrific jam of signals which in the first place made it necessary for some ship to jump in and help the land stations flatter'n a billiard table and tuners as selective as an ash sieve made of three-inch chicken wire. Ships were bursting with traffic, all the land lubber passengers sending messages back home telling the folks how fine the weather was and wishing they were along, etc., etc., and with big commissions in sight every "op" threw his manners overboard and vigorously plied the key to get his business off first. The resultant jam was a wow! I didn't know if I was here or there. Here was where my 120-cycle spark came in good. "AX," "HA" and I would clear the ones nearest us and I would unload to one of the shore stations every time I got twelve or fifteen, my spark cutting clear over the interference. Lacking proximity and a club for the more ravenous of these birds, to keep them quiet until their turn came, my most effective weapon was to threaten to close up and clear nobody until they calmed down and waited to be called. Every time my switch went up to receiving, after giving one ship a final OK,—Zam! it would be on again, with about fifteen all calling at once. Through the fearful din I might be able to recognize one call, to which I would shoot "GA," leaving the rest to cuss their luck until the next contest.

My diary notes a couple of amusing incidents in connection with this work—more amusing now, as is always the case, than when I was worked up to a lather over the proceedings. On one occasion, just as I was loaded with twenty-two relays and about to shoot them to "AX," my juice went off and I was left flat. Investigation disclosed that we were to lay to for four hours to delay our arrival on account of an over-ripe condition of the fruit, the Captain figuring the cargo would keep better fifty miles at sea than alongside the dock through a hot July night. All hands flopped for a four-hour rest and with not enough steam to run a peanut roaster there was nothing doing on the dynamo being started. With "AX" and "HA" calling every minute and saying "GA that wad;" "wake up;" "come to life," etc., and with the gang getting panicky over my disappearance with a bunch of their commission-bringers, I did anything but rest, and when I finally got back on the air with a snappy "AX AX AX UG .. .—." there were yelps of joy from all, including myself.

On the other occasion I got caught with a wad on account of the static coming up suddenly so strong that "AX" could not read me. I was threatened

THE principal spot for this lively work was about half way between "HA," Hatteras, and "AX," Atlantic City, on Sunday morning when all of Saturday's sailings from New York were clustered two-score strong within a hundred or so miles—absolutely too close for any duplex work with waves

Drawn by T. R. Braithwaite

One morning as he started calling Limon, "X," there was a terrific commotion back of the jar rack, sounding like the setting off of a bunch of large firecrackers, combined with the release of a giant clock spring . . . . . like shots from a gun a pair of good-sized monkeys sprang past him and through the window, screen and all. 20,000 volts had pepped them up considerably . . . . .

with the disgrace of having to carry the bunch up to Philadelphia and to the Western Union office, but old "RM," Bob Miller of the slow, steady fist, evolved the bright idea of copying me on a ten-foot wire in place of his high, static-eating aerial, and the day was thus saved. Strange we had to wait ten or twelve years before putting the idea into general use by building loops.

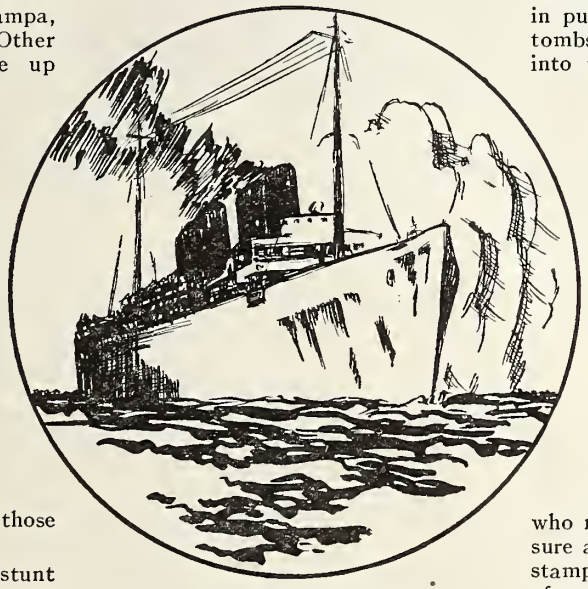
After listening carefully for a couple of trips, getting the "feel" of the situation, I got busy on that fascinating night distance work, and from that time on most of my sleeping was done in the day time and my work during the dark hours. The layout resembled that of the "rapid relay" work, except that it was on a huge scale of two or three thousand miles instead of two or three hundred miles. There was more "quality" to the work than "quantity," so to speak. As against the terrific jam of the in-range work, we had the fading—or swinging of signals from a roar to a faint whisper and out, characteristic of freak work between sets out of range.

Our land connections were, in addition to "AX" and "HA," "PD," Tampa, Fla., and "DF," Coney Island. Other stations would occasionally come up strong enough to relieve us of some traffic, but the four mentioned habitually kept a long distance watch and could be depended upon. "DF" was the most consistent of all, seeming to be in a sensitive spot never equalled until the advent of "WST" at Miami, Fla., several years later, in an entirely different period of my sea experience. "DF" had the usual crude junk, including the crystal detector, but he was a marvel at responding to calls from anywhere. Opr. "RO," Vosburg, was my buddy at that station and many a bundle of "OS" from the far waters did we pass through in those balmy days.

My first two-way long distance stunt was from dock at Port Antonio, Jamaica, to "HA," about 1100 nautical miles—a "knot" being about one and one-sixth land miles. I had finally made up my mind to get in on this distance—smashing work and as "HA" was coming good I gave him a short call. He came back pronto and I slipped him "OS 4 p. m. UG arrived Port Antonio," to which he gave immediate OK. I shut off my motor with the feeling that at last I "belonged" in the business. And keep in mind, dear reader,—a two-slide tuner and a piece of coal.

In milling around in my diary for notable instances to relate, I note that the stuff was so regular as to almost pass out of the category of freak work. I note a long one, but one worth writing about, under December 30, 1909. I had collected a bunch of twelve relays; one I got direct from a cable ship digging up some trouble along the Brazilian coast, about 1500 miles southeast of us. We were off Cape Maysi, Cuba, about a thousand knots from "HA" and 1300 from "DF." The interference was bad up to midnight and several attempts to clear to "HA" or "DF" were unsuccessful. I napped until 3 a. m., when I broke up a little chat between "HA" and "DF" and got a "GA" from "DF." "DF" gave me OK fine on No. 1, then lost me on No. 2 and when I came on I heard "HA" filling him in on No. 2. "DF" then OK'd No.2 and said shoot another. "DF" took three more then said I was getting weak and to finish the bunch to "HA." "HA" and I then cleaned up the bunch, but toward the last, "DF" began to get me good again and he copied the last four messages right from me and broke in ahead of "HA" to give me OK direct. I then gave "DF" a list of OS I had collected and we called it a night. "DF's" last signals were rather weak, and no wonder! I suddenly noticed it was getting unusually light in the room and glancing out the porthole I saw the first act of a glorious sunrise. It was 5 a. m. and in that latitude good and daylight.

This was a good instance of a long sustained communication, but plenty of short snappy work could be done right in the early evening in between the heavy jam.



Two of our special trips took us to Panama, and there I met up with the string of United Fruit Stations that keep company with their large fleet of ships, as well as handle traffic for the U. S. Theirs was a formidable fleet.

A Distance "Stunt"

OUR regular run never took us more than 1500 knots from New York, so there was little chance of doing bona fide work much farther, and working distance for the mere sake of doing it was not in favor on account of the unnecessary jam caused. Occasionally, however, we could not resist a brief call to some ship a couple of thousand out in the Pacific, but if we got a response, these incidents were rarely logged, because of the rebukes they were sure to bring from the office.

Every time I heard one of these Pacific stations, I would wish I could carry my 120-cycle spark over to one of those Japanese runs, where with superior atmospheric conditions and possible runs up to 6,000 miles, the boys used to do (and probably still do) some marvelous work.

My best direct distance stunt with "DF" was from Santa Marta, Colombia, on one of the special trips we made there. About 11 p. m. I got on the warm tropical air, laying for one of the stations up where the snow was flying, and soon had "DF" coming in fair. My diary records show that old "RO" was not at the key, and I believe that was why it took a number of calls to get "DE" to hear me.

However, about 2 a. m. I slipped him "OS 3 p. m. UG arrived Santa Marta" for friend H. J. H. to look over in the morning.

I recall using a home-made loose coupler of Oscar's on the "UG," in defiance of Company orders, and getting into a peck of trouble on account of its EXTREME SELECTIVITY. You can imagine! However, it nearly resulted in putting "nipped in the bud" on the tombstone of my wireless career. I got into trouble with my friends at "SI" Guantanamo, Cuba, U. S. Naval Station, through not hearing them answer about twenty-five calls. I waxed abusive and when I got back to Philadelphia that trip I had three official letters on the subject. Be assured, I was ultra-respectful to Naval stations thereafter. Another funny thing about that case—several months later I met "LR," Chief at "SI," on the Fall River boat coming down from Boston when I was transferred to the "Farragut." Instead of the roaring bull I had imagined him to be, I was talking to a mild-mannered gentleman who reciprocated my surprise and pleasure at meeting so far from our tropical stamping grounds. And after the way of operators, a bit of lunch in the buffet settled all our differences and when he returned to "SI" our good relations were resumed.

On my sixth Jamaica trip one night I had an awful jolt in the memory tank by hearing the following "4:30 p. m. VJ (The "Seminole," you remember) left Monte Christi." Owooah! It gave me a sickness around the stomach to hear that familiar name, and by the way he was laying on the key he was in the same fix I had been—nil communicado, you might say. I took pity on him and shot him an OK and passed his OS up the coast, but when I turned in at midnight his receivers had apparently told him nothing. He was still broadcasting. That night I had a nightmare and woke up groaning just as the aerial lead broke and was swirling down for a sure catch in the Mate's nose!

Jamaica I found to be a delightful bit of tropical island. I wondered at the women doing such heavy labor, and of course got into the usual traffic jams suffered by tourists due to the

(Turn to page 58.)

The Radio Organ Has *Its Day*

¶Karl Bonawitz, of WIP, Proves that Even an Organist Can be Popular

By Harry Aldyne

TO Karl Bonawitz, Organist of Station WIP, goes the palm of victory for receiving the greatest number of popularity votes through the period between Aug. 16 and Sept. 15.

Incidentally, the great wave of sentiment in his favor made him not only victor for the month, but carried the popular musician to a point of vantage at the head of the list where is shown the standing of the candidates to date, from the beginning of the contest last July. But the real contest is only one quarter of the way through, and if history repeats itself, each thirty days will change the complexion of things decidedly before the final count is made.

Those who have not been following the RADIO AGE Popularity Contest, and therefore may not know what it is all about may be guided by the following:

Clip the Popularity Contest Coupon from this and the back numbers of RADIO AGE and send in the name of your Radio favorite. You will take particular note that your candidate may be any person, or group of persons, in any way identified with the great radio industry.

Writeup Each Month

Each month there will appear in the columns of RADIO AGE an intimate write-up about the candidate receiving the greatest number of votes during the thirty days of the second month preceding.

In the meantime, a careful record is being kept of the total number of votes received for each of the candidates, and at the end of the twelve month period the winner will be crowned king (or queen) of them all.

So far, with the major contest only one quarter of the way through, The Duncan Sisters, Bill Hay and Karl Bonawitz have led the field for the month during July, August and September in the order named.

And here is Karl Bonawitz, the first organist we know of who ever walked away with a Radio Popularity Contest. Karl performs regularly from WIP, Philadelphia.

THE WINNER FOR SEPTEMBER

Karl Bonawitz	Organist	WIP—Philadelphia

STANDING TO SEPTEMBER 15th

Name	Classification	Where Heard
Karl Bonawitz	Organist	WIP—Philadelphia
H. W. Arlin	Announcer	KDKA—Pittsburgh
Bill Hay	Announcer	KFKA—Hastings
Lambdin Kay	Announcer	WSB—Atlanta
John S. Daggett	Announcer	KHJ—Los Angeles
Jack Nelson	Formerly Announcer	WGN—Chicago
E. W. Tyson	Announcer	WWJ—Detroit
Harry M. Snodgrass	Entertainer	WOS—Jefferson City
Hired Hand	Announcer	WBAP—Fort Worth
Edward H. Smith	Director and Player	WGY—Schenectady
J. Remington Welsch	Organist	KYW—Chicago
Bert Davis	Entertainer	WGN—Chicago
Duncan Sisters	Entertainers	KYW—Chicago
"Husk" O'Hare's Orchestra	Entertainer	WLS—Chicago
Nicholis B. Harris	Entertainer	KFI—Los Angeles
Wendell Hall	Entertainer	WDAF—Kansas City
Jerry Sullivan	Director-Entertainer	WQJ—Chicago

The above are some of the leaders, showing their relative positions and counting all votes from the beginning of the contest. How will they stand next month and who will receive the greatest number of votes through the coming months? The December number of RADIO AGE will have a story about the candidate receiving the greatest number of votes from September 16th to October 15th. The November contest closes November 15th. December contest closes December 15th.

Will you be one of those to give your radio idol the fitting and lasting tribute he deserves by sending your vote to the Popularity Contest Editor of RADIO AGE? Do it NOW!

POPULARITY CONTEST COUPON

Harry Aldyne,
Contest Editor,
RADIO AGE,
500 N. Dearborn St., Chicago.

I wish to cast my vote for:

Name of favorite.....

Classification.....

Station.....Date Heard.....

Name [optional].....

Address [optional].....

¶Radio Announcers and Entertainers Vie for Popularity Honors

A Word About Bonawitz

Karl Bonawitz, or KB, as he is familiarly known by the hundreds of thousands of radio fans who have heard him over WIP, is one of the pioneer organists in radio broadcasting. The first organ recital was broadcast from the Germantown Theater, Philadelphia, on May 15, 1923, and during the following year and a half more than two thousand compositions have been played and broadcast through WIP, owned and operated by Gimbel Brothers, Philadelphia.

Four thousand letters and cards and seven hundred and thirty telegrams have been received directly by Karl Bonawitz in appreciation of his unusual programs.

Bonawitz was born in Philadelphia in 1894, and studied organ, piano and musical composition in that city, in London and in Berlin. His broadcasts from WIP have entertained countless thousands of radio fans.

"Bonawitz can make the organ talk" has been heard often from his listeners-in. The wonderful personality that Karl broadcasts with his music is not acted. He is that way all day long and all year 'round.

Having "at his finger tips" one of the largest organs in the country, he is able to broadcast many interesting effects from WIP.

Stations Co-operate

Perhaps one of the reasons why Bonawitz continues to draw most of the votes is the unusual co-operation Station WIP is giving RADIO AGE in its popularity contest. Ether fans who listen in regularly to WIP's programs have been told to vote for their favorite, and almost unanimously they have lined behind the organist.

Other stations—particularly KYW of Chicago and KFKX at Hastings, Neb., are doing the same thing, and as a result their announcers and entertainers are leading the field.

This just goes to show what a bit of co-operation on the part of your favorite radio station can do.

So ask your announcer to urge his listeners to vote for his entertainers, you fans! Every vote counts, especially when the contest is as close at it is at present.

THE GOLDEN SONGSTRESS

Such is the title earned by Florence Macbeth, soprano with the Chicago Civic Opera Company, who rose to radio fame last year through her performances in operatic successes. Miss Macbeth will appear over several Eastern and Middle Western Radio stations this Winter, so fans who applauded her last season will be treated again. At present she is in New York.

What the Broadcasters are Doing

The "Sunshine Station"—KFLR

By M. R. Brown

"THIS is the Korber Wireless Station, owned and operated by the University of New Mexico, located at Albuquerque, New Mexico, the sunshine center of America." You may possibly have heard these words, even though you live in Maine, California, or any other part of the United States. They are familiar to the radio fans of the southwest, where broadcasting stations are few and far between. Unlike New York or Ohio, New Mexico does not have a station every few miles.

There are only two stations now operating in this, the fifth largest state in the Union.

If you accidentally tuned in on KFLR during the middle of a program and did not hear the voice of the announcer, you may have thought you were listening to Havana, or Mexico City for the wild waves have carried some of those beautiful Spanish melodies so typical of the southwest.

Good Programs, Too!

During the past year many special programs have been broadcast as well as the regular weekly program each Friday evening. A wire to the football field made it possible to announce the progress of the games play by play. The president of the University and the members of the faculty have contributed their services to make the programs not only doubly interesting, but educational as well. All the local artists have willingly aided to make KFLR a source of pleasure, culture, and education.

Radio in the southwest presents many unusual problems. A local station which can scarcely be heard a hundred miles here is heard all over the United States. The cause may be due to the peculiar characteristics of climate and geography. Nearly every day of the year the sun cooks the parched mesa, making daylight radio practically impossible. It is very dry and only certain kinds of trees will grow even with constant irrigation. Ten miles to the east are the tall pine and fir covered slopes of the Sandia Mountains. At the west is the Rio Grande, and across from that river are five extinct volcanoes with giant lava beds. The altitude is about 5,000 feet. Just what part each of these features play in radio has not been definitely determined, but some of them play a mighty important role.

"Bob" Boniel Directs at WEBH

Robert D. Boniel, who won fame as the popular program director of Station KYW, Chicago, in the early days of radio, is now winning new adherents as Station Director at WEBH, located in the Edgewater Beach Hotel, Chicago.

Mr. Boniel left KYW on September 1 to take over the reorganized WEBH, and it is because of his efforts that the Edgewater Beach Station is so popular today. Bob's picture is shown in the insert above.

(Celebrity Photo)

Miss Maurine Marseilles, shown above, won instant favor with Middle Western Radio fans when she introduced "Charley My Boy" and "Jimmy Gee" from several stations. She is a dancer by profession.

Paying Radio Artists Starts Row

New York: A battle of the air, which may decide the life of the radio as an amusement, has been begun here.

The first phase of the fight will concern itself with whether the radio is to pay for the things it broadcasts or whether the present policy of using volunteer talent is to endure.

Broadcasters not affiliated with the National Association of Broadcasters announced that under no circumstances would they come in on the latter's new policy of paying artists for what they contribute to programs.

The National Association, if the recommendations of its investigating committee be adopted next month at its convention, will put its entertainment on a basis similar to the theatrical business, said Paul B. Klugh, executive chairmen of the association.

Stars of opera and the stage and musicians of the best concert platforms will be booked to sing or play for the radio, the association announced.

How They Stand

A statement issued by the national association described present conditions as "chaotic," and added:

"Radio broadcasting cannot continue on its present basis. All radio programs now are made up of volunteer talent, and some performers are paid by advertisers. The best known performers refuse to broadcast without being paid. Obviously the time has arrived when programs must be improved in quality."

Some of the big independent broadcasters said they were convinced that there was no need for paid talent and their present gratis policy would continue "for several years."

Representatives of the Radio Corporation of America and the General and Westinghouse Electric Companies said they would not enter the adventure.

"Paying performers will not improve the program one bit," said Bertha Brainard, assistant program director of WJZ. "The programs we are broadcasting now are as good as any that could be arranged with artists who demand pay.

"Those whose efforts we broadcast do not wish pay. They feel that they are being rewarded amply by the advertising they derive from contributing to a program."

This Girl Specializes in

Radio Love Songs

Popular Canadian Soprano, After Trying All Brands of Music, Decides She Likes Best to Sing For Sweethearts of All Ages

An Intimate Personality Sketch

BY OWEN E. McGILLICUDDY

Perhaps one of the reasons why Tillie Thorpe, soprano, is so popular is because she sings nothing but well-known, old-time love songs. She is now making a tour of radio stations in the middle west.

(Photo Copyright by Drake Studio)

THERE never was a time in the history of this old world when people were not fond of love songs." Such is the opinion of winsome Jean McLean of Toronto, whose fine soprano voice has been heard many times from Canadian stations and has won for her a host of friends throughout the United States and the Dominion of Canada.

"All healthy people have some romance in their systems," continued this charming soloist, "and to please the majority, one must discover the attitude of the normal person. I have found that the 'Darby and Joan' sentiment is a sound and wholesome one, and one that no artist can afford to overlook if he or she wishes to gain and hold the approval of the general public.

Jazz Had Its Day

"It has been my experience that the invisible audience considers classical songs too stiff or formal. The syncopated, or jazz, songs have their day, but it is a brief one, for the listener grows tired of the constant repetition. On the other hand, the semi-classical, or better type of modern sentimental ballads, are always appreciated and never seem to lose their appeal."

Asked what songs she had found to be most popular with her invisible audience, Miss McLean selected "The Silver Lining," "The Nightingale of June," "Love Was Meant to Make Us Glad," "At Dawning," "For You Alone," and "A Rose, A Kiss, and You."

"I have sung these songs a number of times over radio and have found that each seems to have a distinctive following, for I have received requests by letter, postcard, telegraph, and telephone, to repeat them at future recitals. Some of them are new, while others have been sung for years. Generally speaking, people prefer a number with which they are familiar, for the old songs seem to establish a friendly contact, no matter how many miles away the unseen listener may be."

Miss McLean takes a keen enjoyment in singing for the radio. "When I first faced Mr. Microphone," she declared, "I felt terribly nervous and apprehensive, for I missed the sight of the audience to which I had been accustomed. I had a peculiar, all-alone feeling, but after the first solo, when friends assured me they had heard my voice perfectly, I felt considerably buoyed up. I consider that singing for radio has many compensating advantages, the greatest of which being the larger audience and the sincere appreciation evidenced by the correspondence from listeners all over the continent.

"I am sure radio has opened up not only a new world of usefulness for the artist, but has also brought good music to the ears of those who ordinarily would not be able to hear concert recitals. In this way it has helped to cheer the loneliness and remove the isolation of those who live in far-away communities. People may get tired of the city, but they also get tired of the country. Radio, I am sure, will tend to make our young folks more satisfied with their own homes and bring contentment to many weary hearts."

A Friendly Singer

This conscientious artist "has a way wid her," as the Irish say, and she manages to make her unseen audience feel that they are listening to a really friendly sort of person who is doing her best to please each listener. She has an international reputation as a vocalist and has won the gold medal at the Welsh Eistodfodd; she is a member of the teaching staff of the Toronto Conservatory of Music; and is organist and choir leader at Central Baptist Church, Toronto.

Miss McLean, who has large demands on her time, is a firm believer in physical fitness. "If a musical artist does not keep fit, he will find it next to impossible to get all the work done he should do," she asserted. "I plan out every hour, and,"—here came a confiding smile—"I sometimes split them into half hours. I simply love basketball, lawn tennis, and motoring, and make time for at least one of them every day."

What Songs Do You Like Best? Radio Age Wants to Know!

RADIO AGE would like to find out what kind of songs its readers like best over the radio, and why. Maybe we can do something to give **RADIO AGE** readers the kind of songs and instrumental selections they would like to hear, instead of inconsequential numbers.

Write the Music Editor, care **RADIO AGE**, and tell him what you, personally, prefer to hear; whether it's love songs, jazz, classical, martial or what. We'll tabulate the results and print a few letters in an early issue.

Also, What One Song Do You Like Best?

We believe there are several songs that will never lose their popularity over radio, such as "It Ain't Gonna Rain No Mo'," "After the Storm," "Marcheta," "Love Sends a Little Gift of Roses," "At Dawning," etc. What do you think? Let us know—NOW. *The Music Editor.*

The Home of Artistic Engineering

New York's TWIN Stations

By RUSSELL H. HOPKINS

NEW YORK:—Radio Broadcast Central is one of the most unique broadcasting stations in the world.

With one pair of antenna towers, one transmitting house and one control room, it broadcasts two distinct programs on two different wave lengths from two separate studios.

Briefly, two stations known by the call letters WJZ and WJY, operating on 455 and 405 meter wave lengths respectively, are under the same roof, management and operation.

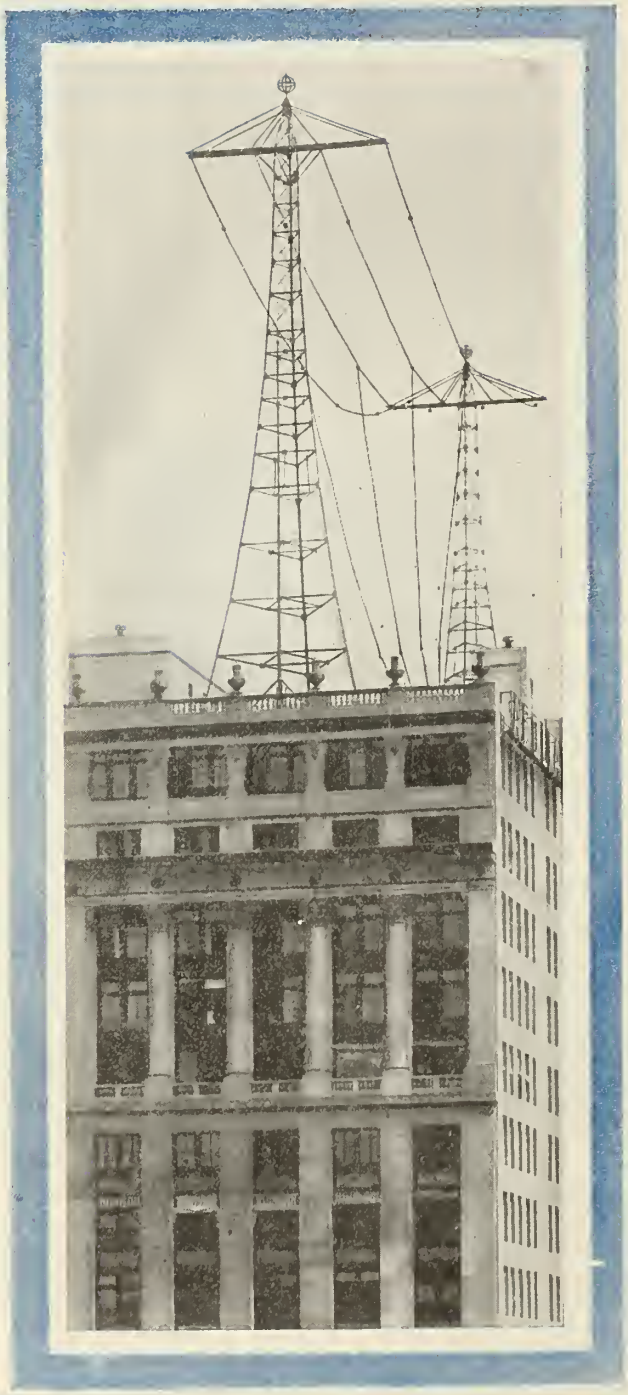
The twin stations are located in the Aeolian Building, on 42nd street just West of Fifth avenue, which itself is the very center of musical and artistic life in New York City. Because they are under the same management these stations can book unusual events with ease.

The engineering installation is of the most advanced in the world, amplified as it is by the latest discoveries in the radio world. The control room adjoins the two studios on the sixth floor and contains two exactly duplicate installations, one for the WJZ channel and the other for the WJY channel. It is here that the delicate sound waves impinged upon the microphone in the studio are modulated to the proper quality, amplified to sufficient quantity and then relayed to the transmitter room atop the roof.

Imposing Antenna

STRETCHING above the roof is the imposing stretch of aerial—175 feet between the cross-trees of the two antenna towers, themselves 100 feet above the roof and 452 feet above the street. The two antennas are in the form of inverted "L's," each leading from one end of the transmitter house, the 50-foot horizontal section being joined by a 35-foot stretch of support.

Perfect transmission of programs is assured by the use of a device known as the oscillograph, which visualizes to the control-room operator the reaction of the radio waves to the voice waves, enabling him by a glance and a twist of one or two dials on the neighboring control panel to maintain perfect transmission.



In the center of New York's musical and artistic life, the towers of WJY-WJZ take their place in Manhattan's new radio skyline.

The studios and reception rooms are the most attractive part of Broadcast Central. Entering the door marked "radio Broadcast Central—Entrance," the visitor or artist (and in this case it's a visitor only) finds himself in a large, sunny and tastefully decorated room, the WJZ reception room. From three big windows he may look down on the green park behind the Public Library or may sit in luxurious easy chairs and skim through the pages of the photograph album of every famous personage who has performed through WJZ; and in the meanwhile he may listen to the receiving set which is tuned to WJZ's own wave—actual proof of the transmission which is given the broadcasting in the next room.

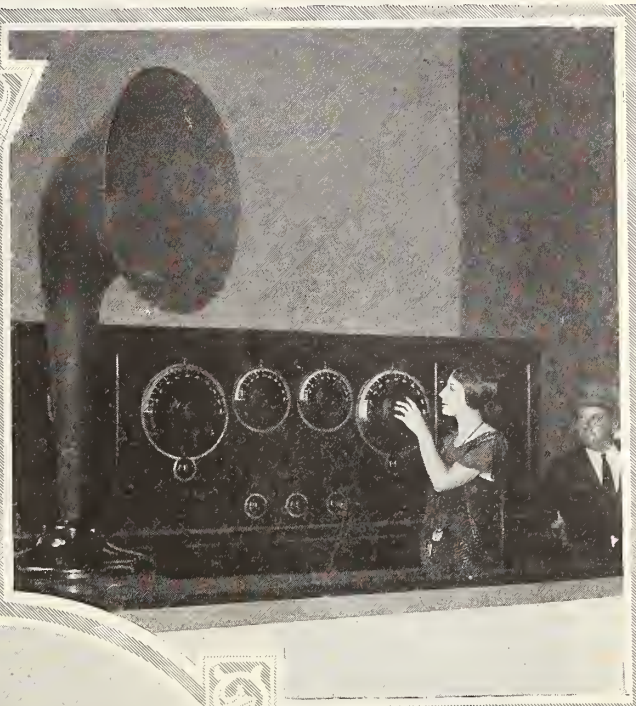
The Twin Studio

PASSING back to the WJZ reception room and turning one's back to the entrance from the hall, we see the door to the WJY reception room, with a perfectly appointed dressing-room on either side of the connecting passage. This room is as lavishly furnished as the other, with an elaborate receiver tuned to WJY's wave length. The panelled walls are furnished in blue and green, the trim and mouldings of salmon pink (can you imagine that?) and the draperies in heavy, vividly-flowered cretonne. This studio, located in the corner of the building, looks out upon the Public Library to the South and on Fifth avenue on the East, with the busiest corner in the world—Fifth Avenue and 42nd Street, almost within speaking distance.

Keeping Up-to-Date *with* Radio

(From Foto Topics)

Marilyn Miller, musical comedy star, takes a bit of morning dancing practice while her hubby, Jack Pickford, operates the family radio set. Marilyn reports that the radio helps her regularly in keeping nimble between productions.



(Photo from P. and A.)

This giant radio set, one of the many surprises at the New York Radio World's Fair, should be able to get Mars without any difficulty. Gertrude Belville, shown tuning above, reports that the volume on this set could be heard for miles around. Oh, yes!

(Kadel and Herbert)

Although he has not taken much of an active part in the present political campaign, President Coolidge is appearing before the Microphone at every opportunity. His informal speeches are being broadcast frequently from WEAF, WJZ and WCAP. Above he is shown before the WJZ "Mike."

E. F. McDonald, president of the Zenith Radio Corporation and owner of WJAZ, discontinued his station in the heart of Chicago's residential district and built a portable station on a truck. It is now touring through small towns near Chicago testing broadcasting facilities. (Underwood and Underwood)

(Foto Topics)

Radio has been installed in New York brokerage houses to enable stockbrokers to keep in touch with market quotations from other cities, as well as to keep up with the presidential campaign. Above is a typical office keeping its stock board from radio reports

"All Abo—oard for the WLS Unlimited!" George Hay, announcer of this famous station, is shown above fully attired as Conductor of WLS and its equally famous locomotive whistle.

Good Evening, Listening In with

HAVE YOU MET

By Milton Lieberman

"NOW little kiddies, fold your tiny hands and sing the Lord's prayer with us—ar-r-r-rrrk--Good-bye—Hello—Polly don't want a cracker."

"Shhh, don't make a sound," Ford Rush said to us, "and the parrot will keep up talking for half an hour. He's got a vocabulary of one hundred words and he uses them as often as a woman."

We were listening very closely while the polly had his talk out.

"Oh, pshaw, now he'll shut up tight." This last came when two young ladies stepped into the studio of radio-phone WLS and started asking the polly if he wanted a cracker. Polly looked at them with a cocked eye, as if to say, "My gosh, are you still asking that silly old question? Why should I want a cracker more than a glass of beer?"

But Polly just kept quiet, apparently insulted that his little monologue should be interrupted. Ford Rush, a member of the famous team of Ford and Glenn (Rowell) who are nationally known as the bed-time story tellers of the station and singers of "How Do you Do?" explained that Mr. Static was just kidding himself and Mr. Rowell when he screamed with that cracked voice of his: "Now little kiddies, fold your tiny hands and sing the Lord's prayer with us." That's the way they close their bed-time stories each evening between 7:45 and 8 o'clock.

"Ford and Glenn" are distinguished because they are the first radio entertainers who ever succeeded in making bedtime stories popular. In fact, so popular has their fifteen-minute "Kiddies' period" become that one day last month when they quit work to attend the Illinois State Fair, the station was deluged with inquiries about their whereabouts. When they returned there was a universal sigh of relief.

Ford and Glenn's success in the bed-time story line can be attributed to their originality. Even their songs are original, and they boast they can put any nursery rhyme to music on a moment's notice.

Some "Big Kids"

THE kiddies aren't the only ones who listen in, either. Ford and Glenn are eagerly awaited on the air by many men and women who won't see even their second childhood again. Glenn estimates that a large proportion of the members of the WLS "Lullaby Club," which was originally intended for little tots only, consists of scores of fathers and grandfathers.

WLS is owned by the Sears-Roebuck Agricultural foundation, and has its studio located on the mezzanine floor of the Sherman Hotel, Chicago. The towers which send out its 500 watts are located at the Sears-Roebuck plant, several miles away.

Mr. Static isn't the only pet of the station. There is "Smoky the duck," who quacks obligingly for the children who are listening in. However, Mr. Static is quite important, and he bears himself with a dignity which shows that he knows how important he is. He is a double-yellow-headed Mexican parrot from the Gulf country and was brought to the station by George Hay, one of the most popular announcers in the country.

"Static" comes from a family of theatrical parrots, as his father and mother do tricks in a circus, his youngest sister is with a carnival and his three older brothers are in vaudeville. This species of parrot usually live to be 150 years old, but Static is just a baby—five years old.

So much for the parrot-mascot of WLS, the greatest station devoted to the interests of rural communities in the world. It is a station literally built by farmers and intended solely for farmers. When the station was conceived and the money appropriated, plans were thought out how it may best serve the farmer. Sam Agaard, director of the Agricultural foundation of the Company, and Edgar L. Bill, his assistant, formulated these plans, and they have been quite successful.

Farm talks are given, schools are conducted for farmers, their wives and children and lessons are taught to better the countryman's mode of living and increase his profits on the products of his profession. Cows and pigs and goats are dissected and put together over the microphone to explain the "innards" of live stock and help the farmer better them. He is told how to grow cabbage and wheat, and what kind of scarecrows best keep those parasites away. Officers of the state granges make regular talks over the WLS microphone and the very cow-paths that lead off of Main street are trod by the WLS teachers.

"All Work and No Play"

EVEN the farmer's amusements are considered and cared for. Every Saturday night old-time fiddlers give a barn dance and the leader calls his steps over the radio. "Turkey in the Straw," "Money Musk," "After the Ball," and old-time cotillons and reels are broadcast.

And Si and Hank and old Sam Hicks like it. To show how much interest they take in it, a rather humorous incident can be told. A contest was being conducted to determine the most popular of the "Old-Time fiddlers" and it was announced that all of the listeners could vote for their favorite. From down in Illinois a regular storm of votes came in. A champion of one of the players had taken several hundred stamped post-cards and printed on the back "This counts as one vote for so and so," and about everybody in the township was given one of the cards to send in. Then from another section of the country a similar stunt was tried, until the votes ran up into numbers. Yes, the farmers are quite strong for WLS.

But the station is not lacking in metropolitan entertainment, either. Regular jazz is a prominent feature and there are many musical programs. The station caters to the railroader, also, and the Pennsylvania Railroad System broadcasts a series of concerts. Talented employes of the road come up about

Everybody! FORD *and* GLENN

"THE BEDTIME STORY BOYS"?

Introducing "Static" the only parrot whose profession is radio broadcasting. And "Static" knows the ropes, too.

every two weeks and give programs. One night on one of these programs the stars of all past Pennsylvania programs were chosen. These were G. W. Morris, an employe-singer of Pittsburgh, with a voice that plans to enter opera; a quartet of Pullman singers that entertain on Pennsylvania trains; Miss Ruth Radkey, pianist-daughter of an employe at Washington Heights, and others. On that night a very unusual thing happened, much to the profit of Miss Radkey. A member of some woman's club heard her play over the radio and enjoyed it so much that she called the studio by telephone and asked her to play at an entertainment to be given by the club.

RADIO AGE has broadcast feature programs from WLS at frequent intervals.

WITHOUT a doubt the most popular character in the station is George Hay, the engineer of the "WLS Unlimited" train. His "This is WLS, Chi-caw-go" announcement, and the toot-toot of his train whistle, are known to all fans. Clem Dacey announces, too, on the late evening programs. Dacey is a vaudeville man, and appears on the stage with Van Alstyne, the composer of "In The Shade of the Old Apple Tree."

A new feature has been tried out by the station which, it is planned, will become a permanent part of its weekly entertainment.

This is the weekly radio play given by the WLS theatre, directed by Henry D. Saddler, of Bloomington, Ill. Every Friday night a one-act play, especially adapted for the radio, is acted, and it has met with much success. Extensive tests have been conducted to determine the most effective way to broadcast drama, and the ingenuity of the station has resulted in schemes to imitate every conceivable sound, so that the imagination can build from the sounds broadcast the scenery, costumes, and facial expressions which ordinarily are necessary parts of the stage play.

A visit to WLS' studio while Ford and Glenn and George Hay are in operation is considered better than a box seat at any legitimate theater. The studio is quite small, and as a result admission is a hard thing to achieve. So packed has the studio become on certain occasions that "The Judge" is threatening to put attendance on an "applied-for-in-advance" basis.

The fun usually begins about 7:45 each evening, when Ford and Glenn seat themselves comfortably on their piano stool and reel off their "Good Evening, Kiddies" greeting to the thousands of youngsters who gather around the family radio for their not-to-be-missed bedtime stories.

IN SPITE of a packed studio and scores of restless, noisy fans who are trying to get in, Ford and Glenn manage to keep their composure enough to amuse the listeners in the studio and the thousands outside of it. Their harmony has won them many vaudeville offers, and their original repartee, which is made up on the spur of the moment and not by laborious preparation, is about the best to be heard at any station—anywhere.

Enter "The Judge"

After the bedtime stories have signed off and "Little Ford" and "Big Olenn" have retired to take a temporary rest, "The Solemn Old Judge," nee George Hay, appears on the scene, doffs his coat, rolls up his sleeve, and lights a fag.

Seated at a small table, he talks into the "Mike" in his intimate, pleasing way, and keeps WLS' evening program humming till well past midnight, on feature nights.

Ford and Glenn usually appear later in the evening to sing a few popular songs, and on several evenings a week Ralph Emmerson, at the Barton studio organ, plays request numbers, most of which are popular or semi-classicall

With such an aggregation of stars as its studio personnel, it is no wonder that the Sears-Roebuck Company has made its station one of the best loved in the Middle West.

Programs from Hotel

Most of the broadcasting from WLS is conducted at the Hotel Sherman Studio, although some of the farm programs come from the studio in the Sears-Roebuck Building on the West Side of Chicago, where the apparatus and towers are located.

Ford Rush and Glenn Rowell, who made "Lullaby Hour" for the kiddies an institution over WLS, are shown above in a moment of harmony. Their bedtime tales make just as much a "hit" with the grownups as they do with the open-eared youngsters.

Enter WJJD

Two Famous Radio Favorites Manage New Mooseheart Station

Photo Copyright by Drake Studio

And here is Jack Nelson, himself, who is to be announcer and director of Radio Station WJJD.

By Jack Nelson
Director-Announcer, WJJD.

MOOSEHEART! A city in Illinois which is, as the name implies, the very Heart of Moose.

On the emblem of the Loyal Order of Moose are the letters P. A. P., standing for Purity, Aid and Progress, and inasmuch as every member of Moose is a father to all the children at Mooseheart, it is common to hear "Howdy Pap" when a Moose is concerned, and we say it now at the birth of W J J D in the Radio World, "Howdy Pap!"

October 27th, Navy Day and the birthday of Secretary of Labor James J. Davis, was chosen as the opening day of this new 500 watt station. The letters "J J D" in the call exist because of a sincere desire on the part of those who know what he has done for the establishment of Mooseheart and for the betterment of thousands of children to give him some public recognition of his service, and it is very appropriate that the Mooseheart Station include his initials for it is due largely to his efforts that Mooseheart exists.

Mr. Davis was successively a bootblack, iron puddler, organizer of the Loyal Order of Moose, founder of Mooseheart and Secretary of Labor in President Harding's and President Coolidge's cabinet and Director General of the fraternity. Mooseheart is a co-operative, fraternal, philanthropic non-money-making enterprise of the Loyal Order of Moose, sustained by its 600,000 members each contributing two dollars a year for the support, care, education, vocational training and the protection of the otherwise dependent children of its deceased members. To date more than $6,000,000 has been expended on this city of childhood.

A Real Paradise

IT IS beautifully situated on its own 1,100 acre estate in the famous Fox River Valley on the Lincoln Highway between Aurora and Batavia, Ill., thirty-five miles west of Chicago. For miles around there is open space, beautiful trees and clear skies. The Fox River runs through the premises and a 16-acre lake offers opportunities for swimming, camping and skating.

Mooseheart is remarkable because (1) it accepts only the dependent children of deceased Moose; (2) it has the lowest death rate of any place in the world; (3) its athletes are highly respected by their opponents and there are a comparatively small number of boys from which to select their teams; (4) its boys' band is one of the most famous in the world; (5) great industries compete for the services of its graduates; (6) every graduate possesses practical knowledge of a trade.

There are now about 1,200 children there.

Mooseheart is ideally situated for a broadcasting station. Away from the unwelcome effect of the tons and tons of steel in Chicago, the 150-foot towers are on the top of a fairly large hill, so that in first seeing them from the Lincoln Highway they look to be at least 250 feet high. The wave length is one where there is little interference (278) and the operator, Ralph Shugart, who worked with me at the Drake for so long, has great expectations. The set is the Western Electric standard 500 watt transmitter, and while we promise no world's record for distance, it is hard to conceive of a more ideal location for a station.

The Mooseheart studio will be adjoining the operating room and lines to the Auditorium, the Athletic field and Superintendent Adams' home will permit the broadcasting of solos, readings, duets, trios, band, orchestra and glee club numbers, football games, etc., all by the students of Mooseheart.

Champion Athletes, Too

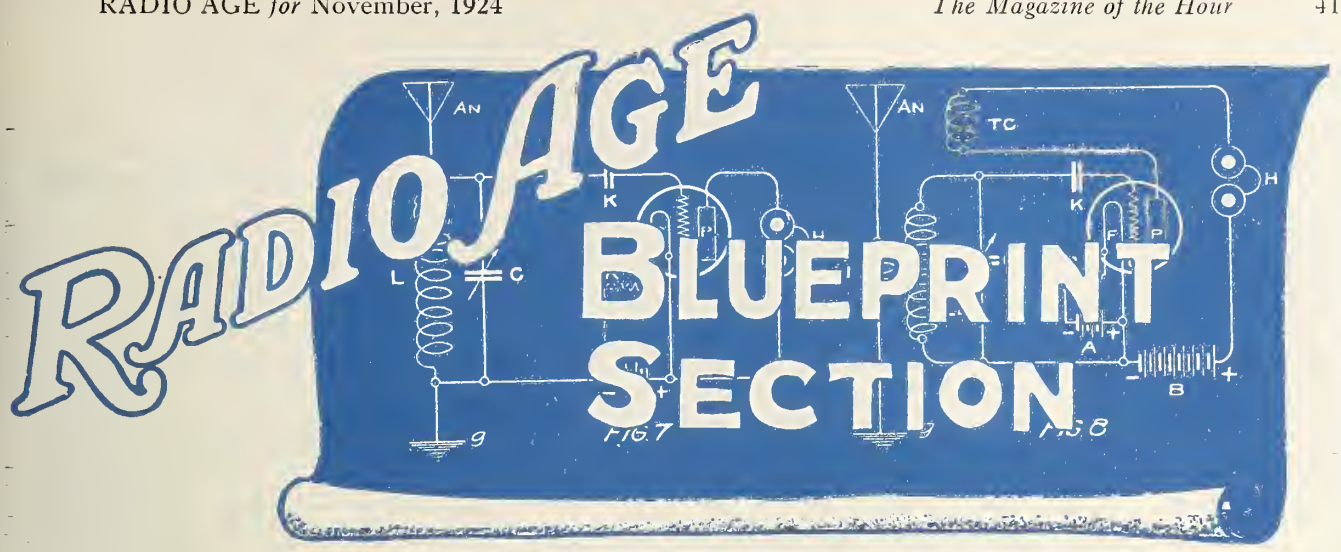
THE foot-ball team, for instance was defeated only once last year, and that time by the Champions of the State, and there are less than one hundred and fifty boys of size enough to pick from. The Mooseheart Band has just returned from a tour through nearly every state and it is famous for its quality. The Novelty Orchestra (a "Jazz Band") is a "hot aggregation" of some of the boys in the Band and Symphonic Orchestra.

There will be a program every afternoon and every evening from Mooseheart and only youngsters of Mooseheart will perform. The entertaining feature of these programs will be in listening to these children, orphans and half-orphans who have tasted unhappiness in watching their progress and hearing the effects of Mooseheart training. There must be something to the training, for in all the years Mooseheart has been in existence there has not been one case demanding

(Turn to page 70)

Photo of Shugart by Drake Studio.

Above are shown the impressive antenna towers and operating building of Station WJJD, Mooseheart, Ill. Another studio in Chicago is to be connected with the Mooseheart operating room by a direct wire. In the circle is Ralph Shugart, formerly chief operator at WDAP, who will hold that position at WJJD. Ralph is known to old-time broadcast listeners as "The Sheik of the Drake."



An Easily Tuned

Single Tube Loop Set

By JOHN B. RATHBUN

Loop Acts as Aerial and As Inductance

MAKING one part of a radio receiving set do the work of two or more of the parts ordinarily employed is the basis of simplification, and simplicity in amateur radio is a virtue, always providing of course that the rearrangement does not interfere with the proper functioning of the receiver. It will be remembered that a distinct step in the direction of simplicity was taken in the reflex set described in the September issue of RADIO AGE, the tuning coupler acting in the dual role of tuning inductance and radio frequency transformer. In the simple one tube regenerative set about to be described, the loop aerial acts both as a collector of radio energy in the usual way, a tuning inductance and tickler coil. In fact, the only tuning instruments in the cabinet are two variable condensers which tune the grid and plate circuit respectively.

As with any loop aerial set, the range for a given number of tubes is considerably less than with an outdoor or "flat-top aerial," but this deficiency is more than compensated for by the greatly increased selectivity and the sweet clear tone. In a certain sense, the directional effect of the loop acts as a third auxiliary to the tuning elements in securing selectivity, and this is of great importance in congested areas where there are two or more local stations broadcasting at the same time. The use of the loop eliminates much of the interference ordinarily experienced due to sign flashers, X-ray machines, violet ray apparatus, and all the other elements that combine to make a bedlam of noises in city reception.

This circuit was tried out thoroughly under very difficult conditions a year ago last summer in the Hotel Commodore, New York. It was assembled from parts roughly stuck together in the confines of a hotel room and the loop was made by sewing wire in and out of a sheet of newspaper. With the loop inside of a steel frame building, stations as far away as Pittsburgh, Pa. (KDKA) were heard with considerable volume, WOR of Newark came in loud and clear, and the local stations were tuned in and out without difficulty. To receive any signals at all with a loop installed in a steel frame building seems a notable achievement for a single tube set, particularly when the parts were only stuck together temporarily without any thought to the proper layout.

Tapped Loop Used

FROM the blueprints it will be seen that the loop aerial is of the ordinary type but that a tap is taken at the eighth turn, thus dividing the loop into the grid and plate sections. Eight turns of the loop form the plate circuit or tickler coil while the remaining sixteen turns form the grid or tuning inductance. According to the construction of the loop and the constants of the apparatus employed in the circuit, some slight readjustment may be required in this distribution of the turns of wire in the loop, but ordinarily it will be found that the specified tapping point is very near that required for the ordinary set. The loop is two feet square, two feet on each side, but this is not critical if the total length of wire in the circuit remains about the same. The wire spacing between turns is taken at one-quarter inch but this may be varied within reasonable limits. A factory made loop, such as can be purchased ready made is of course the most effective and best appearing, but the loop can also be made at home by those who have the patience.

Fig. 1 is a "picture diagram" or plan view of the complete set in a cabinet, while Fig. 2 just below it is a conventional diagram which shows the experienced builder how the set functions. These two views on the same blue print sheet should be used in wiring up the set. The isometric view of Fig. 3 shows the appearance of the assembly taken from the rear of the panel and is a guide in laying out the apparatus. For greater volume, one or two stages of audio amplification can be added in the usual way for the operation of a loud speaker or for better volume on distant stations when using the head phones.

Looking at Fig. 1 or Fig. 2, depending upon the experience of the reader, we see the two variable condensers (C1) and (C2) which comprise the tuning controls. Condenser (C1) tunes the

(Turn to page 48)

HOW TO USE RADIO AGE BLUEPRINTS

The blueprints printed in this section are so arranged as to form a complete unit with the explanatory articles when desired by the reader. For example, the center sheet consisting of pages 43, 44, 45 and 46 contains two blueprints and two pages about a capacity feedback set. Just follow this four-page sheet at the center and you will have a complete section to follow when you make this hookup. Likewise the second center sheet, which also can be followed as one unit, is devoted to the single tube loop set. The blueprints for this hookup are on pages 42 and 47, and the article on pages 41 and 48.

Blueprints appearing in future issues will be arranged in the same manner. —The Editors.

Blueprints for the Single Tube Loop Set on Pages 42 and 47.

RADIO AGE
NOVEMBER 1924

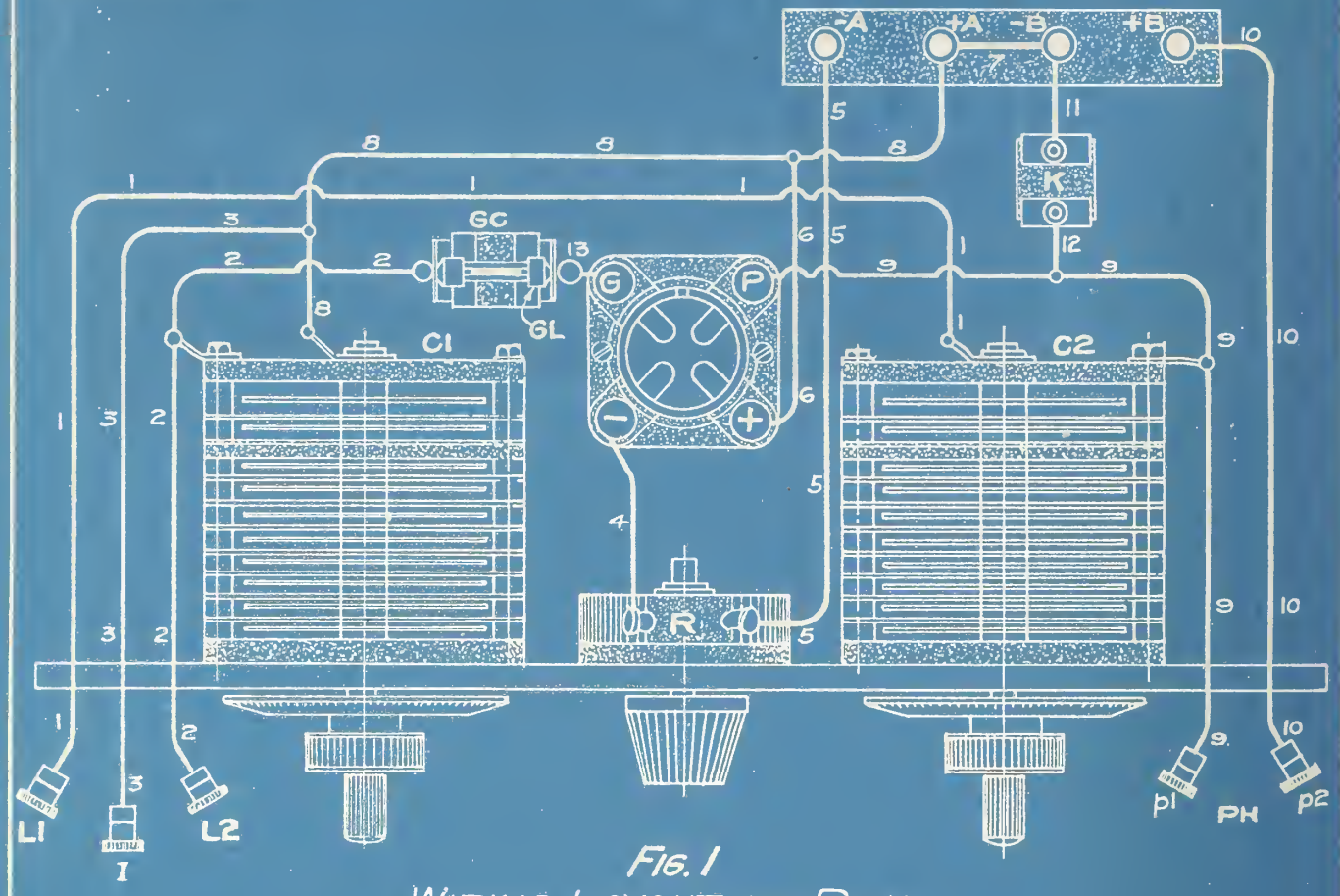


FIG. 1
WIRING LAYOUT AND PLAN

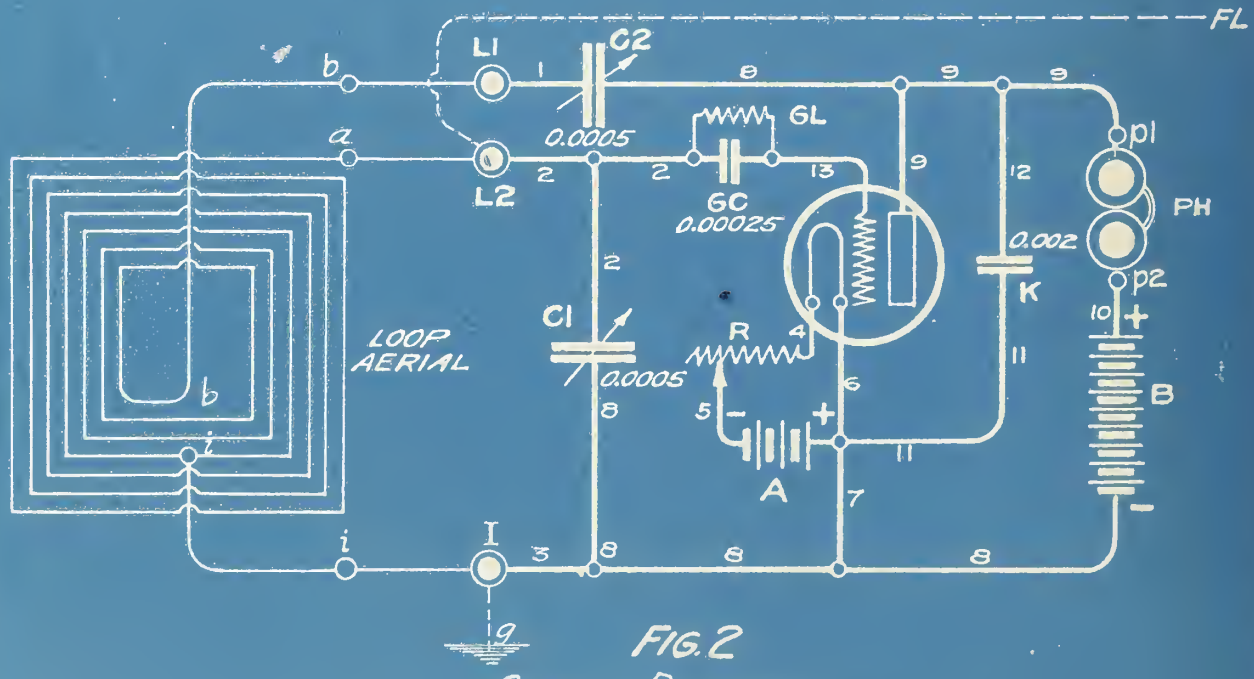


FIG. 2
CIRCUIT DIAGRAM

SINGLE TUBE LOOP SET

PAT. PENDING

J.B. RATHBUN
UA-301

Close Regeneration Control With

A Capacity Feed-back Receiver

By JOHN B. RATHBUN

A Sensitive Circuit with Greater Volume; Variable Condenser Controls Reaction

NEARLY all of our readers are familiar with the inductive feedback types of regenerative circuits in which the plate energy is returned to the grid circuit through the inductive effect of a tickler coil, or by means of tuning the plate and grid into a mutual resonance by means of plate and grid variometers. He is also familiar with the direct feedback type in which the plate circuit is connected directly with the aerial as in the single circuit Ultra-audions and Wizard circuits.

However, there is a third means of feedback which is highly effective, known as the "capacitative feedback" by which the plate energy is returned to the primary and controlled through a variable condenser between the primary inductance and the plate.

As with the inductive feedbacks, there are a great number of circuit combinations possible with the capacity feedback system and one has only to consult an English radio magazine to discover this fact. Its popularity in England is undoubtedly due to the fact that a capacitative feedback circuit has a lesser tendency toward breaking down into free oscillations when the circuit is being forced, and as we all know, re-radiation from the aerial is the Englishman's private pet peeve. Another factor which stands in favor of the capacitative system is the fact that much closer control of regeneration is possible by means of a vernier variable condenser than by the standard tickler coil arrangements, and that the tube can be brought closer to the spilling point without actually causing trouble.

A Sensitive Hookup

I CLAIM no originality for the general type of circuit which is demonstrated in this article except in points of minor refinements. It has been variously known as the "Super-Reinartz," as the "Inverted Weagent," and the "Capacitative Ultra-Audion" at various times. However, no matter what its origin may have been, it is an exceedingly sensitive circuit and gives great signal strength on local. The circuit is tuned to wavelength by means of a variometer while the feedback is controlled by means of a vernier variable condenser. The principal improvement introduced in this article is the use of a spiderweb type of variometer.

In Fig. 1 of the accompanying blueprints we show a wiring diagram and plan view (Looking down on top of the set) which is for the use of our readers who are not familiar with conventional or symbolical diagrams. In Fig. 2 is the symbolical diagram of the set for the information of the advanced readers who may wish to learn how the circuit functions. An isometric view in Fig. 3 shows the general arrangement on the rear of the panel and the run of the wiring, but we advise the reader to make the actual wiring connections with the aid of either Fig. 1 or Fig. 2 as in these views the wiring is clearer and easier to follow. Keep these blueprint diagrams for reference and you will have no trouble with this set.

Looking at Figs. 1-2 we see the tuning variometer (VA) which is really a specially connected vario coupler of the spiderweb type. In the particular coupler shown a movable coil or "rotor" marked (r) is connected in series with the stator (s), the latter being the tapped coil. The tapped portion (L) of the coupler stator is simply the tapped portion of this member but is drawn out separately in Fig. 2 for emphasis in showing the application of the tap switch (TS). The tap switch gives closer control of the tuning and it will be noted that no variable condenser is included in the grid circuit.

Regeneration Control

AT (C1) we have the vernier variable condenser in the plate circuit which controls the regeneration or feed back into the aerial or primary circuit. On tracing out the hookup we will see that the condenser (C1) is effectively in series with the variometer (VA) and therefore that the variometer acts as an auto-transformer for the plate circuit, increasing the potential applied to the grid of the tube. This is very similar in action to the Weagent circuit except that an auto-transformer (Single circuit inductance) is applied instead of the two circuit transformer used in the Weagent. Maximum potential is developed between (C1) and (VA) at the point where the grid circuit is connected through the grid condenser (GC) and the grid leak (GL). The detector tube is at (T1) with its controlling rheostat (R1).

The use of a spiderweb inductance in this circuit eliminates a great deal of the wasteful distributed capacity which commonly grounds a large percentage of the aerial current in single circuit receivers of this class. This is a marked advantage over the layer wound type of coupler and shows up well in practice. The tap points on the section (L) are connected to the tap switch (TS) in the conventional manner, and the blade of the switch is then connected to ground.

Variable condenser (C1) should have ample capacity, hence should be a 43 plate or 0.001 mf type. The grid condenser (GC) is a mica dielectric type with a capacity of 0.00025 mf while the grid leak (GL) should be either a variable leak or else a fixed type with a resistance of about 1.0 to 1.5 megohms. The tube (T1) can be any standard tube of the amplifier type such as the UV-201A or UV-199 type. It will be noted that both the detector tube (T1) and the audio amplifier tube (T2) are connected to the positive terminal of the same "B" battery and therefore that both tubes carry the same high plate voltage. The "B" battery voltage will range from 45 to 90 volts, but the best results are obtained at 67.5 volts with the majority of tubes.

At the output of the detector circuit we have the primary coil (+B-P) of the audio frequency transformer (T) connected in the plate circuit. A fixed condenser (K1) is connected across the primary which has a capacity of 0.001 mf. The secondary coil (—F) and (G) is connected to the audio amplifying tube (T2) through the 4.5 volt "C" battery (C). The transformer (AT) should have a ratio of from 5-1 to 6-1 for the best combination of amplification and clear tone. Lower rations give less distortion but also less volume. It should be particularly noted that the (—) negative pole of the "C" battery should go to the grid post (G) of the amplifying tube socket (T2).

Simple Output Arrangement

SIMPLE single circuit jacks (J1-J2) are used in both stages, and while this leads to slightly diminished volume in the detector stage, yet this is no practical disadvantage as the detector is used only for receiving local stations in the majority of cases. The advantage lies in the simplicity of the jack connections and in the fact that the circuit is not broken at any time in switching from one stage to the other. There can be no open circuits due to poor jack contact nor microphonic noises set up as this point. In the hands of the novice a two circuit jack in the detector stage very frequently leads to trouble. Jack (J2) in the audio stage is of the usual type and requires no further explanation.

The only special instructions that seem necessary for this circuit are those which relate to the conversion of a vario-coupler into a tapped variometer. One lead from the rotor or movable coil shown by (r) in Fig. 2 is connected to the outermost lead from the stator coil (s). In this way the rotor and

(Turn to page 46)

Blueprints of the Capacity Feed-back Receiver on Two Pages Following.

RADIO AGE
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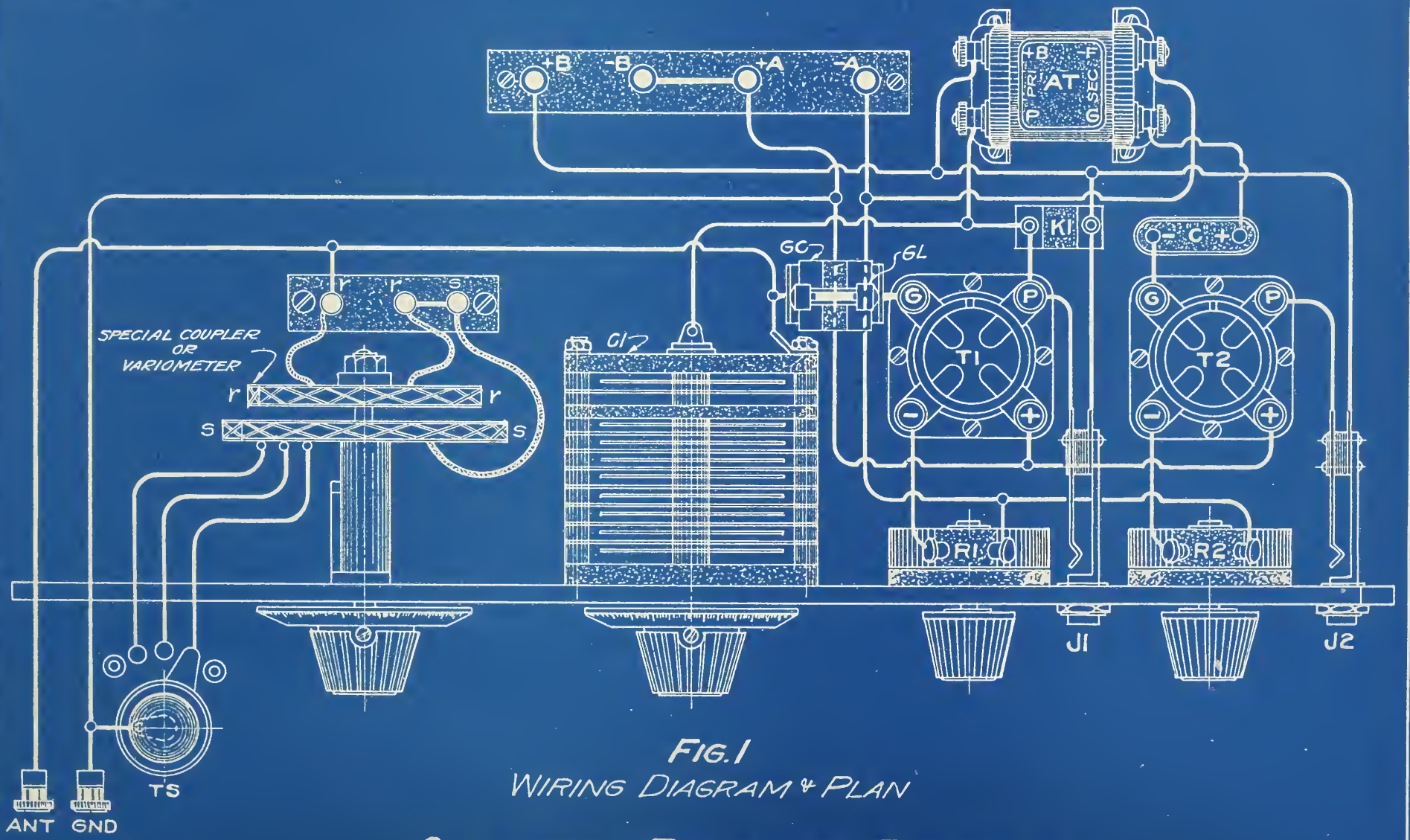

FIG. 1
WIRING DIAGRAM & PLAN

CAPACITY FEEDBACK RECEIVER
(WITH ONE STAGE OF AUDIO FREQUENCY)

PAT. PENDING

J.B. RATHBUN
FB-236

RADIO AGE
NOVEMBER 1924

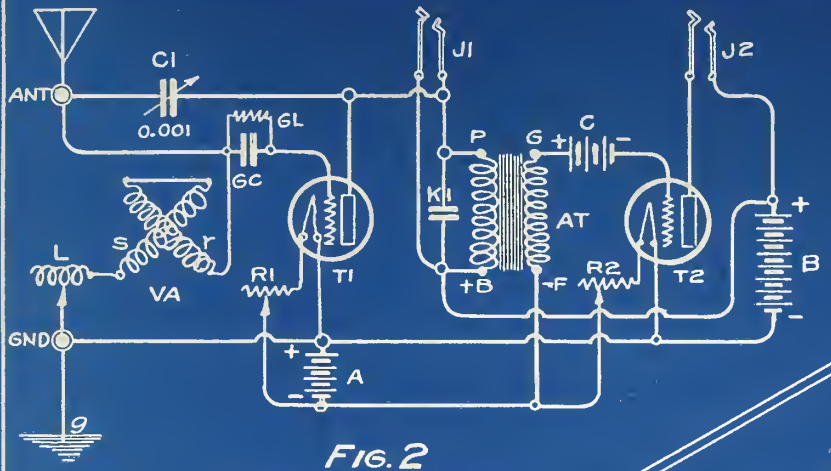

FIG. 2
CIRCUIT DIAGRAM

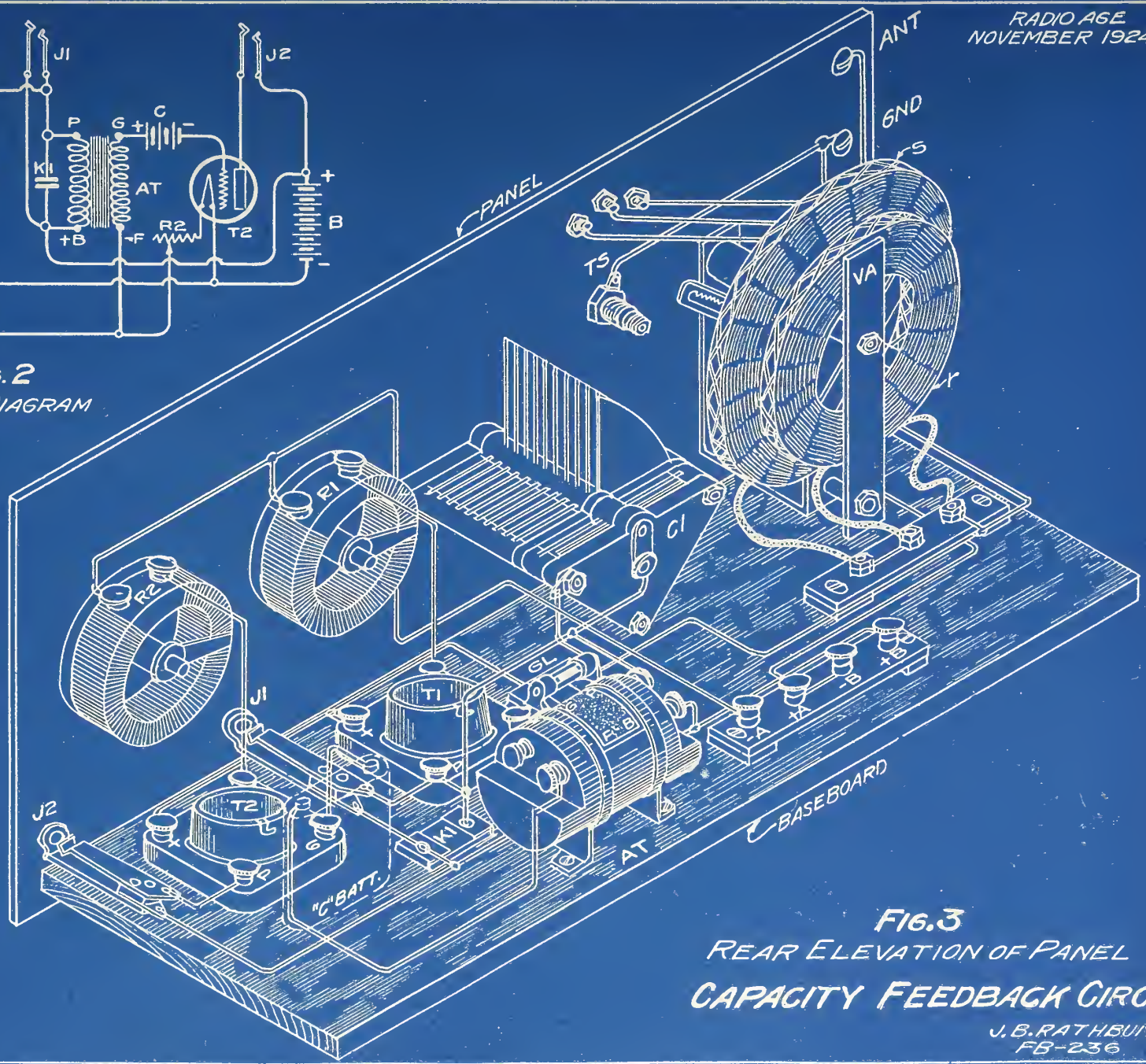

FIG. 3
REAR ELEVATION OF PANEL

CAPACITY FEEDBACK CIRC

J. B. RATHBUN
FB-236

A New Capacity Feed-back Receiver

(Continued from page 43)

stator are connected in series and the device now becomes a variometer. Do not make the connection with the tapped end of the stator coil. Leave the tapped end open for the inductance switch connection.

With this set, the writer has pulled them in for very considerable distances and with surprising volume. It has all the signal strength of a single circuit receiver combined with a great percentage of the selectivity of the three circuit type. It is not quite so selective as a three circuit tuner, especially when two or three local stations are going at one time, but it is much better than the average single circuit arrangement in this respect. One stage of audio frequency amplification is always desirable with any regenerative and is quite economical. It is the addition of the second stage that leads to complication and expense.

One stage of audio permits of excellent loud speaker volume on stations up to 100 miles or so and makes headphone signals audible that would often be passed by with the detector tube alone. With UV-199 tubes, both stages can be worked off of three No. 6 dry cells for a long time and with excellent results. By biasing the audio tube (T2) the total demand on the "B" batteries is very light and the smallest size of cells can be used for long periods.

"B" Battery Current

WHILE the amplification is slightly better with 90 volts of "B" battery on the plate yet 67.5 volts gives nearly the same volume with a much smaller consumption of "B" battery current and with less tendency toward whistling. With 45 volts on the plate the tone is probably purer but the amplification is very much reduced. If only 45 volts are used, then the "C" battery should be reduced to a two cell, three volt type in place of the three cell 4.5 volt battery used for 67.5 to 90 volts.

From 40 to 60 feet of outdoor flat top aerial will give very good results. If the aerial is made longer than this there will be trouble in maintaining the required selectivity although a longer aerial may give a slightly greater range. The great trouble with the majority of amateurs lies in the fact that they try to hang up too much wire in their aerial circuit and in so doing increase the interference and disturbing noises that may originate in the neighborhood. A single wire is better than two wires in parallel.

A 7″x14″ panel can be made to accommodate this apparatus as laid out in the drawings without much squeezing. If it is likely that a second stage of audio will be added in the future then a panel 7″x18″ should be used. Bakelite or hard rubber are the best materials for the panel, and while the baseboard is usually made of wood this can also be made of hard rubber or bakelite to advantage.

[Mr. Rathbun has perfected a new "super" for publication in blueprint form in the December RADIO AGE. Don't miss it!]

No Other Magazine Prints

ORIGINAL BLUEPRINTS

Such as You Find Every Month in

RADIO AGE

Blueprints for the Capacity Feed-Back Receiver on Pages 44 and 45

Baby Hetrodyne Notes

By John B Rathbun

WHILE I believed that the Single Tube Heterodyne circuit which was published in the February issue of RADIO AGE would be of interest to many of our readers, I did not foresee the deluge of correspondence which has poured in upon us steadily for the past four months.

As might be expected with such a critical circuit, the results obtained by the many builders varied widely. The customary 30 per cent of experienced radio experimenters who generally obtain good results wrote in and reported results which were high above the average for a single tube receiver. The remaining 70 per cent, who always experience trouble in some form or other with any circuit, reported every degree of trouble ranging from noisy reception to no reception at all.

Out of all the correspondence which I have handled on the subject I have two heart warmers which have tickled me way down to the ground. One records a reception of 2,600 miles, while the other comes a close second with 2,100 miles, both without amplification and with the circuit exactly as specified. Our booby prize of a fur lined straw hat goes to four of our readers who consistently report zero miles. The leader in our "Longest Aerial Contest" leads by several hundred feet, his aerial, according to his letter, being 400 feet long.

What Some Fans Do

In the words of Captain Favour, who writes in from Fort Sheridan, Ill., "We are constantly hearing of new circuits, but seldom hear of the results obtained by them." Acting on this suggestion I am attaching a very few of the results obtained by our readers which may be a guide for those who are working or who have worked on the Single Tube Heterodyne.

"*Los Angeles, Cal.* Have just finished building the 'Single Tube Heterodyne' as described by John B. Rathbun in your February issue. Had a little trouble in getting it to work properly at first; it whistled and howled until I placed a 0.005 fixed condenser between the plate (P) and the (+F) posts of the tube sockets, and a 0.001 fixed condenser across the phones. It works fine now and is very selective and clear.

"I am living at present within a half dozen blocks of four broadcasting stations. Five nights a week they all work at the same time. I have absolutely no trouble in shutting them out. With a fifty-foot aerial on the roof I can tune in any one of the stations without a trace of the others, and this I believe is going some, as it is the general belief here in Los Angeles that a single tube set is useless in the downtown section without wave traps.

"(Signed) Frank C. Meislalin."

(NOTE): The addition of the 0.005 mf fixed condenser bypass between the plate (P) and the (+F) is quite interesting, and upon experimenting with this addition, I find that it is quite effective under certain conditions where the tube tends to howl. This may be of benefit to those of our readers who have reported howling. Phone condensers placed across the phone posts may or may not be effective, depending upon the characteristics of the phones used. However, this is well worth trying.

* * *

"*Bethelehem, Pa.* Just a question or two that I would like to have answered. I constructed the single tube heterodyne described in the February issue of RADIO AGE. The set works fine and I am delighted with it. I picked up at least thirty stations, but what bothers me is that all of my stations come in at such a low dial reading that the condenser (C1) is never over (30) and at low wave lengths both condensers are at nearly (0). I find that a three megohm leak works best with the C-301A tube. My aerial and lead-in approximate 85 feet.

"(Signed) Leonard R. Krause."

(EDITOR'S NOTE): The condenser positions vary with your local conditions and with the length of the aerial. Either your condensers have not the rated capacity or else you should remove a few turns of wire from the secondary coil of the fixed coupler. The wave length of the set increases with the number of turns on the secondary coil of the coupler, and to reduce the wave length so that your set will work with positive condenser settings on short waves, we should remove a few turns at this point.

* * *

"*Washington, D. C.* I have made up the Baby Heterodyne as described in the RADIO AGE of February. This hookup deserves much praise. However, the length of the coils (M) and (N) makes it impossible to put this set in a cabinet. Could these coils be bank wound? Would Litzendraht wire improve the set any?

"(Signed) Maurice A. Coates."

(To be continued)

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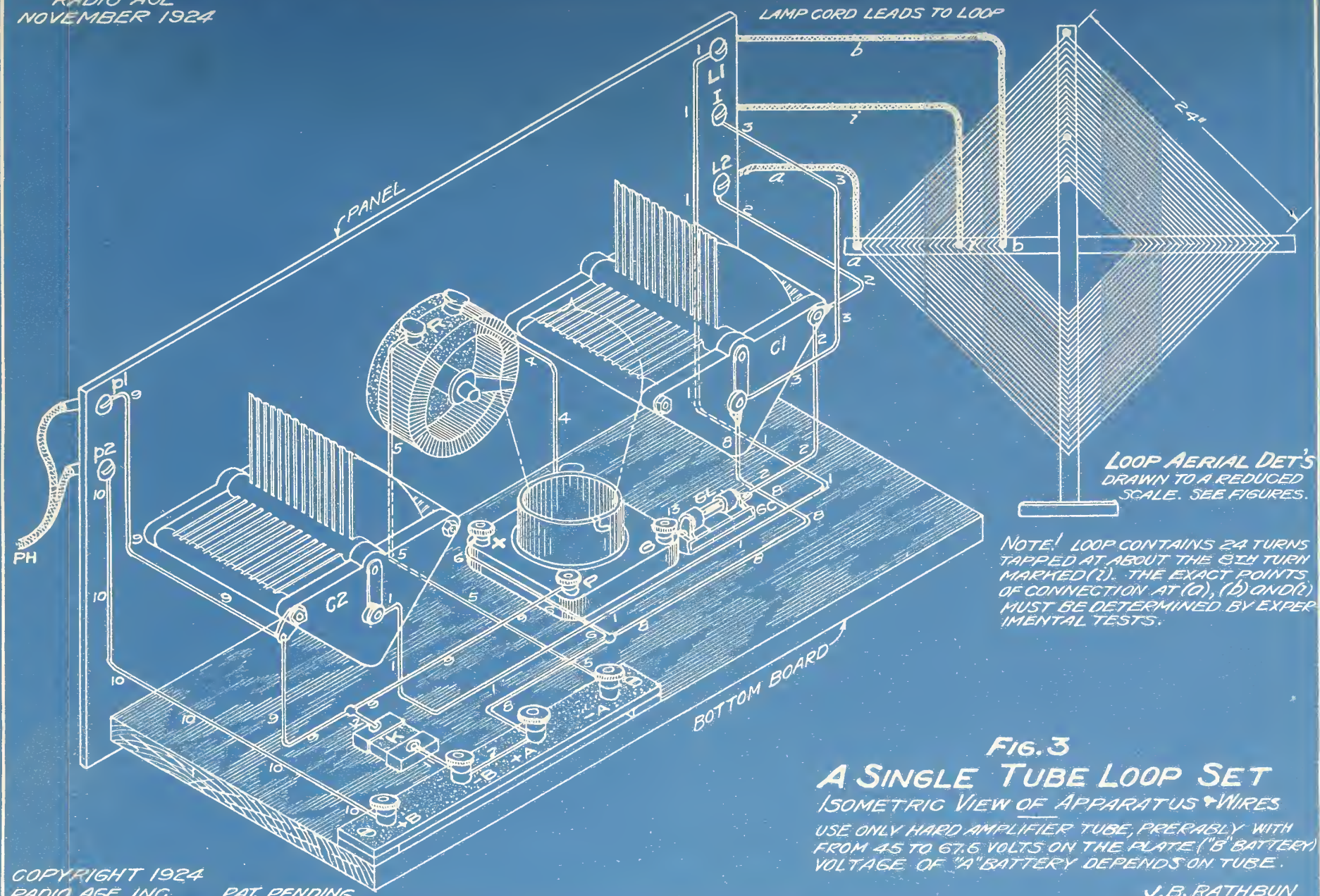
NOVEMBER 1924



LOOP AERIAL DET'S DRAWN TO A REDUCED SCALE. SEE FIGURES.

NOTE! LOOP CONTAINS 24 TURNS TAPPED AT ABOUT THE 8TH TURN MARKED (i). THE EXACT POINTS OF CONNECTION AT (a), (b) AND (i) MUST BE DETERMINED BY EXPERIMENTAL TESTS.

FIG. 3

A SINGLE TUBE LOOP SET

ISOMETRIC VIEW OF APPARATUS & WIRES

USE ONLY HARD AMPLIFIER TUBE, PREFERABLY WITH FROM 45 TO 67.5 VOLTS ON THE PLATE ("B" BATTERY) VOLTAGE OF "A" BATTERY DEPENDS ON TUBE.

J.B. RATHBUN
UA-301

An Easily-Tuned Single Tube Loop Set

(Continued from page 41)

loop aerial to wavelength while (C2) controls regeneration and also aids (C1) in sharp tuning. Connections to the outer turns of the loop are made by the binding posts (L1-L2). Connection to the intermediate tap on the loop is made by binding post (I). Ordinarily the set works very well without a ground connection, but in some cases increased volume with decreased selectivity can be had by grounding one of the posts (L1) or (L2), the exact post to ground being determined by experiment. Grounding increases the effectiveness of the loop as a collector of radio energy but at the same time it partly destroys the directional effect and hence also decreases the selectivity. As this varies with local conditions, no recommendation can be made on this point which will fit every case.

Use Low Loss Parts

OWING to the wide separation of the wire turns on the loop, the distributed capacity is much less than with the more usual tuning coil and it will be found that the loop tunes sharper and more critically than a coil. This means that a vernier type variable condenser is very desirable for both tuning controls if we expect to get the best results with certainty. Both condensers (C1) and (C2) have a capacity of 0.0005 mf or are 23 plate commercial types. The low capacity of the loop results in a minimum of electrostatic coupling between the grid and plate circuits with an attending sharp control of regenerations and a marked absence of whistling and howling when tuning in.

Hard amplifier tubes such as the UV-201A, C-301A, UV-199 or C-299 are best adapted to this circuit, but very good results have also been attained with the WD-12. In fact the New York test was made with a WD-12 tube. Moderate volume can be had with 22.5 volts of "B" battery on the plate but higher voltages are better as they give more volume. With the UV-201A and C-301A we can employ 67.5 to 90 volts with profit while with the UV-199 and C-299 we will find that 67.5 volts is about the limit. Soft detector tubes of the UV-200 type give indifferent results owing to the low plate voltage that must be carried and they take too much filament current to be practicable for this sort of a circuit.

The rheostat (R) is of the ordinary type, the resistance of which depends upon the type of tube used. A plain type rheostat can be installed but a vernier gives better control of the filament current and electron emission. The tubes also control the "A" or filament battery voltage, hence we must first choose the type of tube and then select our rheostat and filament "A" battery to correspond. A 0.002 mf fixed condenser (K) bypasses the radio frequency current around the phones and "B" battery in the usual manner, and is of great assistance, particularly when old "B" batteries introduce a great amount of resistance into the plate circuit.

Grid Biasing Scheme

WITH low plate voltages, ranging from 22.5 to 45 volts, a one megohm grid leak (GL) and a 0.00025 mf grid condenser (GC) give good results as shown in Fig. 2, and will also function well at higher voltages. However, when the voltage exceeds 45 volts it will generally be found that a biasing "C" battery will be better as shown installed in Figs. 1 and 3. This is simply a small three cell flashlight battery of 4.5 volts with the negative pole connected to the grid (G) of the tube socket. This polarity is of the greatest importance and the negative bias must be maintained on the grid (G) by this connection.

THE ORIGINAL
RADIO AGE BLUEPRINTS

On Pages 42 and 47
Will Aid You
In Making This Novel
SINGLE TUBE LOOP SET.

Another unusual Group of Blueprint Hookups in December RADIO AGE.

When the constructor wishes to build his own loop aerial we advise him to use a large gauge of silk or cotton covered magnet wire. Small gauges such as No. 22 to No. 24 will bring in the stations but larger wires or stranded cable such as lamp cord is better. There are 24 turns in all with a width of about 24 inches across the sides of the square. Spacing the wire about 1-4 inch between turns will be perfectly satisfactory for the ordinary range of wavelengths.

IN Fig. 2 we show the probable location of the ground (g) by dotted lines. This ground may or may not be used but it should be at least tried out. It generally stabilizes the circuit, and prevents any tendency toward body capacity, even though it does affect selectivity adversely.

While this set has been mounted on a 6 inch by 7 inch panel, yet it is more desirable to use a 6 inch by 10 1-2 inch size as the larger panel makes it easier to wire up the receiver. From this it will be seen that it is a portable of the first order and that a panel size of 7 inch by 18 inch will permit of carrying batteries and all within the cabinet. In case that it is desired to install the batteries within the cabinet it will be found best to use "A" batteries of a square shape as such batteries pack up closer and are easier to hold in place. Vertical type "B" batteries are now on the market which require a minimum of space and which are very easy to connect.

When range is required regardless of selectivity, noise and other characteristics, it will be found advantageous to connect a short length of aerial to the post (L2) with the ground (g) as shown by the dotted line. In effect this gives us a single circuit tuner in which the inductance is still represented by the loop. When the short flat top aerial is connected in this way, we must still use the loop as the 20 to 40 foot stretch of flat top is simply an auxiliary to the circuit and does not supplant the loop. The combination of flat top and aerial gives greater selectivity than a flat top aerial alone as the loop still gives a strong directional effect, but at the same time the selectivity is reduced in the vicinity of powerful broadcasting stations and the flat top collects various disturbances which result in noises in the phones. The auxiliary flat top aerial is indicated by the dotted line (FL) in Fig. 2.

In making adjustment of the tap point (i) on the loop we must strike a compromise between the wavelength range and the regenerative effect. The turns between (a) and the tap point (i) determine the wavelength range in meters while the loop turns between (b) and (i) determine the regenerative effect. Temporarily, at least, connect up 16 turns between (a) and (i) and eight turns between (b) and (i). Now attempt to tune in stations on very long and very short wavelengths to determine the range. Thus, if the condenser (C1) includes stations having wavelengths of 500 meters and over, and also stations or telegraphic code on as low as 200 meters, then we can feel that the tuning section of the loop (a-i) is of ample range and then can pay our attention to the tickler section of the loop.

If we can obtain a whistle by means of condenser (C2) on any of the stations within the above band of wavelengths, with the tube turned up to normal brilliancy, then we can feel sure that we have sufficient turns in the tickler section (b-i). If we have a great margin left in our condenser (C1) after we have tuned in a station of 500 meters or higher, and if the signals are weak and no whistle appears at any position of (C2), then we can change our tapping point (i) so that more turns are included in the tickler (b-i) and fewer turns are in the grid section (a-i). By experimentally moving the tapping point (i) from one turn to another, we can determine the maximum performance.

Adding Stages

ANY type of audio frequency amplifier can be added, resistance or transformer coupled, with one or two stages as may be desired. The output posts (p1-p2) are connected to the input of the audio stages as is usually the case with regenerative circuits, and the same "A" and "B" batteries can be use for both the detector and amplifier tubes. One or more stages of TUNED radio frequency increase the range but also increase the complication and expense.

Watch for a "dyne" blueprint hookup—the greatest yet, in December RADIO AGE.

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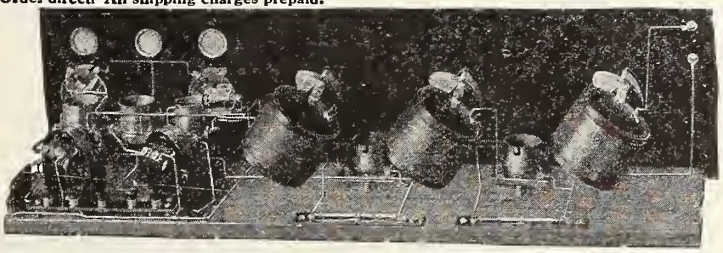
Order Direct From This Page! Save About One-half! Compare our prices with others. Only highest grade nationally known GUARANTEED parts. OUR GUARANTEE PROTECTS YOU. Money cheerfully refunded if you are not satisfied. Be sure to write your order and state prices plainly. Seod post office or express money order or bank draft for total amount to insure prompt shipmeot. ALL PRICES ON THIS PAGE INCLUDE SHIPPING CHARGES RIGHT TO YOUR DOOR. Refer to any bank or commercial agency regarding our reliability. If your favorite circuit is shown here, order direct from this ad. No skill required to build your own radio with Randolph parts, Panels are all drilled. Instructions are simple and complete. Everything comes ready to assemble. Order direct! All shipping charges prepaid.



Complete Parts for Two-Stage Amplifier

May Be Used In Connection With Any Receiving Set

1 7x9 or any standard Bakelite Panel.
1 Thordarson or Columbia High-ratio Transformer.
1 Thordarson or Columbia Low-ratio Transformer.
2 Bakelite Rheostats.
2 Bakelite Sockets.
2 2-circuit Jacks.
1 1-circuit Jack.
1 Baseboard.
9 Binding Posts.

$10.90

Diagram and Instructions for wiring.

COMPLETE PARTS FOR 3 AND 5-TUBE NEUTRODYNE RECEIVING SET

Genuine Hazeltine Licensed Fada, Freed-Eiseman, or other Genuine Licensed Parts

1 7x28x3/16 Drilled Panel.
2 All American or Columbia Audio Transformers.
3 4" Bakelite Dials.
3 Filament Control Jacks.
1 Vernier Rheostat—30-ohm.
1 Plain Rheostat—6-ohm.
1 strip Bakelite, 6x1x3/16.
8 Binding Posts.
1 Grid Leak and Condenser.
2 Bakelite Sockets.
1 .001 Condenser.
1 Dubilier By-Pass Condenser.

PARTS FOR 5-TUBE SET:

3-Gang Bakelite Socket.
35 feet Hook-up Wire.
1 Wave Control Neutroformer.
2 R. F. Neutroformers.
1 Baseboard.
2 Neutrodons.
3 Bezels.

5-TUBE SET $33.75

Complete blue-prints and working diagrams and instructions.

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23-plate plain Cond'r. $1.29
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Bakelite " 30-ohm .59
Bakelite Vernier Rheos't 1.15
Bakelite Potentiometer, 200 ohm ..... .59

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Sinclair Special, 6 to 1, 2.55; 3½ to 1 .... 2.24

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4" Hygrade Dial ..... .29
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Blue Bird Special 3.95

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American Bell 3.95
With adjustable loud speaker unit 6.95

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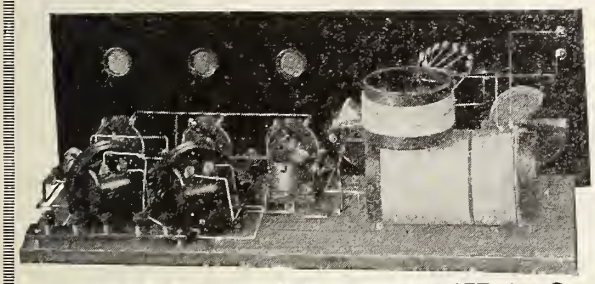
180° Variocouplers .... .95
Reinartz Coils 1.25
Electric Soldering Iron . .98
Cockaday Coil 1.65
Three-Circuit Tuner ... 2.95

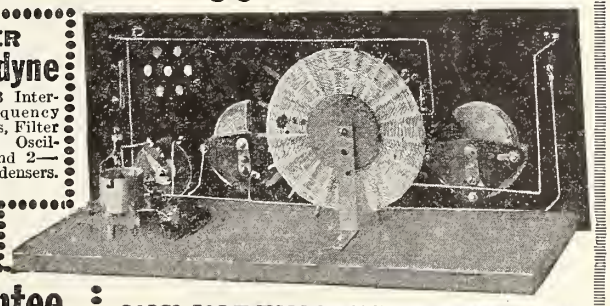


SUPER Heterodyne

Containing 3 Intermediate Frequency Transformers, Filter Transformer, Oscillator Coil and 2—1 M. F. Condensers.

$19.75

with Audio frequency Trans. $26.65



COMPLETE PARTS FOR 3-TUBE COCKADAY RECEIVING SET

1 Cockaday Coil.
2 23-plate Hy-Grade Cond.
1 Bakelite Rheostat, 30-ohm.
1 Bakelite Rheostat, 6-ohm.
3 Bakelite Sockets.
1 high ratio Columbia or All-American Transformer.
1 Single Circuit Jack.
1 low ratio Columbia or All-American Transformer.
2 Double Circuit Jacks.
2 3" Bakelite Dials.
1 Grid Leak and Mica Cond.
7 Switch Points, 2 stops.
1 Bakelite Binding Post Strip.
8 Binding Posts.
1 7x21x3/16" Drilled Bakelite Panel.
3 Bezels.
1 Baseboard.

3-TUBE SET $19.95

Complete blue-prints and wiring diagrams.
1-Tube Set.....$10.45

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Every article exactly as represented. Every article is tested before shipping. Complete satisfaction guaranteed or money will be cheerfully refunded.

PARTS FOR ONE-TUBE REINARTZ RECEIVING SET

1 7x18 Bakelite Panel.
1 Vernier Bakelite Rheo.
1 Bakelite Socket.
1 23-plate Lo-loss Var. Cond.
1 11-plate Lo-loss Var. Cond.
2 Bakelite Dials.
1 Genuine Rheinartz Coil.
2 doz. Switch Points and Stops.
3 Switch Levers.
25 feet Busbar Wire.
1 Freshman Grid Leak and Condenser.
1 Baseboard.
9 Binding Posts.

1-TUBE SET $10.45

Blue-print and Complete Instructions.
3-Tube Set.....$17.55

Complete Parts for 2-TUBE HARKNESS SET

7x14x1/8" Drilled Bakelite Panel, 2 Harkness Flexoformers with Condensers, 2 Dials, 2 Bakelite Sockets, 1 Connecticut Battery Switch, 2 American Bell Transformers, 1 Jack, 1 R-W Detector, 1 Bakelite Rheostat, 5 Binding Posts, Baseboard and Bus Bar Wire—17.95

Acme—1 Tube Reflex Set

$17.45

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$39.85

COMPLETE PARTS FOR 8-TUBE SUPER-HETERODYNE

1 23-plate Lo-loss Vernier Bremer Tully or Duplex Condenser.
1 23-plate Lo-loss Vernier Bremer-Tully or Duplex Condenser.
1 400-ohm Frost Potentiometer.
2 6-ohm Rheostats.
2 30-ohm Bakelite Rheostats.
1 .00025 Fixed Condenser.
4 .002 Condensers.
1 .006 Condenser.
1 Bakelite Terminal Strip for Binding Posts.
1 Multicolucord Cable for connecting batteries.
1 1-Meg. Leak.
2 4" Bakelite Dials.
1 Single Circuit Jack.
2 2-Circuit Jacks.
8 x 35 Baseboard.
35 ft. Busbar Wire.
1 8x36x3/16" Dr'ld. Bak. Pan.
8 Bakelite Sockets.
7 Binding Posts.
1 Filter Transformer
1 Oscillator Coupler.
1 "C" Battery.
1 Battery Switch.
3 All-American or Columbia Long-wave Transformers.
2 All-American or Columbia Audio Transformers.
Instructions, blue-prints and complete layout.

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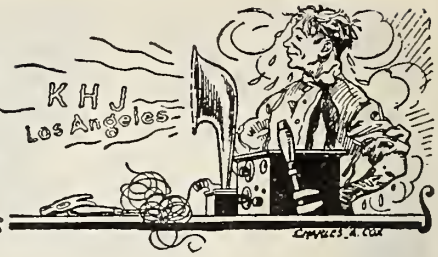
Pick-ups and Hook-ups by our Readers



The material appearing under the title "Pickups and Hookups by Our Readers" in RADIO AGE, is contributed by our readers. It is a department wherein our readers exchange views on various circuits and the construction and operation thereof. Many times our readers disagree on technical points, and it should be understood that RADIO AGE is not responsible for the views presented herein by contributors, but publishes the letters and drawings merely as a means of permitting the fans to know what the other fellow is doing and thinking.

THE Editor of this department owes the readers an apology with regard to the Static Puncturing Contest for August. It was promised that a report of the results of that month would appear in the October RADIO AGE, but—

During the month of September—which is the month when the staff of RADIO AGE is busy making up the October issue, hundreds of letters were received, submitted by fans who had made lists, and the problem of selecting the winners was even so great as to require additional help in the Pickups Department. Now the Editor promised all those who submitted lists a fair chance, and all the letters got it,—some of them being read over and over as many as four or five times.

What the fellows did to Old Man Static—the letters and list tell more plainly than anything that we can write. All we have to say is that he was handed an awful trimming, and further, that the fellow who goes around with a long face saying that "Summer is a bad time to listen to radio" is an unpleasant memory of the past.

With this issue, our readers will find that the Dial Twisters have become an international organization. At the time of this writing we have made no less than five English radio bug Dial Twisters; in our membership lists we have a great many Canadian bugs, and if the interest keeps up, we hope to extend the idea even to more foreign countries afflicted with the indoor sport of radio DX fishing.

The Editor awaits with great expectations the arrival of a letter or two from some "bug" in Australia. We know that if these Australian fans get in with the bunch, there will be something doing. We have heard reports of those fellows working and hearing American stations on absurdedly simple receivers, and when they do hear them,—their mileage runs up into four figures and more.

—The Pickups Editor.

CONTRIBUTORS

Phillip Sidney Weggitt — P. Edward Chapman — Lloyd Stove

Farwell C. Long

DIAL TWISTERS

Name	Address	Circuit
W. A. Neeld	238 N. Galloway, Xenia, Ohio	RCA
R. L. Link	Kirkville, Mo.	Baby Het
W. H. Barlow	Rdo Opr SS Alpena	Grebe CR5
Fred Harrison	34 Virginia Ave., Cumberland, Md.	Special
R. W. Lowe	414 Walnut Ave., Fairmont, W. Va.	Capudine
F. C. Long	1122 Church St., Flint, Michigan	Ultradyne
Vincent T. Kenney	124 West 96th St., New York City	Globe Trotter
Roy G. Harber	32 Northumberland Ave., Buffalo, N. Y.	Reinartz
W. B. Tucker	R. R. 3, Hortonville, Wis.	Pfanstiehl
S. W. Wendel	521 Taylor St., Topeka, Kans.	Single Circuit
Wilber Milnor	196 16th Avenue, San Francisco, Calif.	3 Circuit
Henry E. Leise	2444 Hazelton Ave., NS. Pittsburgh, Pa.	Haynes
Robert C. Simpson	Vincennes, Ind.	Atwater-Kent
Arthur T. Meyer	Templeton, Wisc.	Reinartz
Arthur Goyer	406 Drummond Bldg., Montreal, Can.	Not Stated
T. C. Mahoney	1610 Market St., Burlington, Ia.	Kopprasch
R. K. Ashdown	P. O. Box 139, Freeport, N. Y.	Haynes
Tony Gibas	520 Broad St., Kenosha, Wisc.	Woods
George H. Baker	P. O. Box 755, DeLand, Fla.	Crosley V.
W. C. Wolverton, M.D.	Linton, N. D.	Neutrodyne
John Mullikin	128 Bates St. N.W.	Not Stated
W. J. Head	24 First St., Bristol, R. I.	Single Circuit
Neal O'Donnell	38 Clark St., Astoria, L. I.	Reinartz
Thomas Lawrence	Box 488, Brampton, Ontario, Canada	Special
E. C. Maizniski	Box 403, Tawas City, Michigan	Tryrdin
P. E. Miller	1252 N. Campbell, Chicago, Ill.	Tuned Plate
J. Sulouff	325 6th Ave., Altoona, Pa.	Portable
Oswald Faubel	Box 224A, R.F.D. 4, Brooklyn Station, Cleveland, Ohio	Flewelling
W. L. Bausserman	Gilmore City, Iowa	Go-Getter
P. Kilkenny	478 Frontenac St., Montreal, Can.	Single Circuit
F. A. Carswell	Box 158, Oxbow, Sask., Can.	Ultra Audion
Kester Brewer	626 King St., Monrovia, Calif.	Regenerative
Herbert E. Zebuth	638 N. Refwal St., Allentown, Pa.	Single Circuit
Arthur M. Roach	1006 Grand Ct., Davenport, Ia.	Split Variometer
Russel Caffey	Halfway, Mich.	Reinartz
Edward C. Liker	742 Collingwood Ave., Detroit, Mich.	Ultra Audion
J. D. Kelly, Jr.	262 Lawton St., Atlanta, Ga.	Single Circuit
Benton Pantall	1618 Widener Pl., Philadelphia, Pa.	King Tuner
LeRoy Garman	Franklin Grove, Ill.	Not Stated
Wilbert Waterman	35 S. Edison Ave., Elgin, Ill.	Haynes
O. C. Fletcher	1267 Johnson St., San Diego, Calif.	Not Stated
Gordon Wilcox	2248 Sturtevant Ave., Detroit, Mich.	Single Circuit
Raymond Hall	Johnson St., Wauwatosa, Wisc.	Single Circuit
Ralph Page	716 Iglehart Ave., St. Paul, Minn.	Single Circuit
M. Lundskow	1067 6th Ave., Kenosha, Wisc.	Single Circuit
Vincent T. Kenney	124 W. 96th St., New York City.	Not Stated

Editor's Note:—These names are not listed according to standing with respect to actual operating records.

PICKUPS EDITOR.

Mr. Robert M. Hillis of 1462 Belle Ave., Lakewood, Ohio, sends in the following communication from an English fan with the notation that we write him and tell him about the Dial Twisters. This we did as the following letter will testify:

Mr. Philip Sidney Weggitt,
35 Kings Road,
Bournemouth,
Hants., England.
Dear Sir:

Mr. Robert Hillis, of 1462 Belle Avenue, Lakewood, Ohio, has forwarded to me a copy of your letter, with a notation that it would perhaps be of interest to the Pickups pages of our magazine, RADIO AGE, of which I take the liberty of sending several copies for your reference.

The circuits you enclose seem so entirely different and unusual from the types we use, that I am going to feature them in the November issue of RADIO AGE, in our reader's department. Incidental thereto, I

have Mr. Hillis' permission to publish parts of your letter to him, which I trust will meet with your approval.

Since contributions to the Pickups Section of RADIO AGE are acknowledged by conferring the much-desired honor of "Dial Twister" upon the contributor, I am enclosing herewith the emblem which proclaims this honor, and would casually mention that you hold the honor of being the second of your countrymen to gain entrance among the Dial Twister faction of RADIO AGE readers.

I would be pleased to hear further from you with any news, circuits or other items of interest that you feel would be valuable to your American radio friends.

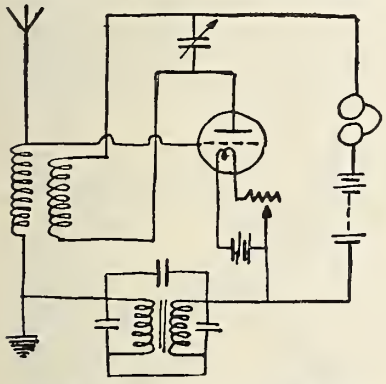
Very truly yours,
RADIO AGE, Inc.

Mr. Weggitt's letter is as follows:

35 King's Rd.,
Bournemouth Hants.,
England.

Dear Mr. Hillis:

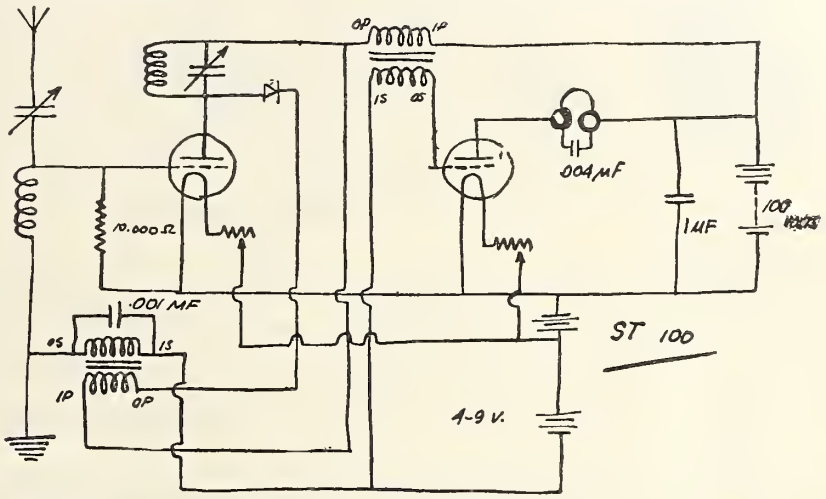
I have heard that you wish to correspond with an English radio experimenter. I am nearly seventeen and have had over two years experience in radio experimenting. I have made dozens of sets, and I test out all the circuits I can get hold of, from crystal to 6-valve sets. The circuits, which I am most interested in are one valve and reflex



circuits. I will now try to describe my testing-lab and station. I am situated about a mile from the Bounemouth broadcasting station, call sign 6BM. My aerial is a "cage," with a "cage" lead-in. The aerial is 60 feet long and to the lead-in end it is 35 feet high and at present I am engaged in erecting a 45 foot mast, instead of a 30 foot one at the other end. There are 4 wires mounted on 3 ft. hoops in the "cage." My earth-wire is about 20ft. long, composed of 3-18 copper wire. On this aerial I have received KDKA Pittsburgh, U. S. A., on about 100 meters, with an inductively coupled single circuit. One evening or early morning I received KDKA from 11:30 p. m. until 2:30 a. m. continuous. On the ordinary one-valve and reaction set I can get all British broadcasting stations and Paris, etc. These stations are easily readable. I am sending you an old photo of my testing-bench will get a friend to take some more.

I can test out most circuits up to 6 valves but I go in mostly for long distance work with one or two valves. I should be very pleased if you could send me some one valve circuits; I don't mind how complicated, I will test them. I should also like some rejector or wave trap and some super-crystal circuit.

I am trying to get a transmitting licence using an artificial aerial but transmitting licenses are so difficult to get in England. It took me three months before I obtained my experimental license and I had to answer bags of questions.



Reflex Circuits seem to be the pet hobby of the English fans, as shown in these diagrams submitted by a British broadcast listener. To the left is a one tube regenerative circuit which embodies some form of special connections for reflexing the AF on to the grid circuit Above, a two tube reflex circuit of the tuned impedance variety which uses a crystal detector. Notice the prevailing use of conductive coupling to the antenna.

I don't know whether you try to make all your apparatus. I do. If you have any stunt or bits of apparatus that I could make, I should be very pleased to have details.

I will now send you a few circuits and I hope you will be able to try them out, and let me know of the results.

I must close down now. I hope to receive a letter from you soon.

Yours truly,
Philip Signey Weggitt.

Please address P. S. Weggitt, 35 King's Rd., Bournemouth, Hants,. England.

As we go to press, we have another letter from an English radio bug which is highly interesting. We regret that it came too late to feature it with Mr. Weggitt's letter, but in next month's Pickups Pages will have this item in its contents. Mr. Weggitt's circuits are shown on various pages herewith and fans who desire more detail are invited to write him. Interesting, this radio game—isn't it?

A circuit from P. Edward Chapman of 805 Preston St. N., Philadelphia should be of interest, so we publish the following:

We have been flooded with letters concerning Mr. Chapman's "Selectdyne" and as a result we are publishing his communication, which will no doubt relieve many of the DTs interested in his circuit and the results.

RADIO AGE,

Gentlemen:

Having fallen victim to your good magazine, which I purchased in June for the first time, you may now count on me as one of your regular readers, for I certainly enjoy reading the technical information you offer your readers.

In reading the June issue, I was very much interested in the diagram of a circuit called the "Superdyne," submitted by M. C. Williams, which resembles very closely a circuit I evolved in 1923 and have been using successfully for eighteen months.

Having had such remarkable success with my circuit (which was published in one of the Philadelphia newspapers) I was overwhelmed with visitors and correspondence, and in order to relieve the situation, I had a few hundred blue prints of my circuit made and gave them away in an effort to help those who wished to build this type of receiver.

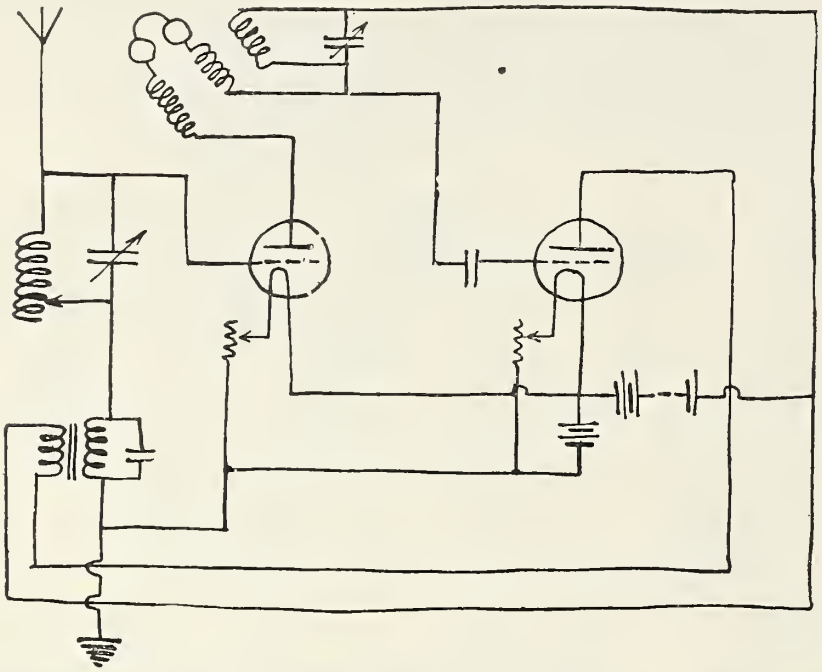
My circuit is extremely sharp in tuning, and gives wonderful volume from stations 2,000 miles away. I am enclosing herewith a copy of the circuit, which I call the "Selectdyne" which is the result of about three years' experimenting. Only the best material (Ed. Note: From an electrical standpoint and a mechanical aspect, of course) is recommended for maximum results. I am also enclosing a list of stations which I have received, in hopes that will entitle me to membership to the "Dial Twisters."

Using a loop with this circuit, I

have heard stations 500 miles away on the horn without using headphones.

I trust this circuit may prove of interest to you, and I want to thank you in advance for any interest you may show in the matter.

Yours very truly,
P. EDWARD CHAPMAN.
805 Preston St. N.,
Philadelphia, Pa.



Another type of reflex circuit which is very popular in England. Notice the queer arrangement of energy transfer between the plate circuit and grid circuit of the first tube.

Mr. Chapman's circuit is shown in an adjoining figure.

Box 363,
National City, Calif.

The Pickups Editor,
RADIO AGE
Dear Sir:

Upon reading the "Pickups" Department of RADIO AGE, I noticed that you made a request for information from readers who are owners of Super-Heterodyne receivers, so here goes

The second week of June, 1924, I purchased a Super-Heterodyne radio receiver which is a second harmonic regenoflex receiver, and since I read your request for information, I have kept a record of happenings.

Upkeep

I have taken upkeep first because it is one of the important factors to be considered. The six dry cell radio "A" batteries used will last from one to two hundred lighting hours. The length of life depends upon use and periods of rest. Let's take an example: The receiver being used on an average of two hours a day, will last from seven to eight weeks or even longer. The length of life of the B and C batteries I do not know, as I have not as yet had occasion to change the ones that came with the receiver.

Selectiveness

The receiver I have found to be very selective, reading from my log under the date of Agust 19, 1924, as follows—Heard music and announcements from KOB and KLX on loud speaker, although both were operating on 360 meters wavelenght. Time, 7:10-7:30, Pacific standard time. As to close tuning, any station may be tuned out by turning the selector pointers either way, 1-16 of an inch. I have been albe to separate the following stations so that they come in with no interference, although they are from five to ten meters apart in wavelength: WTAM, 390: KHI, 395; KFI, 769; WFAA, 476; and KFSG,

Although National City is in the static belt, as it is only twelve miles north of the Mexican border, I have succeeded in receiving KFON, Long Beach, KGO, Oakland; KPO San Francisco; and twice KGW, Portland, when broadcasting their afternoon programs. I have found by connecting a twenty to twenty-five foot length of No. 18 (B & S gauge) silk covered wire, stations at right angles to the small internal loop come in with sufficient volume to operate a loud speaker, in fact is little difference whether headphones or loud speaker is used. I always use loud speaker in logging new stations.

The following are the stations I have received at least twice on the loud speaker since Jun 15, 1924:

KDPT	San Diego, 8 miles
KFON	Long Beach, 100 miles
KFI, KHJ, KJS, KFSG, KNX	Los Angeles, 120 miles
KPO	San Francisco, 456 miles
KGO, KLX	Oakland, 470 miles
KOB	State College, N. M., 595 miles
KFPT	Salt Lake City, 625 miles
KGW	Portland, 935 miles
KFOA, KTW	Seattle, 1,080 miles
KFKX	Hastings, 1,155 miles
WFAA	Dallas, 1,165 miles
CFCN	Calgary, 1,265 miles

Headphones

WTAM	Cleveland, 2,000 miles

Five other stations have been logged, but I was unable to hear call letters because of static.

This list is very short, but I don't think it is so bad considering I am perched down here in the Southwest corner of little old U. S. A., and I hope it is good enough to land me among the "Dial Twisters" of RADIO AGE.

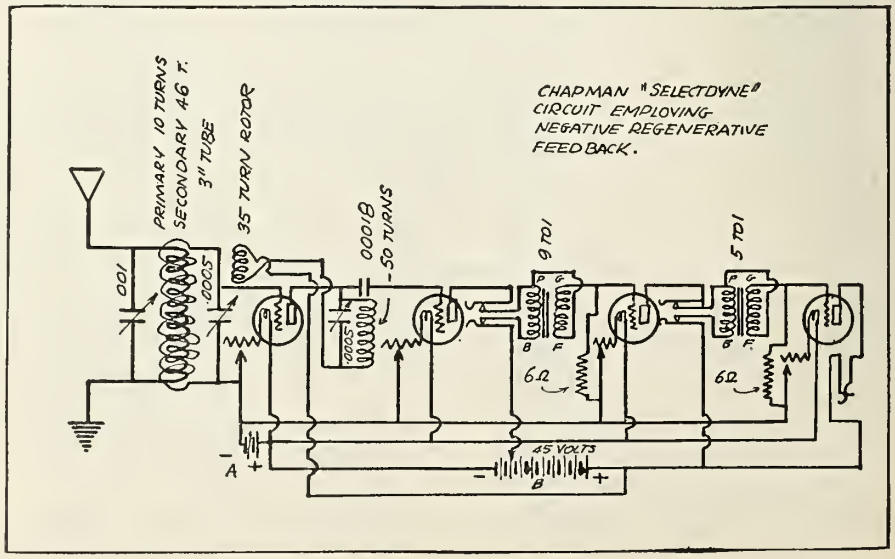
Yours truly,
Lloyd Stove.

Farwell Long, of Flint, Michigan is owner of a super-heterodyne, and he submits the following as the summary of his brief experience with a super-het. He feels that there are great possibilities in store for him.

RADIO AGE,
Gentlemen:

I have been reading the greatest little radio magazine commonly known as RADIO AGE every month.

(Turn to page 54)



Have noticed the absence (which is quite pronounced) of accounts of results with super-hets, neutrodynes and other multi-tube receivers, and believing that I can do a little share in contributing my experience, which is brief, I can help out somewhat in giving the rest of the bunch an idea as to what it really is to own and operate a big set.

I have an Ultradyne which is an improved Super-heterodyne, designed by R. E. Lacault. I am all wrapped up in it you might say, for my wife has to drag me away from it. It is only 3 months old, and has given me fair reception throughout the Summer, having received Texas in the early part of the Summer with good volume, though the static was bad. I have some poor parts in the set, but I am replacing them as fast as my finances will permit.

I am enclosing my list of stations heard more than twice over 400 miles. They are as follows:

Stations Heard by Farwell C. Long

WFAA, WBAP, WEAF, WGY, WLAG, WBZ, WRC, WOS, WHAA, WHB, WDAR, WHAZ, WDAF, KFKX, WOI, WMC, WTAT, WDAE, KFID, WHO, WCAP, WCAL, WDAP, WSAI, WLS, KDKA, WBM, WTAM, WHAS, KYW, WOC, WEAA, WCX, WCAE, WABM, WCAP, WWJ, WLW, WCAY, WEBH, a grand total of 16,774 miles.

Pretty good for the last three months considering the fact that the house is full of people who are content with the programs from WCX, WWJ, and KDKA. I hear these stations nearly every day when they are on the air. I do not expect to make the grade for the DT with this list but hope to soon as I am going to try for a record that makes your hair stand on end.

I have enjoyed reading the Dial Twisters' columns and couldn't resist the temptations to do my stuff. I think I have said enough so will sign off. I am not a subscriber, but you may expect my remittance any time, for there is no other radio magazine than RADIO AGE.

Very truly yours,
FARWELL C. LONG.
1122 Church St., Flint, Mich.

We suppose when Mr. Long really gets the hang of that Ultradyne of his, he'll tear out the broadcast list of RADIO AGE, and make the notation on the margin "Enclosed is a list of the stations I have heard. Omit the stations checked, and you have my log." Atta' boy, Mr. Long!

And now we're going to give you the belated report of the August Static Busting Contest. The biggest list came from John Mullikin, as follows:

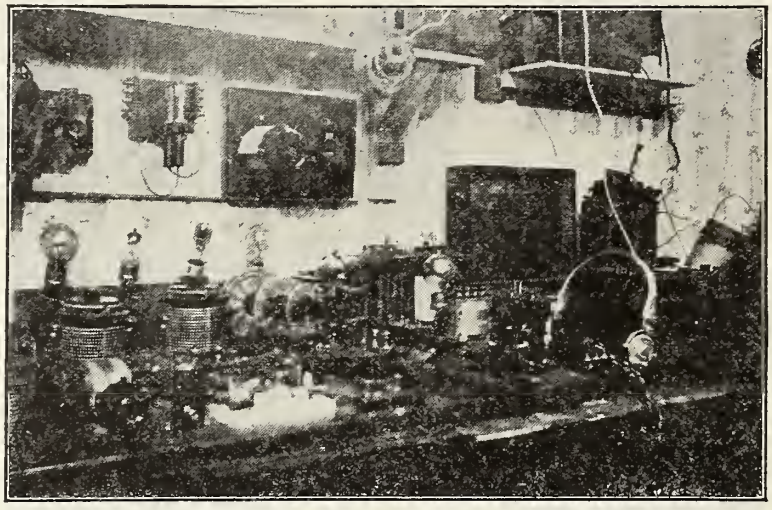
Pickups Editor,
RADIO AGE.

Below is my list for August. There are 121 stations in all.

KDKA, WCAE, KSD, CNRO, WHK, WGI, WFI, WRC, WTAS, WNAV, WEBJ, WJAX, WMH, WTAR, CKAC, WKAD, WSB, WHAZ, CHYC, PWX, WCBA, WGN, WHN, WTAM, WOO, WHAA, WJZ, WTAB, CHCB, WEAF, WAAM, WTAT, WMAQ, WCAO, CFCF, WSAI, WTAY, WWJ, WOQ, WIP, WJAR, WH, WDM, WEAI, WCAY, WQJ, WLS, WJAS, KOP, KYW, KFKX, KQV, WCAP, WABM, WDAF, WEAO, WOAW, WOR, WOS, WCX, WBZ, WBDR, WHAM, WHAS, WBBR, NAA, WCBD, WDAR, WEAN, WEBH, WGR, WGY, WHAR, WJY, WKAQ, WSBG, WABF, WNYC, WHAK, WFAW, WLAW, KLZ, WFBH, WBS, WRW, WDBH, KENF, 6KW, 3ALX, IAAE, 3XAV, 3SB, 3CAB, SAKV, 3LX, 3AHF, 3RS, 3CIR, 3BE, 3BFE, 3CEL, 3LAB, 1OM, 2AIG, 8BVZ, 8AMG, 8DRT, 3AR, 2WH, 2CV, 9BQT, 9AM, CJSC.

I heard Havana four times. My set can tune to low and high wave lengths. I picked up an average of 3 amateur stations a day but lost many of them.

Yours very truly,
John Mullikin,
128 Bates St. N. W., Washington, D. C.



A photograph of the laboratory and circuit testing bench of one of our English Dial Twisters. The photo seems to indicate that the Englishmen are pretty well equipped with respect to facilities for testing circuits.

SECOND PRIZE LETTER AND LIST

RADIO AGE,
Gentlemen:

In the August issue of RADIO AGE you stated that there would be a "Static Puncturing Contest" and for everybody to send in their list of stations for August. Below are the stations I have logged since August 1, 1924 to September 1, 1924. In all there are eighty-four radiophone stations, one airplane, one army station, two ships, and thirty-four amateur stations. I used a Westinghouse RC set, a 90 ft. aerial 26 feet high, and heard a great many of the stations on my loud speaker.

Yours very truly,
WM. A. NEELD.
238 N. Galloway, Zenia, Ohio.

KGO, PWX, CNRO, KDKA, KFKX, WHB; WHK, WIP, WJAX, WJZ, WLS, WJAS, KSD, KYW, WBAV, WHAZ, WHAS, WGY, WGN, WGR, WEAN, WFAA, WDBS, WEAF, WCX, WDAF, WCBD, WCAP, WBZ, WCAe, WMAQ, WNAC, WMC, WWJ, WTAM, WTAS, WRC, WSB, WQJ, WOS, KFKD, WBR, WRK, WBAA, WABN, WHN, WABX, WNYC, WTAB, WOO WOC, WOAW, WOR, KFKN, KFGZ, WSAI, WMH, WLW, WOQ, WEAO, WABP, WTAY, KOP, WMAN, KQV, WBT, CYL, WEBH, WSAY, WMAF, WJAR, WGI, WCK, CNRT, WOI, WJY, WAAM, KFIX, SE5, KDBZ, WEA, AW5. The amateurs are as follows: 8alk, 8awn, 8wl, wml, 8cuo, 8dbg, d8nk, 8alk, 8bng, 8dnb, 8bna, 8dla, 8dor, 8gw, 8cdz, 8cnd, 8of, 8cvv, 8dmr, 8cag, 8zag, 8dc, 8cnl, 8bml, 8boe, 8qh, 8bd, 8bnw, 8dem, 9wc, 8dbj, 9eia, 8ef.

Mr. Neeld explains that the amateurs are not phone stations—he heard them in code. He says he is not a transmitting "ham," but is a BCL who has learned the code, and has much fun copying. His list contains close to 125 stations, and certainly deserves a prize. We like that code work, since we know the terrible interference which exists down to 200 meters, and also the fact that copying a weak ham signal with static pounding in is a real accomplishment. More power to you Mr. Neeld, and may your signals never fade.

Mr. Neeld hadn't seen our magazine before the August issue, and therefore was quite surprised when he found just as others have found that it was a *real* book. It may be of interest to print the following letter from him, received just before his entry into the static puncturing contest, since it tells a little about past records, and also some of his other accomplishments.

RADIO AGE,
Gentlemen:

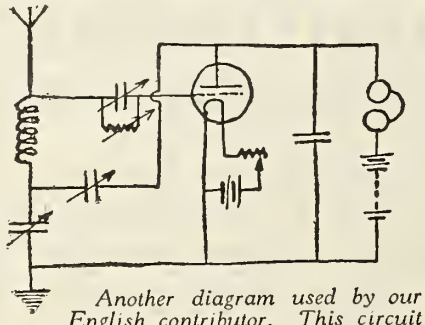
I bought a copy of RADIO AGE this afternoon at the newsstand and say—it sure is some radio magazine. I was greatly interested in the Dial Twister's Club.

Here is the record of my Westinghouse RC Set. I have heard 700 stations; 450 radiophone stations; 250 amateur stations, since May 1, 1924. I have heard KFHS, Lihue, Hawaii, PWX, Havana, WKAQ, San Juan and CYL and CYB of Mexico City besides hearing all the states except Montana, New Hampshire and Vermont. I have also heard every amateur district and four provinces in Canada.

I heard 53 stations one night from 7 to 12 p. m. with a total of 43,000 miles.

I have acknowledgments from over two-thirds of the stations I have heard.

(Turn to page 71)



Another diagram used by our English contributor. This circuit is a form of Ultra-Audion with a capacitative feedback control.

New York Radio Fair Shows Stability

By Frederick Smith

What are the big surprises in radio development, as shown in the exhibits of manufacturers in New York from September 24 to 28?

That is a question which was in the minds of scores of thousands of radio fans who paid their way into Madison Square Garden to see the Radio World's Fair.

It is the same question that is being asked all over the radio world by those who were not privileged to see the displays of equipment at the eastern show.

There are two answers to the question. One big surprise to those who had thought that radio interest had reached its peak was the vastly increased number of those who want radio sets. The show in New York broke all previous records for attendance.

It is confidently predicted that the Chicago show, which opens in the Coliseum on November 14, will shatter the New York mark.

Another outstanding radio development is the uniform increase in quality of sets and accessories. The most casual observer in Madison Square Garden did not fail to carry away the impression that persistent and effective efforts have been made to bring the excellence of transmission and recepton to the highest point possible.

Industry Is Elevated

In seeking the best tone quality, the greatest durability of mechanism, the lowest percentage of required technical knowledge for the operator and a finished appearance of the whole apparatus, the manufacturers have added immensely to the atmosphere of radio stability.

There were no circus stunts in the big radio fair. It is true that both eastern and western manufacturers displayed receivers which, for selectivity and easy operation, are surprisingly far ahead of the sets in use last year.

There were sets with single control, sets that tune out the most stubborn interference with but a turn of a few degrees on the dial. There are sets that may be hooked up to the electric light sockets, portable sets, sets that rest elegantly in polished hard wood consoles and sets that hide conveniently away in talking machines and ride about on what used to be dinner wagons.

Sales to Increase

All of this has nothing in it that should discourage fans. On the contrary it should be encouraging to fans and manufacturers alike. It tends to show that, instead of revolutionary changes, indicating that radio conditions have been chaotic, there is only solid improvement. The old circuits are still our best friends. The most forward-looking manufacturers and engineers simply have brought them to a greater excellence.

You need not wait to buy a receiver, in the fear that if you buy now some inventor will put something on the market that will make your old set seem obsolete. Vast sums in the hands of radio buyers have been held back waiting to see whether it was not "too early to buy."

At the Waldorf Astoria banquet several distinguished engineers addressed the radio trade representatives. Their themes concerned improvement in receiving sets and improvement in broadcasting. They offered nothing radical, nothing revolutionary.

The answer of the New York radio show could be given in one word, "stability." Better financing, better engineering, vastly better results, now benefit the individual who listens in.

Chicago Show in November

The eyes of the radio world will be focused on Chicago from November 18 to 23, when the Chicago Radio Show will open at the Coliseum. Radio fans from all over the Middle West have announced their intention of being "among those present"when the doors are thrown open to those who are eager to see the advances made in radio manufacturing during the past year by local, Eastern and foreign factories.

One of the big features of the New York show will be repeated in Chicago; namely, two contests for amateur builders of receiving sets. Prizes ranging from cash awards to radio sets and parts will be given the lucky winners.

New Inventions There

Displays of new inventions from radio amateurs, experts and other experimenters will be another feature. All entrants in the various contests must submit their apparatus on November 16, at the Coliseum, in order to be declared eligible.

Although the New York Radio World's Fair attracted nearly 20,000 visitors daily, manufacturers and others connected with the Chicago Show declare it will far surpass the Manhattan exhibition, due to the constantly growing interest in radiophone reception in Chicago and vicinity during the past eight months. Accordingly, capacity crowds are expected daily.

(A picture of one of the prize exhibits at the New York Show will be found on page 37, this issue.)

New Crosley Station 25 Miles From Cincinnati

Cincinnati, O.: Radio engineers and surveyors selected Harrison, Ohio, as the ideal place for the new powerful radio broadcasting station of The Crosley Radio Corporation.

Locating the powerful new five-kilowatt WLW broadcasting station 25 miles from the new studios in Cincinnati and away from thickly populated districts will not interfere with the majority of radio fans. Population distribution maps were prepared before the final selection was made for the station. Radio fans will find tuning to the powerful equipment at Harrison extremely sharp as a result of using the very latest apparatus developed for radio broadcasting.

"Brass Pounding" Along the Coast

(*Continued from page* 31)

"keep to the left" rule. Jamaica is always verdant, in contrast to countries farther south which often get brown and barren during the dry season. The Jamaican station was "JCA" and had a funny foreign set with only about three parts to the sending outfit. It used a very low voltage at the spark gap—they told me only 600. I know there was no step-up transformer and only a 600-volt direct current dynamo. I also know they had the deuce's own time making the blighter jump in rainy weather, but when it finally would get across the gap of .009 inch it was good for two or three hundred miles day time. The "ops" were extremely English and very skeptical. They point blank refused to believe accounts of my distance work and as they never listened after six p. m. they had no idea what really was done.

Two of our special trips took us to Panama and I met up with the string of United Fruit stations that keep that company in touch with their large fleet of ships as well as handle much traffic for the U. S. that would otherwise bear heavy cable tolls. Theirs was a formidable fleet. At Bocas del Toro I spent some time with Smith, "op" from "B," who regaled me with many a comical tale of life in the tropics. One of these stories I remember vividly. He said that one morning as he started calling Limon, "X," there was a terrific commotion back of the jar rack, sounding like the setting off of a bunch of large firecrackers combined with the release of a giant clock spring. Startled, he stopped sending, then as quiet reigned he doubted his senses and pressed the key again. Immediately came another loud clatter and like shots from a gun a pair of good-sized monkeys sprang at and past him and through the window, screen and all. 20,000 volts had pepped up the animals considerably and they made wild time back to their habitat, the jungle, close by. I would not vouch for the gospel truth of this yarn, but it is no wilder a tale than I have lived through many a time in person, as I will relate in the course of my later accounts.

While on the "UG" I tried out the famous "break key" originated, or at least introduced to us, by Opr. "PK," Pickerell, of "WA" (Waldorf-Astoria) fame. This consisted of placing your receiving set permanently in the aerial and ground, shunting same out by a "lightning arrester" with about one square inch of sparking surface. Contacts on the key also cut out or shunted

your detector. "WA" and "BS," Philly, worked this fine and one dash from "BS" would be heard at "WA" instantly, and he would stop to see what was wanted. This might have been OK at a nice dry land station, but the first time I pressed the key on the "UG" I got a jolt through the head set that sent me clear across the room. I found that the receiving set was altogether too much connected to the business end of the transmitter and the only way I could handle it at all was to crouch high on the chair, absolutely clear of floor, table and everything else and reach over carefully to tap the key. At that, I was full of shocks at every dot and I gave it up. Probably "PK," who, I read, is Chief on the Leviathan will drop me a line and tell me where I had the thing hooked up wrong.

A Change in Ships

MY transfer to the "Admiral Farragut" put a sad crimp in my wireless activities. The set was a Shoemaker, finely built and containing many innovations, but the ship's dynamos were in bad shape and every time I would start my motor the ship would be plunged into darkness until an engineer would rush over and give 'er more steam.

Divorced from my first love, I awoke to another interesting phase of this sea existence—that of the social possibilities present in contact with people from all the world. However, another barrier presented itself in the ideas of friend Captain on the subject of wireless operators and ship society, said ideas running anti-clockwise to my own. This stirred up considerable unrest in my soul and I began agitating with H. J. H. for a transfer to some New York ship where there was social life worth mentioning and a captain to match.

On my last fateful trip on the "Farragut" I left port in a wrathy state of mind. Up to the last minute I had fondly hoped for a transfer, and none coming I perpetrated some mental malpractice on the poor old "Farragut" by wishing that she would slam into something and have to go back. Of course, I was only thinking of some minor smash in the river and little did I know how vigorously my evil wish was to be granted. At 12:20 Friday morning we loosened a bit of inferno on the waters by crashing full speed into the passenger-laden "Merida," who had slipped up on us in a fog bank some hundred wet miles from shore. Climbing out of the debris of my aerial, I joined the ship's officers in fighting fifty crazed Spanish firemen away from the lifeboats—but Ye Editor says I am to tell you about that next month.

Who's Who in Radio

World War Experience Aids Rauland

Some of the most successful men in the radio business today owe their good fortune in large measure to experience, both executive and technical, acquired as officers in the Signal Corps of the U. S. Army during the World War. Conspicuous among these is E. N. Rauland, president of the Rauland Manufacturing Company of Chicago.

Although Mr. Rauland has been an active worker in the radio field for the past fifteen years, it was during active service overseas with the famous 82nd "All-American" Division that he first visualized the enormous service which radio telephony might perform when the war was over.

E. N. Rauland

With the benefit of his long experience in charge of the entire coil winding department for one of the oldest manufacturers of insulated wire and coils of all descriptions, Mr. Rauland went into business in a small way in 1919 making transformers for radio use. He adopted as his trade name the name of the division with which he had served, and it was but a few months until All-American Transformers were in use all over the world. Statistics compiled from the record of business done, by the larger distributors now prove that All-Americans are in very truth the largest selling transformers in the world.

"The greatest need in radio at the present time," said Mr. Rauland recently, "is that of standardized radio sets of the highest quality, which do not 'bloop' and which can be had at a low price. The only way that quality sets can thus be sold is by leaving the hand work of wiring and soldering up the set to the purchaser himself—a task which is pleasure for him but expensive if done in a factory. The complete sets we are putting out this year are aimed exactly to supply this demand, since they come with the parts completely assembled and mounted, and nothing to be done but to connect the proper points by wires.

"Although we are just now getting into production on them, it looks from the orders already coming into us as though the All-American complete receivers will be sold out even beyond our best production capacity for several months to come."

Watch for the story of your favorite Radio Star in RADIO AGE.

Fighting "The Invisible Menace"

(Continued from page 28)

"Now, come with me; we'll see the rest of the fun," he whispered to Ruth. Then to Mr. Wellman he said: "We're going to see that that raid on that rascal's headquarters is handled properly."

THEY drove away together to the police station. At midnight they were parked in a dark, obscure position, from which they were able to see the "death ray" house—an old, two-story brick structure in a short street, two blocks from a business thoroughfare. With them were two plain clothes men and the owner of the house under suspicion.

They waited half an hour. Ruth discovered the first sign of something doing. It was a moonless, star-lit night.

"There's a light moving up there—see it?" the girl said, pointing upward to the west.

"Yes, that's it," Sid declared after a few moments' gazing in the direction indicated.

Five minutes later the "moving star," hovered over the "death ray" house; then it settled down onto the flat roof.

"Now is our time," said Sid.

Aided by the owner, they entered the house, with scarcely a noise to alarm the occupants. The only light in the building was in the upper story. Sid kept Ruth at the foot of the stairs while the two policemen ascended. There was not a suggestion of alarm in her manner. In fact, she indicated a desire to ascend with the policemen, but Sid forbade this.

Nothing was heard from the officers for about five minutes.

Then a voice called down to them: "Come on up."

A Radio Paradise

Sid and Ruth ascended. They entered a large room, a bewildering elaborate radio laboratory, with an array of massive transmitting coils, a large transmitting loop antenna, radio compass, and a mysterious looking transmitting set with an unusual type of tube. In the midst of these stood the policemen and their prisoner, and on a table near them was the miniature dirigible and the dummy package.

"He went up on the roof by an outside stairway and got this balloon and was opening this package when we stepped in on him," one of the officers explained.

But Sid was scarce listening to this detail. He was gazing at the prisoner, and the prisoner was gazing sullenly at him.

"Lawrence Vickers, slayer of Hugh Dodge," the former A. E. F. aviator exclaimed. "So you're the death ray blackmailer!"

But Vickers did not answer. Silently he accompanied one of the policemen to the station, while the other took

charge of the radio room to preserve its integrity as criminal evidence.

* * * * * * * * * * * *

Need we say much more? It developed that Vickers had learned the secret of the "death ray" from the Germans while with the army of occupation following the war, and that the man servant in the Wellman household, as co-conspirator with Vickers, had "planted" the two charges which were exploded in the garden and in the bird house and the one discovered in a post of the rich man's bedstead.

Vickers had so perfected the "death ray" that by placing pre-arranged relays at definite places, he could concentrate the rays of high frequency electricity with such force as to destroy the insulation of the windings of electromagnets.

The charge of melnite which had been placed by the man-servant in the Wellman bird house had been detonated by the closing of an electric relay. The windings of the relay, having been subjected to the terrific strain of the current focused upon it by Vickers at his apparatus, had short-circuited, and the circuit to explode the charge so closed. Since minute quantities of power supplied by a small battery kept the relay open, the explosion could take place at any time he saw fit to focus the power of the death-ray upon it. the relay to burnit out. As Vickers later explained, he had sufficient power to cause the atoms of the body of a human being to move so quickly as to cause so rapid disintegration that the body subjected would charr with a noise very much like an explosion. He felt that the melnite explosion would convey a greater display of fire and noise, and as he explained, used it to avail himself of the psychological effect which a large explosion of a powerful agent would produce.

When Sid was asked as to how the dirigible was controlled while it was in the air, he explained:

"That was simple enough, once he had the secret of the death ray. Vickers knew that nothing would interfere with the direction of the balloon if he used a frequency high enough to keep interference away. By the simple expedient of using one frequency to start the propelling mechanism, and various other frequencies to raise or lower it, to direct it either rignt or left or even destroy it, he could control it with the greatest ease. The searchlight on the prow of the ship gave him his bearings after the dirigible came into his vision. After he was sure of its position, it was a simple matter to turn the light off and on at will.

"He felt himself quite safe in directing the dirigible by ultra-radio frequency, since he knew that no one had as yet invented a tuner capable of measuring frequencies that high."

And as for Sid and Ruth, the former had well earned a substantial salvage commission on the $100,000 demanded from his prospective grandfather-in-law, who insisted on paying the commission on an admiralty court basis and, in addition, withdrew his objection to the young man as a grandson-in-law.

Hoover Defends Local Stations

Excerpts from his talk before the National Radio Conference

IT IS a pleasure to me to open the Third Annual Radio Conference at the Department of Commerce and to welcome you to its sessions.

Radio has passed from the field of an adventure to that of a public utility. Nor among the utilities is there one whose activities may yet come more closely to the life of each and every one of our citizens, nor which holds out greater possibilities of future influence, nor which is of more potential public concern. It must now be considered as a great agency of public service, and it is from that viewpoint that I hope the difficult problems coming before this conference will be discussed and solved.

At the first radio conference I hazarded some modest anticipations as to its development and use. Some thought them visionary; yet we passed every point of these anticipations within eighteen months. We have, in fact established an entirely new communication system, national in scope.

In the whole history of scientific discovery there has never been a translation into popular use so rapid as in radio telephony. So late as the year before I became Secretary of Commerce there were no broadcasting stations. At the end of four years 530 are in operation, making radio available to every home in the country. The sales of radio apparatus have increased from a million dollars a year to a million dollars a day. It is estimated that over 200,000 men are now employed in the industry, and the radio audience probably exceeds 20 millions of people.

No Time to Relax

We may well be proud of this wonderful development, but in our self-congratulation let us not forget that the value of this great system does not lie primarily in its extent or even in its efficiency. Its worth depends on the use that is made of it. It is not the ability to transmit but the character of what is transmitted that really counts. Our telephone and telegraph systems are valuable only insofar as the messages sent from them contribute to the business and social intercourse of our people. For the first time in human history we have available to us the ability to communicate simultaneously with millions of our fellowmen; to furnish entertainment, instruction, widening vission of national problems and national events. An obligation rests upon us to see that it is devoted to real service and to develop the material that is transmitted into that which is really worth while. For it is only by this that the mission of this latest blessing of science to humanity may be rightfully fulfilled.

I have been convinced that development could only be accomplished by organized co-operation of the industry itself; and the industry is unique in that unless it has stringent rules of conduct to which all elements adhere, it will die of its own confusion.

At each succeeding conference we have had more difficult problems to solve, and those which we present today are of a complexity greater than ever before. In a large sense the purpose of this conference is to enable the listeners, the broadcasters, the manufacturers and the marine and other services to agree among themselves as to the manner in which radio activities are to be conducted.

Radio an Experiment

LIKE the two previous occasions, this may be called an experiment in industrial self-government. Radio activities, so long as they remain within the legislative restriction which holds for the government the fundamental control of the ether, are largely free. The industry's future conduct with a single view to public interest, a voluntary imposition of its own rules and a high sense of service, would go far to make further new legislative or administrative intervention unnecessary. The two past conferences have been successful in these purposes. With only slight modifications, made necessary by changing conditions, the Department has been able to follow their recommendations in the performance of its duties. The industry has supported and conformed to these recommendations cheerfully and uncomplainingly, although at some self-sacrifice. I congratulate you on this spirit, and know that you will enter upon your new deliberations in the same attitude.

When broadcasting first started, the phonograph was a sufficient attraction to the radio telephone listeners, who were swayed chiefly by curiosity and marvel at the new discovery. Public interest has long since passed this stage. The radio telephone would now die in 24 hours if it were limited to transmission of phonograph records. We have made great improvements in material transmitted.

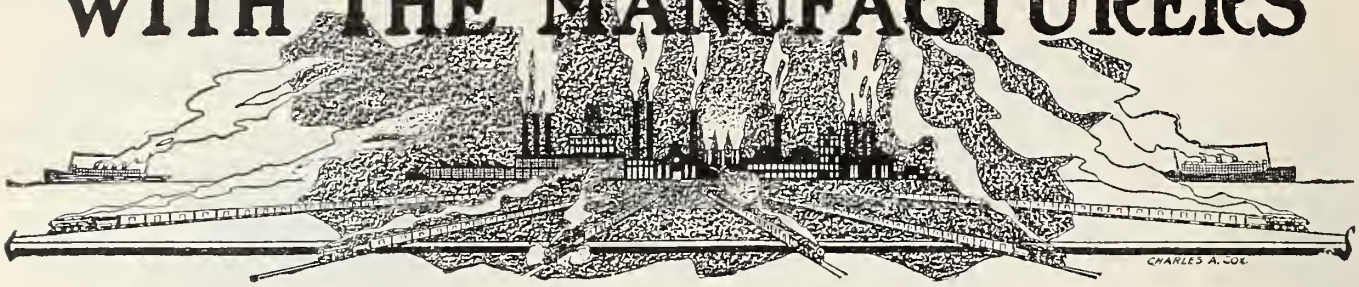
Original music, speeches, instruction, religion, political exhortation, all travel regularly by radio today. Program directing has become one of the skilled professions. I have indeed a great feeling for the troubles of the director in his efforts to find talent and to give to his audience the best that lies at his command.

But we require a still further advance in the character of material beyond the capacity of local station directors if the art is to emerge entirely from the curio and entertainment stage to that of fundamental service.

Experimental broadcasting upon a national scale during the past year has now brought us to the stage where we know it can be done. The local material available for the local program is not in my view enough to maintain assured

(*Turn to page 67*)

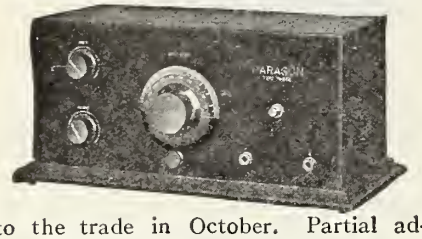
WITH THE MANUFACTURERS



New Paragon Line

Alfred P. Morgan, President of the Adams-Morgan Company, Inc., of Upper Montclair, N. J. announces:—

"A new line of Paragon Receiving Sets—new in looks, new in their simple control, new in *price*—will be offered



to the trade in October. Partial advance information is now ready."

A radical departure has been made from former designs, especially in simplicity of control and lowness of price.

The new models retain the quality of tone, selectivity and sensitivity for which Paragon has enjoyed a world wide reputation for more than ten years. The highest grade of material and workmanship is employed throughout the line, but because of large production, extreme simplicity in design and construction—a major dial control—they will retail at popular prices.

Paragon "Two"—a two tube set—with major dial control—capable of giving loudspeaker volume from stations within a moderate range or coast to coast range for head phone operation.

Paragon "Three"—a three tube set of exceptional sensitiveness, unmatched loudspeaker tone and volume—major dial control.

Paragon "Four"—a four tube set with single major dial control—capable of giving loudspeaker reception over an almost unlimited range.

A Real Low Loss Inductance

One of the most outstanding developments in tuners and radio frequency transformers for this season has been brought to our attention in the Henninger Aero-Coil.

This self supporting coil, though quite rigid, is wound on a light skeleton frame, the amount of insulating material in the field of the windings having been cut down to 5 per cent of similar coils wound on tubing, yet no dope is used on the windings.

The result is a tuner and radio frequency transformer with incomparable selectivity and great increase of volume over any inductance wound on tubing.

Coast Wholesalers Open

The Coast Radio Supply Company, San Francisco, California, organized by Henry E. Lapkin, formerly of the National Carbon Company, and Harry L. Auger formerly of McCoy Motor Supply Company, have opened their new quar er at 648 Howard Street with a complete stock of Radio receiving sets, accessories and parts.

This company will wholesale only. Both Mr. Lapkin and Mr. Auger are well known to the trade. Mr. Lapkin has just returned from the East with some of the newest sets and parts in Radio.

New Solder On Market

Kester's Radio Rosin Core Solder nas just been placed on the market by the Chicago Solder Company, of Chicago.

The solder is especially made for radio work and will not cause dangerous fumes, nor will it spatter. It is a hollow ribbon of genuine tin and lead, having inside a pure rosin flux. This flux is in proportion to the surroundnig solder and feeds out as the solder is used.

The attractive box shown above is furnished to dealers.

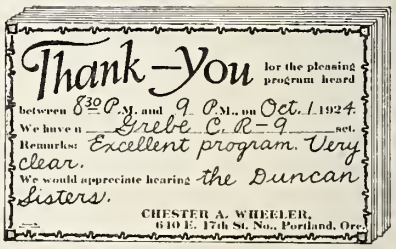
A Broadcasting "Album"

Here's something new! The Ekko Broadcasting station stamp album, made by the Ekko Company, 111 W. Monroe St., Chicago, contains 96 pages with spaces for the stamps of all recognized radio stations in the United States and Canada, arranged alphabetically by states and call letters. Ekko stamps prove reception of each station, and their collection has created a new form of radio amusement. With the album come "Proof of Reception" Cards. The cards are sent to the stations, who in return send the listener their Ekko stamp, which is placed in the album for definite reference.

The "Thank You" Card

"The "Thank You" card, frequently called applause card, has become a nation wide fad—in fact it is all the rage.

The very latest is a special INDIVIDUAL "Thank You" card made by Radio Printers, Mendota, Illinois. On each card is printed the name and address of the sender.



These cards show the day and hour the message was received. The kind of instrument used is also given. There is a large space for remarks as to the weather, the program or anything else. Possibly the most interesting feature is the space for a request of talent or special numbers the sender of the card would like to hear. The fact that the cards contain the printed name and address of the sender shows that he or she is very much interested in radio and such cards should be more appreciated and receive special attention by the radio stations.

Stations really appreciate these cards and so do the musicians and speakers, just as the entertainer does when his audience applauds. Many stations read the cards and names of senders over their microphone. You can listen for your own cards.

Automatic Filament Control

In various multitube and larger receivers which have numerous dials one finds that the nuisance of having to continually regulate the filament current of the less important tubes is often very great. Even in small three tube sets, the business of having to turn on a separate dial or control to adjust the filament of the amplifiers is needless.

The Radiall Company, of New York City, N. Y. well known electrical engineers have perfected an automatic resistance unit that takes care of the filament current automatically. They have justly labeled this unit the "Self Adjusting" rheostat, since once the little device is installed no further attnetion is necessary. Like any other control cartridge, this unit is so designed that it fits in a set of clips.

The device is made in various sizes to suit varying conditions and is inexpensive. It is especially adaptable to larger sets, where space is at premium, since it requires no control on the panel. One "Amperite" as they are called is capable of controling the filament current of several tubes at one time.

Heard of the "Balcon"?

The Pacent Electric Company, Inc., of New York, have recently developed and placed on the market a new balancing condenser. This new condenser, known as the Balcon, is especially designed for use with Tuned Radio Frequency circuits or any other circuit where a capacity balance is desired.

The Balcon consists of two nickel-plated electrodes, their ends being 3-16 inches apart and enclosed in a 1-4 inch glass tube. Around the outside a piece of split brass tubing three-fourths inches long is fitted so that it may be moved from one end of the glass tube to the other. This forms a condenser of very low capacity, the glass tube forming the dielectric. The maximum capacity is obtained when the center of the brass tube coincides with the center of the space between the electrodes. The metal parts are nickel plated and are mounted on a small Radion base.

Why Neutrodynes Are Popular

"The popularity of the neutrodyne radio receiver," said R. E. Thompson, President of R. E. Thompson Mfg. Co., "from the standpoint of the radio public is primarily due to three things. The elimination of reradiation, the simplicity of operation and the securing of maximum possible effect out of each tube are the outstanding reasons for the general acceptance of this type of receiver.

"What technicians call the feathery quality is absent in the neutrodyne when properly constructed, giving clearness of reception. By simplicity of operation I refer to the ability of the neutrodyne to be easily handled by anyone without skill or experience in radio. The reason is that once you have found a station and noted the dial positions, that same station can be found at the same dial settings any time thereafter. This is most important for the army of radio users not experts in playing around with this more or less new art. And lastly, it is human nature to want to get the maximum possible effect and this is surely permitted by the neutrodyne."

New Manhattan Line

New Manhattan Radio Products prepared for fall distribution include six new items, making a fairly rounded out and complete line of parts.

The new items include the Manhattan Junior Loud Speaker, the line of Red Seal Variable Condensers, the Manhattan 180° Vario-coupler, the Red Seal Collapsible Loop Aerial, and the Red Seal "Map-Loop," in addition to which the Manhattan Loud Speaker has been re-designed and furnished with a new horn of increased efficiency and size.

We particularly call to your attention the new Manhattan Junior Loud Speaker as being a reproducing unit especially designed for Loud Speaker work, having the now famous Manhattan Concert Modulator selling at $10.00.

BUYERS' AND SELLERS' SERVICE SHEETS

"A" BATTERIES No. 5-A-24

1. **Type.** Economy of operation:—The battery is the one thing about a radio set that wears out even when not in use. The first consideration which arises in connection with the choice of the "A" Battery is whether it should be a storage battery or a group of dry cells. The principal factor which governs this choice is the operating cost of the receiving set with either type of battery.

In the case of receiving sets employing so-called "dry-cell tubes," such as WD-11, C-11, WD-12, UV-199, C-299, or DV-3, it is always more economical as well as more convenient to use dry cells as the filament current. because these tubes take only a fraction of one ampere each.

Any receiving set which contains a UV-200 tube which draws one ampere can be served more economically from a storage battery.

The UV-201-A tube is on the border line between dry cell and storage battery operation, and choice of the battery is determined by the number of tubes in the set. Sets containing up to three UV-201-A tubes fotencan be operated more economically from dry cells than from the storage battery, but where the set contains three or more, 201-A tubes, a storage battery becomes the more economical.

Quality of reception:—The rechargeability of storage batteries not only makes them the economical source of power for the multi-tube set, but recommends them for use with UV 201-A tubes already referred to, since storage batteries yield continued clarity of reception due to steady voltage. Of course, the current from a storage battery will not give any better reception than the same current from a dry battery, but the storage battery gives full voltage to your tubes as long as kept charged, assuring uniform reception.

2. **Storage A-Batteries.** Design:—Storage batteries for filament work are almost invariably 6-volt batteries of various ampere-hour capacity ratings. In general, any 6-volt storage battery can be made to serve as an "A" Battery, but special radio storage batteries have been developed which not only give better radio service but have better appearance, and therefore are better suited for use in the home. It is well to choose the type of storage battery which has been developed especially for radio use in the home because the better grade of radio storage "A" batteries are so designed that they can be placed on hard-wood floors without marring the finish, and are provided with specially constructed vent caps which prevent the spilling of acid onto furniture or rugs if the battery should be carelessly handled.

Insulation:—Insulation is of utmost importance in radio apparatus. It is equally important in a storage battery and considerable attention should be given to the kind of insulation or separators used when buying a radio battery. Wood is one of the oldest and most satisfactory materials used for this purpose because it is porous enough to permit the necessary action between positive and negative plates, yet will not permit the plates to come together. A soft wood, however, while porous, is soon eaten through by the acid, resulting first in poor reception, and then in failure altogether. A hard wood, while not as porous as a soft wood, when cut as spearators are usually cut, makes the ideal wood separator if quarter sawed; that is, cut so that there is an alternate layer of hard and soft material over the whole face of the separator.

3. **Container and Charge Indicators:**—A battery in a glass container, especially one with a hydrometer or charge-indicator enclosed in one cell, has many advantages. With such a battery it is easy to see when it needs water and when it needs charging.

It is an ideal practice to use a double-pole, double-throw switch connected so the battery can be switched to the radio set or to the charger. This makes it imposible to connect the battery to the radio set and charge at the same time which would very likely burn out tubes.

COMPILED BY
EDMUND H. EITEL

NO. 5-A-24

BUYERS' AND SELLERS' SERVICE SHEETS

"A" BATTERIES—"DRY-CELL" TYPE. No. 6-A-24

1. **Difficulty of Determining Quality.** Dry batteries are very much like eggs, in that the only test of the quality is to use them. In trying to list the points a battery user should have in mind in buying batteries, I feel little more confidence in its usefulness than I would have in a set of directions telling a bride how to pick fresh eggs without shaking or candling them. Like egg a battery deteriorates in time whether it is used ot not. If batteries could be candled, it would be a simple matter to select the good from the bad, but among batteries there is no test which will show whethera battery has run out one-fourth or one half its apacity.

2. **Special A Batteries.** Buy the special radio A batteries, not ignition or general service dry cells. The radio "A" cells are adjusted to furnish a maximum of energy above one volt, whereas the general service cell is adjusted for a voltage spread beween 1.5 and 0.75 volts.

3. **Brand.** Buy from a reputable concern which guarantees its products against mechanical or electrical defects. Such goods are bound to be more uniform, and of better quality due to rapid turn-over.

Each battery is, or should be, stamped with the date on which it was made or when the makers guarntee expires. Charge the battery having the latest date-

4. **Voltage.** The voltage shown on a high grade volt meter should be not less than 1.5 volts per cell. Do not allow a dealer to sell you dry cell radio "A" batteries on the so called flash test;. i e. the number of amperes shown by short circuiting the battery through an ammeter. Most specialy built radio. "A" batteries will show lower than a general service cell on this test, yet the special radio "A" cell will outlast two general service cells as an "A" battery.

5. **Amperage.** This is no indication of the quality, but among a group of cells of satisfactory voltage and of the same grade, the high-amperage battery will probably give better average service.

6. **Connection.** The connections of terminals must be such that good contacts can be made with the heavy leads of the "A" circuit.

7. **Battery Seal.** The battery seal should not be bulged, cracked or wet.

8. **Assembled Batteries.** If not competent to wire single batteries in series and parallel groups, buy the assembled battery for the particular tube in question, thereby avoiding short circuit batteries.

COMPILED BY
EDMUND H. EITEL

No. 6-A-24

Hoover Defends Radio

(*Continued from page 63*)

interest, and therefore the industry, or to adequately fulfill the broadcasting mission. So far as the art has developed, I think we all agree that for accuracy and regularity of reception we can depend only upon the local broadcasting stations. My proposition is that the local stations must be able to deliver every important national event with regularity. The local station must be able to bring to its listeners the greatest music and entertainment of the nation, but far beyond this it must be able to deliver important pronouncements of public men; it must bring instantly to our people a hundred dred and one matters of national interest. To this it must add its matters of local interest. This can only be accomplished by regularly organized interconnection on a national basis with nationally organized and directed programs for some part of the day in supplement to more local material.

Interconnection Realized

IT MAY be stated with assurance that the greatest advance in radio since our last conference is the complete demonstration of the feasibility of interconnection. We owe a debt of gratitude to those who have glazed the way. **The pioneers have been the American Telephone X Telegraph Company in wire interconnection, and the Westinghouse Electric X Manufacturing Company in radio interconnection through the use of short wave lengths.** Their experiments have involved technical skill of the highest character, which could be found or contributed by few other organizations in the world. Their expenditures, running into the hundreds of thousands of dollars, have been made without direct consequential return. It has been possible to broadcast many national events over three-quarters of the United State during the past year, and the whole country has been covered twice.

It is our duty to consider the possibilities and potentialities of interconnection as a regular daily routine of the nation. Unless it be systematically organized, we cannot expect its continuation. I realize that this matter, except insofar as it may be fostered and encouraged, does not lie in the Government. It would be unfortunate indeed if such an important function as the distribution of informatic should ever fall into the hands of the Government. It would be still more unfortunate if its control should come under the arbirary power of any person or group of persons. It is inconceivable that such a situation could be allowed to exist. But I am not now dealing with monopoly. Nor is this a question where any one lays claim to a monopoly. Interconnection is going on to local extent and over the wires of the telegraph companies, the telephone companies, and by radio itself. We have promises of superradio and we have promises of interconnection of wired wireless. If there are

(*Turn to page 69.*)

Blueprint of a Super-Heterodyne in December RADIO AGE.

An Unusually Selective Receiver

(*Continued from page 18*)

the stationary plates of the 23 plate condenser and the revolving plates of this condenser are connected to the other side of the rotor, to the positive binding post of the plate battery and to one side of the variometer. The other terminal of the variometer is connected to the plate binding post on the socket.

The phones are connected between the negative binding posts of the filament and plate batteries. The filament circuit is connected up in the usual way, from the positive binding post of the filament battery to the switch lever on the rheostat and from the resistance of the rheostat to one of the filament binding posts on the socket.

The other filament binding post on the socket is connected to the negative binding post of the filament battery and to one side of the phones. The grid condenser should be of the fixed mica type and is to have a capacity of .00025 M. F.

Sockets, having a bakelite base with a metal tube are usually considered good, or a good bakelite socket will do the work, but because it is sometimes so hard to tell this type of socket from the "moulded mud" type, the other is recommended.

The detector tube may be any of the well known brands, although the larger type such as the UV-200, or the C-300 will probably give the best results. The tube used will determine the resistance of the rheostat. For either of those mentioned, the ordinary 6 to 8 ohm-rheostat will be right, but if the UV-201-A or the C-301-A, UV-199, or WD-11, or WD-12 are used, the rheostat should have a higher resistance. Any type having from 20 to 40 ohms will be satisfactory for these tubes.

A grid leak may also be necessary in some cases, but because its resistance will vary according to the tube used, no specifications are given. It would be well to experiment with those having a resistance from one to four megohms. The plate battery voltage will also vary according to the kind of tube used. For the UV-200 or the C-300, the plate voltage should vary between 16 1-2 volts to 22 1-2, which can be taken care of by the taps on the standard plate batteries now in use.

But for the 201-A or the 301-A tubes a higher voltage will be necessary. This set can very nicely be mounted on a 7x18x3-16 inch bakelite panel and a baseboard of the proper size to fit the cabinet selected.

Do not attempt to wire up the parts with small wire, as the leads are too easily bent out of place and some consideration should be given to the resistance of the connecting wires. No. 14 tinned copper bus bar wire will serve very well, as this is substantial and the tinned coating on the wire will make the soldering of connections a very simple matter.

(*Continued from page 67*)

several methods, it means that we might have several alternative programs always available. But whatever the method of interconnection may be, we are lacking in a definite organization of a national system of programs and a basis of support.

I believe that the quickest way to kill broadcasting would be to use it for direct advertising. The reader of the newspaper has an option whether he will read an ad or not, but if a speech by the President is to be used as the meat in a sandwich of two patent medicine advertisements, there will be no radio left. To what extent it may be employed for what we now call indirect advertising, I do not know, and only experience with the reactions of the listeners can tell. I do not believe there is any practical method of payment from the receivers.

I wish to suggest for consideration the possibility of mutual organization by broadcasters of a service for themselves similar to that which the newspapers have for their use in the press associations, which would furnish programs of national events and arrange for their transmission and distribution on some sort of a financial basis just as the press associations gather and distribute news among their members.

Problem of Wave Lengths

ONE of the most important subjects for your consideration is the providing of operating channels for broadcasting stations. Of the present 530 stations, 57 are Class B, operating on from 500 to 1,000 watts and having a wide range, and 387 are Class A, many using small power and covering small areas. There are still 86 Class C stations, most of which have low power, all on a wave length of 360 meters.

Our chief trouble is with the Class B situation. They are all assigned within the band of 288 to 545 meters, within which there are, under the present system of allocation and excluding the Class C band, only 44 available channels, and only 33 that seem desirable at present. To assign these among the 57 stations necessarily means duplication, although it was the theory of the last conference that individual wave lengths could be assigned to each. At present, 23 stations either have exclusive wave lengths or are sharing with stations so distant that both may operate simultaneously, while the remaining 34 are compelled to divide time. The greatest congestion is in the large cities, New York and Chicago particularly.

An editorial on the radio conference is in this issue.

Mooseheart—A Station with a Purpose

(*Continued from page 40*)

drastic discipline or one case where the officials have scratched their heads and said, "Well, it's happened. Now, what will we do with them?"

Mooseheart officials, of course, realize that a diet of numbers by their charges would not suffice all the time, so arrangements are being made to run a line into Chicago, where we will broadcast every night from 9:00 or 9:30 on, without interruption. The Chicago Studio will probably be in a downtown hotel, where we will have a fine dance orchestra playing for us, and where I will arrange the best programs of the best artists I possibly can for your entertainment.

Not being a Chicago Station, we will be on the air Monday nights, having our silent night somewhere in the middle of the week.

If the station is a success, it will be because there is co-operation all the way through. The faculty and members of the staff of the general offices of the Fraternity are a fine group of people, the children have promised me their support, and I have one of the best Radio Operators behind the scenes, who is also a good scout. He was with me at the Drake, as I say, and I believe that was one of the reasons why WDAP was so well liked. We had co-operation, and that's half the battle.

And while I'm talking about co-operation, may I extend to you the urgent invitation to write often concerning our programs? That is a very important thing to those of us who are responsible for radio programs. Unless you write and tell us what you like and don't like, it is harder for us to give you what you do like. That goes for all stations that you ever heard, and you will be doing me and my "worthy contemporaries" a distinct favor if you will take a few minutes once in a while to write us your comments, suggestions and criticisms.

Please. Thanks.

"And may you laugh in your dreams."

A Radio Thunderstorm

WGY, the Schenectady broadcasting station, recently broadcast the music of a thunderstorm and it probably had a pleasing sound to those living on sun-parched farms. The storm occurred during the broadcasting of a concert by the Schenectady Little Symphony orchestra from Central Park, Schenectady. The musicians had just started "The Calm" section of Rossini's overture from William Tell, when unexpected and unwelcome reinforcements joined the orchestra. Contrary to the prediction offered by "It Ain't Goin' to Rain No More," it was a real storm with an accompaniment of hail. To the listener it might have appeared that the orchestra was taking liberties with the score, but the apparent improvisations were introduced by elements. The sound of thunder, wind and rain was picked up by the microphone and broadcast with the tranquil music of the overture.

Pickups and Hookups

(Continued from page 54)

I use an Inverted "L" aerial 95 ft. long, 25 ft. high.

I am not an amateur which my records seem to show but I know how to read code. I am 14 years old and still have a lot to learn about radio.

Yours till inductance coils,
WM. A. NEELD.

THIRD PRIZE SUBMITTED FOR ONE NIGHT WORK

RADIO AGE,
Dear Sirs:

Being a subscriber of your magazine I believe I am entitled to send you a list of stations that I have picked up between the hours of 8:30 p. m. and 10:55 p. m. Eastern Standard Time. (These stations were received the night of September 4, 1924.)

WBZ, WCX, WJY, WGY, WHO, WEAN, WTAS, WTAY, KDKA, WEAO, WGN, WEI, WHAS, WHB, WSB, WCAP, WEAF, WSAI, WTJ, WOC, WWJ, WNYC, WOAW, KFKX, WCBD.

I am using a portable set of my own design, it being a double circuit using a Kelcoil for tuner and two UV 199 tubes and had two sets head phones attached, as greater part of the time there were two parties listening. Am going to send you a photo of the set soon as same are finished.

Very truly yours,
J. SULOUFF,
325-6th Avenue, Altoona, Pa.

4th Prize Letter

478 Frontenac St.,
Montreal, Can.

RADIO AGE,
Gentlemen:

I've tried nearly every hook-up from the RADIO AGE for nearly two years. I tried with a U. V. 201A; it was not so bad, but the "B" battery killed it. Then I replaced it with a W.D. 12 and it gave me awful static during the last few months. Now I have a Canadian Peanut Valve which I think beats them all. I'm using a "Single Circuit" from the April RADIO AGE. My antenna is umbrella style, 55 feet from the ground, and I put two fixed condensers .00025 on the antenna binding post for high wave length.

Here is what I tuned in during the month of August:

LOG

WOR, WJZ, WEAF, KDKA, KYW, WCBD, WJY, WBZ, WBBP, WHAS, WFBH, WDAR, WKAC, WLS, WQJ, WTAM, WNYC, WOS, WOO, WGN, WCAE, WFI, WGY, WHN, WIP, WEBJ, WRC, CNRO, WTAS, PWX, WKBF, WEBH, CHYC, WCAP, KOP, WGR, KFKX, WNAC, WJAX, 8XG, WQAM, WMH, WMC, WSB, WSAI, WMAF, WAAM, WHAZ, KSD, WHAM, WEAN, WCX, WWJ, WLW, WBSQ, CFCF.

WAAF, WBZ, WCAP, WCBS, WCAE, WCX, WDM, WDAF, WDAR, WDAS, WEBH, WEAR, WEAF, WIP, WFAA, WSY, WJAB, WJZ, WJAS, WGW, WSR, WGN, WGAN, WHAZ, WHAN, WHN, WHAM, WJAZ, WJY, WYAR, WOR, WOO, WQJ, WRC, WSAR, WSAI, WASAP, WTAM, WTAS, WTAY, WLS, WLW, WMH, WMAA, WLAS, KDKA, KYW, KFKX, KFOA, CKCH, CNRO, CKCK, CKY, CFCF, CKAC, CHYC, CNRM.

P. KILKENNY,
478 Frontenac St.,
Montreal, Can.

(Turn to page 75.)

Overcoming "Super-Het" Obstacles

(Continued from page 14)

drawings. The following schedule gives the most desirable and economical rheostat distribution for an eight-tube set, and one which will afford the most accurate control without complicating the tuning operations.

(1) One rheostat for oscillator tube.

(2) One rheostat for both detector tubes.

(3) One rheostat for all radio frequency stages.

(4) One rheostat for all audio frequency stages.

When desired, the stages (3) and (4) can both be controlled by a single rheostat, but this is wasteful when the audio stages are not in use and the finest adjustment of the R. F. tubes is not possible. The oscillator rheostat is a critical control in nearly all circuits, hence this must be independent of all the other tubes. Very often it is possible to tune and detune the set by simply adjusting the oscillator rheostat, and in all cases the adjustment has an important bearing on the selectivity, particularly when the first circuit is of the regenerative type.

Conditions are greatly simplified in the filament circuit when automatic filament controls are used in the radio and audio stages. The use of such controls reduces the rheostats to two—the oscillator and detector rheostats.

First and Second Detectors

In the conventional super-heterodyne circuit two detector tubes are ordinarily used, the first detector being connected in the input and in front of the R. F. stages, while the second detector is connected after the last radio frequency stage. Both detectors are usually supplied with grid condensers and grid leaks as in any other circuit. This arrangement has been blindly accepted for a long time, although I have never yet met anyone who could give me a logical reason for the introduction of the first detector; in fact, it has seemed that this modification of the first tube is an actual drawback in a transformer coupled circuit using air core transformers.

RECENT developments, however, seem to indicate that nearly all makers are dropping the first detector and are using the first tube simply as a straight radio frequency amplifier, the grid condenser and grid leak being dropped on the first stage. From the experiments I have performed on the heterodyne, this shows a marked improvement in range and selectivity over the conventional type, particularly when the grid of the first tube is even a negative bias. Biasing this tube very noticeably increases its sensitivity and volume as is the case with any other radio frequency tube, and the circuit seems far more stable than with the more usual construction.

With iron core transformers, impedance, or resistance coupling, the audio frequency component developed by the first tube when used as a detector is con-

sistently amplified during the successive stages and a certain gain in volume results. However, with the ordinary air core transformer coupling the audio component receives very little amplification; hence it is better to drop the first detector and devote our energies to concentrating on R. F. amplification by means of a biased first R. F. stage.

In the second detector we meet a condition which is not often appreciated by the experimenter and one which has resulted in the partial failure of many heterodyne sets. This is the proportion of the grid condenser of the second detector tube. To use the standard 0.00025 mf. fixed condenser, commonly recommended for simple receivers, is a mistake, for a little thought will show that the second detector is rectifying much longer waves than in the common regenerative circuit and therefore requires a considerably larger grid condenser. With intermediate frequencies ranging from 5,000 to 10,000 meters wave length, it is likely that 0.0005 to 0.001 mf would be a more suitable grid condenser at this point.

Pacent Duoplug on Market

The Pacent Electric Company of New York, manufacturers of the Pacent Radio Essentials, have developed and placed on the market a new plug of unique design and unusual merit.

The new Essential, known as the Duoplug, accommodates two pairs of phones in parallel. No tools are required for making connections. The special type thumb nut connectors may be tightened with the fingers. The nut is slotted so that with a dime or other thin coin an especially secure connection may be made.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of Radio Age, published monthly at Chicago, Illinois, for October 1, 1924.

State of Illinois, County of Cook, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Frederick Smith, who, having been duly sworn according to law, deposes and says that he is the Editor of Radio Age and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and, if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Radio Age, Inc., Chicago, Ill.; Editor, Frederick Smith, Chicago, Ill.; Managing Editor, Frederick Smith, Chicago, Ill.; Business Manager, M. B. Smith, Chicago, Ill.

2. That the owner is: (If the publication is owned by an individual, his name and address, or if owned by more than one individual, the name and address of each, should be given below: if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent or more of the total amount of stock should be given). Radio Age, Inc., Chicago, Ill.; Frederick Smith, President, Chicago, Ill.; M. B. Smith, Secretary and Treasurer, Chicago, Ill.; John H. Lohbeck, Vice-President, St. Louis, Mo.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state). None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner: and this affiant has no reason to believe that any person, association, or corporation has any interest direct or indirect, in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is: (This information is required from daily publications only.)

FREDERICK SMITH,
Editor.

Sworn to and subscribed before me this 1st day of October, 1924.

FLORENCE A. SMITH,
(My commission expires Sept. 21, 1926.)

How to make a loud speaker for clear tone in December Radio Age.

Corrected List of Broadcasting Stations

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh	326
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270
KDPT	Southern Electrical Co.	San Diego, Calif.	244
KDYL	Newhouse Hotel	Salt Lake City, Utah	360
KDYM	Savoy Theatre	San Diego, Calif.	244
KDYQ	Oregon Institute of Technology	Portland, Oreg.	360
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZE	Rhodes Department Store	Seattle, Wash.	270
KDZI	Electric Supply Co.	Wenatchee, Wash.	360
KDZR	Bellingham Publishing Co.	Bellingham, Wash.	261
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	360
KFAE	State College of Washington	Pullman, Wash.	330
KFAF	Western Radio Corporation	Denver, Colo.	278
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif.	280
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280
KFAY	W. J. Virgin	Medford, Oreg.	283
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Azbill	San Diego, Calif.	278
KFBE	Reuben H. Horn	San Luis Obispo, Calif.	242
KFBG	First Presbyterian Church	Tacoma, Wash.	360
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and the Chronicle News	Trinidad, Colo.	360
KFBU	The Cathedral (Bishop N. S. Thomas)	Laramie, Wyo.	283
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFCF	Frank A. Moore	Walla Walla, Wash.	360
KFCH	Electric Service Station (Inc.)	Billings, Mont.	360
KFCL	Leslie E. Rice	Los Angeles, Cal.	236
KFCP	Ralph W. Flygare	Ogden, Utah	360
KFCV	Fred Mahaffey Jr.	Houston, Texas	360
KFCZ	Omaha Central High School	Omaha, Nebr.	258
KFDD	St. Michaels Cathedral	Boise, Idaho	252
KFDH	University of Arizona	Tuscon, Ariz.	368
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	360
KFDR	Bullocks' Hardware & Sporting Goods (Rob. G. Bullock)	York, Nebr.	360
KFDX	First Baptist Church	Shreveport, La.	360
KFDY	South Dakota State College of Agriculture and Mechanics Arts	Brookings, S. Dak.	360
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank Co.	Portland, Oreg.	360
KFEL	Winner Radio Corp.	Denver, Colo.	254
KFEQ	Screggin & Company Bank	Oak, Nebr.	268
KFER	Auto Electric Service Co.	Fort Dodge, Iowa	231
KFEV	Radio Electric Shop	Douglas, Wyo.	263
KFEX	Augsburg Seminary	Minneapolis, Minn.	261
KFEY	Bunker Hill & Sullivan Mining and Concentrating Co.	Kellogg, Idaho	360
KFEZ	Asso. Engr. Societies of St. Louis	St. Louis, Mo.	248
KFFB	Jenkins Furniture Co.	Boise, Idaho	240
KFFE	Eastern Oregon Radio Co.	Pendleton, Oreg.	360
KFFP	First Baptist Church	Moberly, Mo.	266
KFFR	Nevada State Journal (Jim Kirk)	Sparks, Nev.	226
KFFV	Graceland College	Lamoni, Iowa	280
KFFX	McGraw Co.	Omaha, Nebr.	278
KFFY	Pineus & Murphy	Alexandria, La.	275
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	273
KFGL	Arlington Garage	Arlington, Oreg.	234
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFGX	First Presbyterian Church	Orange, Tex.	250
KFGZ	Emmanuel Missionary College	Berrien Springs, Mich.	268
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHD	Utz Electric Shop Co.	St. Joseph, Mo.	226
KFHH	Ambrose A. McCue	Neah Bay, Wash.	283
KFHJ	Fallon & Co.	Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.	Seattle, Wasb.	270
KFI	Earle C. Anthony (Inc.)	Los Angeles, Calif.	469
KFID	Ross Arbuckle's Garage	Iola, Kans.	246
KFIF	Benson Polytechnic Institute	Portland, Oregon	360
KFIL	Windisch Electric Farm Equipment Co.	Louisburg, Kans.	234
KFIO	North Central High School	Spokane, Wash.	252
KFIQ	First Methodist Church	Yakima, Wash.	242
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIV	V. H. Broyles	Pittsburgh, Kans.	240
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huelsman	Fon Du Lac, Wis.	273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	Seattle Post Intelligencer	Seattle, Wash.	233
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	252
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg.	252
KFJK	Delano Radio and Electric Co.	Bristow, Okla.	233
KFJL	Hardsacg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	229
KFJQ	Valley Radio, Div. of Elec. Constr. Co.	Grand Forks, N. D.	280
KFJR	Ashley C. Dixon & Son	Stevensville, Mont. (near)	258
KFJX	Iowa State Teacher's College	Cedar Falls, Iowa	229
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	248
KFJZ	Texas National Guard, One hundred and twelfth Cavalry	Fort Worth Texas	254
KFKA	Colorado State Teachers College	Greeley, Colo.	248
KFKB	Brinkley-Jones Hospital Association	Milford, Kans.	286
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark.	224
KFKV	F. F. Gray	Butte, Mont.	283
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	286
KFKZ	Nassour Bros. Radio Co.	Colorado Springs, Colo.	234
KFLA	Abner R. Willson	Butte, Mont.	283
KFLB	Signal Electric Manufacturing Co.	Menominee, Mich.	248
KFLD	Paul E. Greenlaw	Franklinton, La.	234
KFLE	National Educational Service	Denver, Colo.	268
KFLQ	Bizzell Radio Shop	Little Rock, Ark.	261
KFLR	University of New Mexico	Albuquerque, New Mexico	254
KFLU	Rio Grande Radio Supply House	San Benito, Texas	236
KFLV	Rev. A. T. Frykman	Rockford, Ill.	229
KFLW	Missoula Electric Supply Co.	Missoula, Mont.	234
KFLX	George Roy Clough	Galveston, Tex.	240
KFLY	Fargo Radio Supply Co.	Fargo, N. Dak.	231
KFLZ	Atlantic Automobile Co.	Atlantic, Ia.	273
KFMQ	University of Arkansas	Fayetteville, Ark.	263
KFMR	Morningside College	Sioux City, Iowa	261
KFMT	Dr. George W. Young	Minneapolis, Minn.	231
KFMW	M. G. Sateren	Houghton, Mich.	266
KFMX	Carlcton College	Northfield, Minn.	283
KFNF	Henry Field Seed Co.	Shenandoah, Iowa	266
KFNG	Wooten's Radio Shop	Coldwater, Miss.	254
KFNJ	Warrensburg Electric Shop	Warrensburg, Mo.	234
KFNL	Radio Broadcast Ass'n	Paso Robles, Calif.	240
KFNV	L. A. Drake Battery and Radio Supply Shop	Santa Rosa, Calif.	234
KFNX	Peabody Radio Service	Peabody, Kansas	240
KFNY	Montana Phonograph Co.	Helena, Montana	261
KFNZ	Royal Radio Company	Burlingame, Calif.	231
KFOC	First Christian Church	Whittier, Calif.	236
KFOD	Vern Peters	Wallace, Idaho	224
KFOJ	Moberly High School Radio Club	Moberly, Missouri	246
KFOL	Leslie M. Schafbush	Marengo, Iowa	234
KFON	Echophone Radio Shop	Long Beach, Calif.	234
KFOO	Latter Day Saints University	Salt Lake City, Utah	261
KFOQ	Ora William Chancellor	Galveston, Texas	240
KFOR	David City Tire & Electric Co.	David City, Nebraska	226
KFOT	College Hill Radio Club	Wichita, Kansas	231
KFOX	Board of Education, Technical High School	Omaha, Nebraska	248
KFOY	Beacon Radio Service	St. Paul, Minn.	226
KFOZ	Leon Hudson Real Estate Co.	Fort Smith, Ark.	233
KFPB	Edwin J. Brown	Seattle, Wash.	224
KFPG	Garretson and Dennis	Los Angeles, Calif.	238
KFPH	Harold Chas. Mailander	Salt Lake City, Utah	242
KFPL	C. C. Baxter	Duhlin, Texas	242
KFPM	The New Furniture Co.	Greenville, Texas	242
KFPN	Missouri National Guard	Jefferson City, Mo.	242
KFPO	Colorado National Guard	Denver, Colo.	231
KFPP	G. & G. Radio & Electric Shop	Olympia, Washington	236
KFPQ	Clifford M. Esler	Denison, Texas	231
KFPR	Los Angeles Co. Forestry Dept.	Los Angeles, Calif.	231
KFPS	Carter A. Ross Motor Service Co.	Casper, Wyo.	242
KFPV	Heintz & Koblmoos, Inc.	San Francisco, Calif.	236
KFPW	St. Johns M. E. Church S.	Carterville, Mo.	268
KFPY	Symons Investment Co.	Spokane, Wasb.	283
KFPX	First Presbyterian Church	Pine Bluff, Ark.	242
KFQA	The Principia	St. Louis, Mo.	261
KFQB	Tbe Searchlight Publishing Co.	Fort Worth, Tex.	254
KFQC	Kidd Brothers Radio Shop	Taft, Calif.	227
KFQD	Chovin Supply Co.	Anchorage, Alaska	280
KFQE	Dickenson-Henry Radio Laboratories	Colorado Springs, Colo.	224
KFQG	Southern Calif. Radio Ass'n	Los Angeles, Calif.	226
KFQH	Albert Sherman	Hillsbourgh, Cal.	231
KFQI	The Thos. H. Ince Corp.	Culver City, Calif.	234
KFQJ	Harbour-Longmire Company	Oklahoma City, Okla.	236
KFQK	Democrat Leader	Fayette, Mo.	236
KFQL	Oklahoma Free State Fair Assn.	Muskogee, Okla.	252
KFQR	Walter LaFayette Ellis	Oklahoma City, Okla.	250
KFQS	Dickenson-Henry Radio Laboratories	Manitou, Colo.	246
KFQT	Texas National Guard	Denison, Texas	252
KFQU	W. Riker	Holy City, Calif.	234
KFQV	Omaha Grain Exchange (Portable)	Omaha, Nebr.	231
KFQW	C. F. Knierim	North Bend, Wash.	248
KFQX	Alfred M. Hubbard	Seattle, Wash.	233
KFSG	Angelus Temple	Los Angeles, Calif.	278
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGC	Hallock & Watson Radio Service	Portland, Oreg.	360
KGO	General Electric Co.	Oakland, Calif.	312
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach	360
KGW	Portland Morning Oregonian	Portland, Oreg.	492
KGY	St. Martins College (Reb. Sebastian Ruth)	Lacy, Wash.	258
KHJ	Times-Mirror Co.	Los Angeles, Calif.	395
KHQ	Louis Wasmer	Seattle, Wasb.	360
KJQ	C. O. Gould	Stockton, Calif.	360
KJR	Northwest Radio Service Co.	Seattle, Wash.	270
KJS	Bible Institute of Los Angeles	Los Angeles, Calif.	360
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	360
KLX	Tribune Publishing Co.	Oakland, Calif.	509
KLZ	Reynolds Radio Co.	Denver, Colo.	283
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif.	273
KMO	Love Electric Co.	Tacoma, Wash.	360
KNT	Grays Harbor Radio Co. (Walter Hemrich)	Aberdeen, Wasb.	263
KNX	Electric Lighting Supply Co.	Los Angeles, Calif.	360
KOB	New Mexico College of Agriculture & Mechanic Arts.	State College, N. Mex.	360
KOP	Detroit Police Department	Detroit, Mich.	286
KPO	Hale Bros.	San Francisco, Calif.	423
KQP	Apple City Radio Club	Hood River, Oreg.	360
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	360
KQW	Charles D. Herrold	San Jose, Calif.	360
KRE	V C Battery & Electric Co.	Berkeley, Calif.	278
KSD	Post Dispatch (Pulitzer Pub. Co.)	St. Louis, Mo.	546
KTW	First Presbyterian Church	Seattle, Wash.	360
KUO	Examiner Printing Co.	San Francisco, Calif.	360
KUY	Coast Radio Co.	El Monte, Calif.	256
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	360
KYQ	Electric Shop	Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	536
KZM	Preston D. Allen	Oakland, Calif.	360
KZN	Cope and Johnson Co.	Salt Lake City, Utah	268
WAAB	Valdemar Jensen	New Orleans, La.	268
WAAC	Tulane University	New Orleans, La.	360
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	286
WAAK	Gimbel Brothers	Milwaukee, Wis.	280
WAAM	I. R. Nelson Co.	Newark, N. J.	263
WAAN	University of Missouri	Columbia, Mo.	254
WAAW	Omaha Grain Exchange	Omaha, Nebr.	286
WABB	Harrisburg Sporting Goods Co.	Harrisburg, Pa.	266
WABD	Parker High School	Dayton, Ohio	283
WABE	Young Men's Christian Association	Washington, D. C.	283
WABG	Arnold Edwards Piano Co.	Jacksonville, Fla.	248
WABH	Lake Shore Tire Co.	Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co.	Bangor, Me.	240
WABL	Connecticut Agricultural College	Storrs, Conn.	283
WABM	F. E. Doherty Automotive and Radio Equipment Co.	Saginaw, Mich.	254
WABN	Ott Radio, Inc.	LaCrosse, Wis.	244
WABO	Lake Avenue Baptist Church	Rochester, N. Y.	252
WABP	Robert F. Weinig	Dover, Ohio	266
WABQ	Haverford College, Radio Club	Haverford, Pa.	261
WABR	Scott High School, N, W. B. Foley	Toledo, Ohio	270
WABT	Holiday-Hal, Radio Engineers	Washington, Pa.	252
WABU	Victor Talking Machine Co.	Camden, N. J.	226
WABW	College of Wooster	Wooster, Ohio	234
WABX	Henry B. Joy	Mt. Clemens, Mich.	270
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	263
WBAA	Purdue University	W. Lafayette, Ind.	283
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAN	Wireless Phone Corp.	Paterson, N. J.	244
WBAO	James Millikin University	Decatur, Ill.	360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.	Columbus, Ohio	423
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	360
WBAY	Western Electric Co.	New York, N. Y.	492
WBBA	Newark Radio Laboratories	Newark, Ohio	240
WBBD	Barbey Battery Service	Reading, Pa.	234
WBBE	Alfred R. Marcy	Syracuse, N. Y.	246
WBBG	Irving Vermilya	Mattapoisett, Mass.	240
WBBH	J. Irving Bell	Port Huron, Mich.	246
WBBJ	Neal Electric Co., P. E. Neal	West Palm Beach, Fla.	258
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	283
WBBM	Frank Atlass Produce Co.	Lincoln, Ill.	225
WBBN	Blake, A. B.	Wilmington, N. C.	275
WBBR	Peoples Pulpit Asso.	Rossville, N. Y.	244
WBBT	Lloyd Brothers	Philadelphia, Pa.	234
WBBU	Jenks Motor Sales Co.	Monmouth, Ill.	224
WBBV	Johnstown Radio Co.	Johnstown, Pa.	248
WBBW	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Infantry Co. "B" 118th Inf.	Charleston, S. C.	268
WBBZ	Noble B. Watson	Indianapolis, Ind.	227
WBL	T & H Radio Co.	Antbony, Kans.	254
WBR	Pennsylvania State Police	Butler, Pa.	286
WBS	D. W. May, Inc.	Newark, N. J.	360
WBT	Southern Radio Corp.	Charlotte, N. C.	360
WBZ	Westinghouse Elec. & Mfg. Co.	Springfield, Mass.	337
WCAD	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa.	462
WCAG	Clyde R. Randall	New Orleans, La.	268
WCAH	Entrekin Electric Co.	Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	283
WCAK	Alfred P. Daniel	Houston, Texas	263
WCAL	St. Olaf College	Northfield, Minn.	360
WCAO	Sanders & Stayman Co.	Baltimore, Md.	360
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C.	469
WCAR	Alamo Radio Electric Co.	San Antonio, Tex.	360
WCAT	South Dakota State School of Mines	Rapid City, S. Dak.	240
WCAU	Durham & Co.	Philadelphia, Pa.	286
WCAV	J. C. Dice Electric Co.	Little Rock, Ark.	360
WCAX	University of Vermont	Burlington, Vt.	360
WCAY	Milwaukee Civic Broadcasting Station	Milwaukee, Wis.	226
WCAY	The Milwaukee Civic Broadcasting Assn., Inc.	Milwaukee, Wis.	266
WCAZ	Carthage College	Carthage, Ill.	246
WCBA	Charles W. Heimbach	Allentown, Pa.	280
WCBC	University of Michigan	Ann Arbor, Mich.	280
WCBD	Wilbur G. Voliva	Zion, Ill.	345
WCBE	Uhalt Radio Co.	New Orleans, La.	263
WCBF	Paul J. Miller	Pittsburgh, Pa.	236
WCBG	Howard S. Williams (Portable)	Pascagoula, Miss.	236
WCBI	Nicoll, Duncan & Rush	Bemis, Tennessee	226
WCBJ	J. C. Maus	Jennings, Louisiana	244

CLASSIFIED ADVERTISEMENTS

Don't overlook the value of RADIO AGE'S classified advertisements. Many such messages have paved the way to independent incomes.

The classified advertising rates are but ten cents per word for a single insertion. Liberal discounts are allowed on three, six and twelve -time insertions, of five, fifteen and thirty per cent, respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates and no advertisement of less: han ten words will be accepted.

RADIO SALESMEN WANTED—Make $50.00 weekly selling standard, well advertised radio sets and parts. No investment required. Write for free outfit. Desk 27, WAVELAND RADIO COMPANY, 1027 N. State St., Chicago.

FOR SALE

Silver Wire—Most perfect Conductor known. No Loss of Current. Easy to Solder. In 25-foot Coils. Per Coil $1.25. Aragon Radio Co., 222 N. State St., Chicago.

RADIO JOBS

If you want to turn your knowledge of radio into dollars, insert an ad in the classified section of RADIO AGE at 10 cents a word. You will find that manufacturers and radio dealers are looking for radio men like you.

RADIO CIRCUITS

SPECIAL FOR NOVEMBER

The Reinartz Radio Booklet, by Frank D. Pearne, fully illustrated, and RADIO AGE, for $2.50. Price of booklet alone is 50c. Send check, currency or money order to RADIO AGE, 500 N. Dearborn Street, Chicago.

MISCELLANEOUS

158 Genuine Foreign Stamps. Mexico War Issues. Venezuela, Salvador and India Service. Guatemala, China, etc., only 5c. Finest approval sheets, 50 to 60 percent. Agents Wanted. Big 72-p. Lists Free. We Buy Stamps. Established 20 Years. Hussman Stamp Co., Dept. 152, St. Louis, Mo.

RADIO TUBES

I have just bought a set requiring 201-A tubes, leaving me with two UV-201's and one UV-200. All three have been used only a short time. Who'll take them for $1 each? Guaranteed. Address Box X11, RADIO AGE, 500 N. Dearborn St., Chicago.

AGENTS

90c an hour to advertise and distribute samples to consumer. Write quick for territory and particulars. American Products Co., 2130 American Building, Cincinnati, Ohio.

CASH IN ON RADIO! Build and sell sets for us. No trouble to earn $5 an hour in spare time at home. Auburn Radio Co., Dept. N, Cincinnati, O.

MAKE GOOD MONEY selling radio hookup blueprints. Hookups for all types of receivers from the simplest crystal to the most complex super-heterodyne. Address, Box 111, RADIO AGE, 500 N. Dearborn St., Chicago, Ill.

BUSINESS OPPORTUNITIES

WANTED:—A Chicago organization desires radio proposition of merit from manufacturers, that should prove profitable, sellers direct to the consumer or from jobbing standpoint. Merchandise of established trade name considered, but propositions providing for the use of our own trade name preferred. Give full details first letter. Address Box 112, RADIO AGE, 500 N. Dearborn St., Chicago, Ill.

FOR SALE

BLUEPRINTS—Make your own set from proven original and up-to-the minute blueprints. The following are merely three of a choice of almost one hundred different types:

HT-1-3—Five tube neutrodyne—50c.
FB-6—Three-honeycomb regenerative—35c.
D10-4—Diode single circuit—25c.
All three of above, for $1.00.

These tested blueprints are all made up in easily read circuit drawings. MIDLAND PRODUCTS COMPANY, 1413 Hood Ave., Chicago, Ill. Ask for our complete list, No. R11.

Classified ad copy for the December issue must reach RADIO AGE not later than October 25.

Pickups from Page 71.

5th Prize

Mr. R. Kneeland Ashdown, P. O. Box No. 139, Freeport, N. Y., wins the fifth prize for busting static:

RADIO AGE,

Gentlemen:

I am enclosing a list of the radio broadcasting stations heard during the month of August and which I started on the 6th.

My present set, which is a three-tube Haynes Griffin Regenerative single circuit set and on which I use a loud speaker, tuned in these 57 stations through static thta was at some times quite impossible.

The set, while not a portable, can be transported easily, and while I have used it as a portable receiver, I was not designed as such. I use the old type of tubes, the UV 200 and 201 tubes for detector and amplifier, which permit me to hear most of the stations with considerable volume on my loud speaker.

R. KNEELAND ASHDOWN.
P. O. Box 139,
Freeport, N. Y.

And now it's time for us to sign off before we crowd some good feature out of the book,, so;

If you liked the Pickups Page
To any great extent,
Just drop the gang a letter
And a button will be sent;
You can be a Dial Twister
If you'll quickly write today;
Obey that impulse,
Let's hear from you;
Don't let anything delay.

Mastering the 3-Circuit Tuner

(*Continued from page 12*)

condenser are placed by using the drilling templates furnished with them. A single 5-16 inch hole suffices to pass the shaft for the tickler, the coupler itself being supported by the baseboard and brackets.

The three-circuit set works admirably on a dry cell tube such as the WD-12 or UV-199, and the rheostat selected should have 6 or 30 ohms resistance, depending upon which tube is bought. With either of these a 45 volt "B" battery is advised.

With the aerial connected to point No. 1, the dial adjustments for the tuning condenser should be noted for each local station. They should be recorded again in case either of the other two points are tried, for they will be decidedly different. In the one bulb class, the three-circuit receiver is a most satisfactory outfit to operate, from standpoints of clean-cut selective ability and signal strength—these sterling qualities present in superlative degree only when the optimum value of antenna coupling has been reached.

Not too much, for tuning'll be broad; nor too little, for signals'll be weak; the happy medium is perfection.

WCBK	E. Richard Hall	St. Petersburg, Fla.	266
WCBL	Northern Radio Mfg. Co.	Houlton, Me.	280
WCBM	Charles Swarz	Baltimore, Md.	229
WCBN	James P. Boland	Ft. Benj. Harrison, Ind.	266
WCBO	The Radio Shop, Inc.	Memphis, Tenn.	250
WCBQ	First Baptist Church	Nashville, Tenn.	236
WCBR	University of Mississippi	near Oxford, Miss.	242
WCBS	Charles H. Meester (Portable Station)	Providence, R. I.	246
WCBT	Clark University, Collegiate Dept.	Worcester, Mass.	238
WCBU	Arnold Wireless Supply Co.	Arnold, Pa.	254
WCBV	Tullahoma Radio Club	Tullahoma, Tenn.	252
WCBW	George P. Rankin, Jr., and Maitland Solomon	Macon, Ga.	226
WCBX	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	233
WCBY	The Forks Electrical Shop	Buck Hill Falls, Pa.	268
WCBZ	Coppotelli Bros. Music House	Chicago Heights, Ill.	248
WCK	Stix, Baer & Fuller Dry Goods Co.	St. Louis, Mo.	360
WCX	Detroit Free Press	Detroit, Mich.	517
WDAE	Tampa Daily Times	Tampa, Fla.	360
WDAF	Kansas City Star	Kansas City, Mo.	411
WDAG	J. Laurence Martin	Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South)	El Paso, Tex.	268
WDAK	The Courant	Hartford, Conn.	261
WDAR	Lit Brothers	Philadelphia, Pa.	395
WDAS	Samuel A. Waite	Worcester, Mass.	360
WDAU	Slocum Kilburn	New Bedford, Mass.	360
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	244
WDBA	Fred Ray	Columbus, Ga.	236
WDBB	A. H. White & Co., Inc.	Taunton, Mass.	229
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WDBD	Herman Edwin Burns	Martinsburg, W. Va.	268
WDBE	Gilham-Schoen Electric Co.	Atlanta, Ga.	252
WDBF	Robert G. Phillips	Youngstown, Ohio	246
WDBH	C. T. Scherer Co.	Worcester, Mass.	268
WDBI	Radio Specialty Co.	St. Petersburg, Fla.	226
WDBJ	Richardson Wayland Electric Corp.	Roanoke, Va.	229
WDBK	M. F. Broz Radio Co.	Cleveland, Ohio	248
WDBL	Wisc. Dept. of Markets	Stevens Point, Wis.	278
WDBN	Electric Light & Power Co.	Bangor, Me.	252
WDBO	Rollins College Inc.	Winter Park, Fla.	240
WDBP	Superior State Normal School	Superior, Wis.	261
WDBQ	Morton Radio Supply Co.	Salem, N. J.	234
WDBR	Tremont Temple Baptist Church	Boston, Mass.	256
WDBS	S. M. K. Radio Corp.	Dayton, Ohio	283
WDBT	Taylor's Book Store	Hattiesburg, Miss.	236
WDBU	Somerset Radio Co.	Skowhegan, Maine	258
WDBV	The Quimby Enterprises, The Strand Theatre	Fort Wayne, Ind.	258
WDBW	The Radio Democrat	Columbia, Tenn.	268
WDBY	North Shore Congregational Church	Chicago, Ill.	258
WDM	Church of the Covenant	Washington, D. C.	234
WDZ	James L. Bush	Tuscola, Ill., Star Store Bldg.	278
WEAA	F. D. Fallain	Flint, Mich.	280
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	492
WEAH	Wichita Board of Trade	Wichita, Kans.	244
WEAI	Cornell University	Ithaca, N. Y.	286
WEAJ	University of South Dakota	Vermillon, S. Dak.	283
WEAM	Borough of North Plainfield (W. Gibson Buttfield)	North Plainfield, N. J	252
WEAN	Shepard Co.	Providence, R. I.	273
WEAO	Ohio State University	Columbus, Ohio	360
WEAP	Mobile Radio Co.	Mobile, Ala.	360
WEAR	The Evening Newe Publishing Co.	Baltimore, Md.	261
WEAU	Davidson Bros. Co.	Sioux City, Iowa	275
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Texas	360
WEB	Benwood Co.	St. Louis, Mo.	273
WEBC	Walter Cecil Bridges	Superior, Wis.	242
WEBD	Electrical Equipment and Service Co.	Anderson, Ind.	246
WEBE	Roy W. Waller	Cambridge, Ohio	248
WEBH	Zenith-Edgewater Beach Broadcasting Station	Chicago, Ill.	370
WEBI	Walter H. Gibbons	Salisbury, Md.	242
WEBJ	Third Avenue Railway Co.	New York, N. Y.	273
WEV	Hurlburt-Still Electrical Co.	Houston, Texas	360
WEW	St. Louis University	St. Louis, Mo.	261
WFAA	Dallas News & Dallas Journal	Dallas, Texas	476
WFAB	Carl F. Woese	Syracuse, N. Y.	234
WFAH	Electric Supply Co.	Port Arthur, Texas	236
WFAM	Times Publishing Co.	St. Cloud, Minn.	360
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn.	360
WFAV	University of Nebraska, Department of Electrical Engineering	Lincoln, Nebr.	275
WFBB	Eureka College	Eureka, Ill.	240
WFBG	The Wm. F. Gable Co.	Altoona, Pa.	261
WFBH	Concourse Radio Corporation	New York, N. Y.	273
WFI	Strawbridge & Clothier	Philadelphia, Pa.	395
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa.	248
WGAN	Cecil E. Lloyd	Pensacola, Fla.	360
WGAQ	Glenwood Radio Corp. (W. G. Patterson)	Shreveport, La.	252
WGAW	Ernest C. Albright	Altoona, Pa.	261
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGI	American Radio & Research Corp.	Medford Hillside, Mass.	360
WGL	Thomas F. J. Howlett	Philadelphia, Pa.	360
WGN	The Tribune Co.	Chicago, Ill.	370
WGR	Federal Telephone & Telegraph Co.	Buffalo, N. Y.	319
WGY	General Electric Co.	Schenectady, N. Y.	380
WHA	University of Wisconsin	Madison, Wis.	360
WHAA	State University of Iowa	Iowa City, Iowa	484
WHAD	Marquette University	Milwaukee, Wis.	280
WHAG	University of Cincinnati	Cincinnati, Ohio	222
WHAH	Hafer Supply Co.	Joplin, Mo.	283
WHAK	Roberts Hardware Co.	Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y.	283
WHAP	Otta & Kuhns	Decatur, Ill.	360
WHAR	Paramount Radio & Electric Co. (W. H. A. Pulus)	Atlantic City, N. J.	231
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	380
WHB	Sweeney School Co.	Kansas City, Mo.	411
WHK	Radiovox Co. (Warren R. Cox)	Cleveland, Ohio	360
WHN	George Schubel	New York, N. Y.	360
WHO	Bankers Life Company	Des Moines, Iowa	526
WIAB	Joslyn Automobile Co.	Rockford, Ill.	252
WIAC	Galveston Tribune	Galveston, Texas	360
WIAD	Howard R. Miller	Philadelphia, Pa.	254
WIAH	Continental Radio & Mfg. Co.	Newton, Iowa	258
WIAK	Journal-Stockman Co.	Omaha, Nebr.	278
WIAO	School of Engineering of Milwaukee	Milwaukee, Wis.	246
WIAQ	Chronicle Publishing Co.	Marion, Ind.	226
WIAS	Home Electric Co.	Burlington, Iowa	283
WIAT	Leon T. Noel	Tarkio, Mo.	360
WIAU	American Trust & Savings Bank	Le Mars, Iowa	360
WIAY	Woodward & Lothrop	Washington, D. C.	273
WIK	K. & L. Electric Co. (Herbert F. Kelso and Hunter J. Lohman)	McKeesport, Pa.	234
WIL	Continental Electric Supply Co.	Washington, D. C.	360
WIP	Gimbel Brothers	Philadelphia, Pa.	509
WJAB	American Electric Co.	Lincoln, Neb.	229
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	360
WJAG	Norfolk Daily News	Norfolk, Nebr.	283
WJAK	Clifford L. White	Greentown, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAN	Peoria Star	Peoria, Ill.	280
WJAQ	Capper Publications	Topeka, Kans.	360
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	286
WJAX	Union Trust Co.	Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	448
WJD	Richard H. Howe	Granville, Ohio	229
WJY	R. C. A.	New York, N. Y.	405
WJZ	R. C. A.	New York, N. Y.	455
WKAA	H. F. Paar	Cedar Rapids, Iowa	268
WKDA	Chas. Looff (Crescent Park)	East Providence, R. I.	240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Texas	360
WKAN	United Battery Service Co.	Montgomery, Ala.	226
WKAP	Dutee W. Flint	Cranston, R. I.	360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	360
WKAR	Michigan Agriculture College	East Lansing, Mich.	280
WKAS	L. E. Lines Music Co.	Springfield, Mo.	360
WKAV	Laconia Radio Club	Laconia, N. H.	254
WKBF	Dutee Wilcox Flint	Cransten, Rhode Island	286
WKY	WKY Radio Shop	Oklahoma, Okla.	360
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn.	417
WLAH	Samuel Woodworth	Syracuse, N. Y.	234
WLAL	Naylor Electrical Co.	Tulsa, Okla.	360
WLAP	Wm. V. Jordan	Louisville, Ky.	286
WLAQ	Arthur E. Shilling	Kalamazoo, Mich.	283
WLAV	Electric Shop	Pensacola, Fla.	254
WLAW	Police Dept., City of New York	New York, N. Y.	360
WLAX	Putnam Electric Co. (Greencastle Community Broadcasting Station)	Greencastle, Ind.	231
WLB	University of Minnesota	Minneapolis, Minn.	360
WLBL	Wisconsin State Dept. of Markets	Stevenspoint, Wis.	278
WLS	Sears, Roebuck & Co.	Chicago, Ill.	345
WLW	Crosley Manufacturing Co.	Cincinnati, Ohio	423
WMAC	J. Edw. Page (Olive B. Meredith)	Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	360
WMAH	General Supply Co.	Lincoln, Nebr.	254
WMAK	Norton Laboratories	Lockport, N. Y.	273
WMAL	Trenton Hardware Co.	Trenton, N. J.	256
WMAN	First Baptist Church	Columbus, Ohio	286
WMAP	Utility Battery Service	Easton, Pa.	246
WMAQ	Chicago Daily News	Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute	Auburn, Ala.	250
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	280
WMAZ	Mercer University	Macon, Ga.	261
WMC	"Commercial Appeal" (Commercial Publishing Co.)	Memphis, Tenn.	500
WMH	Ainsworth-Gates Co.	Cincinnati, Ohio	309
WMU	Doubleday-Hill Electric Co.	Washington, D. C.	261
WNAC	Shepard Stores	Boston, Mass.	278
WNAD	University of Oklahoma	Norman, Okla.	360
WNAL	Omaha Central High School	Omaha, Nebr.	258
WNAM	Ideal Apparatus Co.	Evansville, Ind.	360
WNAP	Wittenberg College	Springfield, Ohio	231
WNAR	First Christian Church	Butler, Mo.	231
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa.	360
WNAW	Peninsular Radio Club (Henry Kunzmann)	Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNY	Dept. of Plant and Structures	New York, N. Y.	526
WOAA	Dr. Walter Hardy	Ardmore, Okla.	360
WOAC	Maus Radio Co.	Lima, Ohio	266
WOAD	Friday Battery & Electric Corp.	Sigourney, Iowa	360
WOAE	Midland College	Fremont, Nebr.	280
WOAF	Tyler Commercial College	Tyler, Texas	360
WOAG	Apollo Theater (Belvidere Amusement Co.)	Belvidere, Ill.	224
WOAH	Palmetto Radio Corp.	Charleston, S. C.	360
WOAI	Southern Equipment Co.	San Antonio, Texas	385
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	360
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	360
WOAQ	Portsmouth Kiwanis Club	Portsmouth, Va.	360
WOAR	Lundskow, Henry P.	Kenosha, Wis.	229
WOAT	Boyd M. Hamp	Wilmington, Del.	360
WOAV	Pennsylvania National Guard, 2d Battalion, 112th Infantry	Erie, Pa.	242
WOAW	Woodmen of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOI	Iowa State College	Ames, Iowa	360
WOO	John Wanamaker	Philadelphia, Pa.	509
WOQ	Western Radio Co.	Kansas City, Mo.	360
WOR	L. Bamberger & Co.	Newark, N. J.	405
WOS	Missouri State Marketing Bureau	Jefferson City, Mo.	441
WPAB	Pennsylvania State College	State College, Pa.	283
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	360
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College	Agricultural College, N. D.	283
WPAL	Superior Radio & Telephone Equipment Co.	Columbus, Ohio	286
WPAM	Auerbach and Guettel	Topeka, Kan.	275
WPAP	Theodore D. Phillips	Winchester, Ky.	360
WPAR	Wed Battery and RadioCo.	Beloit, Kans.	236
WPAU	Concordia College	Moorhead, Minn.	286
WPAZ	John R. Koch (Dr.)	Charleston, W. Va.	273
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	360
WQAC	E. B. Gish	Amarillo, Texas	234
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275
WQAF	Sandusky Register	Sandusky, Ohio	240
WQAL	Coles County Telephone & Telegraph Co.	Mattoon, Ill.	258
WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	360
WQAQ	Abilene Daily Reporter (West Texas Radio Co.)	Abilene, Texas	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAX	Radio Equipment Company	Peoria, Ill.	248
WQJ	Calumet Baking Powder—Rainbow Gardens Station	Chicago, Ill.	448
WRAF	The Radio Club (Inc.)	Laporte, Ind.	224
WRAL	Northern States Power Co.	St. Croix Falls, Wis.	248
WRAM	Lombard College	Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	236
WRAO	Radio Service Co.	St. Louis, Mo.	360
WRAV	Antioch College	Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRBC	Imanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corporation of America	Washington, D. C.	469
WRH	Chicago Herald & Examiner	Chicago, Ill.	536
WRK	Doron Bros. Electric Co.	Hamilton, Ohio	360
WRL	Union College	Schenectady, N. Y.	360
WRM	University of Illinois	Urbana, Ill.	360
WRR	City of Dallas (police and fire signal department)	Dallas, Texas	360
WRW	Tarrytown Radio Research Laboratory (Koenig Bros.)	Tarrytown, N. Y.	273
WSAB	Southeast Missouri State Teachers College	Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural College	Clemson College, S. C.	360
WSAD	J. A. Foster Co.	Providence, R. I.	261
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	309
WSAJ	Grove City College	Grove City, Pa.	259
WSAN	Allentown Radio Club	Allentown, Pa.	229
WSAP	Seventh Day Adventist Church	New York, N. Y.	263
WSAR	Doughty & Welch Electrical Co.	Fall River, Mass.	254
WSAU	Camp Marienfeld	Chesham, N. H.	229
WSAX	Chicago Radio Laboratory	Chicago, Ill.	268
WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	233
WSAZ	Chas. Electric Shop	Pomeroy, Ohio	258
WSB	Atlanta Journal	Atlanta, Ga.	429
WSL	J. & M. Electric Co.	Utica, N. Y.	273
WSY	Alabama Power Co.	Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAF	Louis J. Gallo	New Orleans, La.	242
WTAG	Kern Music Co.	Providence, R. I.	258
WTAH	Carmen Ferro	Belvedere, Ill.	236
WTAJ	The Radio Shop	Portland, Me.	230
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gordon & Son	Osseo, Wis.	220
WTAR	Reliance Eectric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	286
WTAT	Edison Electric Illuminating Co.	Boston, Mass. (portable)	244
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	360
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	242
WTAW	Agricultural & Mechanical College of Texas	College Station, Tex	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAY	Oak Leaves Broadcasting Station	Oak Park, Ill.	283
WTAZ	Thomas J. McGuire	Lambertville, N. J.	283
WTG	Kansas State Agricultural College	Manhattan, Kans.	273
WWAB	Hoenig, Swern & Co (John Rasmusson)	Trenton, N. J.	220
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	Alamo Dance Hall, L. J. Crowley	Joliet, Ill.	227
WWAO	Michigan College of Mines	Houghton, Mich.	244
WWJ	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	517
WWL	Loyola University	New Orleans, La.	260
WQAM	Electrical Equipment Co.	Miami, Fla.	283
WYAW	Catholic University	Washington, D. C.	236

Little Lessons in Radio for Beginners

(Continued from page 25)

Cleveland only about 235 miles away. All messages had to be relayed by way of Indianapolis. These curious circumstances may be due to ore deposits.

What is it that sometimes causes a station to fade away without my having changed the tuning controls?

This is a subject about which scientists are still in some doubt. Fading, believed by some authorities to be due to atmospheric disturbances in the "Heaviside Layer." By this term, scientists refer to a strata of rare atmosphere miles above the surface of the earth. This strata produces the effect of an enormous reflector of radio waves. When disturbances affect the "Heavyside Layer," radio waves are absorbed instead of being reflected. Such fading generally lasts for a short time only. The station usually comes back if you leave the controls set as they were when you were receiving the station at proper length.

Why is it that my set will not receive with the range and volume during the day time that it will at night?

It is an accepted fact that radio waves have a range and strength during the day time less than one-fifth as great as they have after dark. The rays of the sun practically absorb radio energy. There is no receiving set made that can change this condition. Get what you can during the day time, but do not attempt the impossible.

What is it that sometimes causes a set to howl when I place my hand upon the controlling dials?

It is the effect of "body capacity." The human body possesses a certain amount of so-called "electrical capacity."

What is it that causes a crackling, pounding noise, at times very much worse than others?

This is what is known as "static." Static is electricity in the air which becomes so intermingled with the radio waves that there is no possible way for separating the two. The finest, most sensitive radio set will naturally bring in "static" even louder than a sluggish receiver, which is not sensitive either to "static" nor to the radio waves you are trying to receive.

"Static" is due to atmosphere conditions beyond control of anyone. "Static" is generally more pronounced in summer than in winter but even on some winter nights, static is bad and on some summer nights, it is almost entirely absent.

Why is it that receiving conditions vary so greatly from time to time?

The latest theory of the transmission of radio energy from broadcasting station to receiving set is that the radio energy is shot off in all directions from the transmitting antenna in absolutely straight lines. (The old theory was that the energy traveled in waves, bounding along on the surface of the earth.)

Canadian Stations

CFAC	Calgary Herald	Calgary, Alberta	430
CFCA	Star Pub. & Prtg. Co.	Toronto, Ontario	400
CFCF	Marconi Wireless Teleg. Co. of Canada	Montreal, Quebec	440
CFCH	Ahitibi Power & Paper Co.	Iroquois Falls, Ont.	400
CFCJ	La Cie de L'Evenement	Quebec, Quebec	410
CFCK	Radio Supply Co.	Edmonton, Alberta	410
CFCL	Centennial Methodist Church	Victoria, British Col.	400
CFCN	W. W. Grant Radio (Ltd.)	Calgary, Alberta	440
CFCQ	Radio Specialties (Ltd.)	Vancouver, B. C.	450
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCW	The Radio Shop	London, Ont.	420
CFDC	Sparks Co.	Nanaimo, B. C.	430
CFQC	The Electric Shop (Ltd.)	Saskatoon, Saskatchewan	400
CFRC	Queens University	Kingston, Ontario	450
CFUC	University of Montreal	Montreal, Quebec	400
CHAC	Radio Engineers	Halifax, Nova Scotia	400
CHBC	Albertan Publishing Co.	Calgary, Alberta	410
CHCB	Marconi Company	Toronto Ont.	410
CHCD	Canadian Wireless & Elec. Co.	Quebec, Quebec	410
CHCE	Western Canada Radio Sup. (Ltd.)	Victoria, B. C.	9
CHCL	Vancouver Merchants Exchange	Vancouver B. C.	440
CHCM	Riley & McCormack	Calgary, Alberta	415
CHCS	The Hamilton Spectator	Hamilton, Ont.	420
CHYC	Northern Electric Co.	Montreal, Quebec	410
CJCA	Edmonton Journal	Edmonton, Alberta	455
CJGC	London Free Press Prtg. Co.	London, Ont.	430
CJCD	T. Eaton Co.	Toronto, Ont.	410
CJCE	Sprott-Shaw Radio Co.	Vancouver, B. C.	420
CJCI	Maritime Radio Corp.	St. John, New Brunswick	400
CJCM	J. L. Phillipe	Monti Joli, Quebec	430
CJCN	Simons Agnew & Co.	Toronto, Ont.	410
CJSC	Evening Telegram	Toronto, Ont.	430
CKAC	La Presse Pub. Co.	Montreal, Quebec	430
CKCD	Vancouver Daily Province	Vancouver, B. C.	410
CKCE	Canadian Independ. Telephone Co.	Toronto, Ont.	450
CKCK	Leader Pub. Co.	Regina, Saskatchewan	420
CKCO	Ottawa Radio Association	Ottawa, Ont.	440
CKCX	P. Burns & Co.	Calgary, Alberta	440
CKLC	Wilkinson Electric Company	Calgary, Alberta	400
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	410
CKY	Manitoba Telephone System	Winnipeg, Manitoba	450
CNRO	Canadian National Railways	Ottawa, Ont.	435

Cuban Stations

PWX	Cuban Telephone Co.	Habana	400
2DW	Pedro Zayas	Habana	300
2AB	Alberto S. de Bustamante	Habana	240
20K	Mario Garcia Velez	Habana	360
2BY	Frederick W. Borton	Habana	260
2CX	Frederick W. Borton	Habana	320
2EV	Westinghouse Elec. Co.	Habana	220
2TW	Roberto E. Ramires	Habana	230
2HC	Heraldo de Cuba	Habana	275
2LC	Luis Casas	Habana	250
2KD	E. Sanchez de Fuentes	Habana	350
2MN	Fausto Simon	Habana	270
2MG	Manuel G. Salas	Habana	280
2JD	Raul Perez Falcon	Habana	150
2K	Alvara Daza	Habana	200
2HS	Julio Power	Habana	180
2OL	Oscar Collado	Habana	290
2WW	Amadeo Saenz	Habana	210
5 V	Leopoldo V. Figueroa	Colon	360
6KW	Frank H. Jones	Tuinucu	340
6KJ	Frank H. Jones	Tuinucu	275
6CX	Antonio T. Figueroa	Cienfiegos	170
6DW	Eduardo Terry	Cienfiegos	225
6BY	Jose Ganduxe	Cienfiegos	300
6AZ	Valentin Ullivarri	Cienfiegos	200
8BY	Alberto Ravelo	Stgo. de Cuba	250
8FU	Andres Vinnet	Stgo. de Cuba	225
8DW	Pedro C. Anduz	Stgo. de Cuba	275

British Stations

2LO	London	365
51T	Birmingham	475
5WA	Cardiff	350
6BM	Bournemouth	385
2ZY	Manchester	375
5NO	Newcastle	400
5SC	Glasgow	420
2BD	Aberdeen	495
6SL	Sheffield (relay station)	303

French Stations

YN	Lyon	740	
FL	Paris (Eiffel Tower)	2,600	
8AJ	Paris	1,780	
ESP	Paris	450	

Effective Inductances

By JOHN B. RATHBUN

Because of its exceedingly low distributed capacity, the spider-web type of coil has long been noted for its effectiveness as a tuning inductance or radio frequency choke. Properly constructed, such coils represent practically pure inductance due to the fact that adjacent turns of wire are not parallel, and hence have no wasteful condenser effect through which the radio energy can be short circuited. Almost any hookup can be improved to a marked degree by substituting spiderweb type coils for the single layer drum windings more commonly employed as inductances.

In the older type of spiderweb, the wire was wound in and out through a number of radial wooden spokes with the latter imbedded in a wood disc core. The spokes at one time afforded a support for the wire and a means of winding the coil. While this was a marked improvement on the single layer and honeycomb type of winding, yet it was found that there was a loss due to the mass of wood within the magnetic field of the coil and that the coil functioned much better when the wooden spokes were withdrawn. When this latter method was adopted, the coils were made self-supporting by coating them with a non-capacitative varnish which eliminated all dielectric material within the electric field except the wire covering and the thin coating of cellulose varnish.

Adopting this principle in its entirety, the Pfanstiehl Radio Company of Highland Park, Ill., have developed a full line of "Pure Inductances" ranging from simple and tapped inductance coils to complete variometers, couplers and oscillators. All of the coils made by this firm are of the self-supporting type without wooden cores and protected by a special non-capacitative varnish of great mechanical strength. So far as my tests have gone on this apparatus, and I have tried out the devices in a number of circuits, the coils show an improvement of from 20 to 40 per cent in the sensitivity and signal strength over the common single layer tube wound coils. They tune much sharper and there is less loss due to capacitance between turns.

The advantages of the disc windings are particularly in evidence in the Pfanstiehly couplers and variometers where two of the discs are magnetically coupled by placing them face to face with about one-quarter inch between the two coils. As the coils are only about one-quarter inch thick, all turns of wire are included in the mutual fields, which is not the case with tubular or honeycomb coils where the far turns of one coil may be removed several inches from the coil to which it is inductively coupled.

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6 Aerials, patent
7 Aerials, socket plug
8 Amplifiers
9 Amplifying units
10 Ammeters

B
11 "B" batteries
12 Batteries (state voltage)
13 Battries, dry cell
14 Batteries, storage
15 Battery chargers
16 Battery chemicals
17 Battery clips
18 Battery handles
19 Battery holders
20 Battery paint
21 Battery plates
22 Battery substitutes
23 Bezels
24 Binding posts
25 Binding posts, composition
26 Binding posts, initialed
27 Binding posts, insulated
28 Binding posts, nickel-plated
29 Books
30 Boxes, battery
31 Boxes, grounding
32 Bridges, wheatstone
33 Broadcasting equipment
34 Bushings
35 Buzzers

C
36 Cabinets
37 Cabinets, battery
38 Cabinets, loud speaker
39 Carbons, battery
40 Cat whiskers
41 Code practisers
42 Coils
43 Coils, choke
44 Coils, coupling
45 Coils, duo-lateral
46 Coils, filter
47 Coils, grid
48 Coils, honeycomb
49 Coils, inductance
50 Coils, Reinartz
51 Coils, stabilizer
52 Coils, tuning
53 Compounds, battery sealing
54 Compounds, impregnating
55 Condenser parts
56 Condenser plates
57 Condensers, air
58 Condensers, antenna coupling
59 Condensers, by-pass
60 Condensers, coupling
61 Condensers, filter
62 Condensers, fixed (paper, grid or phone)
63 Condensers, variable grid
64 Condensers, variable mica
65 Condensers, variable air
66 Condensers, vernier
67 Contact points
68 Contacts, silver
69 Contacts, platinum
70 Contacts, switch
71 Cord tips
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RADIO AGE BUYERS' SERVICE,
500 N. Dearborn St., Chicago, Ill.
Gentlemen:

Please see that I am supplied with buying specifications and prices on the articles numbered herewith:

(If you are engaged in the radio industry, please check one of these squares):

☐ Dealer ☐ Jobber ☐ Mfgrs.' Rep. ☐ Manufacturer

Firm [If identified with Radio industry] .....

My Occupation ..... My Name .....

Address ..... City ....., State .....

Attach any other necessary comments on separate sheet

DEVICES displaying this seal have been tested and approved by the RADIO AGE INSTITUTE. Look for the seal. It is your guarantee of good apparatus.

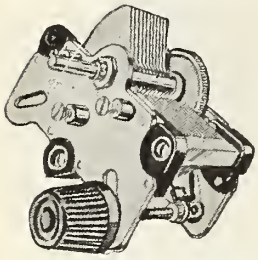
The apparatus illustrated and described below have successfully passed our tests for November, 1924.

Radio Age Institute

Manufacturers' Testing Service

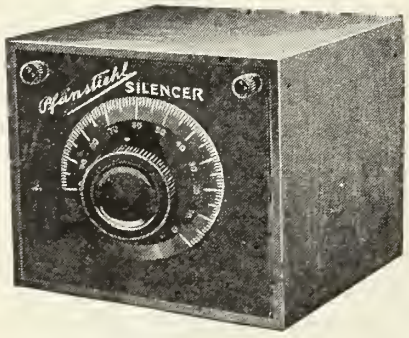
MEMBERS of the staff of RADIO AGE will be pleased to test devices and materials for radio manufacturers with the object of determining their efficiency and worth. All apparatus which meets with the approval of various tests imposed by members of the technical staff of RADIO AGE will be awarded our endorsement and support, and the seal shown to the left will be furnished free of charge by RADIO AGE, indicating that the apparatus submitted fulfills requirements of good design, electrically and mechanically. It will be a pleasure to test out materials that are marketed, without charge. Materials for testing should be sent to

RADIO AGE INSTITUTE
504 N. Dearborn Street, Chicago, Ill.



American Brand Condensers

Test No. 14. VARIABLE CONDENSER. Manufactured by the American Brand Corporation of 8 West Park St., Newark, N. J. Embodies a new idea in vernier control of the plates. Mechanical construction of the condenser is very good. Insulating material so placed with respect to electrostatic field that losses are at a minimum. A worm drive gear system having a ratio of 100 to 1 is employed, this arrangement moving the entire set of plates. Plate ends finished in a new way to cut down radio frequency loses. Has a low zero capacity. The phase angle difference of this condenser is less than 20' and the insulation resistance is 6 ohms at approximately 1,000 cycles. Furnished with or without the worm gear vernier drive. Tested and approved by RADIO AGE Institute.



Pfanstiehl Silencer

Test No. 15. WAVE TRAP. Known as the Pfanstiehl Silencer, made by the Pfanstiehl Radio Company of Highland Park, Ill. This trap is an inductively coupled absorption circuit which can be used on any type of receiver, as an interference preventor. The unit is connected in the antenna lead of the receiving system and is tuned to the unwanted station. The un-wanted signal is absorbed and dissipated in this circuit, and any other frequency may be tuned to without interference. Tested and approved by the RADIO AGE Institute.

Marle Audio Transformer

Test No. 16. AUDIO FREQUENCY TRANSFORMER. Made by the Marle Engineering Company of Orange, N. J. Two ratios were submitted for test, both transformers showing up very well under rigid observation. Has inding posts conveniently located to facilitate connections. Both types encased in a durable hard rubber shield, well finished. Tested and approved by the RADIO AGE Institute.

Test No. 17. FIXED GRID LEAK. Made by the Durham & Company, Inc., 1936 Market St, Philadelphia, Pa. This grid leak is of the type using the system of blowing a resistant metal on the inner wall of a glass tubing, and connecting metal end thereto. This construction assures perfect contact, and prevents changes in resistance, a perfect resistance conductivity, and noiseless operation. Made in twenty-eight sizes ranging from 5000 ohms to 10 megohms. Tested and approved by RADIO AGE Institute.

Durham Grid Leak

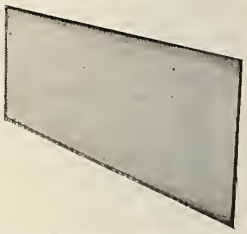
Test No. 18. RADIO FUSE. Made by the Chicago Fuse Manufacturing Company. Designed to protect the filament circuit of radio receivers from overload, and short circuits. The fuse is so designed that it will burn out if a current of over 140 milliamperes is passed through the circuit. The fuse is made employing an element of very fine fuse wire stretched between two metal terminals and covered with a small glass globe to make performance uniform with all fuses. The fuse is inserted into a small clip arrangement, the end of the clips being used as soldering lugs as well as fuse holders. Tested and approved by RADIO AGE Institute. Sold by the Chicago Fuse Mfg. Co., Laflin and 15th Sts., Chicago, Ill.

Radio Tube Fuse

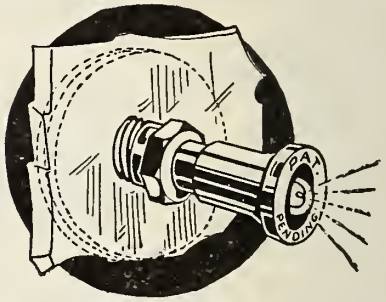
Test No. 19. TUNING UNIT, known as the Ambassador Coil. Made by the Ambassador Sales Company of New York. The unit is well made with the intention of keeping down losses to a minimum. All coils are wound with high frequency cable Litzendraht; to keep wire resistance low. The tuner has no other losses in the form of taps or other devices to change the coupling ratio. The primary is of the aperiodic design in fixed relation to the secondary coil, and the tickler is wound on a rotor ball, which is so designed to least affect the tuning of the secondary circuit. This unit is an excellent one for most any conventional circuit using tickler coil feedback. Tested and approved by the RADIO AGE Institute.

Ambassador Coil

Bakelite Insulating Material



Test No. 20. INSULATING COMPOUND, Known as Bakelite. Made by the Bakelite Corporation of 247 Park Avenue, New York, N. Y. This insulating compound is mechanically strong, does not chip and is impervious to moisture. It does not acquire the irridescent bluish glaze so common to other insulating compounds of poor quality. Used in the manufacture of hundreds of radio appliances. Tested and approved by RADIO AGE Institute.



Kant-Blo Signal

Test No. 21. FILAMENT CIRCUIT PROTECTIVE DEVICE known as the Kant-Blo Switch or Binding Post Signal. Manufactured by the Ganio Kramer Co., Inc., of New York City, N. Y. This device embodies the idea of using a small signal light similar to that of a switchboard which lights up immediately if the filament circuit is short-circuited with a heavy overload. Made in two styles, one the Kant Blo Binding Post, which has the tiny bulb inside of the cap, and the Kant-Blo Switch which has the signal light imbedded in the switch knob protruding from the panel. Tested and approved by the RADIO AGE Institute.

Flint Audio Transformer

Test No. 22. AUDIO FREQUENCY TRANSFORMER. Made by the Flint Radio Company of 1804 Wilson Avenue, Chicago, Illinois. Has a laminated core made of good silicon steel, with the design so effected as to insure an even distribution of flux throughout the entire field. Coils wound with No. 40 enameled copper wire, the layers being well insulated. Shielded in a black enameled metal case with nickled trimmings. The ratio of the transformer is 4 to 1. Each transformer is individually tested on broadcast signals before shipment. Tested and Approved by RADIO AGE Institute.

ZENITH RADIO

TRADE MARK

—it tunes through everything

Super-Zenith VII

The New SUPER-ZENITH

for people who take pride in their homes

ONE glance at the new Super-Zenith and you are instantly impressed with the sheer artistry of its design, the excellence of its craftsmanship, the superb beauty of its finish—you know that within its case is a receiving set capable of the most extraordinary performance—a receiving set entitled to the place of distinction in the finest home.

Radio enthusiasts: Note that the new Super-Zenith is NOT regenerative. It is a six-tube set in four different models ranging from $230 to $550, with a new, unique and really different patented circuit controlled exclusively by the Zenith Radio Corporation. Amplification is always at a maximum in each stage for any wave-length. *The Super-Zenith line is not affected by moisture.* For the first time, you have here a set that—

1—tunes through *everything* and selects the station you really want.
2—requires only *two* hands—*not three*—to operate.
3—brings in each station *at only one point on the dial.*
4—affords such mathematical precision and simplicity that you can run over the entire dial in 1½ minutes and pick up *more* stations with greater clarity and volume than any other set on the market. Direct comparisons invited.

Write for the name of the nearest dealer from whom you can obtain a demonstration of this outstanding marvel of the radio world.

Dealers and Jobbers: Write or wire for our exclusive territorial franchise.

Super-Zenith VII (Not regenerative)—6 tubes—2 stages tuned frequency amplification—detector and 3 stages audio frequency amplification. Installed in a beautifully finished cabinet of solid mahogany—44⅞ inches long, 16¾ inches wide, 10⅝ inches high. Door panels inlaid. Slanting panel of sheet bronze, mahogany finish, with scales and indicators in metallic relief. Gold plated pointers, to prevent tarnish. Compartments at either end for dry batteries. Can be operated on either wet or dry batteries. Either inside or outside antenna. Price (exclusive of tubes and batteries) $230

Super-Zenith VIII Same as VII except—built with mahogany legs of well-proportioned appropriate design, converting model into console type.
Price (exclusive of tubes and batteries).....$250

Super-Zenith IX Same as VII except—built with legs and additional compartments containing built-in Zenith loud speaker on the one side and generous storage battery space on the other.
Price (exclusive of tubes and batteries).....$300

Super-Zenith X Contains two new features superseding all receivers.
1st—Built-in, patented, Super-Zenith Duo-Loud Speakers, (harmonically synchronized *twin* speakers and horns) designed to reproduce both high and low pitch tones otherwise impossible with single-unit speakers.
2nd—Zenith Battery Eliminator, distinctly a Zenith achievement. Requires no A or B batteries or charger. Price (exclusive of tubes)..... $550

Zenith Radio Corporation

Eastern Office: 1269 Broadway, New York
Executive Offices: 332 South Michigan Ave., CHICAGO

ZENITH—the exclusive choice of MacMillan for his North Pole Expedition—Holder of the Berengaria Record

Zenith Radio Corporation
Dept. 11C
332 South Michigan Avenue, Chicago, Illinois

Gentlemen: Please send me illustrated literature giving full details of the Super-Zenith.

Name.....

Address.....

Of Course It's a CROSLEY

Better-Cost Less Radio Receiver

TO combine the two most desirable things in radio—distant, clear reception at the lowest possible price—there is only one receiver for you. That is a Crosley.

During the past twelve months Crosley made and sold more sets than any manufacturer in the world, we believe. This is self-evident proof of Crosley Quality and Crosley Performance. From the one-tube Armstrong Regenerative Receiver Crosley 50 at $14.50, the lowest priced regenerative set on the market, to the three-tube Armstrong Regenerative and Reflex Trirdyn Regular at $65—in special mahogany cabinet $75—Crosley Receivers, each in its own class, assure you as good or better reception than any other instrument of the same number of tubes. At the same time they are the least expensive sets ever offered to the public.

The Trirdyn Regular has especially come through the summer with flying colors. The combination of one stage of tuned radio frequency, with regenerative detector and reflexed amplification, has proven beyond a doubt that the features of selectivity, volume and ease of operation can be obtained with three tubes better than heretofore has been possible with five tubes. We believe no other receiver combines these features so well incorporated in the Trirdyn.

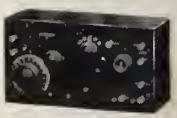
Before You Buy—Compare Your Choice Will Be a Crosley
For Sale By Good Dealers Everywhere

Crosley Regenerative Receivers are licensed under Armstrong U. S. Patent 1,113,149
Prices West of the Rockies add 10%

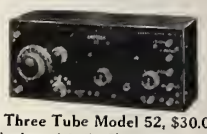
Write For Complete Catalog

THE CROSLEY RADIO CORPORATION
Powel Crosley, Jr., President
1163 Alfred Street Cincinnati, O.
Crosley Owns and Operates Broadcasting Station WLW

Crosley One Tube Model 50, $14.50
With tube and Crosley Phones $22.25



Crosley Two Tube Model 51, $18.50
With tubes and Crosley Phones $30.25



Crosley Three Tube Model 52, $30.00
With tubes and Crosley Phones $45.75

Crosley
Head Phones
Better—Cost Less
$3.75

Crosley Two Tube Model 51-P, $25.00
With tubes and Crosley Phones $36.75

Crosley Trirdyn Regular, $65.00
With tubes and Crosley Phones $80.75

Crosley Trirdyn Special, $75.00
With tubes and Crosley Phones $90.75

Mail This Coupon At Once

The Crosley Radio Corp'n,
1163 Alfred St.
Cincinnati, O.

Mail me, free of charge, your catalog of Crosley receivers and parts with booklet entitled "The Simplicity of Radio."

Name_____

Address_____

RADIO AGE

The Magazine of the Hour

December
1924

Price
25
Cents

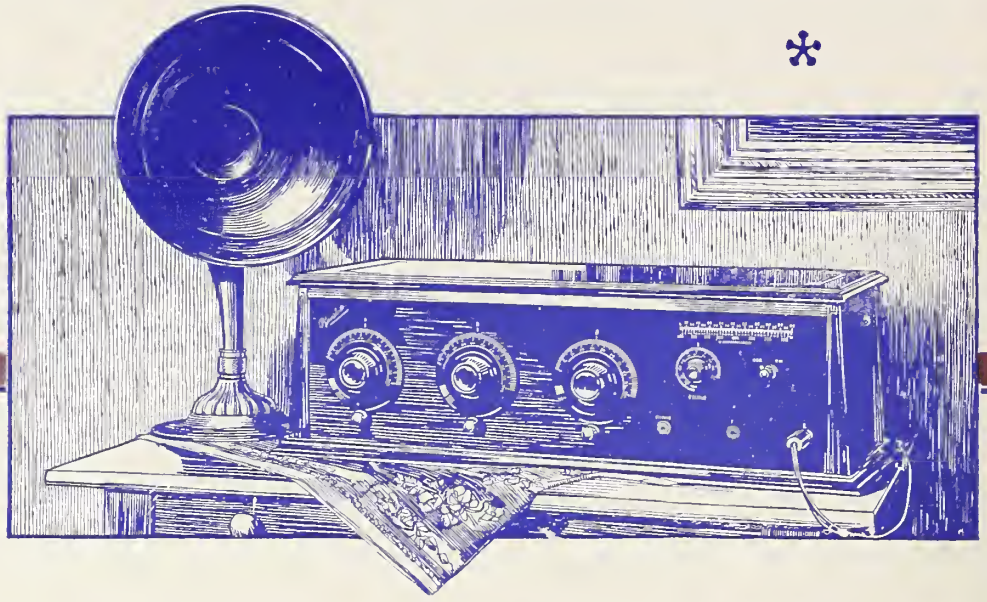
In This Issue

- Complete Blueprints of a New Super-Heterodyne.
- How to Make a Receiver that Minimizes Static.
- What Increased Power will Mean to Radio.
- Stories and Pictures of Your Radio Stars.
- "Pickups and Hookups" by Readers.

Blueprint Section Every Month

Let Our Hookups Be Your Guide

"1000 Miles Away the Same as a Local Station"



The PFANSTIEHL Model 7

The Last Word in Simplicity

Read what Frank D. Pearne, noted Radio Editor and Expert says:

"After testing hundreds of radio sets, I decided upon the Pfanstiehl Model 7 for my own personal use, and I can recommend it because it produced the most satisfactory results I have yet attained with any set.

"The test was carried on during all conceivable kinds of weather, but even when static was at its worst it was possible to get stations more than 1,000 miles away on the loud speaker, with all the volume of a local station.

"As the Pfanstiehl Model 7 is Non-Oscillating, no sound other than signals was heard. The selectivity was excellent and many long distance stations were picked up when local broadcasting was going on at the same time, only a few miles away.

"Several other types of receivers were compared with the Model 7, and whenever it was possible to pick up the same stations with other receivers, the reception was not so good."

The Pfanstiehl Non-Oscillating System

Radio frequency has had one serious obstacle to overcome; it has heretofore generated oscillations which caused howls, squeals and other disturbing noises, if not suppressed. Formerly these oscillations were considered as inevitable and were suppressed more or less effectively with resistances, potentiometers, neutralizing condensers, etc.

Pfanstiehl believed these oscillations could be avoided and traced them to their sources. Through his new system of controlling and shaping electro-magnetic and electrostatic fields, no disturbing oscillations are generated in the Pfanstiehl Model 7 Receiver. No neutralizing or adjusting is therefore necessary. In consequence a new simplicity of operation is attained. The effect of no misdirected fields is to give a new purity of tone and a new efficiency which is reflected in great distance and volume.

The New "Station Finder"

is another big Pfanstiehl improvement that takes the guesswork out of tuning. This consists of three large dials which tune the three large circuits. Therefore, these dials are turned identically, or to the same number, for any given station. This means that to receive on any one "wave length" you need to know but one number. That number is given by the "Station Finder" on the right-hand upper corner of the panel. On its lower scale read the "wave length" of the station desired. (This information is obtained from the daily program in the newspaper.) Directly above the "wave length" read the number at which the three large dials are all to be set to secure reception.

DEALERS: Write for the facts about the Pfanstiehl Model 7 and special exclusive-territory proposition.

THE PFANSTIEHL RADIO COMPANY
Highland Park 22 S. Second Street Illinois

Pfanstiehl

Earn $50 to $200 a Week *in* RADIO *

You can. Hundreds of ambitious men are already earning thousands of dollars in this wonderful new industry—you, too, can get your share. Mail coupon below for Free Book which describes fully the amazing money-making opportunities in Radio and tells how YOU can earn from $5,000 to over $10,000 a year.

The astounding growth of Radio has created thousands of big money opportunities. Millions of dollars were spent during the past year on Radio, and thousands of young men are needed right now to meet the ever-increasing demand of work.

Men are needed to build, sell and install Radio sets—to design, test, repair—as radio engineers and executives—as operators at land stations and on ships traveling the world over—as operators at the hundreds of broadcasting stations. And these are just a few of the wonderful opportunities.

Easy to Learn Radio at Home in Spare Time

No matter if you know *nothing* about Radio now, you can quickly become a radio expert, by our marvelous new method of practical instruction—instruction which includes all the material for building the latest up-to-date radio apparatus.

PAY INCREASES OVER $100 A MONTH

I am averaging anywhere from $75 to $150 a month more than I was making before enrolling with you. I would not consider $10,000 too much for the course.

(Signed) A. N. Long,
120 N. Main Street,
Greensburg, Pa.

DOUBLES SALARY

I can very easily make double the amount of money now than before I enrolled with you. Your course has benefited me approximately $3000 over and above what I would have earned had I not taken it.

T. Winder,
731 Bedford Ave.,
Grand Junction, Colo.

FROM $15 to $80 A WEEK

Before I enrolled with you I was making $15 a week on a farm. Now I earn from $2080 to $4420 a year, and the work is a hundred times easier than before. Since graduating a little over a year ago, I have earned almost $4000 and I believe the course will be worth at least $100,000 to me.

(Signed) Geo. A. Adams,
Route 1, Box 10,
Tamaqua, Pa.

Scores of young men who have taken our course are already earning from $75 to $200 a week. Merle Wetzel of Chicago Heights, Ill., advanced from lineman to Radio Engineer, increasing his salary 100% *even while taking our course!* Emmett Welch, right after finishing his training, started earning $300 a month and expenses. Another graduate is now an operator of a broadcasting station—PWX of Havana, Cuba, and earns $250 a month. Still another graduate, only 16 years, is averaging $70 a week in a radio store.

Wonderful Opportunites

Hardly a week goes by without our receiving urgent calls for our graduates. "We need the services of a competent Radio Engineer." "We want men with executive ability in addition to radio knowledge to become our local managers." "We require the services of several resident demonstrators"—These are just a few small indications of the great variety of opportunities open to our graduates.

Take advantage of our practical training and the unusual conditions in Radio to step into a big paying position in this wonderful new field. Radio offers you more money than you probably ever dreamed possible—fascinating easy work—a chance to travel and see the world if you care to or to take any one of the many radio positions all around you at home. And Radio offers you a glorious future!

The National Radio Institute is America's Pioneer Radio School—established in 1914. Our course is the absolutely complete one now being offered which qualifies for a government first-class commercial license. It gets you the *bigger* paying jobs in Radio.

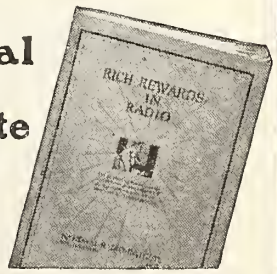
Send for FREE RADIO BOOK

Learn more about this tremendous new field and its remarkable opportunities. Learn how you can quickly become a radio expert and make big money in radio.

We have just prepared a new 32-page booklet which gives a thorough outline of the field of Radio—and describes our amazing practical training in detail. This Free Book, "Rich Rewards in Radio," will be sent to you without the slightest obligation. Mail coupon for it *now!*

For a short time we are offering a reduced rate to those who enroll at once. Act promptly and save money.

National Radio Institute
Dept. 53MA
Washington D. C.



NATIONAL RADIO INSTITUTE
Dept. 53MA, Washington, D. C.

Please send me without the slightest obligation your Free Book, "Rich Rewards in Radio," and full details of your special offer of Free Employment Service. Please write plainly.

Name..... Age.....

Address.....

City..... State.....

RADIO AGE
The Magazine of the Hour
Established March, 1922
WITH WHICH IS COMBINED RADIO TOPICS

Volume 3 *December, 1924* *Number 12*

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Radio Age is published monthly by RADIO AGE, Inc.
Member: Audit Bureau of Circulations.

Publication Office, Mount Morris, Ill.
Chicago Office, 500 N. Dearborn St.

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Final Advertising forms close on the 20th of the 2nd month preceding date of issue

Issued monthly. Vol. 3, No. 12. Subscription price, $2.50 a year.
Application made for transfer of second class entry from the post office at Chicago, Illinois, to the post office at Mount Morris, Illinois

A Chat With the Editor

POPULAR RADIO for November, with delicious aplomb, launches several announcements which indicate that our contemporary's swelling superiority complex is about ready for the anaesthetic and the surgeon's snickersnee.

The magazine at last introduces picture diagrams into its pages, at the same time making a left-handed apology to "experienced experts" who may encounter them.

Picture diagrams were first published in RADIO AGE in May, 1923, and a year ago we predicted that eventually other radio publications would adopt this obviously excellent method of aiding the inexperienced beginner. We were fortunate enough to increase the number of our regular readers by this improvement, for we consistently published wiring diagrams along with the picture diagrams, so that both the experienced and the inexperienced readers might have what they wanted. This policy has been followed in our free blueprints published as a part of RADIO AGE each month.

After making its announcement that it is now falteringly taking the well-worn trail, our contemporary goes on to say:

> Of course the Editor believes that the average reader of Popular Radio is quite a bit more intelligent and exacting than the reader of any other radio periodical.

We have suspected all along that the editor of Popular Radio believed just that. But to have him broadcast it places us in a condition bordering on incrustation. And think of our readers! (Our December press run was more than 80,000 copies!)

We are convinced that the teaspoon still is mightier than the pen in negotiating apple sauce.

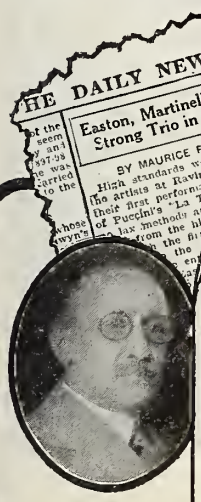
Frederick Smith

Editor of RADIO AGE.

At Last!

Radio That Satisfies

The Music Critic



THE DAILY NEWS, SATU

Easton, Martinelli, Danise, Strong Trio in "La Tosca"

BY MAURICE ROSENFELD.

High standards were maintained last ... the artists at Ravinia last ... their first performance ... "La Tosca" ... of Puccini's ... lax methods and ... lax from the hig... the fir... the ... en...

THE CHICAGO DAILY NEWS
EDITORIAL ROOMS

August 6, 1924.

E. N. Rauland, Pres.
Rauland Manufacturing Co.,
2650 Coyne Street, Chicago, Ill.

My dear Mr. Rauland:

I want to express my great pleasure in witnessing the recent test of amplifying transformers in your laboratory, and in selecting, from different instruments tested, the one which seemed to me to reproduce most exactly the artist's original tones. I was indeed gratified to learn, after the tests, that the instrument which I had repeatedly selected as by far the most successful in reproducing, not alone the music, but even the very personality of the artist, was none other than your own new "Rauland-Lyric" Transformer.

I feel confident that music lovers everywhere will appreciate the contribution you have made to their enjoyment in the creation of this reproducing instrument.

Very truly yours,
Maurice Rosenfeld
Music Critic,
Chicago Daily News —

Price, $9.00

In placing his mark of approval upon Rauland-Lyric, Mr. Maurice Rosenfeld has invested Radio with a new beauty and dignity. His words carry positive assurance, to music-lovers and trained musicians, that they can now admit Radio to their field of appreciation and enjoyment, with the certainty that all voices and instruments will be reproduced with their original and distinctive Tone Quality.

Mr. Rosenfeld, a veteran among metropolitan music critics, selected Rauland-Lyric, upon the sole basis of Tone Quality, from a group of the world's best audio transformers.

Karleton Hackett, famous critic of the Chicago Evening Post, pronounced Rauland-Lyric a "distinct advance in the musical quality of radio reproduction."

You can have, in your home, the amplifying instrument which has been commended by eminent critics. Rauland-Lyric can be installed in your present set, or one that you may buy, to replace any ordinary audio transformer.

Ask your dealer.

RAULAND MANUFACTURING COMPANY
Pioneers in the Industry
2680 Coyne St. Chicago, Ill.

The RADIO KEY BOOK contains the clearest explanation ever given of the nature of audio amplification and equally valuable discussion of many other subjects in Radio. Sent for 10 cents, coin or stamps.

Rauland-Lyric
AN
ALL-AMERICAN
TRADE MARK
TRANSFORMER

The RADIO KEY BOOK
E. N. Rauland

Standard Audio Frequency Transformers
"All-American for Reliability"

Ratio 3 to 1 . . R-12, $4.50 Ratio 5 to 1 . . R-21, $4.75
Ratio 10 to 1 . . R-13, $4.75

Built by precision methods in a modern plant, All-American Standard Audios meet the demand of the public for a dependable, high-quality transformer at a price made possible only by enormous production.

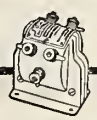
Long Wave Transformer

For highest amplification of intermediate frequencies and perfect reproduction of side bands; 4,000 to 20,000 meters (75 to 15 kilocycles) R-110, $6.00

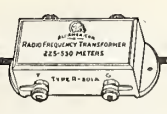
Power Transformers

For *Tone Quality* in a Third Stage, or for Loud Volume with Clearness.

Input type . . R-30, $6.00 Output type . . R-31, $6.00



Precision Made for *Reliability*



Self-Tuned Radio Frequency Transformers
"Wound to Suit the Tube"

Effectively amplifying all frequencies within the radiocast range. For "199" Tubes R-199, $5.00
For "201A" Tubes R-201A, $5.00

10,000 Meter Transformer

(Filter or Input). It gives superior results in beat reception, filtering out a 30 kilocycle frequency with high selectivity and no side-band distortion . . . R-120, $6.00

Radio Frequency Coupler

(Oscillator Coupler). A uniform output at 150 to 650 meters R-130, $5.00

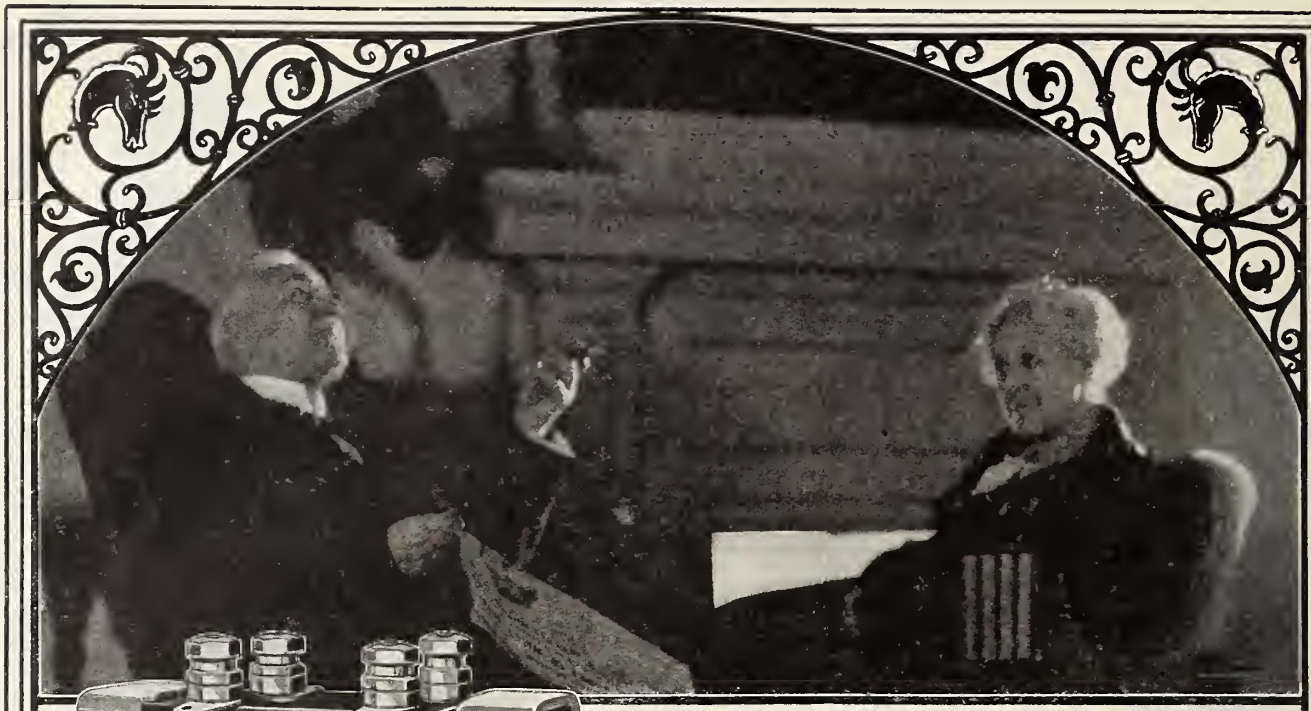
Universal Coupler

Sets a new standard of efficiency as an antenna coupler. As a radio frequency transformer in tuned stages it is unsurpassed R-140, $4.00

ALL-AMERICAN

Largest Selling Transformers in the World

Tested and Approved by RADIO AGE



The Satisfaction of Perfect Reception

An evening of reminiscence with the radio; cherished memories recalled by songs of younger days—school—and sweethearts—and shady lanes—songs long unsung but not forgotten; scenes of the present—jazz—orchestra—speech—all perfectly received with no distortion to mar their full enjoyment.

That's the work of Jefferson Transformers! Perfect reproduction of the voice or instrument with the natural tones faithfully preserved. Full, smooth amplification over the entire musical range. Radio fans the world over will attest as to these Jefferson qualities.

Such excellent performance is but the natural outgrowth of over 20 years specialization in the perfection and manufacture of high-grade transformers. Jefferson Transformers meet matched construction specifications. You have the advantage of the best transformer that science and engineering can produce at a most nominal price.

Sold by all reputable dealers and distributors.

Write for our latest booklet giving information on how to secure proper amplification. It's free.

Manufacturers of

Radio Transformers
Bell Ringing Transformers
Sign Lighting Transformers
Automobile Ignition Coils
Jump Spark Make and Break Coils
Oil Burner Ignition Coils
Furnace and Oil Burner Transformers
Testing Instruments
Toy Transformers
Auto Transformers

✻

Jefferson Electric Mfg. Co.
438 S. Green St., Chicago

Jefferson Super Sensitive Transformers

✻ *Tested and Approved by* RADIO AGE ✻

RADIOTORIALS

MORE power to you! That, in effect, is the United States Government's official greeting to adio broadcasting stations, expressed during and since the Third National Radio Conference in Washington, D. C.

We would not have it understood that this was merely a friendly slap on the back. It was direct word from headquarters that more power in broadcasting stations would mean better reception for millions of receiving sets. Inasmuch as Uncle Sam wants radio reception to attain maximum efficiency, the government allied itself on the side of those who wanted increased wattage behind the microphone.

The Washington conference was participated in by government officials, manufacturers, scientists and broadcasters. There was stubborn opposition to the decisions finally made, and that fact alone justifies a thorough study of what was done and of the probable immediate results. Numerous broadcasting station owners argued that increased power would mean accumulated interference. They protested that stations which lacked the funds to finance greater power would be forced out of business. Therefore, they argued, the project meant eventual monopoly of the air by a few broadcasters.

We believe that such a monopoly would be a radio calamity. At no distant day the majority of American homes will have installed receiving sets. Nobody with vision or conscience would desire to have the control of the great voice that will reach those millions of firesides placed with an interlocking directorate of very rich gentlemen. Anybody who has sufficient optimism and money may start a newspaper or a magazine if he likes, and he may say what he likes in his newspaper or magazine, always providing that he does not step on the rights of others.

Any man who has sufficient capital or credit may build a broadcasting station and he may put on the air nothing but funeral dirges, if he so chooses. It would not pay him to do so any more than it would profit an editor to publish death notices exclusively. In the first instance, the radio fan would tune out the broadcasting station and in the other case the public would stop buying the newspaper.

But it takes all sorts of men to make society and it takes all sorts of broadcasting to fill the radio bill. For that reason radio must remain as free as free speech and the free press. The public must decide what shall survive. It is not so in Europe, either with relation to the press or to radio, but it is certainly so in America.

It is probable that radio broadcasting will resolve itself into a survival of the fittest stations. There may be fewer stations and stations may require more financial capital. But there will be no broadcasting monopoly. Also there will be no censorship of broadcasting. The Department of Commerce is definitely committed to those two propositions.

Would super-power stations and those many lesser stations which are soon to materially increase their present power without essaying the status of superstations, cause radio confusion on the air? Would the result be chaotic interference in congested centers?

The answer to that is the emphatic declaration of the Department of Commerce that all increases of power are to be licensed *experimentally*. If reception is found to be more difficult under the new conditions, the licenses will be withdrawn.

Among the most vigorous advocates of super-power at the Washington conference were two very important manufacturers of receiving sets, neither of whom could possibly be thought of in connection with an effort to aid the so-called radio combine for the simple reason that both are independent manufacturers in active competition with the "Big Four." Both have been earnest promoters of quality broadcasting for the obvious and perfectly worthy purpose of maintaining and stimulating interest in radio.

It is logical to assume that if E. F. McDonald, Jr., president of the Zenith Radio Corporation, and Powel Crosley, Jr., president of the Crosley Radio Corporation, are in favor of more powerful stations, it is because they believe such stations will improve radio reception universally.

THE radio scene shifts. New York, the Mecca of radio-land a few weeks back, now looks to Chicago for the latest in radio technique. From November 18 to 23, at Chicago's Coliseum, the best there is in radio and the men who made it possible will gather to show the equally enthusiastic Middle Westerners what is in store for them in 1925. Smaller shows in the East and in California are doing their bit to keep the public educated radiologically and to prove that no self-respecting citizen can afford to be without a radio. Phrases like "Make this a Radio Christmas" are being coined by alert radio advertisers and imprinted indelibly on the receptive American mind. Radio is becoming a National Institution. It is no longer a toy. It is something we must have, like three meals a day, 8 hours' sleep and political campaigns.

JUDGING from the letters we receive, America's radio fans are up in arms against broadcasting stations who have not mastered the technical art of keeping within their allotted wave bands. Irate listeners complain that "my whole evening was ruined because station W—— didn't keep to its own wave length and could be heard all the way up and down my tuning dial." There are several such violators of the transmitting laws. Whether intentionally or not, some of our most respected stations increase their power several times during an evening and spoil the DX hound's attempts at reaching out into the ether for faraway stations. Some of these broadcasters excuse themselves by explaining that to increase their power after midnight doesn't do any harm, because most of the local stations have signed off by that time. These persons forget that the Western and Middle Western fan's best and sometimes only chance to hear Pacific stations is after midnight. And when a high-powered broadcaster becomes even more powerful, the radio industry suffers several undeserved epithets. Therein lies a point of discussion for Mr. Hoover's conferees. The air is crowded enough as it is.

(Photos by World Studio, and Strauss-Peyton, N. Y.)

With the advent of the new dramatic season, radio plays are coming into favor once more. In the East WGY is furnishing the theatrical entertainment over the air, and KGO, the Pacific Station at Oakland, Calif., is pleasing the fans with fresh masterpieces from Hollywood. Now comes KYW, at Chicago, with the announcement that several dramatic "hits" will be broadcast direct from the stage this Winter. The first was sent over the air last month, when "Applesauce," a farce comedy, was broadcast from Chicago. Miss Claiborne Foster, shown above, is one of the reasons the fans kept listening to the whole play, and Allan Dinehart, in the insert, was the object of masculine envy as the voluble lover of the aforementioned lady.

RADIO AGE
The Magazine of the Hour
M. B. Smith
Business Manager
A Monthly Publication
Devoted to Practical
Radio
Frederick A. Smith
Editor

What Does 'Super-Power' Mean?
HUGE *Stations Still a* DREAM

By S. R. WINTERS

Stormy Petrel of Conference Fades

THE term super-power, the stormy petrel of the early sessions of the Third Annual Radio Conference, lost its identity during the closing hours of this national gathering. The proposed 50,000-watt broadcasting station of David Sarnoff, vice-president of the Radio Corporation of America, lapsed into a remote possibility, if not a dream. Instead of the designation super-power, at once a bugaboo and a magic word, was introduced the conservative term increased power for transmitting stations.

When Mr. Sarnoff announced that the Radio Corporation of America is ready to begin the immediate erection of a great super-power broadcasting station at some point outside of the city of New York, he injected into the deliberations of the Third Annual Radio Conference the outstanding debatable issue. The ensuing debate between the advocates and opponents of this measure introduced both serious and humorous aspects of powerful transmitting stations.

For instance, Charles E. Erbstein, owner of a broadcasting station at Elgin, Illinois, facetiously classified the powerful radio companies as four horsemen riding for a control of the ether waves. On the other hand, Powel Crosley, Jr., in a serious mood, advocated the use of increased power as an agency in overcoming atmospheric disturbances or static and thus making of radio communication something more than a seasonal pastime.

U. S. Paves Way

THE subject of maintaining or removing the limitations on the amount of electric energy put into the antenna at transmitting stations was of itself of great importance. The gravity of the situation was further accentuated by the necessity of the United States Department of Commerce acting upon five or six applications already received from broadcasting authorities asking for permission to use an increased amount of electric power. For instance, Powel Crosley, Jr., has already purchased equipment for installing a 5,000-watt transmitter.

Another reason suggesting the necessity of liberalizing the government regulation with respect to power limitations came to the fore from representatives of broadcasting stations on the Pacific Coast under the serious restrictions of atmospheric disturbances and the effects of daylight. This condition applies generally all over the country, but seems to be especially a limiting factor on the Coast of the Pacific Ocean.

Powel Crosley, Jr., who sponsored "increased power" for broadcasters at the Third Hoover Radio Conference. He owns Station WLW at Cincinnati.

The problem of interference at once offered complications to broadcasting, if power limitations were to be lifted or liberalized to a great extent. Unfortunately, the members of the radio conference had no practical information upon which to base an intelligent opinion as to the amount of interference that would be caused by measurably increasing the power of transmitting stations. The only approach to the needed information consisted of experiments conducted by two or three of the now relatively powerful broadcasting stations —notably, KDKA at East Pittsburgh and WGY at Schenectady—which have been experimentally broadcasting with the use of as much as 5,000 watts. These tests, although not conclusive, seem to indicate that the use of five kilowatts does not appreciably contribute to the interference already existing in the reception of broadcasting programs.

One Favorable Case

THE situation in the United Kingdom, where broadcasting conditions are so dissimilar to those in this country as to make comparisons of little value, offers an instance where a high-power broadcasting station has created considerable interference. The powerful broadcasting station formerly located at Chelmsford, about 30 miles from London, has been removed to a point 70 miles from the congested centers of the city. This was found necessary when the British Broadcasting Company increased its use of electric power to 25,000 watts. This is clearly a case of where interference had been appreciably multiplied by building a super-power transmitting station even 30 miles away from the congested area of London. However, the General Manager of the Radio Corporation of America, in proposing a powerful transmitting station for New York, indicated that it would be located with due regard to the minimum of interference with listeners and with local stations maintained by other interests,

and capable of serving directly millions of people within the range of its voice.

The technical opinions of Dr. George K. Burgess, director of the Bureau of Standards, and Dr. J. H. Dellinger, Chief of the Radio Laboratory of this branch of the Government, were sought as authoritative and unbiased views for guiding the action of the Radio Conference with respect to permitting a more liberal use of electric energy by the transmitting stations. Their expert judgment indicated the necessity of locating broadcasting stations in the country, thirty miles or more removed from congested areas, if the power is to be increased measurably.

This action seems necessary owing to the interference that would arise from a transmitting station—say of 5,000 watts power—in the midst of hundreds and even thousands of radio receiving sets. After correctly appraising the great value of relatively strong signals from the local broadcasting stations, Doctor Burgess, Director of the Bureau of Standards, indicated the reason for this and the theory for establishing and operating high-power broadcasting stations in the following analysis:

The reason why the local stations give technically superior quality and satisfactory reception is simply because they deliver a radio wave to the receiving antenna of an intensity greater than that of the atmospheric disturbance. In order to deliver a signal of the same intensity to a larger number of people or a larger territory, it is necessary to use higher power in the transmitting station. Carrying this thought to its limit, we are led to the consideration of very high power broadcasting stations. There need be no fear that this will interfere seriously with the smaller stations nor displace them, provided some very simple principles are followed in their establishment.

In the first place, proper frequency separation must be observed. If a new class of specially high-powered stations is established, it should preferably be assigned frequencies at or beyond one end of the present broadcasting frequency band. In the second place, such stations should be separated from others, not only in frequency, but also geographically. It is merely necessary that the signal intensity with which the waves from such a station reach any large body of listeners shall not be materially in excess of the signal intensity from the more ordinary broadcasting stations. This will be readily attained if the broadcasting stations of specially high power are kept out of the cities. Many 1-kilowatt stations are now located in the midst of large cities. Supposing such station to be three miles from the average listener in the city, the average interference in that city will be the same as caused by a 10-kilowatt station located 30 miles out.

The utility value of broadcasting stations with increased power was effectively presented by Powel Crosley, Jr., of the Crosley Radio Corporation, in an address in which he emphasized this as means of overcoming atmospheric disturbances and the limitations of daylight transmission. Furthermore, he indicated that an enlargement of the effective range of broadcasting stations would result in penetrating farming regions and other rural areas.

Radio to farmers, according to Mr. Crosley, means more than a mere pastime. The rural dweller has accepted this art of communication as a medium for bringing information and entertainment to millions of homes. The city dweller has diverse interests and many forms of entertainment to engage his attention; radio is the one means of regularly bringing the information and enjoyments of urban communities to the country.

E. F. McDonald, Jr., President of the Zenith Radio Corporation, who was one of the first to apply for an "increased power" station outside of Chicago. The government is expected to permit several experimenters such as Mr. McDonald to test the feasibility of increased power before "super-power" is made a definite policy.

The speech of David Sarnoff, vice-president and general manager of the Radio Corporation of America, in which he defended his organization against the charge of monopolizing radio interests and in which he championed the cause of super-broadcasting stations, drew rapt attention. He said that all political parties and sects were permitted to make deliverances through stations allied with his company. Further, in answer to the charge of monopoly, he implied that if there were a monopoly it existed at present in the interconnection system of broadcasting, whereas in establishing super-power stations there would be maintained a competitive system.

In further advocacy of the building of a high-power transmitting station, he agreed to finance the undertaking, operate the station under supervision of the Government, and after a period of time that if it proved a public nuisance instead of a public service, he would abandon the project and sustain the financial loss thus incurred.

"Is there anything fairer than this?" he inquired in a dramatic conclusion.

SECRETARY of Commerce Herbert Hoover, in assigning the subject of high-power broadcasting stations for consideration of the committee on interference, suggested that recent experience during the development of radio seemed to indicate that somewhat higher power for all stations throughout the year during the daytime and also at night in the Summer would be one method by which static could be overcome and the distance range of listeners to each station maintained. In the farming districts the listeners who are located at considerable distances from the station were unable to receive signals during the past Summer and are now unable to do so during the daytime.

Hoover's Viewpoint

Mr. Hoover indicated that there arises a question as to how far power can be increased in the neighborhood of other stations without creating interference and damage to established stations, and he suggested that the question resolved itself into a matter of adjustment between the proposed increased power, the location of stations, and the wave-length assignment to these stations.

The final conclusions of the Third Annual Radio Conference with respect to the removal of the limitations of power for broadcasting stations will permit of an increased use of electric energy for this purpose by transmitting stations in Class B, which designation has been changed to Class 1. The decision of the Conference does not, however, specify the amount of the increase, but it is reasonable to anticipate that instead of a dozen broadcasting stations operating on 1,000 watts there will be this many or more pumping 5,000 watts into the transmitting antennae.

This additional power may be utilized by some stations throughout the year, while others may avail themselves of the increased output during daylight hours and in the Summer months, when atmospheric disturbances overwhelm orderly radio signals. There may be several stations that will use as much as 10,000 watts, although this is purely speculation, and a subject which rests within the regulatory powers of the Bureau of Navigation of the United States Department of Commerce.

"Super" or Increased Power?

The resolution embracing the subject of a super-power station permits of the experimental operation of such a project under government supervision. However, the power that can be used is to be prescribed by the Department of Commerce; its location and other conditions of operation are factors that must enter into the stipulations of any such experimental license issued by the Government. The statement of Secretary of Commerce Herbert Hoover that confusion had arisen between the terms super-power and increased power implies that the former term is thrown into discard for the present.

At any rate, if the writer correctly interprets the conclusions of the Radio Conference, the broadcast listeners

need not anticipate the reception of deafening signals from a 50,000 or 25,000-watt station in the immediate future. The owners of the more than 500 broadcasting stations might as well dispel any delusion that their offerings may ride the invisible waves under the handicap of being sidetracked by any signals from a giant broadcasting station that would hurl its energy across two continents.

For the present, it seems that there will be no masts or towers reaching, like the Tower of Babel, to the sky, and that the intimate association of 50,000 or 100,000 watts with broadcasting stations is but a dream of future accomplishment.

Better Service Assured

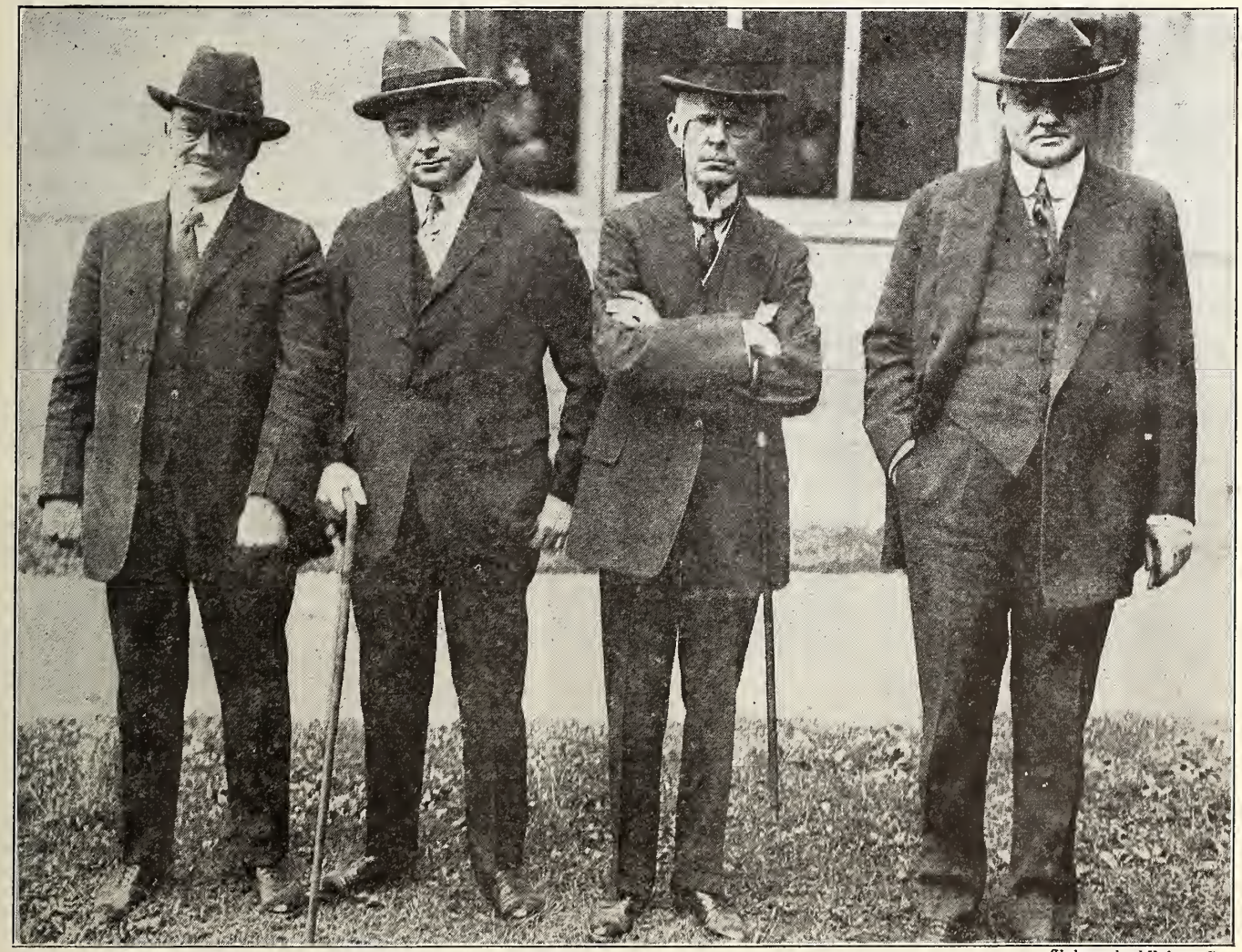
THE third annual radio battle is over and the clean-up squad of supervisors and technical experts finished its work re-zoning stations and reallocating wave lengths. Unlike the World Series, it was not a very bloody battle, and few casualties have been reported. Practically everything went through, and in general the radio public and, in fact, the whole industry will be better served in the future.

Although the Government refused to take off the lid in regard to power limitations, experimental licenses for high-power broadcasting are assured and it is up to the radio engineers to show the radio supervisors and the listening public the benefits of high-power broadcasting.

It is probable that nine smaller broadcasters will also apply for permission to broadcast with 5KW sets under the same conditions, and, as was pointed out, a broadcasting system of pure radio may soon be competing for radio popularity with the chain of the inter-connected stations served by the American Tel. & Tel. Co., which has made possible nation-wide broadcasting.

Among the important decisions reached were: the addition of 30 wave channels for broadcasting stations, bringing the total to 100; the removal of the marine sparks on 300 meter from the broadcast band, and the designation of 600 meters for distress calls only, clearing the air programs of code interference. A re-classification of broadcasters and the transfer of all class C stations from 360 meters, improves the situation further, while the re-zoning of the country into six zones will further aid broadcast operation. This it is planned will provide a separate zone for the New England States, including New York City and part of New Jersey; Zone two will comprise the rest of the Atlantic states, Pennsylvania, West Virginia, and the western part of New York; Zone three, Michigan, Ohio, Illinois, Kentucky, Tennessee, West Georgia, Alabama and Mississippi; the Central states are divided horizontally, the southern states forming Zone 4, and the northern, Zone 5; all the Pacific states with Idaho, Utah and Arizona, constitute the sixth Zone. When assigning experimental stations power-higher than now permitted, the Department intends to use this system and in assigning new class 1 station waves.

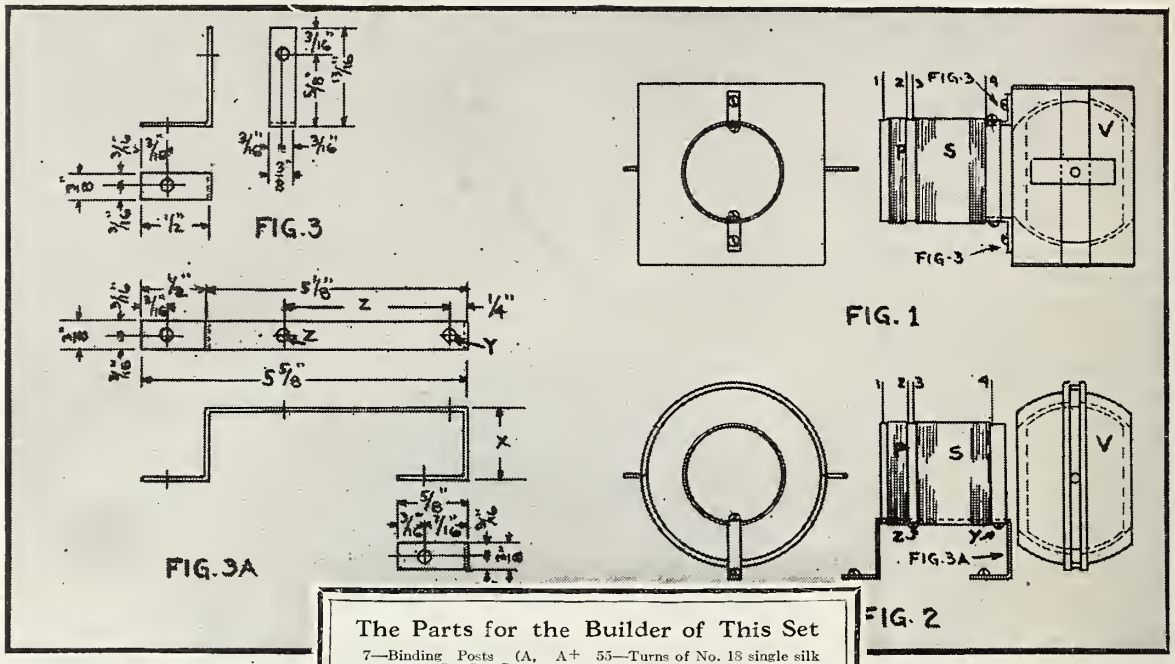
Marine communications will be handled on 660, 730, 875 and 706 meters, giving the ships five channels instead of two, also removing coast-wise interference and congestion. Amateurs retain substantially the same wave bands as heretofore, but benefit by low wave lengths assigned temporarily by the Department recently.



(Underwood and Underwood)

Four leading figures at the Third National Radio Conference in Washington are shown in the picture above. From left to right they are, C. Francis Jenkins, inventor of "radio movies;" David Sarnoff, Vice-President of the Radio Corporation; Maj. Gen. George O. Squier, former chief of the U. S. Signal Corps; and Herbert Hoover, Secretary of Commerce. The results of this notable gathering are expected to be made known gradually within a few weeks. Re-allotment of wave bands is expected to be one of the first decisions of the members of the conference.

¶ *A Receiver* Designed Especially *for Selective*



The Parts for the Builder of This Set

7—Binding Posts (A, A+ A— B1, B2, C1 and G)
1—Variable condenser. (C) .0005 mf.
1—3″ or 4″ Composition dial for same.
1—Variable condenser. (D) .001 mf.
1—3″ or 4″ Composition dial for same.
1—Three element, fixed condenser. (E) Described in this article and shown in figures 4, 5 and 6.
2—Fixed condensers. (F, F1) .0003 mf.
1—Cutoff jack. (H)
1—Phone jack. (K)
1—Tubular grid leak. (L) 2 megohm.
3—Vacuum tube sockets. (M, M1, M2)
1—Audio amplifying transformer. (T1) Ratio 5-1
1—Audio amplifying transformer. (T2) Ratio 3-1
1—Composition tube. 3″ to 3½″ outside diameter, about 5″ long. (To be used to wind the "P" and "S" coils on.)
18—Turns of No. 18 single cotton covered wire or Litzendracht cable. Litzendracht cable is 48 strands of No. 38 enameled copper wire, twisted to form a small cable and covered with a silk covering. (Primary winding "P")
55—Turns of No. 18 single silk covered wire or Litz. cable. (Secondary winding "S")
1—Variometer, wood or molded composition type. (V)
1—3″ or 4″ Composition dial for same.
2—Filament rheostats. (R, R1)
1—Composition panel.
1—Composition shelf for mounting the apparatus.
2—Composition strips. 1″ wide, 6″ long.
1—Wood cabinet.

Miscellaneous items, such as screws, solder and wire and terminals.

1—Strip of brass, 1-16″ thick, 3-8″ wide and about 18″ long for mounting the primary and secondary coil to the variometer and for brackets to fasten the shelf to the panel. If a moulded variometer is used, about 12″ more brass will be required.
1—Strip of spring brass, 1-2″ wide and about 8″ long, for Details 1 and 3.
1—Strip of sheet fiber, 1-16″ thick, 5 1-2″ long, for Detail 2.

Tinfoil and wax paper for making the three-element condenser (E)

¶ *The diagram above shows assembly and mounting details for the tuning element. The top view, Fig. 1, shows the coil P and S mounted to a wooden type variometer. The lower view, Figs. 3 and 3A, shows the mounting of the coil when the moulded composition variometer is used.*

Unusual with a "SUPER

By H. FRANK

Assoc.

WE WILL all agree that the biggest problem of today in DX radio broadcast reception with the average receiving unit is *static*. We tune in a station a few hundred miles away, get all set to listen in on a real program and show the neighbors what they are missing by not having a radio, and Mr. Announcer cuts in and tells us that "This is station J—Crack—Z—Zizz-z-z-g, East SSS-Scratch—Bang, broadcasting their regular Whir-r-r-r-r-ram, the next number will be G-r-r tweetr-r-r-reams."

Then we hear a most delightful overture of static, interrupted now and then with a few strains of our favorite piece of music, or it may be the interesting part of the current news of the day. You finally give up in disgust and tune in on one of the local stations. To quote a well-known cartoonist, "Thus the evening is utterly ruined."

A new problem will also confront the amateur in the near future, when the increased power stations get on the air, and unless our receiver is capable of very sharp tuning, we will be unable to hear little else than what these stations put on the air, or we can go turn on the old piano for a change.

An Up-to-Date Set

THE set described in this article is, therefore, right in keeping with the times, as it will give the maximum selectivity with few controls and will reduce static interference to a minimum, while it remains within the reach of the fan's pocketbook, being of the popular three tube, regenerative variety.

In all of the diagrams of this article, each part bears a designating letter or detail number. In this way it will be easier to distinguish each part and to connect it properly into the electrical circuit. The same designations and detail numbers are used throughout this article and are also shown after each part in the list of parts.

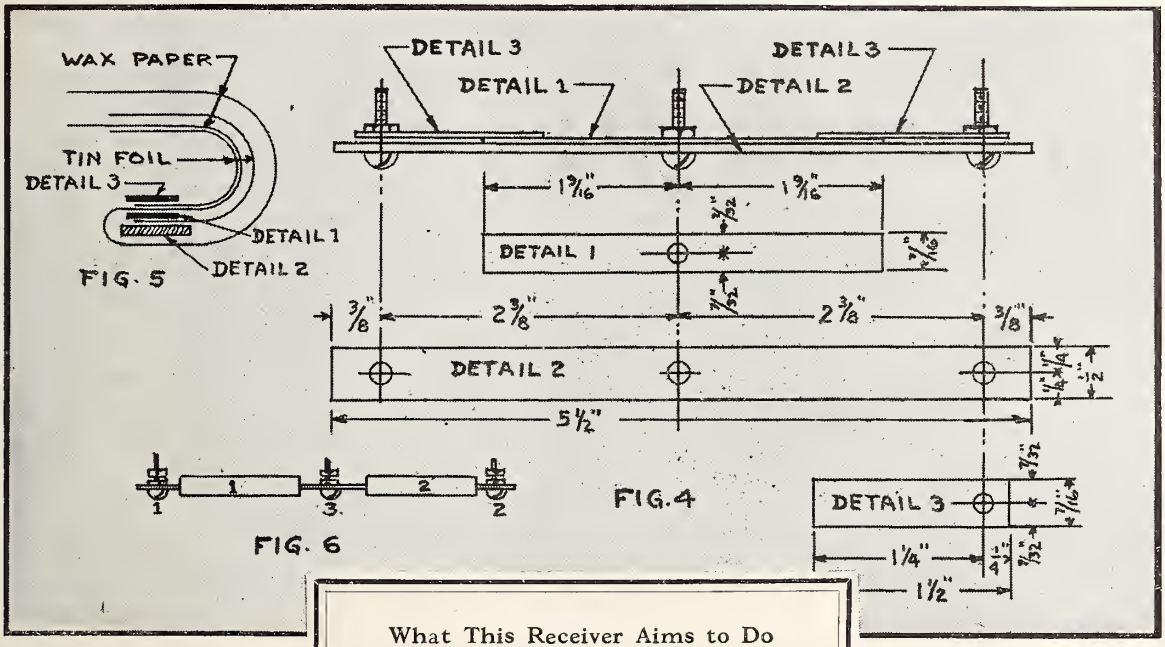
All of the parts used in building the set may be purchased at any radio shop, but as some of the prospective builders of the set may wish to build what parts they can, the construction of the most uncommon pieces is described and explained in figures 1 to 6.

The first step will be to list the parts that will be needed and it is well to have them all at hand before work is started. The cabinet, shelf or panel will not be detailed as to size or drillings, as most of you have your own ideas on how a set should be mounted. Some desire a long low cabinet and others prefer a square paneled outfit, while some just like to try new hookups and mount the apparatus openly. It is often difficult to secure a cabinet of just the shape or size described.

No Parts Specified

ANOTHER undesirable feature in laying out a panel is that the type of apparatus to be used would have to be specified, such as a John Jones Variometer, a blank condenser, a Henry Smith Resistance and Dorothy's Jacks, all of which would vary in size and shape from any other make to the extent that these particular parts would have to be secured, which is not always possible. However, to more easily describe the construction and operation of the set, a

Tuning and for *Eliminating* the Static "*Bug-Bear*"



Clarity 3-Tube CIRCUIT"

HOPKINS

A. E. E.

What This Receiver Aims to Do

This unusual receiver, described in the accompanying article, will produce remarkable results when properly constructed, being noted both for its long distance range and clarity of tone.

The fan should not go about building this set, however, in the belief that it will positively cut out static. No receiver designed can do that. But this 3-tube "Super-power set" *will* reduce static, and when it was tested under the influence of static by RADIO AGE, the static was found to be minimized to an almost inaudible "crackle," as compared to the unbearable pounding heard when another set was tried under the same conditions.

This set was also designed for the purpose of tuning out the strong high-powered stations to be built within the next few months, and although one test was made but a few blocks from a strong Chicago broadcasting station, amazing selectivity was shown and long distance stations tuned in without interference.

Figure 4 in the diagram above shows the details and assembly required in making the three-element condenser used in this set Fig. 5 shows the placing and winding of the elements and Fig. 6 shows the completed condenser.

general arrangement is shown in figure seven, giving the relative location of each part.

The parts needed to build the set are to be found on page 10.

Let us now start building the tuning element by cutting the composition tube to a length of 5" and squaring up the ends. Mark a point 3-8" in, from the left end of the tube and drill two small holes, in the direction of the winding and about 1-4" apart. These holes are for fastening the No. 1 lead of the primary coil "P," which is done by passing the wire down through one hole and back up through the other and again through the first hole, leaving about six inches of wire extending out from the inside of the tube. Now proceed to wind eighteen turns of No. 18 single cotton covered wire in an even row, in the direction of the hands of a clock. When the eighteen turns have been completed, drill two more holes in line with the last turn and fasten the end of the primary coil in the same way as was done before, making lead No. 2, being careful to leave about six inches extending out from the inside of the coil.

The primary coil "P" being completed, we will start on the secondary coil "S" by drilling two more holes as was done at each end of the primary coil. These holes should be 1-4" from the end of the primary winding. The end of the wire will then be made fast and brought out from the tube, forming lead No. 3. Now proceed to wind fifty-five turns of No. 18 single silk covered wire in the same direction as the primary winding, making the end fast in a like manner and bringing the end of the winding out from the tube forming lead No. 4.

THE Litzendracht cable may be substituted for the No. 18 wire on the coils if it is desired, which will afford slightly better results in both tuning and signal strength. The results obtained with the solid copper wire, however, will be nearly as good, as a regenerative circuit tends to reduce the resistance of the coils, eliminating the losses of the circuit.

Mounting the Coil

Upon completion of the coils, the next step will be to make the mounting details shown in figures 3 and 3A. If a wood frame variometer is used, two details, as shown in figure 3, will be required. The tube is then drilled on the secondary end, and the brackets fastened by small brass screws and nuts. The coil is then mounted on the variometer by small brass wood screws, as shown in figure 1. Care should be taken in the handling of the coils so as not to injure the insulation and ground the coils to the brackets.

If a moulded composition variometer is to be used, one detail, shown in Figure 3A, will be required. In making this detail, the dimension "X" will have to be determined by measuring the height of the variometer shaft from its base, subtracting one-half the diameter of the coil. The detail will then be formed and the holes drilled as shown. The tube can then be prepared by drilling a hole, 3-16" in from the secondary end for the mounting screw "Y"; and another hole, directly in line and on the same side, will be drilled between the primary coil "P" and the secondary coil "S." The hole "Z" will then be drilled in the detail to line up with this hole in the tube, and

the bracket made fast with small brass screws and nuts. The complete unit is now ready to be mounted as shown in Figure 2.

The Three Element Condenser

THE next step will be to make the three-element condenser, shown in Figures 4, 5 and 6. One detail 1 and two details 3 will be cut from the spring brass and mounted to the fiber strip, detail 2, with three No. 6 brass screws, 1-2″ long, making an assembly as shown in Figure 4.

Now cut two pieces of tinfoil, 1″ wide and 1 1-2″ long and two pieces 1″ wide and 2 1-2″ long. Then cut two pieces of heavy wax paper, 1 3-4″ wide and about 8″ long. Take one of the pieces of tinfoil, 1 1-2″ long and place it between the fiber strip and detail 1, as shown in Figure 5. One piece of wax paper will then be folded in the center, the top half will be inserted between the brass details 1 and 3, and the remaining piece of tin foil, 1 1-2″ long, will be laid on top of the wax paper, directly over the first piece and under detail 3, as shown.

This should then be wound tightly around the assembly and the waxpaper made fast with glue, forming element No. 1 and half of element No. 3. The end terminal should then be marked No. 1 and the center terminal No. 3. The remaining half of element No. 3 and all of element No. 2 should then be wound on the other half of the assembly, using the pieces of tinfoil, 2 1-2″ long.

The terminal at this end should then be marked No. 2. The condenser is now completed and ready to connect into the circuit.

Assembly of the Set

THE first step in the assembly of the set will be to cut the panel and shelf to the correct size to fit our cabinet. When this has been done, the edges should be smoothed off with a fine file and rounded with fine sand paper to avoid chipping. The shelf should be about two inches shorter than the panel and should clear the cabinet by at least a half of an inch on all other sides. The brackets for mounting the shelf to the panel are made from the remaining piece of 3-8″ brass, in the same manner that detail No. 3 was made, except that they should be about twice the size and have two holes on each leg, to pass the mounting screws.

The next step will be to lay out the panel and shelf for drilling. This is usually done by placing the instruments around until a satisfactory layout is found, starting with the shelf. The holes for mounting each piece are then marked with a sharp pointed instrument, the instruments removed and the holes drilled. The panel will then be laid out in the same manner.

A great deal could be written about the placing of one piece of apparatus in relation to another and in some cases it is important that this be followed out in order to get the desired results. In this set, however, it is vital to only three pieces, the tuning element and the two audio amplifying transformers. With this in view, the shelf should be laid out so that the tuning element is at least five or six inches from the first audio transformer; also, that the transformers are mounted at right angles to each other and as far apart as is possible, making sure that they do not come closer to one another than 3 1-2″.

If a square panel is used, it will be necessary to mount the transformers on the under side of the shelf in order that the required clearances may be obtained. The jacks would then come through the panel below the shelf and much of the wiring would be taken from the top of the set. This is also a desirable feature as it will tend to reduce the internal capacity of the set.

When the panel and shelf have been drilled, the instruments should be mounted to each and the shelf fastened to the panel with the brass brackets. Brass mounting screws should be used in mounting all of the instruments, as iron screws are sometimes the cause of noisy sets, setting up little magnetic fields. The set will then be ready to wire.

BEFORE we start to wire the set, it may be well to first consider just what the wiring accomplishes or is meant to accomplish in a receiver. Many radio fans who make their own sets have a great feeling of relief when the panel is drilled and the instruments all mounted. They say, "Now all I have to do is wire it up and it is finished." They get out the circuit diagram and do just that thing, running all the wires nice and straight, with beautiful square turns and corners, and parallel runs, all bunched together in a fine workman-like manner.

Wiring the Set

Many sets, wired in this manner with the square bus-bar wiring that looks so neat, work poorly because the wiring does not accomplish what it is supposed to. The wiring is supposed to connect the different instruments in their proper electrical places so that they will all pull together with as little interference as possible. With this in mind, let us wire the set, keeping the control circuit wiring separated from the energy circuits; in other words, the grid leads, which control the vacuum tube circuits, should not be run parallel to the filament or plate energy circuits and should be as far apart as is convenient.

When connecting two instruments together with one wire, do it by the shortest path, unless it interferes with the moving parts of the tuning element or the condensers, or tends to bring two leads of a control circuit and an energy circuit, respectively, too close to each other.

Do not use too large a size of wire for the connections. No. 14 is plenty large enough to handle any of the currents flowing in the set. The use of too large a size of wire tends to increase the capacity of the set. The capacity between two parallel wires may be high enough to interfere with the proper functioning of the circuit. The little imaginary condensers thus formed will in reality act as filter circuits in the set and will filter out and weaken the signals.

When the wiring has been completed and the set mounted in the cabinet, it will be ready to operate.

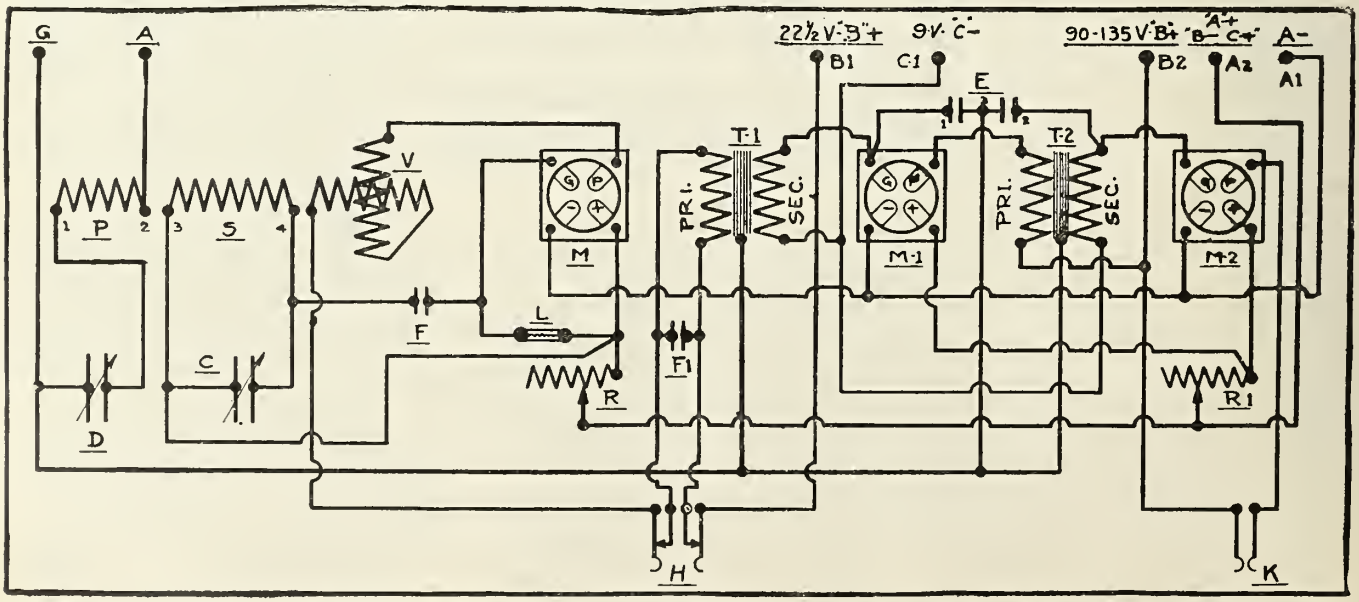


Fig. 3. A schematic circuit diagram of the three tube super-power receiver that reduces static and other outside noises to a minimum. The construction and operation is fully described in the accompanying article.

Operation of the Set

IN CONNECTING the set for operation, care should be taken in handling the battery leads to make sure that the plate or "B" battery leads do not come in contact with the filament circuit, as the high voltage will burn out the tubes, which is a rather expensive accident.

The negative A battery terminal is connected to the binding post A1. The positive terminal of this same battery is connected to the binding post A2. Binding post B1 is for the positive terminal of the 22 1-2 volt B battery for the detector tube plate circuit and binding post B2 is for the positive terminal of the 90 to 135 volt B battery for the amplifier tube plate circuits. The binding post C1 will be connected to the negative post of the 9 Volt "C" battery. The negative terminals of the two B batteries and the positive terminal of the C battery will be connected to the binding post A2.

The antenna lead connects to the binding post A and the ground lead to the binding post G.

To put the set into operation, insert the plug of the loud speaker into jack K, turn the dials of resistance R and R1 until the tubes glow, but not far enough so that they oscillate.

The dial of the condenser D should be set at about 50 and the dial of the condenser C rotated slowly until the signal is heard. The volume will be controlled by adjusting the dial of the variometer V. Be careful not to cause too much regeneration as this will tend to distort the signals.

When this set is constructed properly, and the operator becomes familiar with the method of tuning, stations from all over the country may be tuned in clearly with little or no interference.

By watching the dial sets on different stations of a known wavelength, the dials may be slipped around on their respective shafts, until by setting all of them at 35, a station whose wave length is 200 meters is heard, and so on. It will then be an easy matter to calibrate the set.

The Ideal Antenna

SINCE the antenna is of the "fixed tune variety" it is not important as to how long this part of the system is. The ideal antenna for a set of this type is one having a effective flat top portion (actual length without lead in) of about 75 feet. This, with a lead in system of about 35 feet, is sufficiently long to give the loudest signals possible without loss of selectivity.

A word might be said here about the ground system, which should be of the very best type available if the maximum results are expected.

Use a cold water pipe, scraped clean and bright, and after wrapping a piece of tinfoil around the scraped portion, bind the wire around the tinfoil.

The tinfoil has a greater effective surface, and gives just about as good a contact as solder will. It is often impossible to solder a cold water pipe, due to the fact that the solder crystallizes before it really gets a chance to set.

A Grid Leak Mounting

If the reader happens to have some spring brass handy, it is a wise plan to make two little supports for the grid leak. Since the object of the set is to exclude and eliminate noises, this particular unit should be used very intelligently, as carelessness in respect to the grid leak will result in the failure of the entire receiver from a standpoint of internal noises.

The mounting clips can be made from two pieces of spring brass, 1 1-2 inches long and 1-2 inch wide. The brass is bent so that a half inch foot is formed, leaving an upright of 1 inch. The hole for mounting the clips on the shelf is drilled in the 1-2 inch foot of the clip, and a smaller hole to act as a receptacle for the grid leak tip is drilled 1-8 inch from the top of the 1 in. leg. Set the two clips thus made about 1 7-8 inch apart, with their tops bent toward each other to give the clips tension when the resistance unit is inserted. This little kink will often save you a lot of annoying noises later in the course of listening with the set.

In regard to the wiring, recent experiments show that it is highly advisable to keep the low tension wires rather bunched; that is, to keep them running together in as mall, well defined path throughout the set.

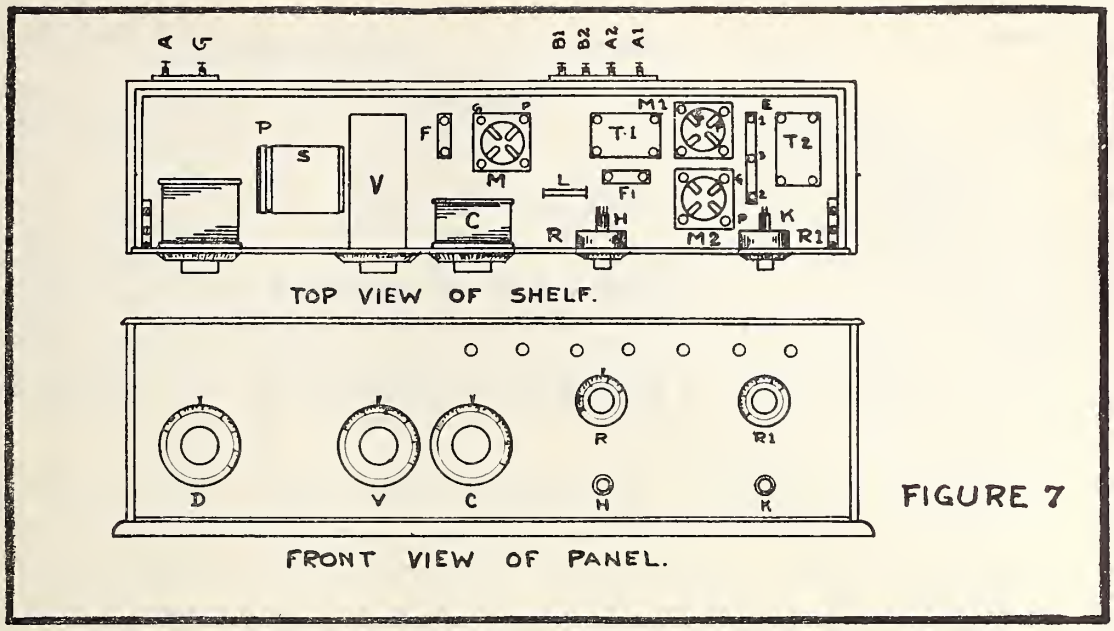


FIGURE 7

Fig. 7, the top view, showing the relative locations of the equipment on the shelf and panel, with the cover of the cabinet removed. The lower view shows the front of the panel and the controls.

Keep Wires Free

BY the low tension wires, the A battery leads and their respective connections and the B battery wires and connections are referred to. These wires are all at so called "ground potential," since they are not actually engaged in carrying radio frequency currents. The grid and plate wires as well as the antenna circuit connections should be kept free and open. They should run direct, and should not have right angle bends which tend to make them longer. In using the "right angle" bend system of wiring, one creates small loop antennas which have the property of absorbing and picking up small quantities of radio frequency currents, all of which are detrimental to the clarity of the received signals.

Incidentally, it is often a good plan to connect a high resistance across the G and F terminals (secondary) of the audio transformers, if one wishes further to help matters out with regard to clarity. These resistances may be of the standard type made for that purpose, or may be grid leaks of the tubular type with a resistance of about 3 megohms. However, this is entirely experimental, and is left to the judgment of the constructor.

Small fixed condensers of 0.00025 Mfds. capacity may be used in the same manner in conjunction with the grid leaks, but this decreases volume somewhat though they give exceptional freedom from noises when used.

[Next month Mr. Hopkins will tell you how to build a four-tube neutrodyne-ref'ex set, using a loop or outside aeria'—a real DX getter with volume and selectivity]

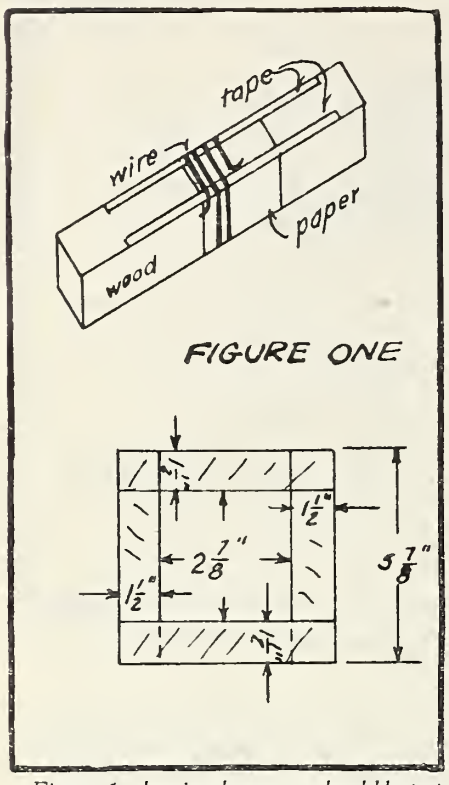


Figure 1, showing how core should be put together and how to lay tape over paraffined paper.

End Your Pet Battery Troubles For All Time with a

Home-Built Battery Charger

A Reliable Rectifier

By C. WILLIAM RADOS

A STORAGE battery charger is an essential for all receiving sets using storage batteries, as it will keep them charged with a minimum of cost and bother. The tungar charger is probably the best and is easy to build. It is fool-proof and economical. Before attempting construction of a tungar charger, we should understand how it works.

The house current is reduced or stepped down through a small transformer and then passed through the tungar. As the tungar bulb is a one-way valve, it produces a pulsating direct current which is connected to the storage battery. The bulb works on the same principle as an audion tube, but it has no grid and is more sturdily built. The filament is heavy tungsten, the plate of graphite, and these elements are enclosed in a large strong glass bulb filled with argon, an inert gas.

When the filament is lighted, it throws off particles of negative electricity, which shoot off into the gaseous space. Negative electricity is attracted by positive electricity or a positively charged electrode. The plate is connected sixty times a second to a positive pulse of electricity. During these intervals the electrons are attracted to the plate and a steady stream from filament to plate occurs sixty times per second. When this occurs, the supply current flows from plate to filament, causing rectification. When the plate is negative, nothing occurs between plate and filament, and only the positive half of the alternating current gets through.

The Construction

THERE are two sizes of tungar bulbs available on the market, the two-ampere and the five-ampere bulbs. Details for constructing rectifiers to use both bulbs will be given. The parts necessary are a transformer, a fuse block, switch and socket.

The transformer is the only part which has to be made, as the rest of the parts can be bought cheaply. The core is made of transformer iron No. 28 gauge. The electric light companies' service stations are the best places to get this and get it cheaply. About five pounds of iron will be sufficient. Have the iron cut by a tin shop and see that they cut all pieces exactly the same size. The dimensions are 1½x5⅞. All pieces are the same size. As the core is square, it is easy to build up. Fig. 1 shows how the core should be put together. In Fig. 2, the odd layers are sketched at "a," the even layers at "b." The core is carefully built up, making certain that the corners are square and even. When the core is assembled, put it in a vice and tighten it up. Carefully tape three sides with one layer of friction tape, being sure to draw the tape tightly. One side of the core is then pulled out after assembly to allow the windings to be slipped on.

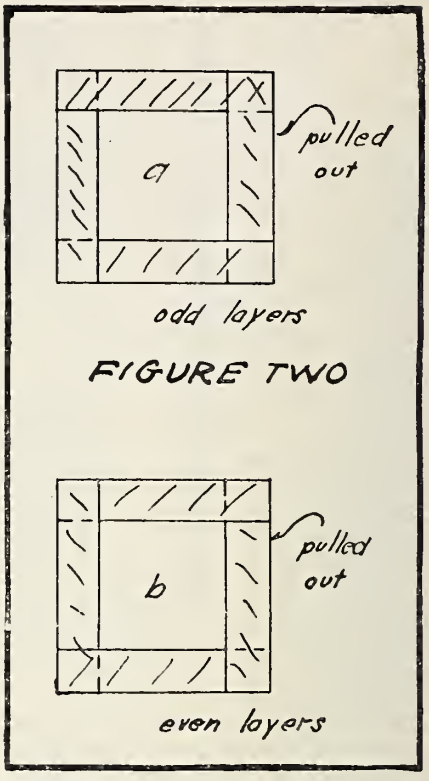


Figure 2. Notice how the odd layers are sketched at "a" and the even layers at "b." Be sure the corners of the core are even.

Laying the Paraffin

Now obtain a piece of hard wood 1¾" square and at least 10" long. Lay over it carefully two sheets of paraffined paper 2¾" wide. Over this lay two pieces of tape about 12" long, as shown in sketch, Fig. 1. Now wind on carefully and evenly one layer of No. 18 dcc for a distance of 2¾ inches. Lay over with a piece of paraffined paper 2¾ inches wide. Start the second layer from the same end as the first layer was started. Continue this process until 550 turns are on, putting down a layer of paper for every other layer of wire. This is the primary. It connects to the 110 volt house current.

The filament winding is wound directly over

(Turn to page 59)

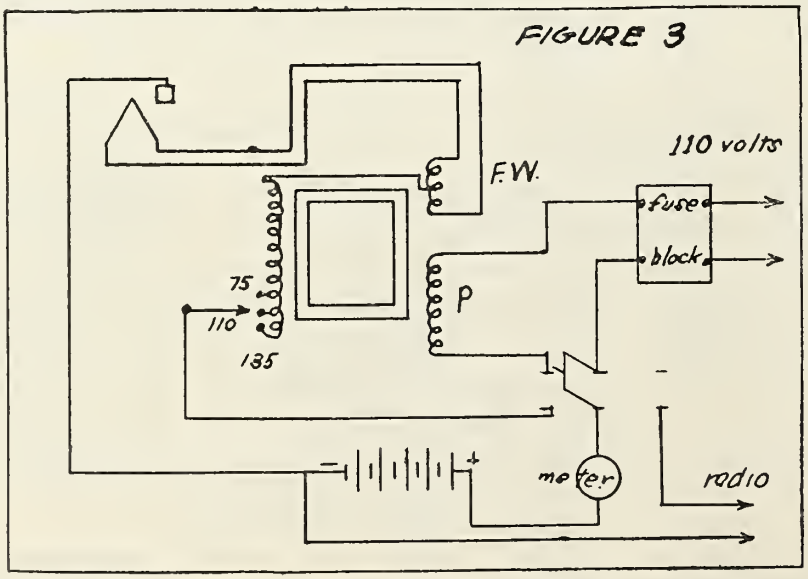


Figure 3. The wiring diagram of the home-built rectifier. Once wired in this fashion, it is only necessary to throw the switch from side to side to have the battery on charge or discharge. Quite simple, fans.

Some Suggestions for Brushing Up TUNED R. F. STAGES

By BRAINARD FOOTE

Elimination of the Annoying Whistles in Neutrodynes Depends on Placing of Coils

THE Neutrodyne type of receiver, despite the inroad upon its fame being made by super-heterodynes, is surely the set of to-day. It is being built in far greater numbers than any other of equal number of tubes and its wide popularity is based upon its clean-cut performance in selectivity, sensitivity and clock-like precision in its dial adjustments.

We are beginning to realize that the tuned R. F. receiver can be worked successfully without neutralizing capacities and we are discovering that much depends upon the relative positions of the coils with respect to each other for the elimination of the annoying whistles often common to this form of R. F. amplifier.

Then, again, we are observing that the dimensions of the antenna system, its capacity and inductance, exercise no little effect upon the success with which the receiver may be operated in a given situation. To this end I am endeavoring to call attention to one or more details wherein the tuned R. F. receiver may be the recipient of a bit of "trouble-shooting."

Antenna Coupling

AS pointed out last month in my discussion of the three-circuit tuner, there is a proper degree of coupling for every antenna and receiver, which does not necessarily hold true in another installation, where the antenna is of different length and height. Hence, some way of adjusting the antenna coupling after the set has been finished is most helpful in increasing signal volume, where this seems deficient.

In certain cases it is customary to provide a separate winding for the antenna coupling coil, although this is not essential and the same results may be had by tapping in the antenna lead at a point near the filament end of the first grid coil. In Fig. 3 this method is depicted. Four taps are taken when the coil is wound at approximately 5, 8, 11 and 14 turns from the filament end of the coil. The antenna wire is first tried on each tap, on an evening when plenty of DX is available, and soldered permanently to the point at which the volume is satisfactory but where the selectivity is likewise acceptable. In the case of a separate antenna coupling coil, it's easy enough to wind 15 turns and take out five or six taps for the same method of coupling adjustment.

Coming now to inter-action between the R. F. transformers, we may entirely eliminate inductive coupling between coils of the various stages by placing them in such a position that the coupling between is zero or negligible. In the neutrodyne this is accomplished by fastening the coils to the tuning condensers at a certain definite angle and then spacing the condensers far enough apart to arrive at the condition of zero coupling between adjacent windings.

In Fig. 1 is shown a rear view of a receiving set in which a different scheme is used. Brass brackets bent to a wide "U" shape are employed to mount the three coils, secured by two nuts and bolts to their lower extremities. In this way, they may be swung to right or left as the occasion demands, and held permanently in the correct setting by tightening the mounting screws with a screw-driver. By adopting this arrangement, I found it possible to eliminate magnetic coupling between adjacent coils. There remains, of course, the coupling in the tubes themselves and between primary and secondary of the R. F. transformers to cause oscillation.

Were the primary windings too large, oscillation couldn't be overcome, and were they too small, sensitivity would be very low. Using 50 turn grid coils, tuned by .0005 mfds. variable condensers, I found that as many as nine primary turns could be employed without causing oscillation of the R. F. tubes on wavelengths above 200 meters. As the condenser capacity is decreased to tune for the shorter waves, oscillation becomes more and more easy, and it is therefore mainly on waves beneath 350 meters than most tuned R. F. receivers are apt to cause trouble of this sort.

Oscillation

With the coils adjustable in this manner, it is a simple thing to connect up the outfit and start to tune. When the three dials are in synchronism, or at the same wavelength setting, oscillation may occur. The positions of the coils are then altered slightly until the oscillation ceases. Then a lower wavelength is sought and the process repeated until the receiver tunes smoothly and without squeals or whistles throughout the range of broadcasting.

To allow of considerable latitude of motion, the connecting bus bar wires could not be run directly to the primary and secondary terminals of the R. F. windings. To simplify these connections, a little connector block of panel material was affixed to one of the mounting screws of each variable condenser, fitted out with several small machine screws and nuts and connections soldered to them. Flexible wires run thence to the coils.

Fig. 2 gives a different view of the R. F. windings and shows how the supporting bracket is fastened to the coil tubing from inside. Two small wood screws serve to hold the bracket to the baseboard.

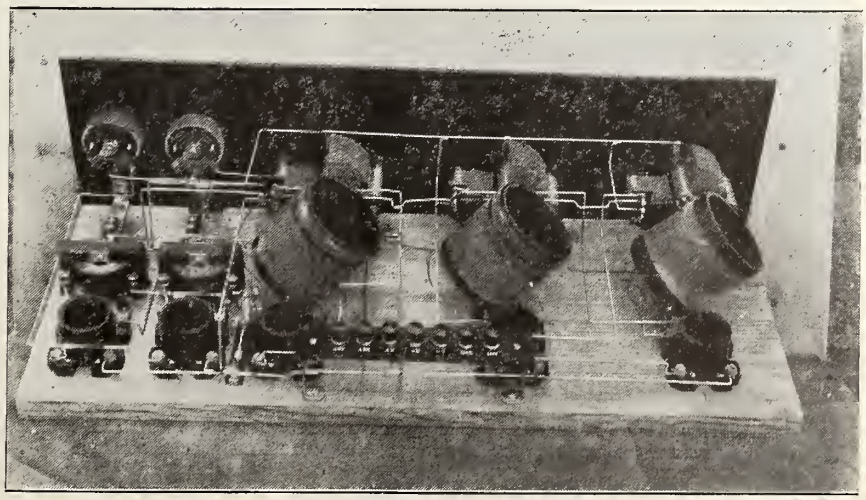


Fig. 1. A tuned R. F. receiver laid out simply and efficiently. Sockets are all in a line, with their respective transformers behind them. Connecting wires are at the rear and rheostats and jacks used to fill the space at the left.

A simple layout for the R. F. receiver of five tubes may be observed in Fig. 1. The five sockets are placed in a row near the rear of the baseboard, behind them a "binding post panel" held up by two anglepieces for all external connections. Behind each socket lies its respective transformer, whether audio or radio. They're the same in principle, the former being broadly tuned by the heavy iron core and the latter air-cored and tuned accurately.

[Turn the page]

MANY prefer the soft detector tube, but personally I don't care for them on account of the characteristic mushiness and sizzling sounds for which they are so famous. Of course, a little may be lost in sensitivity, perhaps, by the hard detector tube, but so much is gained in ease of tuning, in simplicity of rheostat control and in elimination of extra wiring that I prefer it in all cases with the possible exception of a single tube regenerator, where DX and lots of it is all I care for.

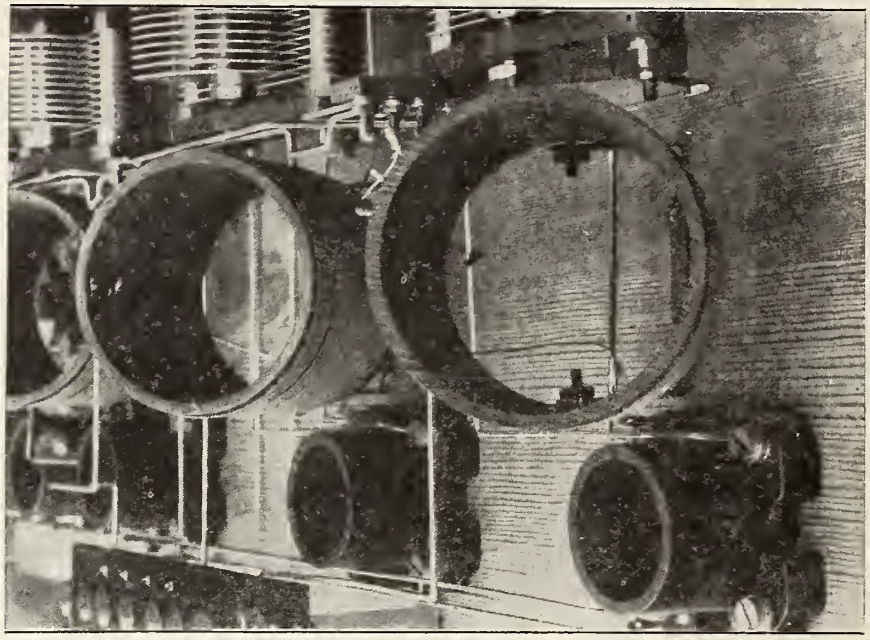


Fig. 2. How "squealing" is overcome. The tuned R. F. coils are pivoted on brass brackets, set to the point where howling stops, and fastened there with a machine screw and nut.

Choice of Tubes

Moreover, the quality of signal delivered by the hard tube is considerably superior to that of the soft tube, this phenomenon being due to the fact that its characteristic curve is almost a perfect straight line, whereas that of the soft tube resembles the letter "S." In the case of the hard tube, the fluctuations in plate current correspond very closely to those in the grid voltage, and consequently speech and music are more naturally reproduced than with a soft and gassy detector tube.

Now that this little argument is over, we find that we are using hard tubes all the way through. Hard tubes of the "A" kind aren't critical in their filament requirements, so that one rheostat may serve a number of tubes. With a 6 ohm rheostat controlling the two R. F. amplifier tubes and the detector, we have a three tube receiver for use with headphones. For the loud speaker, however, two audio amplifier tubes are needed, and these may be controlled by a resistance of 10 to 15 ohms. No jack is provided for access to the first audio amplifier tube, since this isn't used for headphones and is not enough for the loud speaker. That omission simplifies wiring and improves panel appearance, for there then are but two rheostat knobs and two jack "holes" underneath them.

There's a "C" battery in use also and all the grid return leads except that of the detector are connected to the "C minus" binding post. A "C" battery of three volts is employed. This makes a great reduction in "B" battery current and almost doubles the life of this expensive accessory, while somewhat improving the tonal quality at the same time.

While you are going over all these little things, don't forget to give the grid leak on the detector tube a little of the much-needed attention it requires for good results. A great deal depends upon the proper adjustment of this little unit in getting the best signal clearness. If your leak resistance is too high, (when using the hard tubes) the music and voice will sound tinny, and the receiver will be hard to control. On the other hand, if the leak resistance is too low (that is, if the value in ohms is smaller) your music will take on a mushy and dull aspect, and will not give the pleasing effect which is delivered by a properly adjusted detector tube.

The grid leak adjustment of the plate battery on the detector usually go hand in hand. Too high a plate voltage often renders the detector insensitive and finicky—it becomes hard to control, and the signal is very much distorted—a bad condition. When the plate voltage is decreased, it will be noticed that the tube gives the best results.

Remember that you have five tubes in the set, and each one of those five has its own characteristics. You can't try every possible combination that five tubes can give since by certain mathematical laws it runs up into an astounding figure, but you can at least endeavor to find out just which tubes make the best RF amplifiers, the best AF tubes and the one which is the best detector by a little changing around until the right one is found. Very often sets which refuse to work with tubes in certain order, break forth into life immediately upon changing the tubes around in the sockets.

If your dealer has a radio test set (a set used to determine the characteristics of the plate and grid of a tube) ask him to give you an idea as to which tube is the best for RF detector or AF. It is a good plan to have him do this when you purchase the tube.

Last of all, don't forget that the normal plate voltage for the A tubes is 45 volts, and if you use a higher voltage you should make corresponding increases in the grid bias circuit.

[Another Foote hook-up in January]

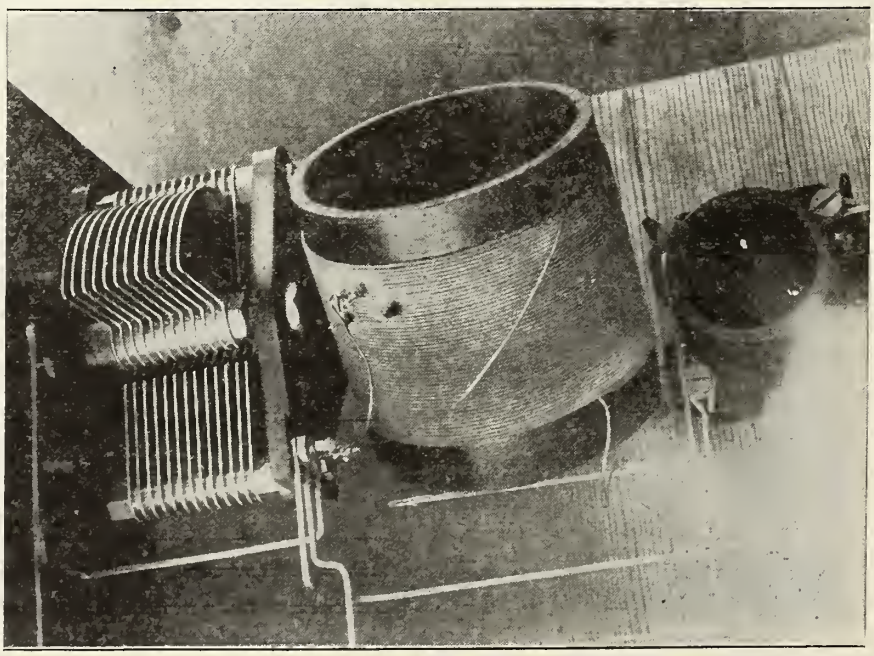


Fig.3. Here's a stunt for suiting your antenna coupling to your tuned R. F. outfit and your particular antenna. Several taps are taken out near the filament end of the grid coil and the antenna lead soldered to the one giving the best all-around results.

Mastering the Super-Het

This figure shows the panel arrangement for separate control of each of the fundamental circuits. Instead of complicating matters, this control system actually makes the operation of the set much simpler.

Tracing the CAUSE *of* SUPER *Troubles*

BEST RESULTS REACHED BY STUDYING FIVE CIRCUITS

By PAUL GREEN

IN THE October issue of RADIO AGE the writer had the pleasure of describing "An Easily Made Super-Het."

So many inquiries have been received from fans who have or are building Super-heterodynes that it seems best to answer these questions at one sitting, keeping in mind the relationships that exist between the various parts of the circuit. The best understanding can be secured by considering it as not one, but rather five circuits. These are, in the order of their arrangement on the baseboard, the oscillator circuit, the modulator or first detector circuit, the radio frequency or intermediate (long wave) circuit, the second detector circuit and the audio frequency circuit.

Curious and oftentimes baffling symptoms arise, which, owing to the relationship of each of these circuits to the others, may seem to have origin in a certain supposed cause, whereas perhaps only effect rather than cause has been considered. For this reason many fans ask questions which are little short of impossible to answer. By mentioning a few typical symptoms and telling how they have been overcome is in part a function of this article.

Experts Often Stumped

ODDLY enough, it is not always the perfectly "green" fan who encounters the most trouble with the super-heterodyne. In a number of conspicuous cases the greatest difficulties seem to have beset the path of the more seasoned fan. A partial explanation of this apparent paradox lies in the fact that the man of less experience who has the "nerve" to tackle the super will usually adhere closely to specifications.

Just recently two of the writer's friends began supers at about the same time. One is an experienced electrical engineer who deals in theory as well as the highly practical side of engineering. The other man admittedly lacks any ability along the lines of engineering and radio. In fact, the super was positively his first venture in radio. He had never handled tools of any kind, and scarcely knew a soldering iron from a buck-saw. The engineer has long since given up in disgust, saying: "It can't be did." The other man now has four supers in such successful operation that one must sit down and watch him operate his set to believe the yarns he tells. Does the above experience signify anything; is it typical? If so, what does it mean?

The engineer is a man who usually has learned that any specific instructions are for those who need guidance. Therefore, he says to himself: "Oh, well, that's all very nice, but I am going to substitute for this condenser one that I now have," and, "I don't see the use of this little 'doo-dad' here; guess I'll leave it out. This condenser has altogether too much capacity for the oscillator circuit, I'll just change that little detail."

Who's to Blame?

WHAT'S the result? His set refuses to work. He condemns the diagram, the man that gave him the diagram, the transformers, the panel board; in fact, everything but himself, for how could he make a mistake? The very idea!

Now, how does the other type of man go about it? He admits in the very beginning that he knows nothing. He is willing to be guided. He at least takes the diagram and specifications at their face value and fully expects failure if he deviates one infinitesimal iota from the specifications. Result: His set works.

While it does not fall within the province of this article, nor is it the policy of RADIO AGE to give trade names of parts used, yet enough cannot be said in favor of high grade parts, especially in the case of the super-heterodyne circuit. Each super-heterodyne circuit and each set of parts are or should be designed to operate best at a certain pre-determined frequency. It is obvious, then, that to use parts not specified will more than likely lead to trouble.

The governing factor is the frequency at which the intermediate transformer works best. The complete list of parts with values for each part will be furnished all who will get in touch with the writer, care of RADIO AGE.

Tubes to Use

In the set described in October issue, UV 199 tubes were used. Many have written asking whether the 201-A or 301-A tubes might be substituted. Yes, they may, but it must be remembered that probably very little extra volume will result and several times as much filament current will be used. However, as many fans already have the larger tubes and hesitate to buy smaller ones, it is thought best to provide a suitable circuit for these tubes. Incidentally, it might also be mentioned that in so doing, we also eliminate many of the previously mentioned puzzling characteristics of the set. This refers to providing five separate filament controls so that each circuit may be operated independently. In practice this is quite an advantage, in view of the economy of tubes and current, to say nothing of being able to compensate for changes in filament voltage.

So rapidly are conditions changing that since the October article appeared it has become (temporarily at least), difficult to procure well matched tubes

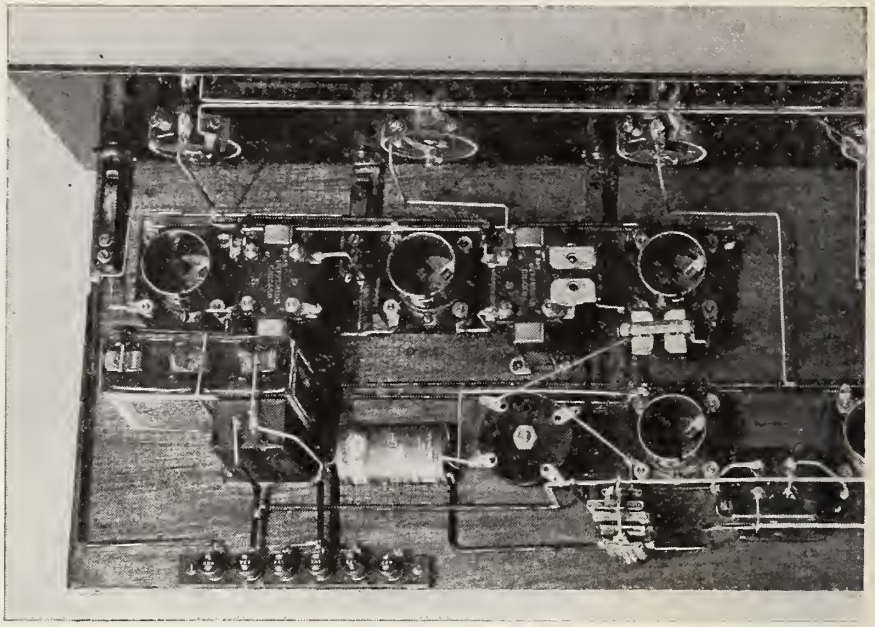
without almost getting "in bad" with the dealer. Without being able to procure tubes of fairly similar characteristics, it is at once seen that it may be very difficult at times to make all the five circuits work in harmony. This is especially true since part of the tubes are operated with a plate voltage of 90, whereas the balance operate at 45 volts. Variations in plate or filament voltage only serve to accentuate any lack of balance. It is the belief that this alone accounts for a very large number of the difficulties experienced by builders of the circuit. A set of tubes that have been matched may prove entirely satisfactory for the time being, but later give trouble due to their not ageing alike.

A Battery Voltage

IN THE writer's experience it has been found imperative to keep the "A" battery fully charged at all times. Local stations may continue to come in with apparently their usual volume when the "A" battery gives a poor reading, while the more distant stations possibly are cut off altogether. Recharging this battery will usually correct this trouble. Of course, if one can provide himself with a voltmeter, he can watch the voltage and hence avoid many of the troubles which arise from improper voltage. In such cases the two filament control system with properly matched tubes will undoubtedly prove satisfactory.

Should trouble then later arise from this unequal ageing factor, re-testing of the tubes will be necessary so that new ones of the proper characteristics may be purchased to replace the worn-out ones. Experience is proving that many fans not realizing to what an extent the "A" battery affects the operating of the set start turning the rheostats up just as soon as the set fails to respond as it should. The result is that within a short time the tubes have passed their useful life. With only two controls such a procedure subjects at least four of the tubes to dangerous filament voltage. With separate controls for each circuit only one or possibly two of the tubes feel any strain. What is more, the operator soon learns that it is useless to try to force certain parts of the circuit and hence comes to recognize the "battery too low" sign before matters have gone so far as to require crowding the filaments. As a matter of fact, the heterodyne is probably more exacting of "A" battery voltage than is true of most circuits. With "A" battery fully charged, the tuning will be rather broader, all other things being equal, than when it is low. This characteristic of the set undoubtedly covers more hard-to-account-for peculiarities than any other one factor. Volumes could be written on this one subject, but it is thought best to limit the discussion to important generalities rather than a host of smaller ones which would merely tend to confuse.

At the beginning it was pointed out that this circuit is virtually resolvable into five subsidiary circuits. That being true, and at the same time acknowledging the difficulty of procuring well

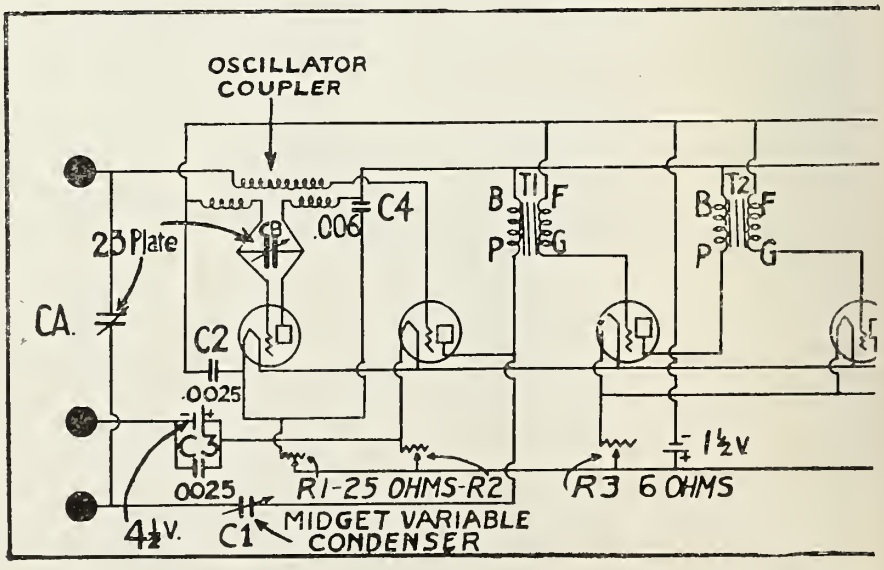


The baseboard arrangement. This layout enables the builder to Green's super-heterodyne, which has

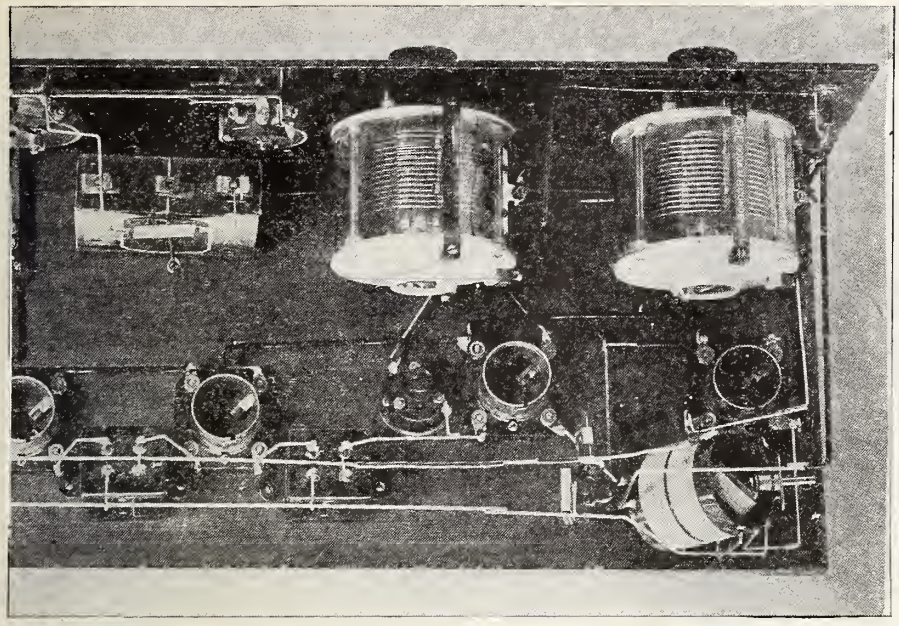
matched tubes and the evident preference among fans for a circuit in which any of the standard tubes may be used, it becomes apparent that practically as many filament controls must be provided as there are subsidiary circuits. This system has the advantage of being very flexible and permitting of studying the peculiarities of each of these circuits. From this as a basis the builder can eventually consolidate certain of the filament circuits which have similar filament requirements. It is logical to assume that the separate control method will be the means of most quickly acquiring a working understanding of the circuit.

The set shown in this article was recently built, embodying this plan for separate control and serves to illustrate the several points involved. A panel and baseboard 36 inches long was used so that it would be possible to give each unit more space for purposes of observation. As a number of combinations of oscillator coils and condensers were tried, this circuit was changed a number of times. Hence no apology is due for what may appear as somewhat "sloppy" wiring.

In operating the set it very soon became apparent that little was to be gained by turning up the filaments on the two detector tubes. In fact, with these rheostats barely on, full volume was secured. The intermediate circuit, however, required full voltage for full amplification. The audio circuit required less filament voltage than the intermediate circuit. The oscillator tube was probably the most critical, but even there the voltage could be lowered almost



Above is the wiring diagram of Paul Green's super-heterodyne, this circuit report that little was to be gained by turning up the filaments volume was secured. The intermediate circuit, however, requires full the voltage was lowered almost to the vanishing point



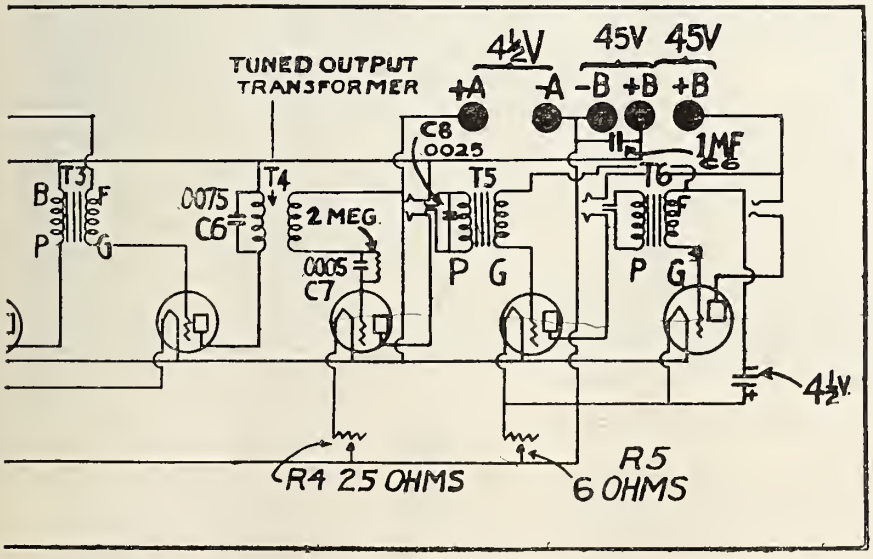
understand the operation of each of the fundamental circuits in Mr. made quite a "hit" with the super fans.

to the vanishing point, once the circuit was oscillating. A change in condenser settings with such a rheostat setting usually caused the receiver to go out of oscillation.

Oscillator and Output Coil

THROUGH an oversight the detail drawings for these coils were omitted in the former article. Those described were designed to be made at home. In case you do not wish to "roll your own," here is what you can do. The oscillator coupler pictured in this article can be easily recognized as a type that can be bought in almost any radio store. The tuned output filter or output transformer can be replaced by two 1,000-turn honeycomb coils mounted in the conventional manner so that they can swing from 1-2 to 6 inches apart. This allows for loose or tight coupling with a corresponding variation in sharpness of tuning. Each of these coils is tuned by means of a .001 fixed condenser. When using these coils it should be understood that they replace the primary and secondary of the homemade output coil. The writer has found that the homemade coil operates best when tuned by means of .0255.

Owing to the nature of the circuit as a whole, it is common to hear of trouble in the audio stages. This usually but not always points to the fact that the audio transformers are not adapted to the circuit. Certain oscillations are set up in the first step, which are barely noticeable, but which are passed on to the second stage and may entirely obliterate the music or voice from the second stage, if the second stage is used. For this circuit the audio transformers must have very stable characteristics. Incidentally, it is of interest to note that rarely is the second stage of audio required. In Chicago it frequently has been possible during the last few months to receive the west coast stations on the first stage of audio with enough volume to give good loud speaker results. Probably the most ideal plan is to make the last stage of audio push-pull.



outlined in detail in the accompanying article. Fans who have tried on the two detector tubes. In fact, with these rheostats barely on, full voltage for full amplification. A change in condenser settings when usually caused the receiver to go out of oscillation.

There can be little question but that the super-heterodyne is by far the last word in quality of tone. This may seem a very strange statement to those who have repeatedly heard that the super is a noisy set. For one who has never heard a good super there is a treat in store. To say that it rivals the crystal in purity of tone may be an exaggeration, but at least it would be hard to amplify average crystal reception to the same degree, and still have quality that would compare to that of the super.

Future of the Super-heterodyne

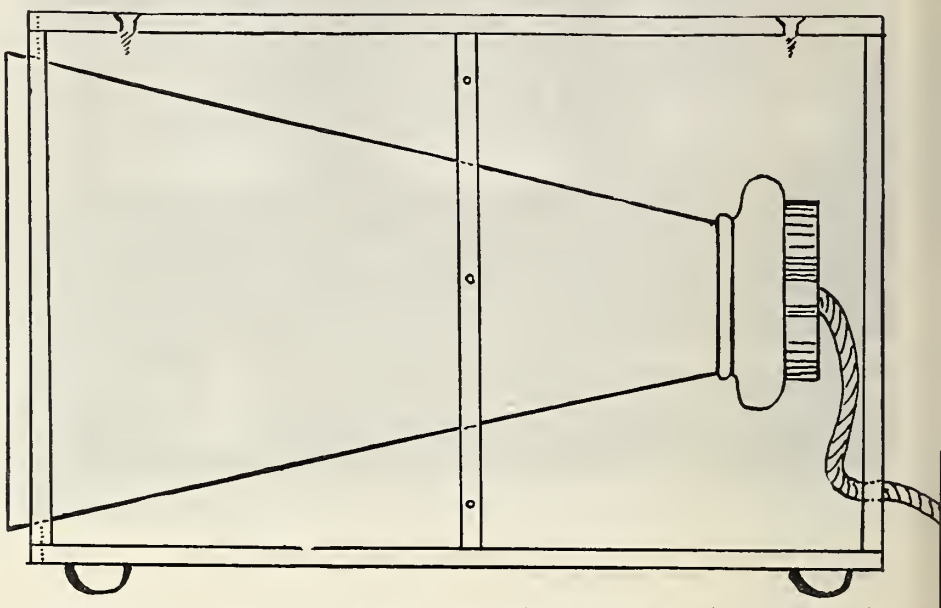
WITH the variables previously mentioned ironed out, by providing for separate filament control, there seems to be no reason why this circuit will not within a very short time be considered by fans who like to build their own, the last word in radio refinement. However, for the radio public at large there is a serious situation to be overcome. It is already apparent from the questions received that a large number of the "to-be super-het" fans desire to operate this set on an aerial. Enough cannot be said right now by way of discouraging this purpose. If you have such a thought in your mind, get rid of it immediately. The oscillator circuit as used in any super-heterodyne set will, if connected to an aerial, give your neighbors more trouble then any single circuit regenerative set yet concocted. Other fans have inquired for means of coupling to aerial and ground through inductances. This, because of the comparatively tight coupling, will also give rise to more or less disturbance unless very carefully handled. The set herein described has been constructed solely for loop reception and should in no case be connected to an aerial.

Recently the writer had a letter from the editor of a radio publication who stated that he was going to publish an article bitterly attacking the super-heterodyne. It was apparent that the editor had founded his conclusion either upon misinformation or had heard or seen sets operated improperly. Subsequent events proved that the editor had judged the super solely from the standpoint of its having been worked on an aerial. He claimed that in his home town life was made intolerable because of the super-heterodyne "maniacs" and their infernal noise machines. Let us not give others, perhaps less well informed than that editor, reason for jumping at the same conclusion. There is no reason why we should try to operate the super-heterodyne on an aerial. It brings in all of the volume that can be possibly used on all stations south and east of Chicago on the first stage of audio when working on a loop.

Are You Nearing the Loud-Speaker Stage?

Then Here Is a Clear-Tone Speaker for You to Build at a Low Cost

By PAUL THORNE



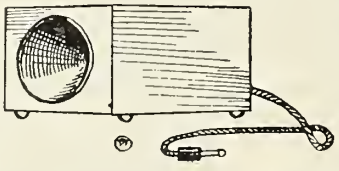
Above is a side view of the home-made loud speaker described by Mr. Thorne in the accompanying article, showing how the horn itself is placed in the cabinet, which likewise can be constructed by the builder at a small cost.

EVERY radio enthusiast eventually reaches the loud speaker stage. While the DX scout will find it best to continue to use his headset on his occasional ether voyages, sitting night after night with the phones on your ears becomes tiresome.

Then, too, the knowledge that you are selfishly keeping the rest of the family from enjoying radio treats gradually disturbs your conscience.

The loud speaker affords the utmost in radio enjoyment. You may dance to the tunes of famous orchestras, join in the chorus with the radio songster, listen to tales of travel from your favorite easy-chair, and have a thousand and one nights of entertainment in many ways that would not be possible without the loud speaker. The whole family, as well as visitors, may listen in, and any one of the group is free to make comments on the program, or there may be a general conversation, which cannot comfortably be done with the phones clasped on one or more heads.

To Buy or Build?



THE acquiring of a loud speaker is easy for the man who has plenty of cash and prefers to buy his radio equipment ready-made. There are any number of good loud speakers on the market for those who can afford them. But there are thousands who feel that their present radio investment precludes any large additional outlay. Then there is the amateur radio builder; the man who gets his greatest kick out of his hobby by being able to say: "*I* made it!" He is not satisfied to tie a factory-built loud speaker to that skilfully home-built radio set.

Both the man who must count the dollars and the amateur builder have been frightened away from loud speakers. One has investigated the cheaper commercial types and decided to stick to his headphones. The other has gathered from numerous technical articles, full of intricate mathematical formulas, that building a super-heterodyne is child's play compared to correctly designing and building a loud speaker. So the real pleasure of radio is lost to many families.

It is true that the need for a loud speaker has been partly and economically met by a phone unit attached to the phonograph. As a rule, however, the radio set and the phonograph are neither designed nor placed in suitable locations to work together. And anyway, each has its individual place in entertaining the family.

As I am one of the radio bugs who will not have anything that is not largely home-made, I attacked the loud speaker problem and solved it satisfactorily. So many persons have asked for the construction details after listening to my loud speaker, that I am going to tell you here just how I built it. You will be both surprised and pleased to learn how simple and easy it proved to be (in spite of mathematical warnings), and I am sure that no home will longer be without the joys of a loud speaker after this number of RADIO AGE arrives.

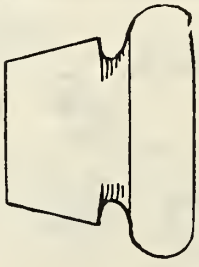
Two Vital Parts

WHEN you dissect the ordinary commercial type of loud speaker, you discover that there are really but two vital parts—the special phone unit and the horn. The horn is the big stumbling block in construction. Any kind of an effective horn is hard to build at home, and the articles which have appeared usually made it plain that unless certain scientific and mathematically calculated proportions were maintained the loud speaker would be a failure.

Perhaps you will recall how college boys on the campus or the athletic field place a megaphone to their mouths. If you happened to be opposite them at the time you heard a clear, strong voice issue from the megaphone, and carry to a considerable distance. Now, is there very much difference between a voice issuing from the human mouth or from a loud speaker phone unit?

I decided there was very little, except in volume. And if a boy's voice could carry across a football field by the aid of a simple little megaphone, why could not a phone voice carry across a room by the same means?

That settled the horn problem, and I went about securing the necessary material for my loud speaker.



A

B

I purchased a small, twenty-five-cent megaphone at a sporting goods store. This was of heavy, varnished fibre—a particularly inert composition, and therefore not sensitive to vibrations. It was eight inches in length, and the large opening was five and one-half inches in diameter. The mouthpiece was a nickeled metal rim, which gave added strength.

The next step was to buy a good loud speaking unit. I bought the Baldwin Type C, but you will find others that will serve just as well. *Do not expect, however, to get real loud speaker results from an ordinary phone unit.*

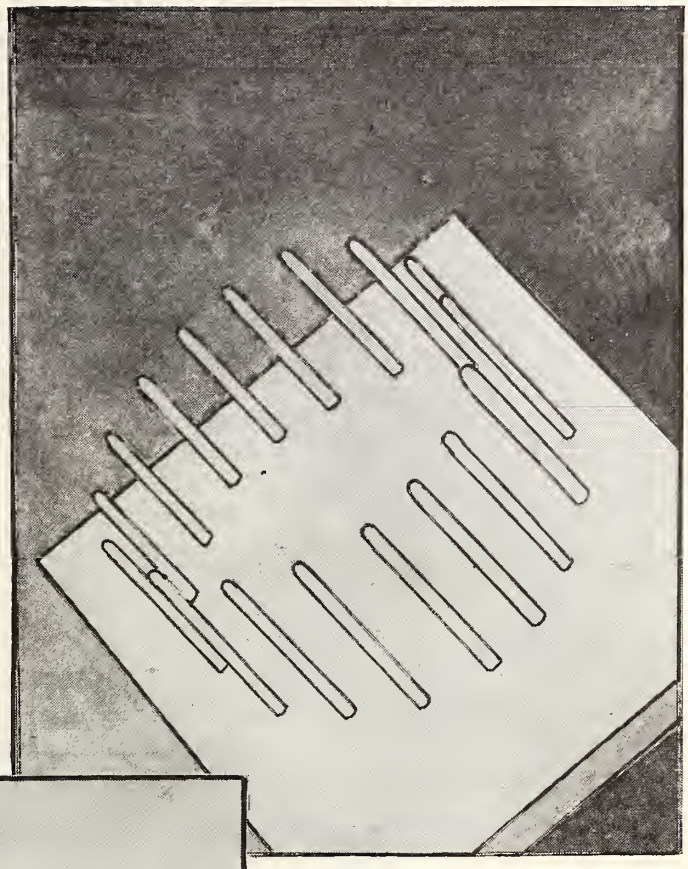
The next problem was to fasten the unit properly to the megaphone. For this purpose I obtained one of the rubber adapters for attaching

(Turn to page 57)

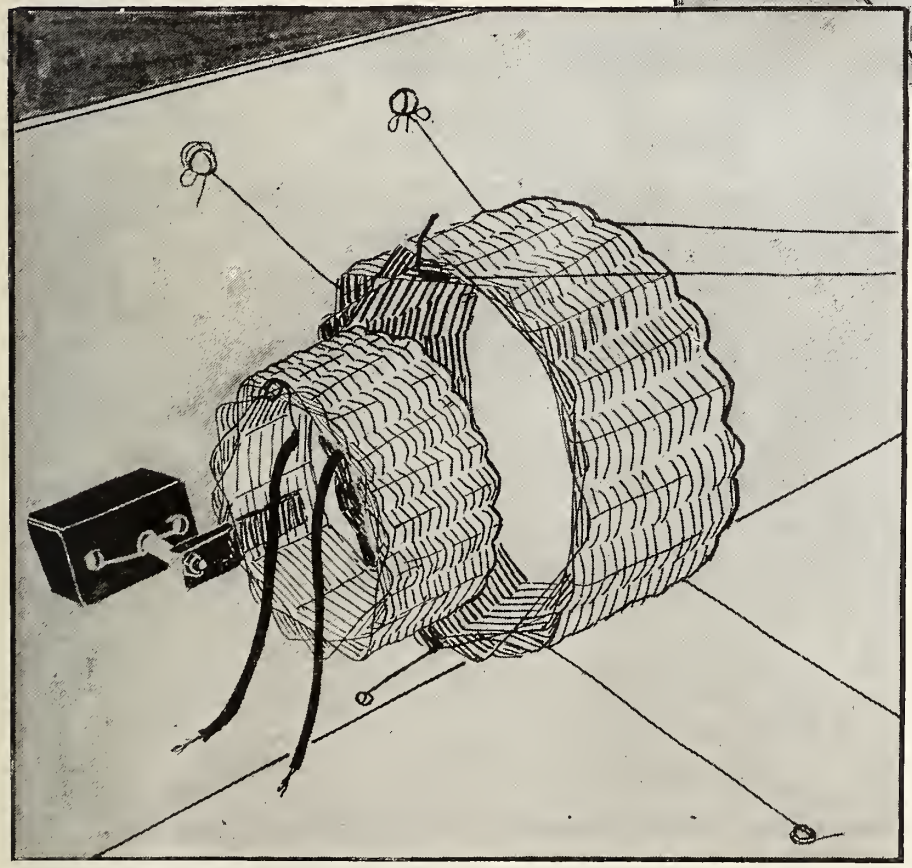
Angling *for* 'DX' Signals

Here's a Receiver That Has Proved To Be a Real Record-Breaker

By *FELIX ANDERSON*
Assistant Technical Editor



The winding form for the secondary and anode coils. Seventeen pegs about 4 inches long are set into holes drilled in a pine board in a circle three and three quarters inches in diameter. The coils are wound by winding over one peg, skipping two, then winding over the third, and again skipping two until the desired number of turns is wound.



An illustration showing the assembly and mounting of the anode and feedback coils. The feedback coil is variable with respect to inductive relation to the plate coil.

A Vital Summary of Experiments with England's 3-Tube Circuit Which Received Fifty American Stations

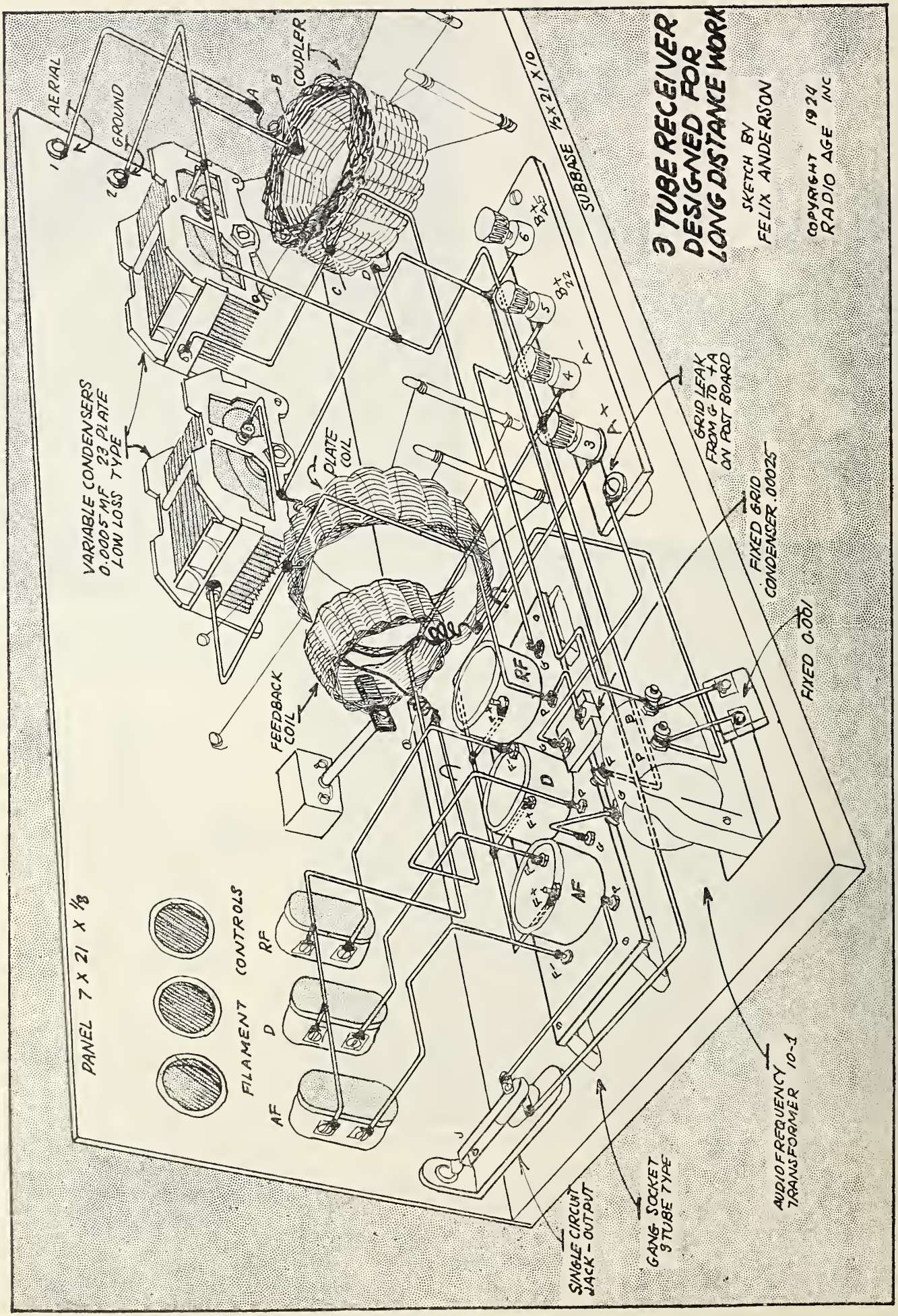
FISHING, whether it is for long distance stations or for fish, has two distinct types of adherents. In the grand old pastime with bait and rod, we have the type of fisherman who trolls along with a large bait, works hard, and when he gets results, he usually gets them to the extent of a nice big catch.

On the other hand, we have the fellow who goes out with a fly rod, and a little feathered hook, and if he is skillful, he gets a nice catch of sweet morsels.

In radio we have the same thing. We have the man who goes after the stations with a big receiver—a super-heterodyne or a neutrodyne, and when he gets the station he "baits" for, he gets him on the loudspeaker. Then we have the fellow who listens with his head set, with one to three tubes and he also gets them, and probably more than the other fellow, though they do not "weigh" so much.

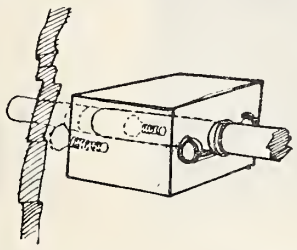
I am one of the latter type of radio bugs. I prefer to listen with the headset, and pick out stations at ease (just as I would rather fish for trout) because I get a much greater thrill out of the results. I'd rather get the East coast or West coast on the phones five or six times a week, than I would to listen to them probably once or twice a month on the loudspeaker.

You will be interested in hearing how this can be done. *[Turn the page]*


3 TUBE RECEIVER DESIGNED FOR LONG DISTANCE WORK
SKETCH BY FELIX ANDERSON
COPYRIGHT 1924 RADIO AGE INC
SUBBASE 1/2 x 21 X 10
PANEL 7 X 21 X 1/8
AERIAL
GROUND
COUPLER
VARIABLE CONDENSERS 0.0005 MF 23 PLATE LOW LOSS TYPE
PLATE COIL
FEEDBACK COIL
GRID LEAK FROM G TO +A ON POST BOARD
FIXED GRID CONDENSER .00025
FIXED 0.001
FILAMENT CONTROLS
RF
D
AF
SINGLE CIRCUIT JACK - OUTPUT
GANG SOCKET 3 TUBE TYPE
AUDIO FREQUENCY TRANSFORMER 10-1

Choosing a Circuit

FIRST of all, I wanted a circuit that was not too complex; one that had only two or three controls which could be worked with two hands, and one that did not require a great many adjustments. Second, I was looking for a circuit that would give results, sharp tuning, and one that would allow me to log the dial readings once I got a station. Considerable scouting around was done before I lighted upon a circuit that would comply with these requirements.



Remembering that the English fellows were hearing American stations with regularity, I decided to try out one of these circuits, and suffice it to say that while their circuits are not radical, they do give results. It might be well to add here that these results come from no little experimentation and painstaking care in design.

The circuit I chose to develop consisted of a stage of radio frequency, a detector, and one of audio. The radio gives DX, the detector—well, you know what that does, and the single stage of audio gives sufficient amplification to make the signals just loud enough to be comfortable with the headset, and not so loud that it will deafen you to other weaker signals. The original circuit had straight conductive coupling to the grid of the RF tube, which made the tuning too broad, so I changed this system to fixed tune antenna coupling by making a fixed coupler, wound low loss style. Otherwise, with the exception that the original circuit had coils wound on tubes, it is identical to the circuit I started out with. However, the few changes made no doubt contributed to the efficiency of the set, since coils wound on forms of hard rubber, bakelite, and other materials decreased the signal strength on some of the weaker stations. All in all, dry and slightly "doped" cardboard tubing, (very thin) was found to give the best results of all the tube forms.

How to Make the Set

TO make the set, procure the following materials:

1 Panel 7x21x⅛ inches.
1 Baseboard.
1 pound No. 18 DCC or DSC wire.
2 0.0005 MFD (23 plate) Low Loss condensers.
Non vernier, straightline plates preferred.
1 triple gang (UV199) Socket stand.
6 Binding posts.
3 Filament controls.
1 Single Circuit jack (output).
1 0.0025 MFD Fixed Mica Condenser.
1 0.001 MFD Fixed Mica Condenser.
1 Set variocoupler shaft fittings. (Cost .15c at any salvage radio shop).
3 UV199 tubes.
1 B battery 45 volt type tapped.
1 set dry cells for A battery.
1 strip bakelite 1x8x⅛ inch. for binding post mounting.
1 10 to 1 Audio Frequency transformer.
3 Panel Bezels (optional—you can drill a set of holes in diamond formation).
String, ¼ inch wooden rods (17 of 'em) about 4 to 4½ inches long, and all the other necessary paraphenalia to put the common variety of set together.
2 Vernier dials (anti-backlash type).

Winding the Coils

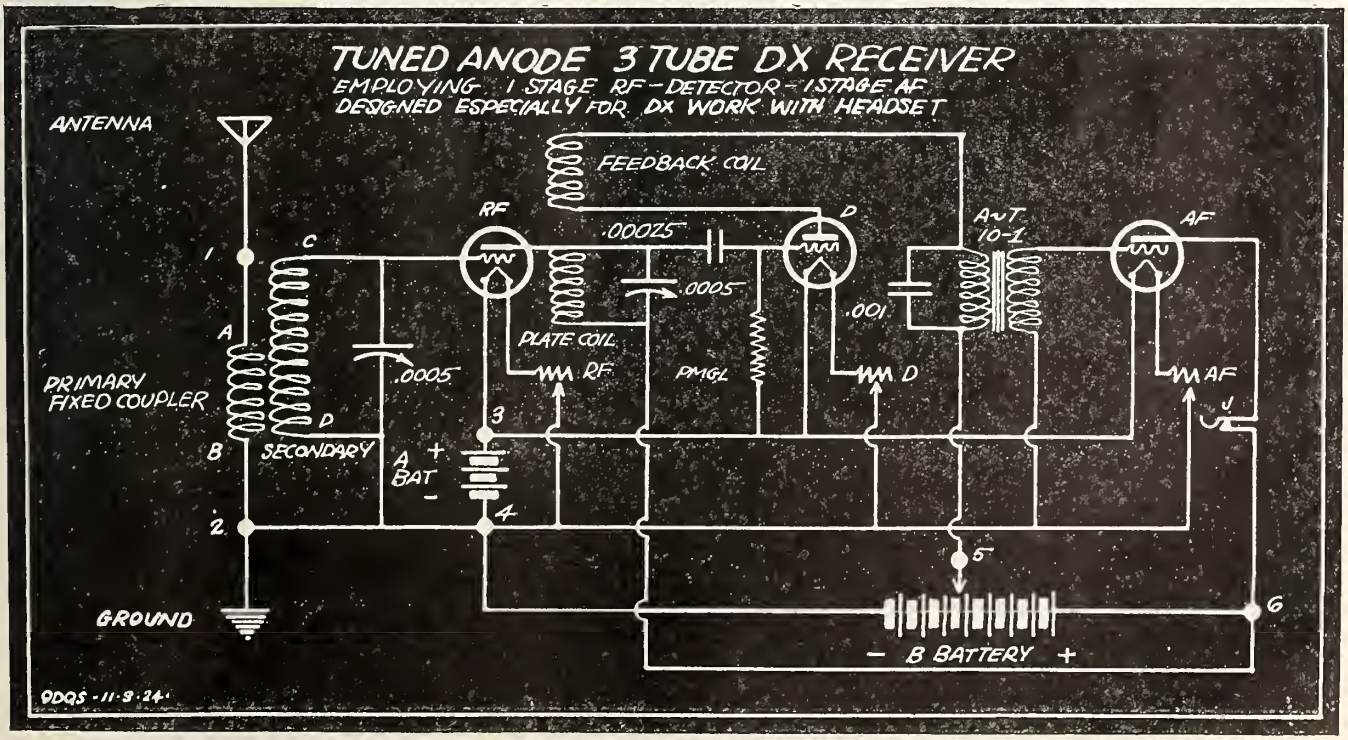
The first job (an easy one) is to wind the coils. If you desire, you can use honeycombs or pancake coils whose specifications come closely to the ones I am going to give, but if you possibly can, wind them yourself, since there is nothing like making your set to conform to the surroundings in which it is to be operated. Get a piece of board about 8 inches square and 1 inch thick, and with a compass describe a circle with a diameter of 3¾ inches. Then divide the circumference of this circle into 17 even divisions, and drill holes deep enough to permit the wooden doll rods to be set in. I put mine in with a little glue, and have a permanent form, and I get a nice coil out of the form since it makes it more rigid.

When you've finished the coil former, lay it aside to allow the glue to dry, and proceed to drill out the panel for the condensers and filament controls, as well as the feedback coil mounting arrangement. I found the arrangement shown (in the perspective sketch) to be very good, since it keeps the two condensers together, with the feedback coil control within easy reach of the right hand. The other detail is not important. We'll let you use your own judgment with respect to the other parts with the admonition that you use a large baseboard (spar varnished preferred). Give your units plenty of room on the baseboard; keep the coils clear by at least two or three inches.

By this time, your coil former will have dried, and you can proceed to wind your coils. Start with the fixed coupler, by winding over one of the pegs (fasten the starting end with a little tack outside of the circle) then skip two of the wooden uprights, wind over the fourth, skip the fifth and sixth, and then wind on the outside of the seventh, the tenth, thirteenth, sixteenth, and start the second turn on the second peg (the one next to the one you started with). The third turn will bring you back to start winding the fourth turn beginning with peg No. 1.

For the coupler, wind 50 turns of No. 18 DCC or DSC wire for the secondary in the foregoing fashion, and when you have finished the 50th turn, give the wire a turn around the peg you

(Turn to page 77)

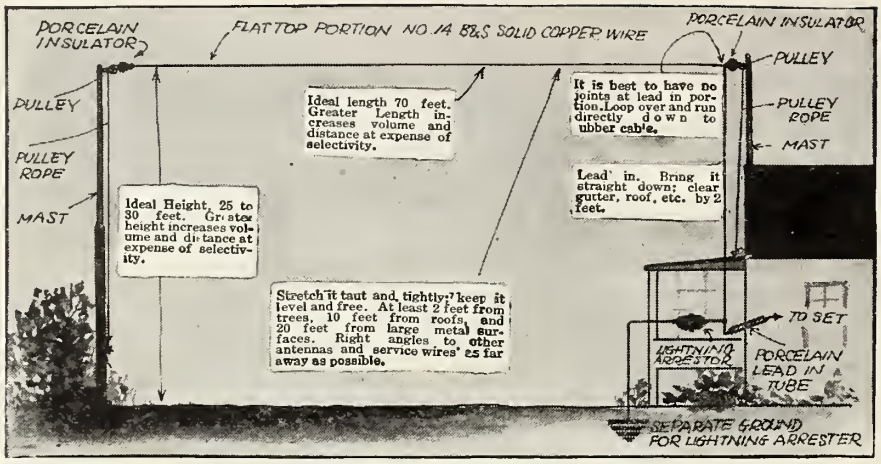


The circuit diagram of the Tuned Anode DX receiver can be traced down to nothing more than a good single circuit receiver with a stage of RF and one of AF. Since the merits of the straight single circuit with regard to results are so well known, it is no wonder that the circuit works.

The Best Way to Lies in Building

HOW To *Your* SIMPLE

By EDMUND



A photo-diagram showing the ideal dimensions for the antenna to be used on any average broadcast receiving set. If the instructions printed on the diagram are followed religiously, the listener can expect very good results from practically any receiver he tries out.

THE way to learn radio is to build a few receivers. No amount of study, no pouring over theories, will teach you adequately. It is interesting to hear a station a thousand miles away on some other man's receiver, and it seems marvelous enough. But it is ten times as thrilling and ten times as marvelous, when you pick that distant station up on a set you have built with your own hands!

Before attempting to construct any of the circuits recommended, you should know a few of the fundamental principles which must be adhered to in order to obtain maximum results.

Antenna and Ground

A CHAIN is no stronger than its weakest link, and radio reception, no matter how good the receiving set may be, cannot be satisfactory without a good antenna and ground system. The most efficient antenna is an outdoor aerial fully described in accompanying drawing of an "ideal antenna," into which pages of instruction have been compressed.

Be sure your "ground" conducts electricity deep into the ground. A water or radiator pipe (not gas pipe) serves the purpose well. File or sandpaper the pipe, tighten copper clamp tightly to it; solder clamp to your ground wire. If you are in doubt about the effectiveness of your "ground," use two grounds. One fan who has picked up 267 stations actually uses four different kinds of grounds.

Since it is a fact that the energy gathered by the antenna is generally but a trifling fraction of a fly-power, you want the set you build to be the last word in sensitiveness and efficiency. Otherwise you in effect move your station many miles farther away. A dollar saved through buying a cheap condenser, for example, may cost you 1000 miles of distance.

If we analyze any circuit, we find three fundamental factors which determine the efficiency of the particular circuit selected; namely, inductance, capacity, and a rectifying device.

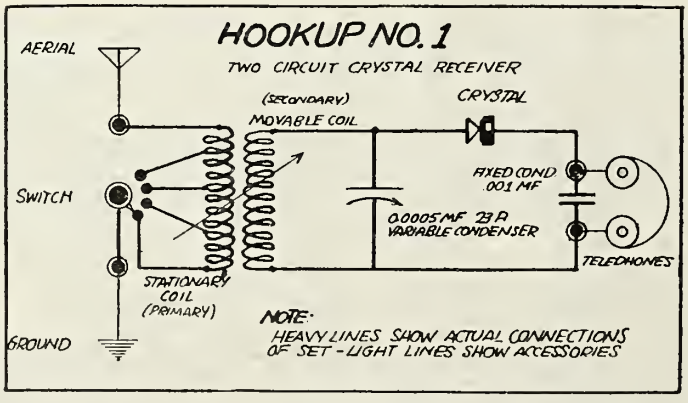
The coil or coils constitute the inductance; the condensers (fixed or variable) the capacity; and a crystal or vacuum tube the rectifying device.

The Inductances

IN the selection of a really efficient coil or coils for inductance, several factors must be borne in mind.

First, Insulation. Since the flow of current in a coil occasions the sending out of "lines of force" (which constitute a "magnetic field"), you should have the least possible insulating or supporting material about it. Rubber, phenol compounds, compositions, fibre, etc., produce a loss of energy through absorption.

Second, the Method of Winding. Layer windings on a cylinder, because the adjacent turns of wire are close and parallel, give a wasteful condenser effect. This loss is called "distributed capacity" and it acts as a resistance to the incoming signal.



Third, Coupling. The method of coupling the "magnetic fields" when two coils are used, is important, as will be explained.

Carl Pfanstiehl, physicist and inventor, who has made a life-long study of electromagnetic forces including the electrical exploration of the "fields" about all types of windings, has found the stagger-wound form of inductance to be the most efficient for radio reception. The successful application of this form of inductance to the Reinartz circuit, led to the construction of new and perfected variometers, variocouplers and the recently developed three-circuit low-loss tuner.

In these tuning units, we find an absence of absorptive (or dielectric) material. Even the spiderweb or wooden frame is eliminated because it absorbs energy, and the coils are made self-supporting with a special low-capacitative cement. "Distributed capacity" between the windings has been eliminated.

The disc shape of the windings produces flat "magnetic fields" in which the lines of force are concentrated and do not reach out and interfere (i.e. generate disturbances, howls, etc.), with other parts of the set. As the coils are only a quarter of an inch thick, all turns of wire are included in the mutual "fields." This is not the case with tubular or honeycomb coils where the far turns of one coil may be removed several inches from the coil to which it is coupled inductively (i. e. joined through the electromagnetic action of the "fields.")

Capacity

THERE is no use to use a low-loss inductance, however, if you hook it up to a high-loss condenser. All insulating material should be kept down to a minimum, and what little of it is used must be located as far outside the electrostatic field as possible, since any electrostatic lines of force which pass through insulating materials absorb energy from the circuit. (The loss takes place in the form of heat.)

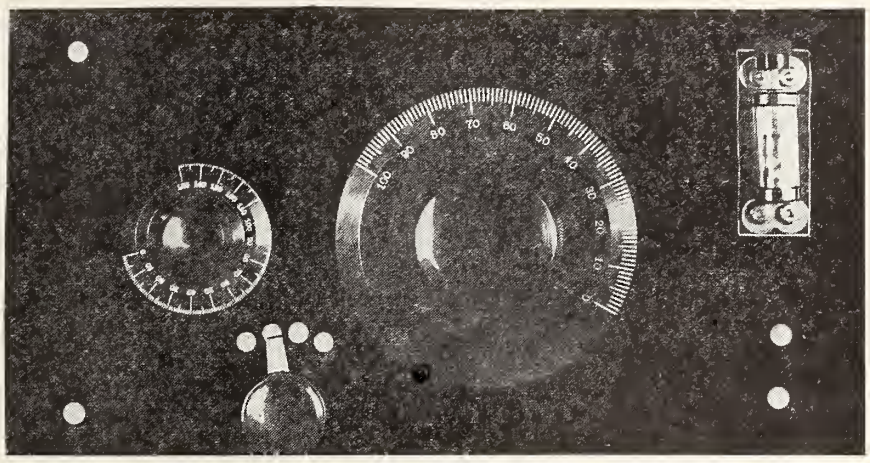
The surface of insulating materials collects a little dust and sometimes a thin film of moisture. If this leakage path is short and wide, considerable energy will leak across, instead of being stored up in the condenser.

The fixed condensers, since they generally must be accurate and must be made of the best insulating material,

Master Radio a Few Hookups

BUILD *First* RADIO

H. EITEL



A front panel view of the beginner's crystal receiver, showing the simplicity of the panel layout.

should be of the best quality, and a reliable brand. In general, quality is just as necessary as in all other apparatus, such as in grid leaks, head-sets, etc.

Other points to be regarded are:

1. A cheap condenser is no economy unless you prefer saving a little money, to getting distant stations!
2. A frictional contact is a poor and unreliable connection to the rotor as compared to a "pig-tail" connection.
3. For most circuits it is best to have both rotor and end-plates grounded to eliminate "body-capacity" effects.
4. "Shaped" plates are a sign of good design. They are superior to symmetrical plates since they give a "straightline" effect or regular change of capacity per degree turn of dial. Therefore they avoid the bunching of stations on the tuning dial.
5. The plates should be tightly wedged into their supports or soldered. Washers do not form an efficient path, but introduce resistance.

Rectifying Device

The purpose of a rectifying device is to suppress one-half of the "alternations" of the current and thus change the alternating current to direct current. The crystal accomplishes this purpose with a minimum of distortion. Sets using crystal detectors are notable for their purity of tone. Of course, a tube with its three "elements" has the advantage of acting like a valve and releasing a secondary current (from B battery). In this way, it greatly reinforces the weak signal.

There are many reliable crystals, both fixed and adjustable, on the market. If vacuum tubes are to be used, we suggest that you refer to a schedule of vacuum tube data for the characteristics of the various makes of tubes.

Other Parts

Nothing has been said of the other apparatus which is necessary for the construction of a good receiving set. We believe that if the builder has selected efficient coils, condensers and rectifying devices, he will naturally make the proper selection of his rheostats, fixed condensers, grid leaks, tube sockets, binding posts, jacks, dials, phones, panels and cabinet.

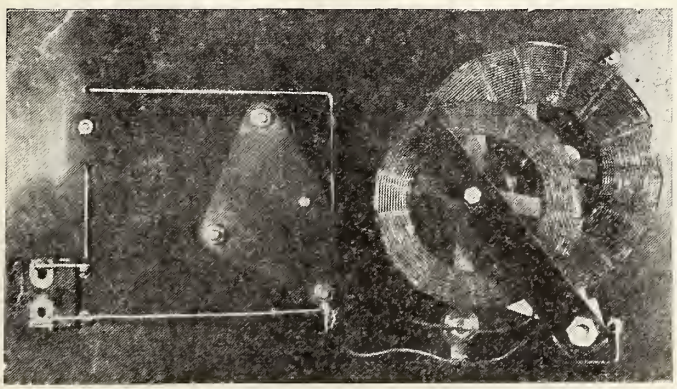
Having very briefly discussed the factors which make for efficiency in radio reception, we trust that the circuits which will follow, will prove interesting and most efficient in their operation.

Hookup Number One

A simple, efficient and selective crystal receiver that does not cost a fortune to construct.

IT IS the opinion of the writer that every radio beginner should commence his radio career with a crystal hookup. The reason lies in the fact that it embodies practically all the fundamental principles which are the basic laws of radio, and since there are so few parts (which are fortunately not expensive) it is an easy matter for the beginner to study and follow out the various functions of the set, as well as to gain a good general knowledge of radio principles.

It is with this idea in mind that the writer wishes to describe in a concise as possible manner the construction of one of these little "first grade receivers."



Building the Set

FIRST of all it will be necessary for you to appropriate about 25 dollars out of the weekly pay envelope. Your set will total close to this amount when all the accessories have been counted in. The second step is to pick out some reliable radio dealer, whom you can trust not to prey upon your lack of knowledge of the game. Then give him the following list, the bill comprising the necessary units and apparatus which will be needed in constructing the set:

BILL OF MATERIALS

1 Variocoupler, staggerwound type as illustrated.
1 Variable Condenser, 0.0005 MFD grounded rotor type, plates cut for straightline effect in tuning. Do not use one with bakelite end plates or one that uses a bakelite bushing for insulating.
1 Double crystal detector. Silicon-bornite combination, or if desired, straight galena.
1 Switch lever; you choose according to price.
4 Switch points (for coupler shown. Otherwise, as many as there are taps on the coupler.)
4 Binding posts, you choose according to price.
1 fixed mica condenser, 0.001 MFD. Do not use one with paper insulation.
1 panel, bakelite, formica, hard rubber or other good insulating material. Size 7x10x1-8 in.
1 Cabinet (if desired).
1 Set headphones; mica diaphragms if you can stand the expense; otherwise spend about $6.00 for a good, standard pair. It pays in the long run.
1 coil of antenna wire (100 foot length) solid copper, enameled preferred.
1 coil of rubber covered No. 14 B & S copper cable long enough to be used for lead in and ground connection. You supply dimensions.
1 set of insulators to suit type of antenna you build. The long, skinny glazed porcelain type is best. Insulate the antenna well—the best is none too good. (See illustration for detail of ideal BCL antenna).
1 Lightning arrestor (you can add that later).

If you intend to experiment in the radio game, it would be wise to supply yourself with a little soldering outfit, a pair of wire-cutting square jawed pliers, a hand drill and a screwdriver.

Put up your antenna first—do it the first nice day you have the chance, since your zeal later will no doubt drive you to put it up 10 minutes after you have finished the set, and the weather may not be just what it should be for climbing roofs. The illustration accompanying shows the construction, which should be adhered to as closely as possible.

Laying It Out

The rest is easy. Lay out the apparatus on the panel as the illustration shows, or if you prefer, use your own judgment. Keep the coils clear by at least two inches if possible, no matter what arrangement you use. Templets are furnished with nearly all of the units now on the market, and the actual

(Turn to page 63)

A Set for the Beginner
A SINGLE TUBE REFLEX

By FRANK D. PEARNE

IT IS rather a hard proposition these days to select a receiving set for the beginner, because some care only for local reception, some care only for distant reception, while others want both.

Sets which will cover all three of these requirements may be constructed, but at an increased expense over those which are adaptable to local reception only. A set of this character must be selective and sensitive, or it will be of no practical value. As a matter of economy, the reflex type is the best, because in reflexing, the tube or tubes are made to do double duty; that is, the signal is first passed through the tube at radio frequency, is then rectified by the detector, after which it is again passed through the same tube at audio frequency, which causes double amplification with a single tube.

It is for this reason that the single tube reflex has earned the reputation of loud speaker reception. Accomplishing double amplification with a single tube naturally reduces the cost of apparatus and the clear, pure reception afforded by the crystal detector greatly improves the musical tone of the programs over those received on a tube detector.

In the simple reflex circuit, shown in the accompanying drawing, we have not only a good distance getter, but also one which will give loud speaker reception on local and many distant stations. It will be noticed that this circuit is slightly different from those before shown and the results obtained are exceptionally good.

Use Standard Parts

The materials and apparatus used are all of standard construction and one should have no difficulty in obtaining all the necessary parts from your local radio store. The antenna circuit is tuned by means of a 23 plate variable condenser and a variometer. These are of the ordinary standard type, although in the case of a variometer it is always advisable to use a large one in any kind of a set. The radio frequency transformer should be one having a wave band broad enough to cover all the broadcast waves. The audio frequency transformer in this case may be one of high ratio, as very little distortion will be noticed even if the ratio is as high as 10 to 1. The tube should be of the amplifier type. Either the UV-201-A, or the 301-A will work very nicely and probably the same results may be obtained with some of the other new tubes; the tube used in this test was a standard 201-A.

Short Wiring Needed

ALL wiring should be as short as possible to prevent interference and howling, and the wire used should not be smaller than No. 14. Tinned copper bus bar wire will make a very nice job and the soldering will be found to be a comparatively simple matter because of the tinned coating.

The set is wired as follows: from the aerial binding post to the rotary plates of the 23 plate condenser. The stationary plates of the condenser are connected to the grid of the tube and to one of the

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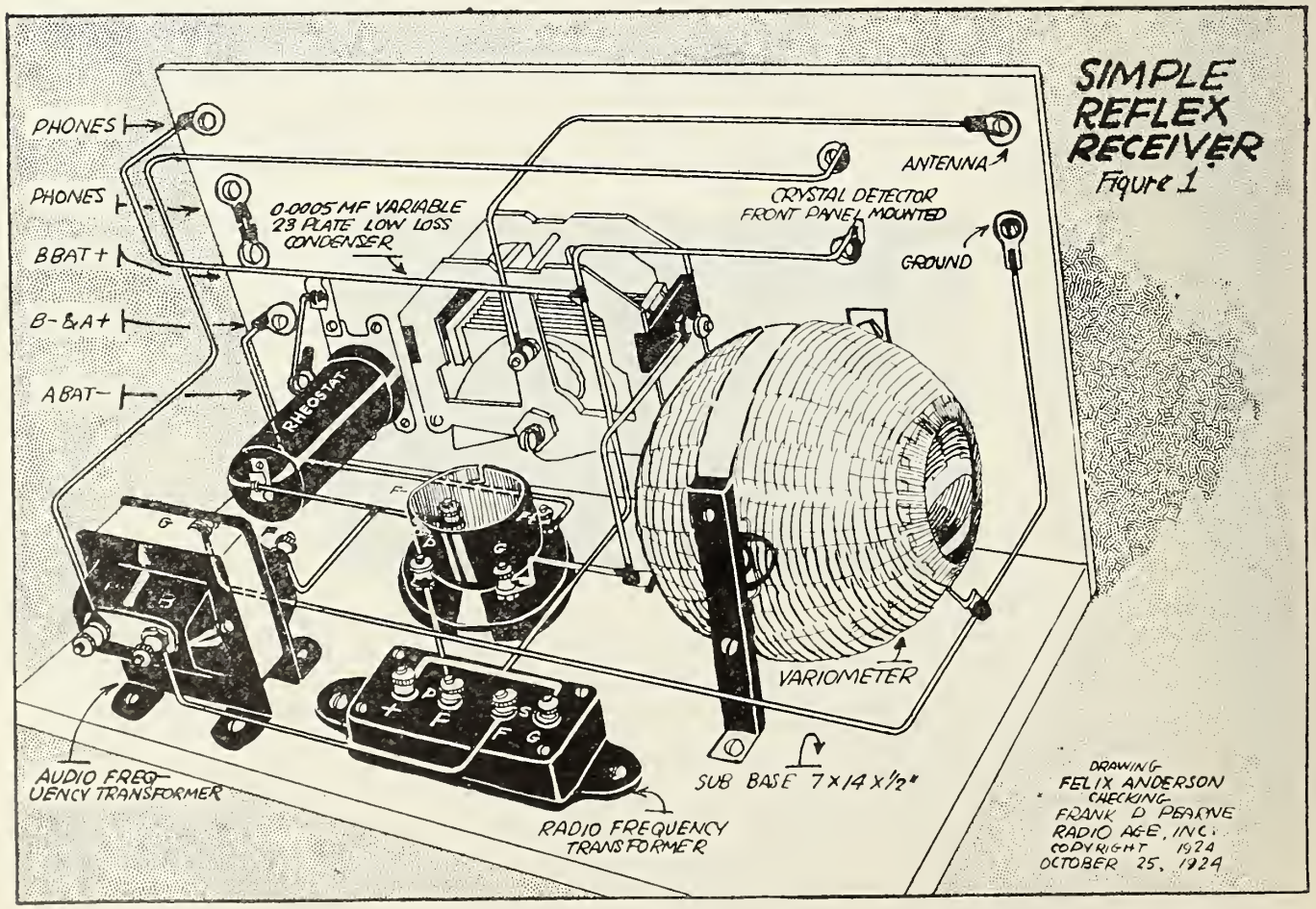
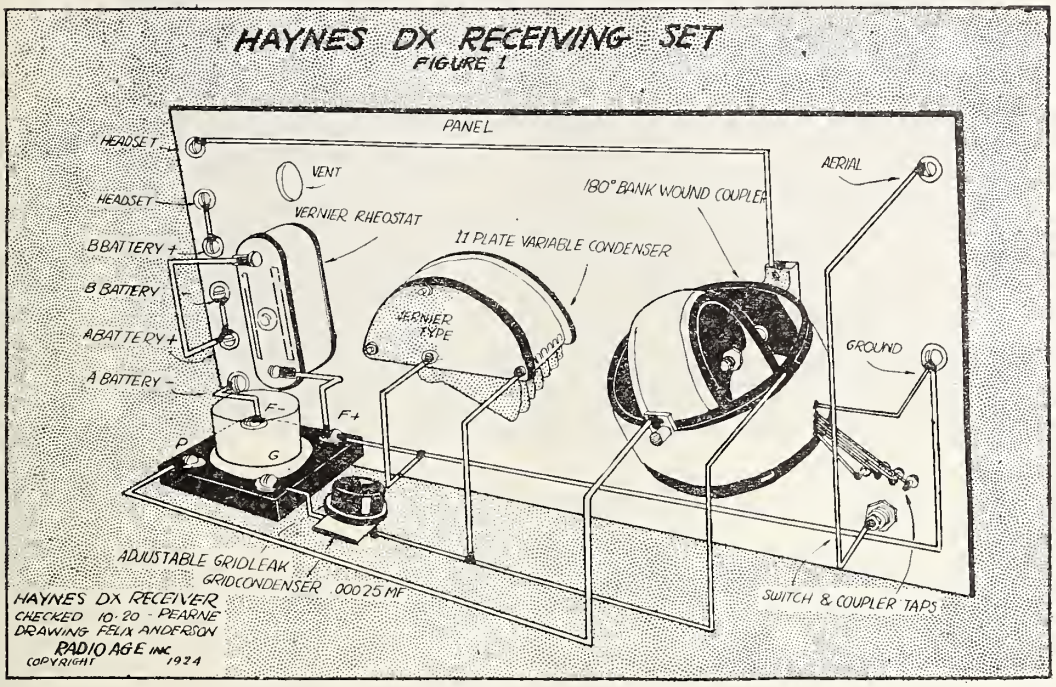


A perspective drawing of the simple single tube reflex, showing the simplicity and the lack of complication in its construction. The tube is made to do the work of both radio and audio frequency amplification, while the crystal detector gives exceptionally beautiful signal quality. The set is an ideal receiver for those "bugs" who wish to operate local stations on the loud-speaker.

An UNSELFISH *Regenerative Set*



Crime of Radio is to Cheat the Other Fellow of a Program by Allowing your Receiver to Radiate—Haynes Hook-up Gives Single Circuit Results Less "Canary Bird" Tuning

By ALLISON BUDLONG

IF YOU are the owner and operator of a good single circuit receiver, you will probably approach the reading of what follows in a rather hostile mood. So before we go any further, I'd like to suggest that the reader put himself in an unbiased and unprejudiced frame of mind in order to judge most fairly the gist of the statements which follow. I know as well as you do that the straight single circuit gives wonderful volume, incredible DX results, and general satisfaction all around, as a rule. But I also know what it does to the other fellow's share of a DX signal if it is not properly handled, and if you know anything at all about radio, I'll wager you have a rather guilty feeling while tuning DX signals when the set says WHE E E E e e e e! Yet when another bug does the same thing after you have the station tuned in and the tickler coil just below the spillover point, you wax hot and furious—did you ever look at it that way?

This radio game has no room for selfish people and selfish sets. Unless we all take the attitude of making the game a better one, it will not grow—and without growth, nothing can continue.

Anti-Single Circuit

HOWEVER, let's not dwell on this phase of the problem. We all take it for granted that squeals are not intentional—that the fellow who operates his set does not know that he is doing the other fellow an injustice. If there are any fans who are still inclined to believe that the merits of the single circuit are great enough to warrant its general use, it is to be regretted, since the attitude of the radio public has only too plainly manifested itself in this respect. Since it is so simple a matter to prevent controversies in this regard, I am sure that it will be only a period of a few months before the effect of propaganda and sentiment will assert itself. Suffice it to say that the average radio enthusiast, with a fair knowledge of the art of radio, will not excuse the use of a circuit that is a violent offender and a menace to the peace and confidence of the broadcast listening pastime.

When you get this far, you will probably feel like turning over to the next page with the conviction that "it's the same old stall—duty to the public and all that rot. It gets into everybody's system more or less around election time."

Eliminating the Squeal

THAT Mr. Single Circuit Bug is a bad viewpoint to take on the subject. Remember that if you change your set over to something that is not so violent an offender, even to one that does not squeal, you not only set the example for coming BCL's, but for many of your other single circuit addicts as well.

Now don't get me wrong. I don't expect any average radio man to throw out a perfectly good set—that's impractical. What we can do is employ some circuit that gives us results without the bad feature tacked on. That's easy; there are a number of good hookups to follow.

The simplest way for the single circuit owner to get into the game right is to change the method of coupling the antenna circuit to the set. Get yourself a copy of the May, 1924, issue of RADIO AGE, read over the article on page 15, and then get busy and make yourself a considerate radio listener. There's nothing to it. A coil of wire used the right way, and the squeals of your receiver are cut down to a point where they can be of very little harm. Since the article covers many of the "blooper" circuits now in use, you should have little or no trouble. As the article says, when you make the change, you not only become a good radio bug, but you make your set more selective, you inherently increase its range, and you get practically the same volume. Best of all, you get the satisfaction of knowing that you are not the one who is selfishly breaking up reception for probably five or six blocks around you.

It may be that you are interested enough in this movement to build a new receiver, so I will give you the details of the construction of a receiver that was designed with the object of keeping the

advantages of the single circuit receiver in its make-up. Its design is of a nature that it materially sharpens tuning, with correspondingly greater DX ranges made possible, and also keeps the set in a state of extreme stableness so that stations may be logged.

Specifically, this set, which is known as the Haynes DX Receiver, is a combination of all the good features of various circuits, so employed that all of them are at their best. Best of all, the system of antenna coupling, (called semi-aperiodic coupling) keeps the radiation factor of the set down, sharpens the tuning, and makes the set exceptionally stable.

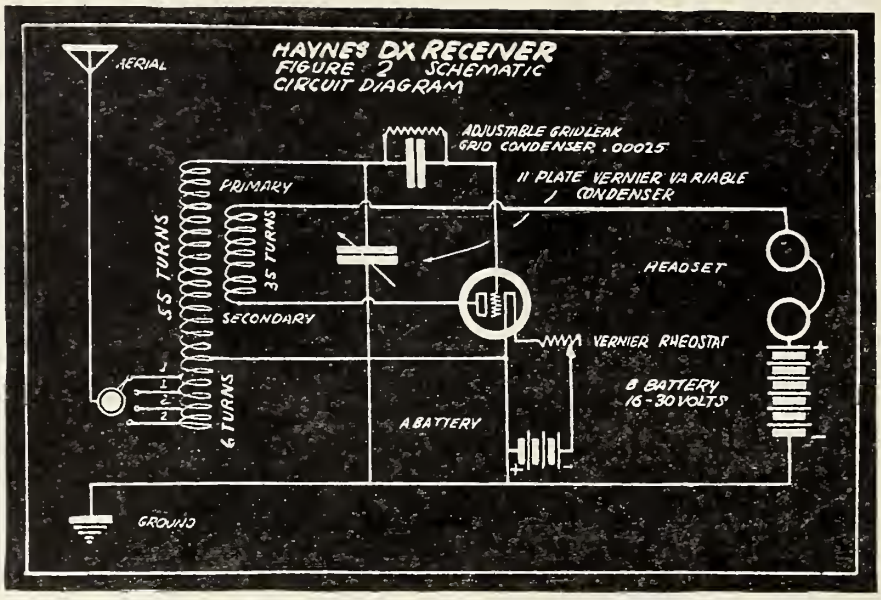


Figure 2. A circuit diagram showing the connections of the Haynes DX receiver. This set has the advantage of being a consistent DX-getter without the nuisance of creating squeals common to conductive coupling of regenerative circuits.

Constructing the Set

THE construction of the set is as simple as that of any single circuit receiver and probably more so. First of all, we will need a specially wound coupler. The ordinary variocoupler will not do for the purpose, since the circuit requires the use of a low resistance bank wound secondary coil, and a rotary element set at an angle of 180°. The use of bank winding makes possible the employment of a smaller variable condenser to tune with, and as we all know the smaller condenser we use to cover a given band of waves, the less critical the tuning of the circuit will be. The coupler may be homemade if desired, so long as the 180° style is used. The coupler may be purchased unwound, and the winding put on as follows: 55 turns are wound in bank fashion after which a tap is brought out. Another turn is then wound and a second tap is made. Two more taps are then wound and another tap made, then two more and another tap. The 55th turn is connected to the ground and filament after which the 56th, 57th, 59th and 61st turn taps are brought out to switch points on the panel.

The tickler or rotor can be wound with about 35 turns to start. The final number of turns on this coil is determined by setting the condenser at maximum, and then stripping turns off the rotor until the set oscillates readily at that adjustment.

The operation is very simple. If the constructor so desires, the coupler may be purchased at practically any good supply house.

The condenser should be one of the low-loss, grounded rotor type having a low minimum capacity. An 11 plate type is recommended, it giving the greatest ease in tuning. If you have a 23 plate it may be used if some of the plates are removed to give the desired capacity. A condenser having a vernier moving all the plates of the rotor is advised, since logging is more certain and the losses are smaller than when a separate vernier plate is used.

Other Accessories

THE rheostat should be one of the vernier type, the tube socket should be a good porcelain or bakelite or if desired a good hard rubber type (avoid tar paper or composition sockets) and the grid leak must be variable. The choice of these parts is left to the judgment of the constructor.

The accessories are mounted on the panel as shown in Figure 1, and are wired as shown. The filament rheostat appears in the positive F lead on the isometric sketch and in the negative on the circuit diagram and while this is a little inconsistency in drawing, it makes no difference in the working or

(Continued on page 56)

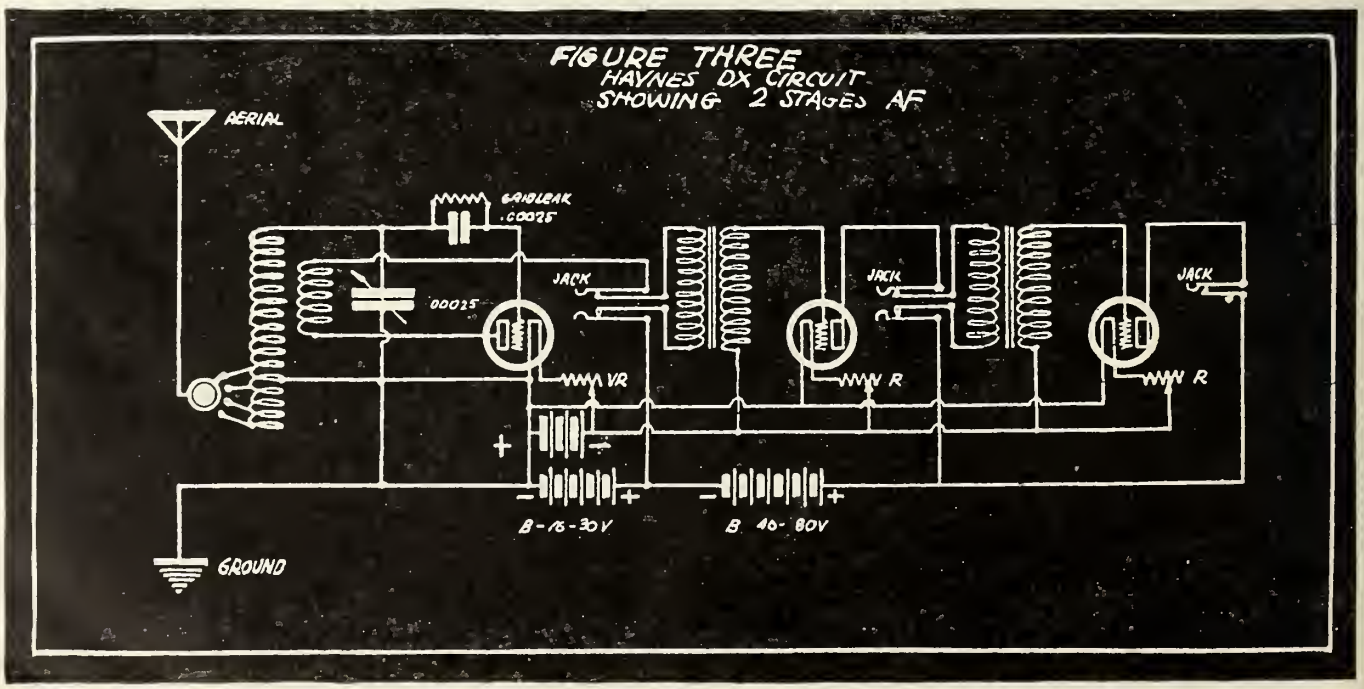


Figure 3. The DX receiver showing how two stages of audio frequency amplification may be added. The receiver as shown herewith is capable of accomplishing 1500 mile reception under average conditions.

The Fourth of This Interesting Series by a Veteran Commercial "Op," Proving That Life Surpasses Fiction

THRILLS *that go with* SOS

What Happened When the Merida was Rammed

By ARTHUR LEECH

Dark senoritas from Mexico, attired in the gay costumes of their country, were among the picturesque survivors from the doomed "Meridas"

THOSE of you who, at a warning shout, have looked aloft just in time to see a five-ton safe about to make contact with the ole bean, will realize how I felt shortly after midnight on Friday, May 12, 1911, when, on hearing the ship's siren blow the emergency signal, I rushed out onto the starboard deck to see, through the darkness and heavy mist, a ship about forty times our size headed for a bull's-eye three feet forward of the radio shack.

That blast on the ship's whistle raised the curtain on as exciting a sixty-hour period of my life as I ever care to pass through. During this interval we calmly sailed from Philadelphia on time; drove into the side of a fat fog bank surrounded by dense darkness; with the same fell swoop stove in the side of a ship carrying four hundred people; rescued said four hundred people under difficulties and the stress of intense excitement; re-built a demolished antenna by the sense of touch alone to broadcast an "SOS" which started two ships scurrying to us through the fog-bound darkness; limped into a New York dry-dock with our front end a mass of twisted beams and plates right up to the foot of the forward mast.

As I related last month, I had left Philly Thursday morning with a smouldering resentment that I had been forced to start another trip in a ship which, because of local conditions, had become distasteful to me. I also noted that I had thought some very wicked thoughts against the dear old "Admiral Farragut," wishing that she would have a little smash in the river and be obliged to turn back. Little did I know, however, that my mental malpractise would be visited upon us a hundred-fold, and when we passed out of the Delaware Capes at five o'clock Thursday afternoon, I had become resigned to the belief that another voyage was safely under way.

In the early evening I had noticed that the weather was turning hazy, but up to 11:30 p. m. visibility had been good. At that time I could clearly see the lights of a vessel some five or six miles off the port bow.

Shortly past midnight, after copying press, I had closed the station and gone to my stateroom. Suddenly there came a jangle of bells in the engine room, followed by a series of short wails on the siren—the danger signal. Fortunately I rushed right out onto the starboard side, where the fireworks were being set up for a grand display. Bearing down on us from a few points ahead of the beam was a monster steamer, aglow with lights which showed a thousand little rainbows through the dripping fog.

AS a matter of fact, the "Merida"—as we four hours later learned it to be—was probably three times our tonnage and one and a half times our length, but under the harrowing circumstances she was distorted into a ghastly phantom of tremendous proportions.

In reality, it was not over two minutes from the time I sighted the oncoming ship until the moment we struck her, but time is as subject to distortion as space and it seemed that hours were crowded into the period. For about a week during the first minute the "Merida" was oblivious to the danger and bore straight on toward us with no effort to avoid the impending crash. Then her officers apparently sighted us and jammed the wheel hard over, as suddenly the ship swerved sharply—or as sharply as a 10,000-ton vessel can—to starboard (right). Our officers, exercising the prerogative of disregarding maritime rules in an emergency, swung our vessel's head to port (left), their idea being to minimize the force of the collision by making it a side-swipe rather than a head-on. But their efforts were futile.

However, the "Merida" swung to starboard and avoided what would have been a fatal crash for the "Farragut." Had she kept on as she was headed, she would have certainly cut us right in half. This would have meant a snappy three-minute tragedy with a score of survivors clinging to bits of wreckage. By chance or choice the "Merida" sacrificed herself in the effort to save us. Her swing to starboard ran her directly across our bows and as I gazed straight forward at the rows of lights along the "Merida's" several decks, it seemed that an eternity was consumed by the weird procession. It appeared for a time as if the ship might get by and allow us to plow across her stern instead of ramming her.

The suspense was broken by a terrific, grinding, rumbling, ripping crash that lasted for several moments, accompanied by a quick rocking to and fro of the "Farragut" which sent me reeling violently across the wet deck. It seemed as if everything above, on deck, and below was smashing to pieces. A minor crash close beside me proved to be the after spreader of the aerial, the six wires tangling about my ears. Immediately pandemonium broke and everybody

(Turn to next page)

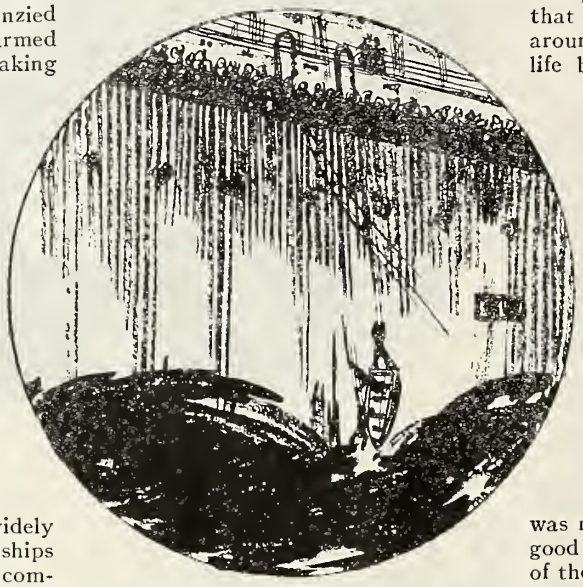
was on deck stirring up a beautiful panic.

The stricken "Merida" quickly drifted away into the darkness and fog off our port bow and was lost to sight, but her whistle at once took up the distress signal of four long blasts, sounded every few minutes, and we knew that she was doomed. We had, however, a houseful of trouble at home and at the moment could not concern ourselves with her possible fate.

So many things happened in the next ten or twenty minutes that a complete impression would be difficult, if not impossible, to convey. Probably the most ridiculous and unimportant incident is always the one that comes to my mind first when I think of this interesting night. It was the sight of First Mate O'Neil, who had been off duty and asleep, rushing down the deck wrestling a refractory pair of trousers up over his pajamas, a revolver under his arm, cursing volubly at a frenzied mass of Spanish firemen who had swarmed up out of the forecastle and were making a sad mess of trying to launch several lifeboats. Severely handicapped by the personal problem of securing his pants, he was a pitifully impotent figure for a few seconds, although a powerful man physically and a valiant leader of his men. His galluses properly adjusted, however, matters took on a new aspect in his vicinity, and this flash from the film fades out in my memory with a comfortable majority of Spanish gentlemen falling cold to the deck from the impact of O'Neil's revolver butt.

For myself I cannot say that I was among the least excited of those present. Not being widely experienced in ramming vessels amidships on pitch dark foggy nights, I was completely sold with the idea that a young seaquake such as had just occurred meant but one thing—the prompt sinking of all the craft concerned. Not a little disturbed by this conclusion I wondered what port we would be rescued into and how uncomfortable I would be parading the streets of this unknown city minus shirt, collar and tie and with no hat. This small time worry was rudely banished by another group of the aforementioned Spaniards, who reeled from O'Neil's onslaughts and dashed toward a boat on the other side. Taking my cue from O'Neil's attitude, I gathered that the most expedient thing was to ward these eager gents away from the life boat before they gummed it up beyond recourse. My physical proportions counted for nothing, however, and an undershirt looked little like a uniform, so that I made scant headway against their frenzied efforts until reinforced by the First Mate, who had vanquished his pack of Spaniards and driven them below. Handing me a broken spar of some kind, he manfully jumped into my contingent and together we cleaned up the situation. A few random shots from the gun clinched matters and a few minutes later the firemen were herded together on the lower deck under guard of a husky seaman.

Free from matters of public policy for the moment, the question of personal safety loomed up again and I looked over the side fully expecting the shafts of light from our portholes to show the waves about ready to pour over the lower deck. Surprising to say, it still seemed a long jump to the water line and my hopes mounted immediately. Possibly, I thought, there was still time to patch up my wrecked aerial before the inevitable sinking. The intense blackness of the night made it impossible to tell the exact extent of the damage, but having been showered by the tangled wreckage of the after cross arm I knew that that end was a hopeless jumble. I figured the best thing to do was to report conditions to the captain, ascertain how much time we had before the final chapter, and obtain instructions.



Passengers and crew were still wildly fighting to get life boats launched. One boat dropped overboard and capsized, and another we could see in the light of electric lanterns to be hanging by one davit . . . the crew did wonders in saving those who dropped over the side.

Fighting my way through the crazed rabble of passengers and crew, who were madly struggling amongst the wreckage, boat gear, etc., I shortly stood before Captain Mader on the bridge. Here was the first sign of calm I had encountered. The skipper was in possession of reports from all vital parts of the ship and even then was publishing reassuring advices. We had received a poke in the nose which had paralyzed our bow for twenty feet or so, but the collision bulkshead was holding and no water was entering the ship!

Feeling my way back to the radio shack through the soupy fog, I aided other officers in quelling the panic which was then the only feature offering immediate danger. Passengers and crew were still wildly fighting to get life boats launched. One boat had been dropped overboard and capsized and another we could see in the light of electric lanterns to be hanging by one davit, the forward tackle having been let go in the excitement. Working under these difficult conditions, the crew had done wonders in saving those who fell over the side.

Investigation showed the forward end of my aerial to be intact. This made it necessary to untangle the wires and rig up a substitute for the after-spreader. At first there was no help available, all hands being busy with their own work, and I spent many precious minutes falling around over debris of every description trying to straighten out the wires. I finally gave up the idea of trying to re-establish the full six-wire aerial, and bunching the ends of the wires together, attempted to pull them up on the after mast as a single cable. Three times I figured everything was clear, but found upon heaving away that one or more wires was wrapped around the smoke stack, or under a life boat, or afoul of the engine room grating or some other such obstruction, making it necessary to unfasten the wires and start all over.

A Display of Fireworks

After an hour and a half of work, everything seemed to be clear finally, but at the first press of the key a grand pyrotechnical display around the after mast showed that one of the stays which had broken adrift was wound up in my leads. In addition to the shower of sparks, a chorus of lusty yells from a dozen men working at the foot of the mast advised me that all was not well. Twenty thousand volts of good transformer juice had sent a dozen of these gentlemen in as many directions, and as we were not over-supplied with able-bodied men, I desisted yet again lest I electrocute some of the available supply. My "SOS" was once more postponed until we could unscramble my leads from the rigging.

This meant more work in the darkness, but two seamen sent by the Captain rendered able assistance and were immediately aloft, shortly to report everything ready for another try. Pressing the key this time resulted only in a normal discharge at the spark gap and I plunged into a siege of wireless work which did not end until the following Saturday afternoon when we arrived at New York.

This being in the good old days when ships only carried one operator, repeated "SOS" calls were for a time of no avail. We were within easy range of many ships and at least two land stations, but all the operators were pounding their ears on the downy at two o'clock in the morning and might as well have been in the South Seas.

In the meantime we had begun to hear signs of life from the "Merida." By the diminished volume of the oft-repeated four dismal blasts of the

(Turn to page 67)

(Photo by Drake Studio)

SPEAKING OF VERSATILITY—

Hugh B. Marshall, whose pleasant voice may be heard nightly from WTAY, Oak Park, Ill., is a jack of all trades and master of several. Professionally he's a prosperous dentist, and artistically he's announcer and program director at WTAY. Not only that, but his tenor voice helps to enrich many of the interesting programs broadcast from this station. He is particularly adept at Scottish interpretations, as shown above.

Enter "The Premier Announcer"

¶Harold W. Arlin, KDKA, Leads in the Radio Age Popularity Contest

By Harry Aldyne

VOTES from the friends of Harold W. Arlin have awarded him a place of distinction for the month of October in the RADIO AGE Popularity Contest. During that month, the world's pioneer broadcaster received more votes than any of his contemporaries.

Since his debut at KDKA in February, 1921, Harold W. Arlin's voice has carried to listeners in all quarters of the world and votes received indicate that each day is increasing his universal popularity.

In observing the standing of candidates to October 15th, RADIO AGE readers will find several notable changes since the preceding month.

The order of the first four stands as before. E. L. Tyson moved from seventh to fifth place. Remington Welsch has jumped from eleventh to sixth position. Fred Smith has mounted the ladder from far down the scale to the ninth round, and the Duncan Sisters, who received the greatest number of votes during the first edition of this contest, and then had a brief slump, show a regain in favor by moving from 13th to 10th place.

THE WINNER FOR OCTOBER

H. W. Arlin ..... Announcer .... KDKA—Pittsburgh

WINNERS OF PRECEDING MONTHS

July ..... Duncan Sisters
August ..... Bill Hay
September ..... Karl Bonawitz

STANDING TO OCTOBER 15th

Name	Classification	Where Heard
Karl Bonawitz	Organist	WIP—Philadelphia
H. W. Arlin	Announcer	KDKA—Pittsburgh
Bill Hay	Announcer	KFKX—Hastings
Lambdin Kay	Announcer	WSB—Atlanta
E. L. Tyson	Announcer	WWJ—Detroit
J. Remington Welsch	Organist	KYW—Chicago
John S. Dagget	Announcer	KHJ—Los Angeles
Jack Nelson	Announcer	WJJD—Mooseheart
Harry M. Snodgrass	Entertainer,	WOS--Jefferson City
Fred Smith	Announcer	WLW—Cincinnati
Duncan Sisters	Entertainers	KYW—Chicago
Hired Hand	Announcer	WBAP—Fort Worth
Edw. H. Smith	Director-Player	WGY—Schenectady
Bert Davis	Entertainer	WGN—Chicago
Nick. B. Harris	Entertainer	KFI—Los Angeles
Jerry Sullivan	Director-Entertainer	WQJ—Chicago
Wendell Hall	Entertainer	WDAF—Kansas City

Radiocast fans who listen in on KDKA regularly will be pleased to know that Harold W. Arlin—the KDKA announcer—received more votes in the RADIO AGE Popularity Contest for October than any of the other contestants.

Not Over Yet

THE contest has several months to go. Probably the name of the candidate who will receive the greatest number of votes does not appear in the above list, for there are any number of radio favorites who have not received the recognition to which they are entitled.

In the spirit of Christmas giving, why not see that your radio favorite receives your votes? Your vote might be the deciding ballot in electing the monthly winner, if not the final victor. And while the matter is on your mind, what is your suggestion for a unique and appropriate gift for the final winner of the contest? The contest editor would like to know.

Mr. Arlin was born in La Hayse, Illinois, December 8, 1895, and was raised on a farm in the Southwestern part of Missouri. After completing his studies at the Carthage High School, Carthage, Missouri, in 1913, he entered the University of Kansas, electing to take the course in electrical engineering. He was graduated from the University of Kansas with the degree of Bachelor of Science in Electrical Engineering in 1917 and received his professional degree of Electrical Engineer in 1921.

Mr. Arlin was first employed by the Westinghouse Company in 1917, but it was not until February, 1921, a few months after the establishment of station KDKA on regular broadcasting schedules, that he was engaged to make the announcements from the Pittsburgh station.

In his capacity of announcer from the various studios and pick-up stations of the Westinghouse Station, the premier broadcaster has met many famous personages and world celebrities from foreign diplomats and statesmen to renowned performers in the athletic world.

Included among the famous personages received while appearing before the Westinghouse Station are: Theodore Roosevelt, Former President of the United States; Marshall Foch of France; David Lloyd George, Ex-Prime Minister of Great Britain; Roger Ward Babson, well known statistician; Governor Pinchot of the State of Pennsylvania; Jimmie Murphy, late Champion Automobile Racer; Hughey Jennings, ex-Manager of the Detroit Tigers and present Assistant to Manager McGraw of the New York Giants and Will Rogers, well known Comedian of Vaudeville and Motion Picture fame.

Appears at Four Studios

MR. ARLIN has made the announcements from the four studios of the Westinghouse Station KDKA located at the Main Works of the Company at East Pittsburgh, the Pittsburgh Post Westinghouse Studio in the Pittsburgh Post Building, the University of Pittsburgh Studio located in the Pittsburgh University and the Stockman and Farmer Studio at the offices of the National Stockman and Farmer.

In addition to appearing at these studios, Mr. Arlin has also appeared at the forty or more pick-up stations of KDKA located in the Pittsburgh District. He has appeared before the microphone as announcer from the Alvin, Davis, Ritz, Schenley, Cameo, Grand and Rowland Theaters; The Wm. Penn, Fort Pitt and Schenley Hotels; Kaufman's, Horne's and McCreery's Department Stores; and from the Point Breeze Presbyterian, Shadyside Presbyterian, E. E. Christian, Calvary Episcopal, Smithfield M. E., Sixth Avenue U. P., Trinity, and South Avenue Churches.

The world's pioneer broadcast announcer has also appeared at many other points where pick-up stations have been installed for various events.

¶Old Time Radio Stars Regain Favor as Contest Hits Stride

POPULARITY CONTEST COUPON

Harry Aldyne, Contest Editor,
RADIO AGE, 500 N. Dearborn St., Chicago.

I wish to cast my vote for:

Name of favorite .....

Classification .....

Station ..... Date Heard .....

Name [optional] .....

Address [optional] .....

What the Broadcasters are Doing

KDKA Celebrates Its Fourth Birthday

FOUR years ago, on November 2nd, 1920, Westinghouse station KDKA of East Pittsburgh, broadcast voice and music for the first time in history.

This pioneer station of the world went on the ether for the first time when it broadcast the election returns that resulted in the election of the late Warren G. Harding to the Presidency of the United States. November 2nd goes down in the annals of history as an anniversary date for Radio. This has resulted in an expansion in radio activity, whereby today there are over 500 broadcasting stations in the United States, and a radio audience which is estimated at from 12,000,000 to 50,000,000 people and a business of more than $300,000,000 per year. It has resulted in the establishment and operation of broadcasting stations in Canada, Mexico, South America, Great Britain, Germany, France Czecho-Slovakia, Australia and China. November 2nd, 1920, started a world wide movement which is still reaching out and evidently knows no limitations.

KDKA today broadcasts news, time signals, sporting events, church services, vocal and instrumental selections, farm programs, etc.

KDKA is the first station to install outside pick-ups, whereby programs are picked up and transmitted to the broadcasting station by means of special telephone wires.

Soon came the search for radio receivers—the manufacturers were swamped, they had not gauged the demand correctly. The popularity of radio was manifest. Others took it up. The *Pittsburgh Post* was the first newspaper to acquire a broadcasting station.

A wave whereby one station could broadcast and another pick up for rebroadcast was next developed. The Westinghouse company installed equipment at KDKA, in addition to their regular station, whereby programs could be broadcast on a special frequency wave of about fifty meters. On this short wave, H. P. Davis, vice president of the Westinghouse company, broadcast greetings to the people of Great Britain, which were picked up by the Metropolitan Vickers Company at Manchester, England. This station was linked by land lines with the stations operated by the British Broadcasting Company and on January 1st, 1924, for the first time in history, an event of this kind was carried out. Since that time KDKA'S programs have been picked up in England, Scotland, Spain and even Africa.

WBCN Makes Bow

The Englewood section of Chicago is to have a broadcasting station of its own, to be known as WBCN. The *Southtown Economist*, the leading south side community newspaper, has under construction at 728-34 W. 65th St., a 500-watt set of the very latest type and expects to be on the air the latter part of November.

The staff of seven is already functioning and a number of important bookings have been made.

The staff of the new station includes the following popular radio men: Director, Robert Northrop, late of WCAY, Milwaukee, KYW and WLS, Chicago; assistant director, Harry A. Zook, Jr., formerly with KYW; John Ralph Foster, ex-chief engineer of CGCK, Winnipeg; musical director, Guy Shrigley.

"Bob" Northrop's picture shown above.

(Photo by Drake Studio)

Above is pretty Martha Bjorn, youthful singer who has just established herself as a soprano from Chicago, Pittsburgh and Davenport radiocast stations. She is just out of high school, but she sings like a veteran, according to the most critical listeners.

Another N. Y. Station on the Air

NEW YORK'S newest radio broadcasting station was inaugurated last month when Station WGBS, operated by Gimbel Brothers, went on the air for the first time. An unusually entertaining program was presented for the benefit of millions listening in at their radios as well as several hundred guests who were present—prominent people from all fields of endeavor: theatre, music, journalism, motion pictures and public life.

During the week preceding its opening WGBS had been sending out test programs nightly after other programs were over and the ether clear. Letters, telegrams and long distance calls from many parts of the country were received daily, as far west as Ohio and from many Pennsylvania towns, saying that the programs were being heard with perfect clarity and had a high degree of modulation. Because of these tests thousands stood by expectantly last night, awaiting the official opening of WGBS.

The opening program was also relayed by special ground wires to station WIP, operated by Gimbel Brothers in Philadelphia, and from there sent out over the large radius of that section. WIP has a record-breaking radius, its programs being received in the far corners of this country as well as in Europe. WIP has been heard at Danzig, Poland and, in the other direction, at Pearl Harbor, Hawaii.

Many of the numbers of the program were given on a specially constructed stage, as completely equipped as the stage of any theatre. The broadcasting was done through microphones on the stage.

A unique feature of the station is that it is entirely enclosed by glass and that broadcasting is visible and open to the public at all times. This is the first time in the history of radio that the public has been able to see the various phases of broadcasting at all hours.

"The Miracle," Morris Gest's play, was broadcast in its entirety from the Century Theatre. Five mocrophones, with a special remote control station, were installed in the theatre to send the symphony orchestra and organ music, the singing of the choir and the story of the pantomime, told by the actor, Fred Eric, over the ether.

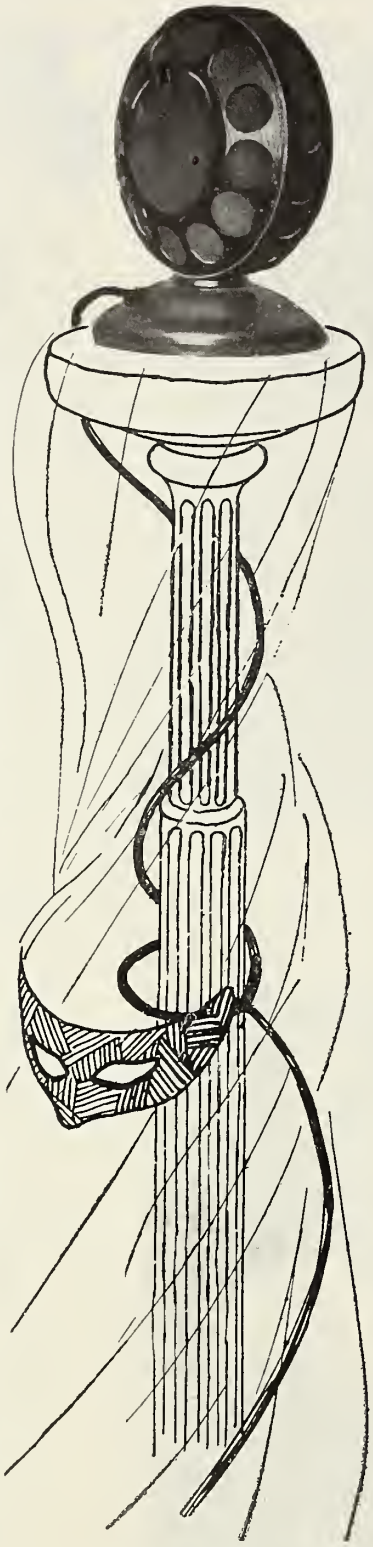
TUNE IN!

Don't forget to listen to RADIO AGE'S Congress Hotel Jazz Carnival from KYW, 536 meters, Saturday, December 6, at midnight!

It's Funny How the "*Veiled Lady*" SCARES *'Em*

What's the Ideal Voice for Radio?

By William Cunningham



THE world's best little eavesdropper. The universal record holder for distance demolition. The greatest foe of bunk ever known to man. The only device which, with no pain at all and practically no cost, can stretch a human ear from an Iowa parlor to Madison Square Garden.

That's the Mike.

The radio microphone, if you please. Or, if you are romantically inclined and relish a dash of poetry now and then, the Veiled Lady.

There are no set rules anywhere in radio as yet. Staffs vary in size and functions. Programs vary in length and in composition. Studios vary in tactics and policies. Wavelengths vary. Mechanical equipment varies. Everything varies except—except the Veiled Lady. She is absolute queen of the studio, ruling her minute dominion from a movable mahogany pedestal that lifts her to the height of a singer's face.

A broadcasting station consists of a very simple room, or studio, where entertainers perform, and a very complicated power plant on top of the building from which the radio's message is hurled through the heavens and the earth. A staff of announcers, a station secretary, a director of broadcast, and a stenographic force ride herd on the studio, its programs and fan mail, while a staff of operators, licensed by the government, handles the switches and dials upstairs.

And the Veiled Lady is the center of it all. Her throne-room is really a padded cell with ceiling, floor, and walls heavily upholstered to kill all echoes and overtones.

This padding is a vital feature and marks the major cleavage between broadcasting and ordinary concertizing. Acoustics are pre-requisite in the concert hall; lack of acoustics pre-requisite in the studio.

The Lady Frightens 'Em

THE Veiled Lady always shares her snug apartment with a respectful and subservient grand piano, but never once does she lose her dignity nor cease to be the dominating personage even after the performers enter. It isn't the actual Lady, herself, that is commanding. At best she is only a small circular affair of gun metal and concealed coils standing like a blackened soup plate on edge atop the pedestal. It's the almost sinister suggestion of thousands of silent listeners out beyond her somewhere, ready and able to hear the very breath you draw, that chills the feet and shackles the speech of the broadcasting neophyte no matter how facile or voluble he may be from the lecture platform.

Radio stage fright is a strange and ever present phenomenon. Even the best of them get it. Roy Chapman Andrews, lecturer and naturalist, recently in international print for his discovery of the dinosaur eggs in China, is famous as an extemporaneous speaker. He frequently addresses audiences for an hour and a half without notes or previous preparation.

In Detroit recently Mr. Andrews was asked to speak for five minutes over the radio. It was his first experience, but, true to custom, he faced the Veiled Lady without notes or manuscript. Halfway through his five minutes he suddenly found himself in trouble. The inspiration and guidance of a visible audience were missing for the first time. The Lady, dumb and smugly self-satisfied, grinned at him with tantalizing indifference. She neither smiled approval nor curled her lips in scorn. Her hard-boiled attitude totally wrecked his aplomb. He later characterized those last two minutes as the stiffest assignment of his career.

A metropolitan station was temporarily nonplused one night when an orchestra due to go on the air missed a train. Its director of broadcast never allows a performer to face his microphone without having first investigated what the performer has previously done and where he has done it. But in this emergency all bets were off and an urgent call for talent was sounded. A man responded who highly recommended himself as an experienced monologist. He had never faced the Veiled Lady but was sure he wouldn't have the slightest difficulty if he were only allowed to do his own announcing, to gesticulate freely, and just be himself, as he expressed it.

Assured that he could stand on his head if he wanted to, he reported to the studio in full evening dress, stepped up to the microphone, and announced that his first number would be a reading of Gungha Din.

Then he backed off about ten feet and made a low, sweeping bow. Waving his arms and weaving from side to side, he thundered the opening cadences. Suddenly, he looked at the Lady. Next at the deadened walls. Then he straightened up, choked, and started over again.

Reaching the identical point, he stumbled, stuttered, and hauled up again.

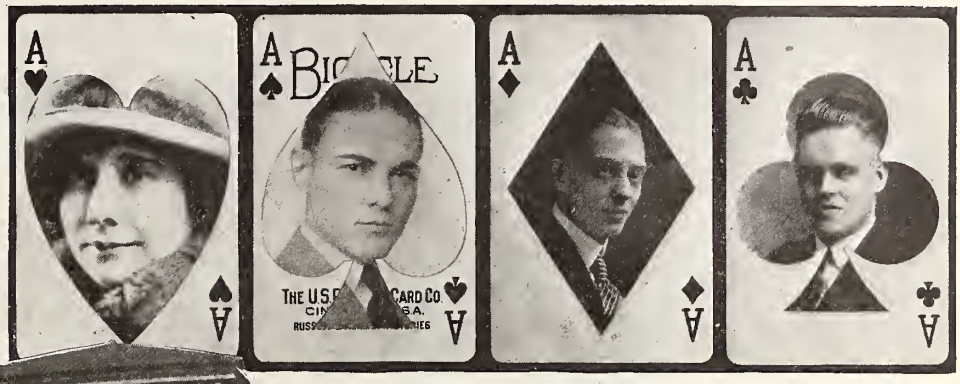
The third time he made his start. Perspiration beaded his brow by this time (the Veiled Lady won't stand for any fans in her apartment) and his back feathers were rapidly rising. For the third time he collided with the line he had recited in public no less than two thousand times, according to his own admission, and again he went ox-eyed and limp-lipped.

"Hey, yank this thing off and let me out. *I'm licked,*" he yelled before the operator could pull the plug. That was the gentleman's farewell to his audience and his tribute to the confounding personality of the Veiled Lady.

(Continued on page 62)

WITH "FOUR ACES" WSAI IS ALWAYS A WINNER

Led by An Able "Queen of Hearts," This Famous Station Has Proved to be One of the Most Versatile in the Middle West; Every Kind of Musical Taste Appeased in One Evening's Broadcasting.

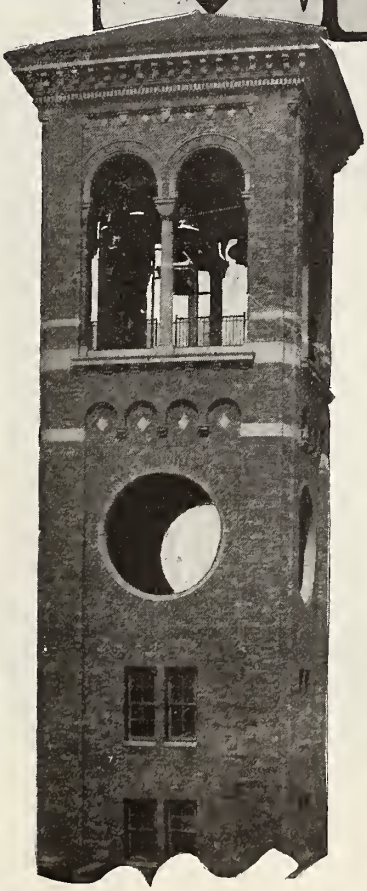


Here are the "Four Aces" who constitute WSAI's winning hand throughout the year. Left to right, Frances Jones, musical directress and Queen of Hearts, Paul Greene, chief announcer and Ace of Spades; E. S. Mittendorf, announcer and Ace of Diamonds: and Evans Cooper, chief "op" and Ace of Clubs.

CINCINNATI:—A radio station that can furnish every conceivable kind of program on a moment's notice is a real radio station; and WSAI, owned and operated by the U. S. Playing Card Company in Cincinnati, is just that.

It is only recently that the ether fans have begun to notice the high caliber and versatility of programs sent out from this unusual station. And the more one studies it, the more he is convinced that Cincinnati fans have no need to tune for DX—for everything they could desire to hear is usually broadcast from WSAI during the course of an evening's entertainment.

The owners of the station modestly admit that the prime reason for this station's success lies with the "Four Aces" who guide its destiny. The "Four Aces," so nicknamed because of their affiliation with the playing card concern, are Frances Jones, musical directress; Paul Greene, chief announcer; E. S. Mittendorf, another announcer and R. Evans Cooper, the chief operator who keeps the waves on their best behavior when they leave WSAI's antenna.



Above is the WSAI chime tower which broadcasts unusual chime concerts on Sundays. The microphone is suspended in the air 300 feet away.

Passing the Buck

FACED with the accusation that they are responsible for the station's phenomenal popularity, the "Four Aces" pass the buck with typical modesty by saying that Cincinnati as a city is so versatile that any kind of a program can be had by appealing to the galaxy of talent residing in the city. So that's that.

Plenty of talent is supplied by the faculty and students of the Cincinnati Conservatory of Music and the Cincinnati College of Music. Their programs are a regular part of WSAI's daily broadcasts.

WSAI consists of two studios; one for regular concert work and singing; and the other for bands, orchestras and glee clubs. The station studios are about the most pretentious in the broadcasting world, and every effort is made to make visitors and artists feel "at home."

WSAI's chime concerts are known from coast to coast. They are broadcast every Sunday afternoon and for fifteen minutes on Tuesdays and Saturdays. The chimes are composed of twelve bells, built especially for broadcasting. The chimes are located in a nine-story bell tower on the U. S. Playing Card Company's grounds. Music from the chimes is caught by a hidden microphone three hundred feet from the tower itself.

They're All Experts

"Texas" Green, the Ace of Spades in the playing card station, has done engineering work on nearly all the big broadcasting stations in the Middle West before settling down at WSAI. Miss Jones, who arranges the musical programs and who accompanies nearly every artist at the piano, is the "Queen of Hearts" in more ways than one; E. S. Mittendorf, whose staccato "W-S-A-I, Cin-Cy-Natty" is a byword among Middle Western fans, is the Ace of Diamonds and R. Evans Cooper, the operator, enjoys the cryptic title of Ace of Clubs, which may mean much or little.

Ever Tune In?

WSAI is comparatively easy to get because it enjoys a fairly low wavelength—309 meters. It is far enough below the big ones to be heard without interference, and far enough above KFKX, WTAS, WJJD, WMAK and WEAN to be likewise free from disturbances. On the upper band, right near WSAI, such stations as KDKA, WGR and others are hovering, but WSAI usually comes in with sufficient volume to be heard alone. That is another broadcasting accomplishment in these days of crowded ether lanes.

WSAI also enjoys the reputation of being a well-modulated station. The fault with scores of stations today is their tendency to fade in and out during the course of an evening's program. This causes much exasperation on the part of well-meaning listeners, and sometimes these offending stations lose many of their adherents because their modulation is inconsistent.

Not so with WSAI. Clear, unadulterated volume is its outstanding feature, and cities as far East as the Atlantic Coast and as far West as the Dakotas report receiving this Cincinnati broadcaster with all the clarity and consistency of a local station. That's a record—but then, everything one mentions about WSAI is a record!

Another thing—all young folks are in charge of this station. Their buoyant enthusiasm keeps WSAI alive and full of pep; and just because they're young doesn't mean they have to play up jazz all the time. They know the desires of every class of listener—which means they're psychologists as well. Ho hum!

How America is Turning to RADIO AND THE DRAMA

HAVE you ever heard a radio play? It left quite a lot to be imagined, didn't it? WGY, the Schenectady broadcasting station, realizes that radio listeners cannot see; accordingly it is producing radio plays that leave nothing to be imagined and keep the interest alive in every act. Miss Hungerford tells all about it in this article.

By WINDERMERE HUNGERFORD

WGY Leads All Stations in Producing Plays that Are Suited To Radio

The plays broadcast from WGY are as varied as those that attract the crowds along Broadway. Above is the "cast of characters" from a rural production recently broadcast from WGY. The actors dress their parts and accordingly "put over" the spirit of the play just as if they were facing their audience.

SEVERAL months ago the wiseacres said a legitimate play (or any other kind) could not be broadcast by radio for the very simple reason that the army of theater-goers must see a play before they can enjoy it. In fact, these critics pointed to the movies in an attempt to prove that a a play doesn't even have to be *heard;* vision is enough, they averred.

The first few plays broadcast by radio stations seemed to bear out this pessimistic belief. They were flat failures for the reason they were not picked out for broadcasting purposes. There would be several moments of mysterious silence, in which the vast radio audience would wonder what was going on on the stage; what *could* be going on, that seemed to hold the theater audience in such rapt attention and of which the radio audience had no idea?

The first radio plays were just like that. They did not take account of the fact that something must be *said* or done *audibly* every minute of the play in order to keep an absent audience from tuning off that wave length.

It took quite a few failures to realize this, and it was only by bitter experience that these pioneer play-broadcasting stations hit upon the ideal radio play; the kind that is slowly re-establishing radio plays to their rightful popularity in the Great American Radio Heart.

WGY the Pioneer

Without a doubt WGY, the General Electric Station at Schenectady, is the leader in the radio drama field. Untiringly this station has kept up its broadcasting of plays and acts—musical, melodramatic and plain comedy. When this station found that it was too hard to search New York's White Way for suitable radio plays, it decided to form a theatrical company of its own and to write plays that would be suitable to radio broadasting.

The experiment has been a success. The plays to be heard weekly from WGY are perfect from a radio standpoint. Perhaps they would fall down if put on a regular stage before a critical audience of visible first-nighters; but the listeners who "see" these plays through their ears have "eaten them up and cried for more."

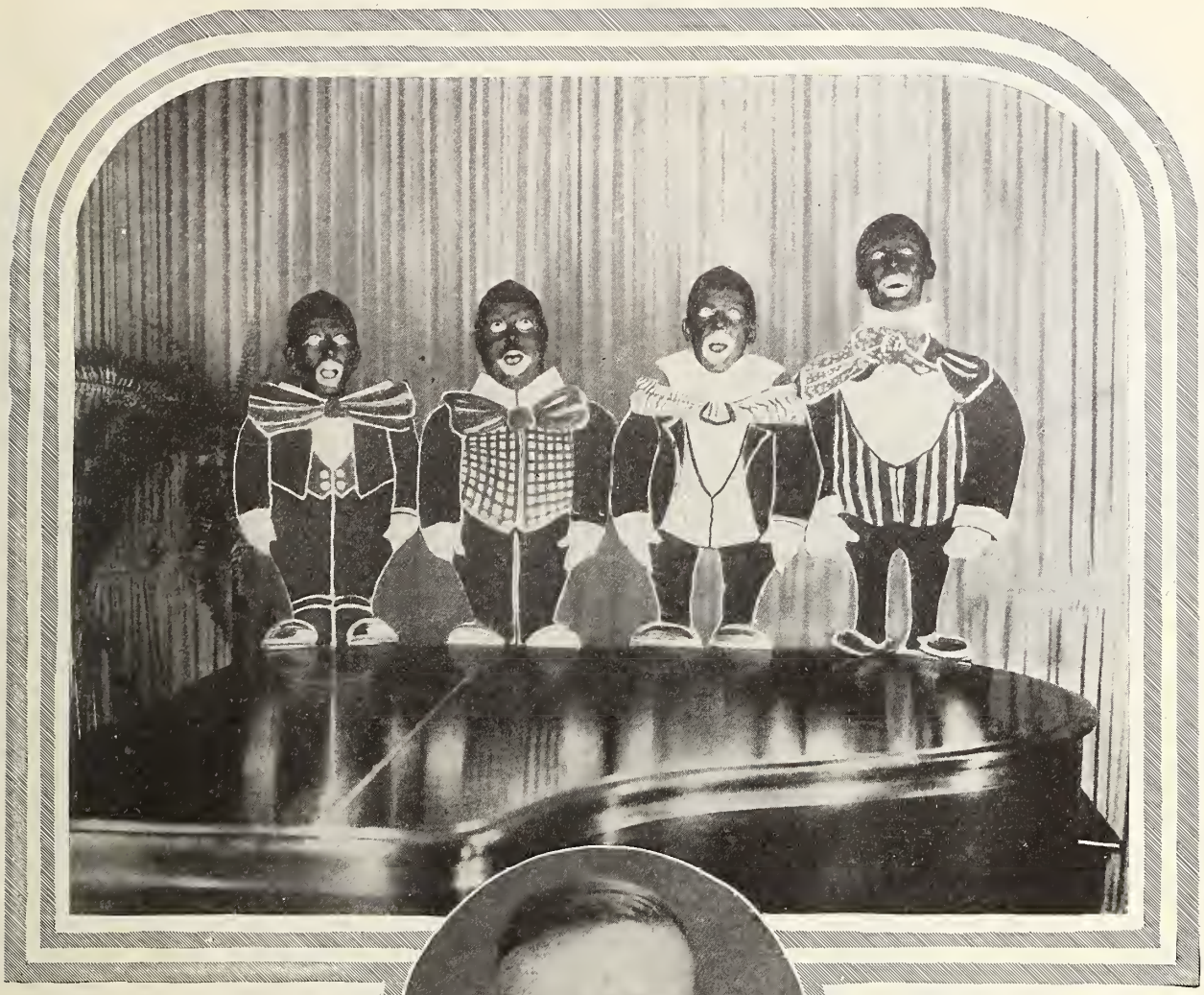
"Radarios" on WGY

Other stations are following the lead of WGY, but very few have developed the radio drama art to such a state where they can afford or desire to form their own company. A new class of writers has sprung up, however, and if more stations adopt theatrical broadcasting, we will have a new profession in our midst; a profession of psychologists well versed in the art of turning out "radarios," the name recently coined for "radio scenarios."

Two of the most typical "radioly perfect" plays ever put on the air are "Abie's Irish Rose" and "Applesauce." Although these plays are interesting to look at in the theater itself, they are equally easy and pleasant to hear—for a running fire of side-splitting conversation fills every minute of every act. And that's what makes a real radio play; and if such plays appeal to the imagination through the ear instead of through the eye, the radio drama has unlimited possibilities.

How They Do It

Perhaps the most interesting and thrilling play broadcast from WGY was the melodramatic success, "Pierre of the Plains," by Edgar Selwyn. The actors grouped themselves around the microphone, and in order to make a fight in woodland leaves seem realistic, onion-skin paper was sprinkled on the floor. A microphone was placed next to the leaves on the floor, and two of the "actors" grappled in a life and death struggle in the leaves. Their deep breathing and muscular motions were picked up by the "mike" and transmitted to a thrilled audience.



Above is one of the jolly minstrel teams of WOAW, and, incidentally, one of the reasons why the "Wowls" are so popular.

In the circle is Lester Polmer, program director. "Eorly to Bed and Early to Rise makes him one of WOAW's unusuol guys."

Are You One of the *Order* of WOWLS ?

If You're Not, Then Station WOAW Can Help You

Says Milton Lieberman

BY being the home of the "radio Billy Sunday," the "WOWLs," and above all, Eugene Konecky, the poet laureate, Station WOAW (pronounced "wow" by the light-headed) of the Woodmen of the World, Omaha, Nebraska, deserves the fame it has achieved recently.

Religion is a big thing to WOAW, and it claims to have the largest congregation in the world, estimating the number as high as a quarter of a million. Although the Woodmen of the World is a benevolent and insurance organization, there is no truth whatever to the statement that it preaches religion to save lives and thereby save insurance money.

Not at all, for they are not so mercenary.

The only reason that the Honorable W. A. ("Big Bill") Frazer, president of the Woodmen, started the station was because he believed that an insurance society must keep abreast of the times, must discharge its civil duties, and must deliver the goods by serving and educating the members in addition to paying claims.

"Fellowship of the Air"

BIG BILL FRAZER is a fraternalist. It is no coincidence that he carried his fraternalism into the radio field. In fact, he visioned a great fellowship of the air, a fraternity of men, women and children connected with one another by means of the latest scientific marvel of the century.

So he organized the Radio Church of the World, giving morning, evening and Sunday sermons. And he obtained the Rev. R. R. Brown, the "Billy Sunday of the air" to hold the microphone pulpit. Nobody could have done the job better, either, for the Rev. Brown has so reached the hearts of his children that they would do anything for him. He is constantly receiving gifts from them as a means of expressing their appreciation. Crates of country eggs, honey in the comb, angel cake, pie, candy, ham and bacon are many of the articles which the mail man delivers to his home.

Rev. Brown says of his congregation: "I see 'em all, in the steel-framed glass circles of my microphone. There's the hard-boiled husband who won't go to church with his wife. There's the gang at Billy's billiard hall. There's that little consumptive girl who is taking the fresh air cure. There's an old couple out on the farm who wrote me: 'You brought Sunday back to us.' There's that little lad at the school

(Turn to page 71)

KYW—*The Only Station with* 24-HOUR RADIO Service

At the right is Walter C. Evans, chief engineer of KYW.

KYW, the Westinghouse station at Chicago, is the only broadcasting unit in the world on duty twenty-four hours each day. Over this daily period the station is actually in operation eight hours and thirty-six minutes, but its mighty transmitter is in readiness at all hours of the day and night to go on the air.

From a station requiring a personnel of five, KYW has expanded to its present proportions, with a force numbering almost thirty people. KYW today has studios in the Edison Building, Hearst Square, the Congress Hotel and Garrick Theater Building, and also has private wires to other places from whence entertainment is put on the ether.

All Tastes Satisfied

With the varied class of entertainment, radio fans can meet all their desires by tuning in this station. The programs from the Edison studio are classic in nature and only the most select artistry is accepted. The Congress Hotel Saturday evening concerts include only the foremost and highest class entertainment obtainable.

The World Crier broadcasts its material in the form of world news, stock reports and sporting news, every hour and half hour, consuming an average time of five minutes on each occasion.

The World Crier has also served on several occasions by request, when heavy snowstorms crippled telegraph and telephone wires. On these occasions the World Crier added laurels to the value of radio, in broadcasting train dispatches and seeking information of lost trains, also acting as the official news herald. Always ready for service.

Mail Piles Up Fast

The continued increase in the daily receipt of an already vast number of letters and postal cards, clearly indicates the rapidly growing popularity of KYW with its invisible audience.

KYW's endeavor always has been to please its silent audience with interesting news, entertainment and announcements, and the station enjoys the confidence of its uncountable fans. KYW is often called upon by radio listeners-in to render personal services.

Wilson J. Wetherbee is general manager of the station and Eddie Borroff assistant director and announcer.

The Chief Operator

Walter Evans is the man behind the apparatus at KYW. He is one of Chicago's pioneer chief operators, and accordingly he knows whereof he speaks when he gives advice to aspiring radio operators. The following information was obtained from Walter in an effort to enlighten those readers who think operating a radio station is a "snap":

"There are two general classes that make good operators," he began. "First is the graduate electrical engineer who has learned enough about radio to obtain a government license. The other is the old time radio operator who has passed the experimental or bug stage and with whom radio is a serious means of earning a living.

"The work in each particular radio station is vastly different from any other, so it is more desirable to start a new man, green as far as broadcasting is concerned, and to train him to specialize on a particular equipment in the station in which he is to operate. The ex-amateur operator is too inclined to experiment and change the equipment

(Turn to page 70)

Here we have "Coon" Sanders' original Kansas City Night-Hawks of Radio Fame, who are now furnishing jazz regularly from KYW, Chicago. They earned their reputation at WDAF in days gone by.

(Photo by Gueldre.)

Edythe Sackett, pianist-accompanist who is appearing on the Chicago Concert Company's classical programs from KYW.

Entire Country Hears "Radio Age" Programs from Chicago Stations

By
RUSSELL H. HOPKINS

Able Radio Artists Give Fine Programs

HAVE you tuned in on one of RADIO AGE'S broadcast programs lately? Every month classical and popular programs may be heard from well known Chicago broadcasting stations, under the auspices of "The Magazine of the Hour."

RADIO AGE was the first radio publication to demonstrate belief in the importance of promoting good radio programs, when, last July, it arranged to present varied selections from local stations. WTAY was the first to broadcast RADIO AGE programs, and, encouraged by the success of this first attempt, dates at other stations were obtained.

Since the first presentation last summer, RADIO AGE artists have appeared at Chicago's biggest stations, including WEBH, on the Edgewater Beach Hotel, WLS, the Sears-Roebuck station, KYW, the Westinghouse radiophone, and from WTAY, on the Oak Park Arms Hotel.

Programs in Demand

Gradually, through appearing at these various stations, RADIO AGE has built up a staff of artists that can compete with the best to be heard on any station in the country. Vocalists, instrumental musicians and others have been obtained to present their best numbers, and as a result "RADIO AGE nights" have been in demand.

Nor has RADIO AGE'S effort to promote the best in broadcast programs been confined to Chicago alone. WSAI, the U. S. Playing Card Station at Cincinnati, has put RADIO AGE on the air for its efforts to promote quality broadcasting, and Nick Harris, of Station KFI, Los Angeles, keeps the Coast fans informed of this magazine's doings.

Splendid co-operation has been offered by such well known radio figures as Edgar L. Bill, Ford Rush and Glenn Rowell, of WLS; Bob Boniel of WEBH; Telfer MacArthur of WTAY and Wilson J. Wetherbee, Eddie Borroff and E. E. Mattson from Westinghouse KYW.

RADIO AGE'S most recent program was on Saturday, November 8, when a "RADIO AGE Carnival" was put on the air from the Congress Hotel studio of KYW, (536 meters) from 12 midnight to 2 a. m. This midnight program is one of the most popular in the country, drawing requests from coast to coast and from gulf to Canadian frontier.

Starting at the top oval, from left to right, are some of RADIO AGE'S broadcast artists: Arthur W. Hickman, baritone; Elizabeth Berry, soprano; Tillie Thorpe, soprano; Hugh Marshall, WTAY singer and director: Anna Leeb, soprano; Maurine Marseilles, character soprano of jazz selections. In the center inset is Banks Kennedy, popular piano monologist who appears exclusively for RADIO AGE. (Photos of Miss Berry, Miss Thorpe and Mr. Marshall by Drake Studio; of Miss Marseilles by Celebrity; of Miss Leeb by Russell.)

Now, a word about the artists who are making this reputation for RADIO AGE. Misses Elizabeth Berry, Tillie Thorpe, Anna Leeb and Maurine Marseilles have built up a following, each in her own line. Miss Leeb and Miss Thorpe have elicited voluble praise for their efforts in classical and semi-classical numbers, while Miss Berry and Miss Marseilles have won the hearts of the jazz fans.

Two Peerless Baritones

Arthur W. Hickman has built up a radio reputation solely because of his splendid baritone singing of semi-classical numbers. Carroll Kearns is another baritone and newcomer to the ranks of RADIO AGE artists. He, too, is winning deserved comment.

Banks Kennedy, former organist at the Tivoli Theater, Chicago, appeared for the first time at RADIO AGE'S classical program over KYW and later at the jazz frolic, proving efficient in both lines with his piano monologues. Eddie Borroff of KYW asserts Mr. Kennedy has an ideal radio voice. More than two score telegrams in one evening corroborated Ed's opinion.

Then there are "Jack and Jill," a new pair who are specializing in popular numbers. They will be heard again within a few weeks on another of RADIO AGE'S midnight KYW carnivals. Jill presides at the piano, while "Jack" does the vocal exercise ably.

George W. Jatho and his instrumental soloists help break up the vocal numbers with pleasing selections. All in all, RADIO AGE presentations have been regarded as examples of "balanced programs."

Here Are Two New Programs

As we go to press, it is learned that RADIO AGE'S artists will be on the air once again in November and on December 6.

Thursday evening, November 20, RADIO AGE may be heard from WEBH (370 meters) between 9 and 10 p. m., with a popular and semi-classical program. Tune in on this station if you want to pass a pleasant hour.

Jazz fans will be pleased to hear that RADIO AGE may be heard hereafter the first Saturday in every month from KYW, Chicago, on its Saturday night Congress Hotel Carnival. This program begins at midnight and runs till 2 a. m.

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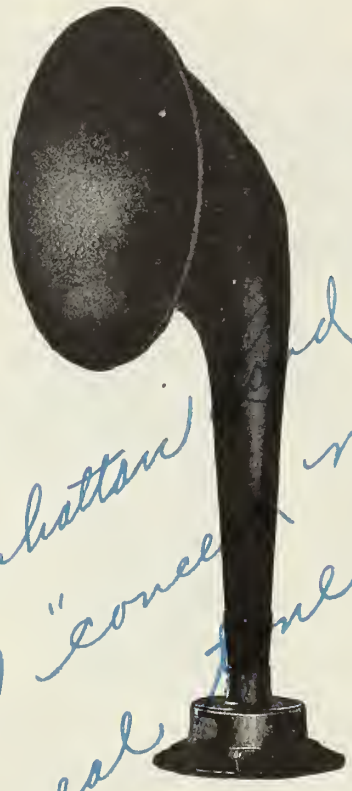
ELECTRICAL SUPPLY CO., INC.

MAKERS OF THE FAMOUS



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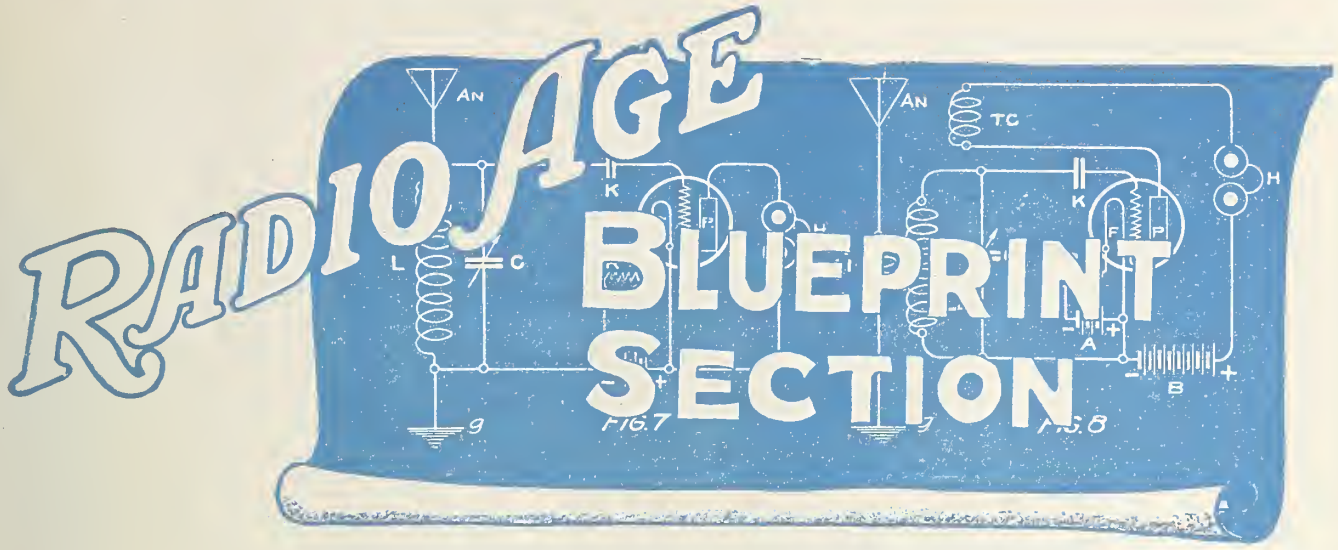

At Last! A Master Receiver

A New 8-Tube Super-Heterodyne

By JOHN B. RATHBUN

A Super That Gives Distance and Tone

SO much has been printed in RADIO AGE upon the elementary principles of the super-heterodyne that it seems hardly necessary to enter again into the theory in much detail.

Briefly, the super-heterodyne is a special form of radio frequency circuit in which radio frequency amplification takes place at a much longer wavelength than that of the incoming radio waves, thus reducing the losses in the tubes and R. F. transformers and adding to the efficiency of the set. Broadcasting wavelengths ranging from 200 to 600 meters are converted into wavelengths approximating 10,000 meters before the waves enter the radio frequency stages. After amplification, the waves then are rectified by the usual detector tube producing audible signals which can be further amplified by one or more audio stages.

A typical eight tube super-heterodyne of the type to be described consists of the following principal unit divisions of tubes:

(1) The first detector tube.

(2) Three radio frequency amplifying tubes.

(3) One oscillator tube used as a frequency changer of the heterodyne type.

(4) One second detector for rectifying the output of the radio frequency stages and thus producing audible signals.

(5) Two audio frequency stages for increasing the volume of the audio component so that a loud speaker can be used.

The Detector Tube

IN a certain respect, the first detector tube (1) can be considered as a radio frequency amplifying stage, and in some circuits is used exclusively for this purpose without the conventional grid condenser and leak, but when iron core radio frequency transformers are used the detector tube is of advantage in providing an audio component in the first stages of the circuit. It should be noted that the R. F. tubes and transformers work normally at a frequency which is not very much greater than the higher audio or voice frequencies, and therefore a certain amount of audio amplification is also possible in the radio stages, when iron core transformers are used at this point. With air core transformers the audio component receives little if any amplification in the radio stages, and hence under these conditions the rectification of the first tube (1) is not of importance and can be considered and used as a strictly radio frequency stage. The advantages and disadvantages of either system are still a matter of some dispute.

We now come to the oscillator tube (3) by which the wavelength or frequency of the incoming waves is converted into the desired value for use in the radio frequency stages. Really this tube is an independent unit as far as the rest of the circuit is concerned, for it does not enter directly into the amplification or rectification of the waves. It simply produces a series of independent, continuous oscillations, which are combined with the incoming radio waves to form a third series of oscillations having a greater wavelength or lower frequency than either of the original series. This method of changing frequencies is known as heterodyning. The third wave is amplified by the succeeding radio stages. The frequency of the oscillations set up by the oscillator tube is determined by an inductance coil and a variable condenser in such a way that a constant frequency is maintained in the R. F. stages, regardless of the incoming radio frequency. The oscillator condenser forms one of the two tuning controls of the circuit.

The R. F. Transformers

ALL of the radio frequency transformers operate at a constant fixed wavelength or frequency at which maximum amplification takes place, regardless of the frequency of the broadcasting station which may then be tuned in. This optimum frequency is determined by the windings of the transformers and more particularly by the filter condensers placed across the first or last R. F. transformers. The transformers are therefore sharply tuned to a single definite wavelength or frequency to which the heterodyned waves must be adjusted by means of the oscillator variable condenser. As the transformers will not respond to any other frequency than that determined by the filter, the oscillator condenser becomes an effective tuning control, which in connection with the aerial or loop condenser insures a high degree of selectivity.

All the radio frequency transformers, whether of the air core or iron core type, are of the "long wave" design especially designed for the super-heterodyne circuit. In the circuit illustrated, the transformers are designed for operation on approximately 45 kilocycles (45,000 cycles frequency) which corresponds to a wavelength of 6,000 meters. This is not a fixed standard frequency which must be maintained strictly in all cases, but has been found in practice as the most effective compromise for the circuit at hand. Actually, the waveband may extend from 1,200 to 25,000 meters in many circuits, but at either extreme certain objectionable features appear which make the 6,000 meter type the logical compromise for use with iron core transformers.

(Turn to page 43)

Blueprints for the New Super-Heterodyne on Pages 42, 44, 45 and 47

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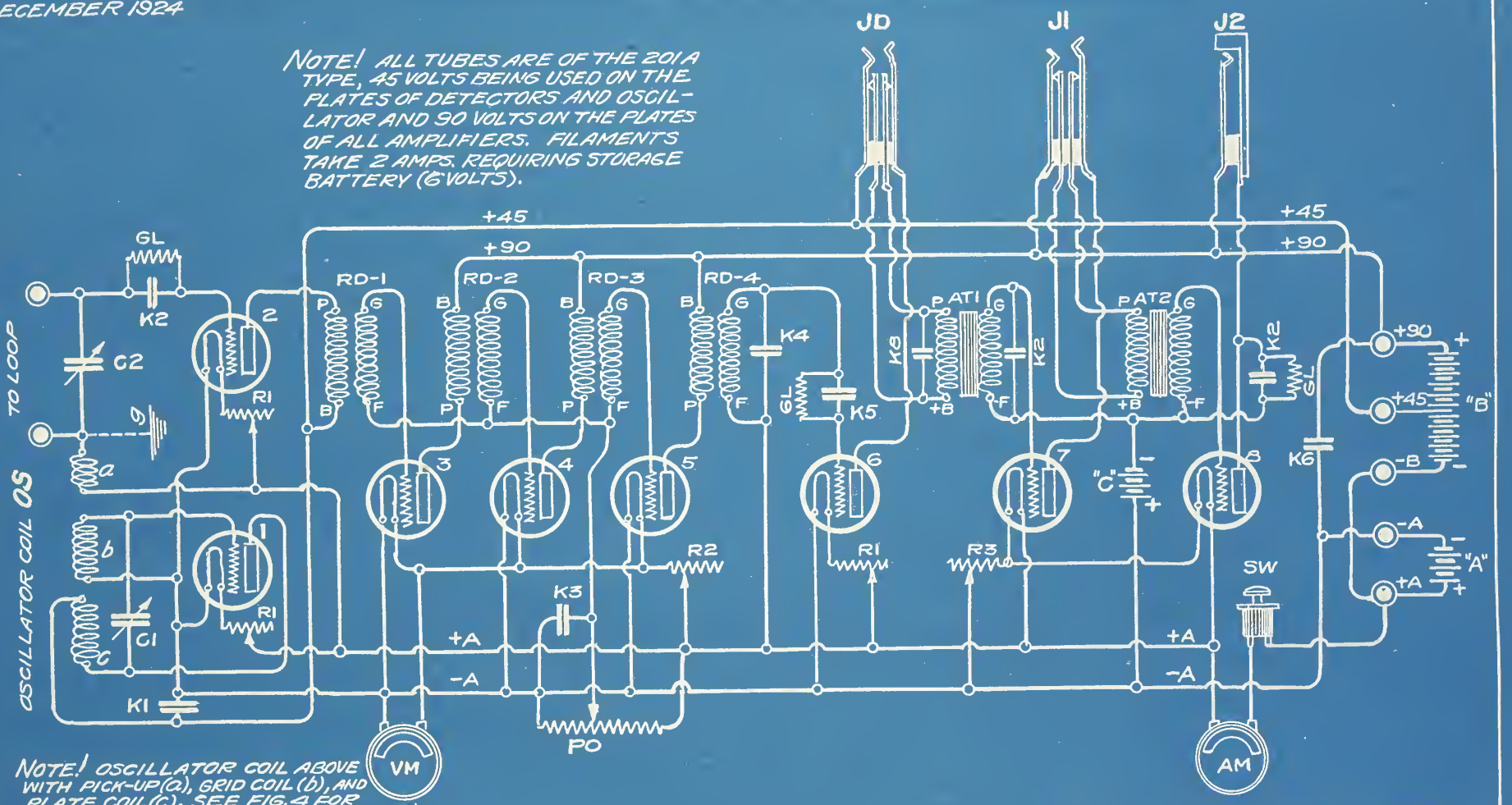
NOTE! ALL TUBES ARE OF THE 201A TYPE, 45 VOLTS BEING USED ON THE PLATES OF DETECTORS AND OSCILLATOR AND 90 VOLTS ON THE PLATES OF ALL AMPLIFIERS. FILAMENTS TAKE 2 AMPS. REQUIRING STORAGE BATTERY (6 VOLTS).



NOTE! OSCILLATOR COIL ABOVE WITH PICK-UP (a), GRID COIL (b), AND PLATE COIL (c). SEE FIG. 4 FOR GENERAL DESIGN AND ARRANGEMENT OF OSCILLATOR.

COUPLING BETWEEN (a) AND (b) MUST BE VERY "LOOSE" WITH ONLY FOUR TURNS OF WIRE ON COIL (a).

TUBES AND TRANSFORMERS MUST BE MATCHED IN RADIO ST;

FIG. 1

EIGHT TUBE SUPER-HETERODYNE

OSCILLATOR, THREE STAGES OF RADIO FREQUENCY, TWO STAGES OF AUDIO AND TWO DETECTOR TUBES. WORKS ON STANDARD 200-600 METER LOOP AERIAL, 24"-30" SQUARE.

ANY GOOD MAKE OF AUDIO FREQUENCY TRANSFORS (AT1) AND (AT2) CAN BE EMPLOYED AND WITH ANY PRACTICABLE RATIOS. A RATIO OF 5 TO 1 FOR BOTH TRANSFORMERS PROBABLY BEING BEST.

USE A 4.5 VOLT "C" BATTERY FOR PUTTING A NEGATIVE BIAS ON THE GRIDS OF BOTH TUBES. FILTERING IS ACCOMPLISHED BY K2-GL.

J.B. RATHBUN
SH-55A

Uniformity of Tubes Vital in "Super"

(Continued from page 41)

Circuit Diagrams

Fig. 1 is the schematic circuit drawing of the super-heterodyne developed by Mr. Posth of the Radio Doctors, Inc., Chicago, and which has been built by a number of amateurs with excellent results. It is not a radical departure from conventional practice, but is a simple, compact layout which is easily constructed by the novice in "dyne" circuits with an excellent chance of getting results immediately after the completion of the set. It is the result of nearly a year's continual experimenting by one who has alternately added and then eliminated various experimental features which have been brought up from time to time in heterodyne development until the present circuit was arrived at.

Fig. 2 is a picture diagram of the hook-up which will be of service to those who have not yet delved into the mysteries of conventional diagrams. Here each part is drawn out as it actually appears in the proper proportion, with the wiring runs located at the most advantageous points. The letters and figures on Fig. 1 correspond to those marked on Fig. 2, so that the relation between the two drawings can be easily traced out. For convenience, Fig. 2 is divided into two parts. The lower half of the drawing represents a plan view of the baseboard and apparatus as it appears to the observer on looking straight down on the set. The upper half is the rear view of the panel as seen from the rear of the assembly. Between the upper and lower views we see the connecting wiring drawn in heavy lines, which connect the apparatus mounted on the baseboard to that attached to the rear of the panel. Arranged in this way, the connections are easily followed.

Fig. 3 is a front elevation of the panel which shows the controls and the center to center dimensions between the various units mounted on the panel. As will be seen from the blueprints, the panel is 8″x32″x1/4″, a reasonable size for a super-heterodyne and a panel not much longer than that used with many tuned radio frequency outfits. The circuit is arranged exclusively for use with a loop aerial, and with this arrangement the loop plays no small part in gaining absolute selectivity in districts where there are a number of broadcasting stations located within a short distance of the receiver.

Starting in with either Fig. 1 or Fig. 2, depending upon the experience of the reader, we note the two variable condensers (C1) and (C2) mounted on the panel at the right. Both are of the low loss type with external vernier adjustments, and both have a maximum capacity of 0.0005 microfarad or the capacity of the standard 23 plate. Condenser (C1) controls the oscillation frequency of the oscillator tube (1) and the oscillator coil (OS). Condenser (C2) tunes the loop and the grid circuit of the first detector tube (2). These are the only tuning controls used and therefore the actual operation of tuning is much simpler than with the usual tuned radio frequency set.

Further along the panel we have four filament control rheostats (R1-R2-R3) with resistances varying according to the number of tubes that they control. Rheostats are based on the use of 201A tubes throughout both for the amplifiers and detectors. The three rheostats marked (R1) have a resistance of 20 ohms and control respectively the oscillator tube (1), the first detector tube (2) and the second detector tube (6). Rheostat (R2) controls the three radio frequency tubes (3-4-5), and because of the greater current has a resistance of only six ohms. Rheostat (R3) has a resistance of 15 ohms for the control of the two audio tubes (7-8).

Watching Potentiometer

AT (PO) is a 400 ohm potentiometer or stabilizer which controls the grid potential of the radio frequency stages. In actual operation the potentiometer has a marked influence on the volume and selectivity but is not frequently used after the set is set into operation in the same sense that the condensers are used. A potentiometer of lower resistance is not recommended, as it does not give sufficiently accurate control of the grid potential. A voltmeter (VM) is desirable for indicating the potential across the filaments of the radio tubes, but it is not absolutely essential. By means of this voltmeter (0-10 volt scale), the tubes can be kept accurately to the point of greatest sensitivity. An ammeter, shown by (AM) gives the total current consumed by all tubes in the circuit. A battery switch as at (SW) is very convenient and is an insurance against the accidental burning of the tubes after leaving the set for the night. It makes the complete readjustment of the rheostats unnecessary when the set is used the second time. All of the above apparatus is mounted on the panel as shown by the upper view of Fig. 2.

Three output jacks are provided. Inserting the plug into jack (JD) gives reception from the tubes up to and including the first detector tube (6) and this corresponds to the detector tube circuit of the ordinary regenerative circuit. Plugging into jack (JI) gives the addition of one stage of audio amplification, while jack (J2) includes all of the tubes or two stages of audio. Experience has shown that one stage of audio is all that is required for loud speaker operation on all but the faintest and most distant stations.

An oscillator coil (OS) of the fixed winding type is located between the first detector tube (2) and the oscillator tube (1). The functions of this inductance coil have been described before. This coil is very compact and requires no adjustment. The inside bakelite tube is 1.5 inch in diameter and carries about four turns of wire near its center which corresponds to the "pick-up coil" of the usual heterodyne oscillator coil. The outer tube is 2.5 inches in diameter and carries both the grid and plate coils of the oscillator circuit. The grid coil carries 20 turns of No. 26 D. S. C. wire and the plate coil consists of 40 turns of the same size wire. The latter is spaced about one half inch from the grid coil. A detail of the oscillator coil is shown in Fig. 4 where the external plate and grid coils are clearly seen. The inner and outer tubes are mechanically connected by short pieces of small fiber tubing through which brass screws are run. When tuned by the 0.0005 mf condenser (C1), this oscillator will fully cover the ordinary range of broadcasting wavelengths.

At (2) we have the first detector tube with the grid condenser (K2) of 0.00025 mf capacity and the grid leak (GL) with a resistance of two megohms. As will be seen from the plan view in Fig. 2, the oscillator coil and the two tubes (1) and (2) are located well back on the baseboard, so as to clear the variable condensers (C1-C2) indicated by the dotted lines. The outline of the baseboard is indicated by (F). A bypass condenser (K1) has a capacity of 0.005 mf.

Next in order come the radio frequency stages consisting of the tubes (3), (4), (5) and the long wave radio transformers (RD1-RD2-RD3-RD4). All of the transformers are of the iron core 45 kilocycle type and are tuned to work in agreement with the oscillator by means of the fixed condensers (K1-K4). (RD1) is the input and (RD4) is the output transformer. Any iron core of 45 kilocycle type can be employed. Condenser (K4) has a capacity of 0.00025 mf. Owing to the body capacity which is sometimes in evidence, it is frequently desirable to ground the metal cases of the transformers as indicated by the dotted line (g).

With the particular transformers shown in Fig. 2, the tube sockets and transformers can be set very close together, about 2 7/8 inch centers. The transformers are of the metal shielded upright cylindrical type, which lend themselves nicely to compact formation. The grid post (G) of the output transformer (RD4) goes to the grid condenser (K5) and grid leak (GL) of the second detector tube (6). The grid condenser (K5) has a capacity of 0.0005 mf, while the grid leak has a resistance of 2 megohms.

201A Tubes Used

BY using 201A tubes throughout with a current consumption of 0.25 ampere per tube, the total current is only 8x0.25 = 2 amperes, the exact amount of current taken by a five tube neutrodyne when a soft detector tube is used. As a soft detector of the "200" type takes about one ampere and introduces a certain amount of hissing tube noise, its use is not recommended in this set. Owing to the high potentials on the grids of the tubes, it is necessary to use the highest grade of sockets to insure against leakage and internal capacity effects. For the same reason, the bottoms of the sockets should be raised well above the

(Turn to page 46)

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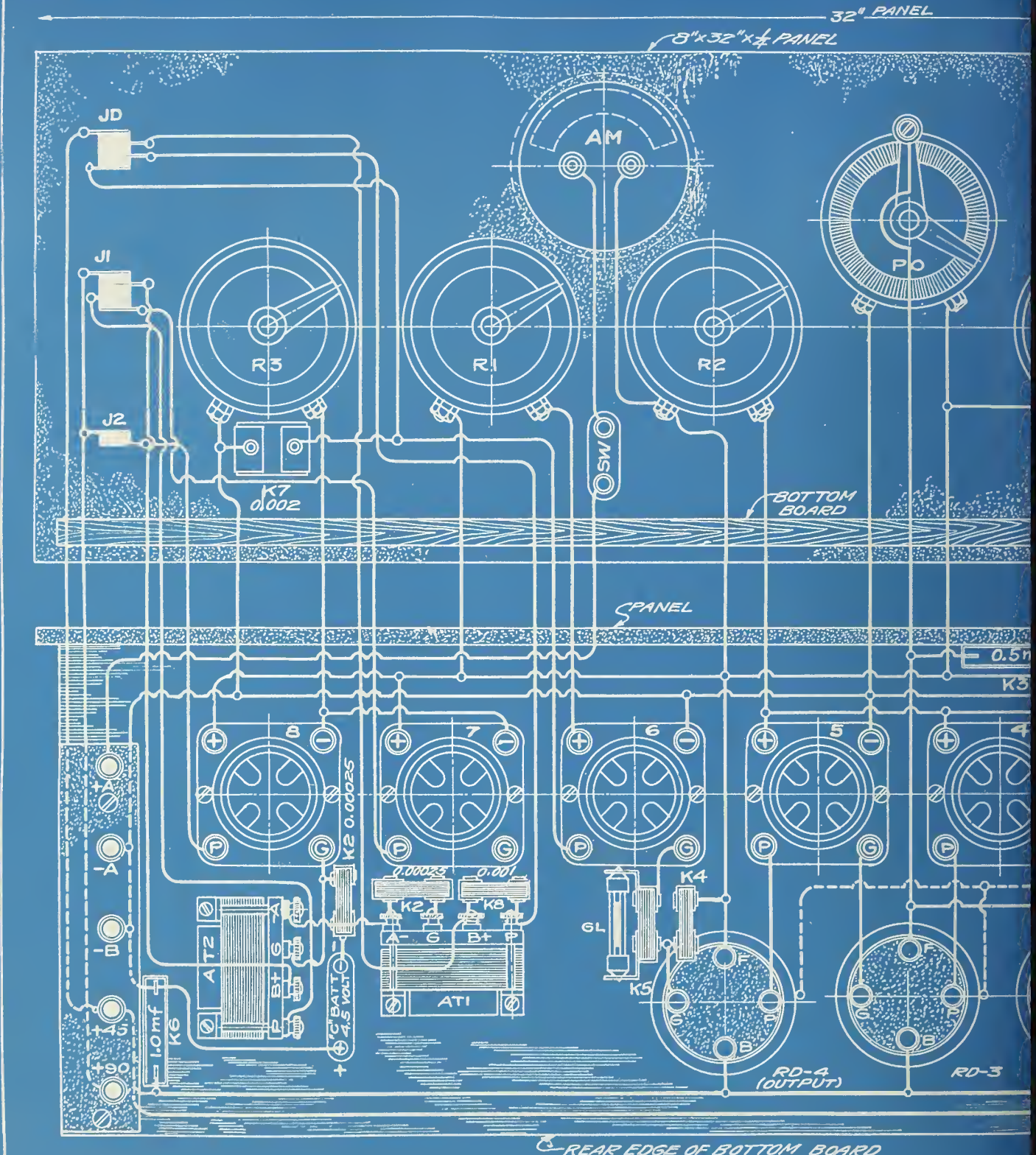


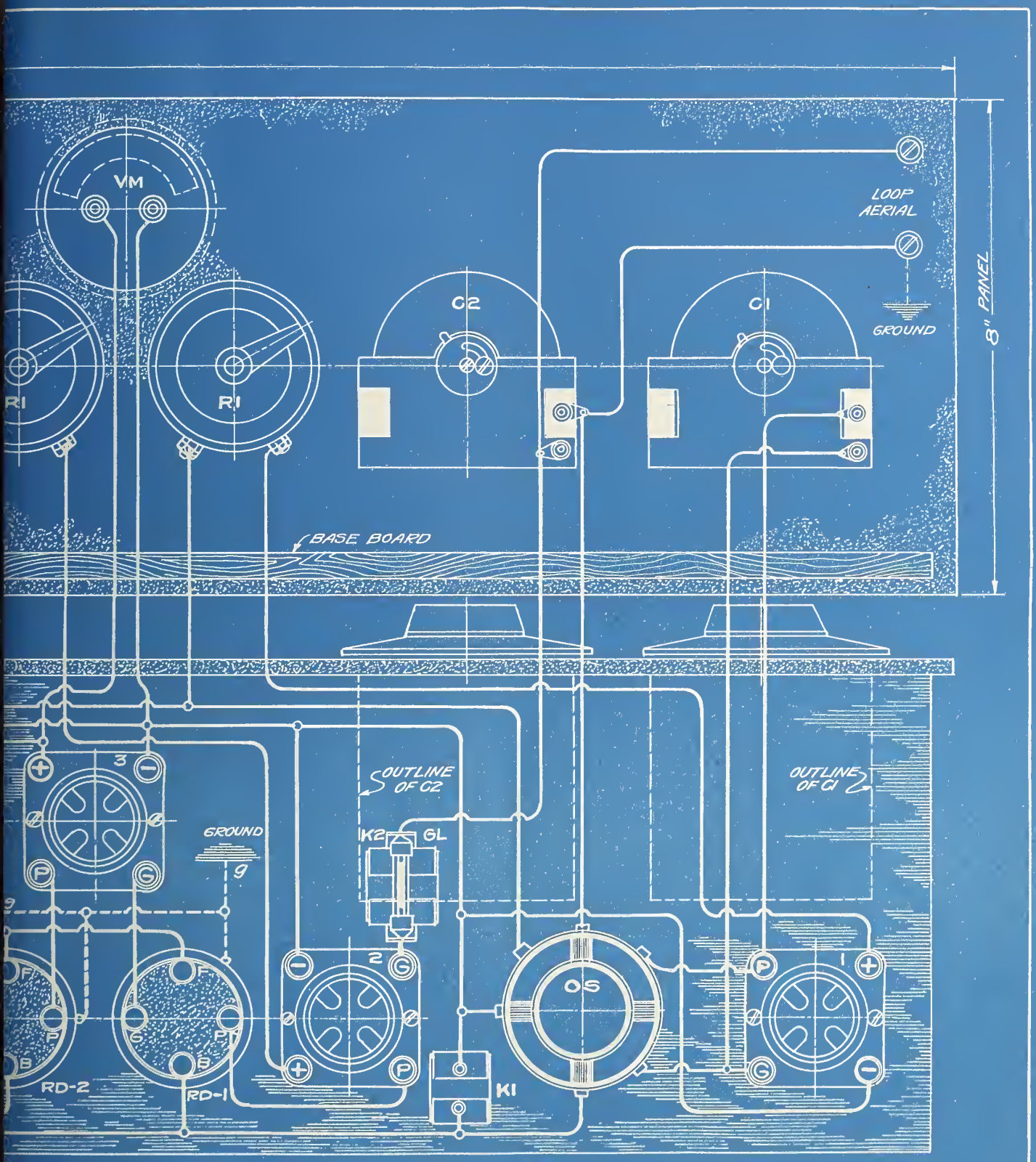


FIG. 2

THE EIGHT TUBE "A-4" SUPER-HETERODYNE

OSCILLATOR, THREE STAGES RADIO, TWO STAGES AUDIO AND TWO DETECTOR TUBES. ALL TUBES TO BE UV-201A, C-301A, OR OTHER "A" TYPES.

J.B. RATHBUN
SH-55A

CONDENSERS	
K1 -	0.005 mf
K2 -	0.00025 "
K3 -	0.5 "
K4 -	0.00025 "
K5 -	0.0005 "
K6 -	1.00 "
K7 -	0.002 "
K8 -	0.001 "

RADIO AGE
DECEMBER 1924

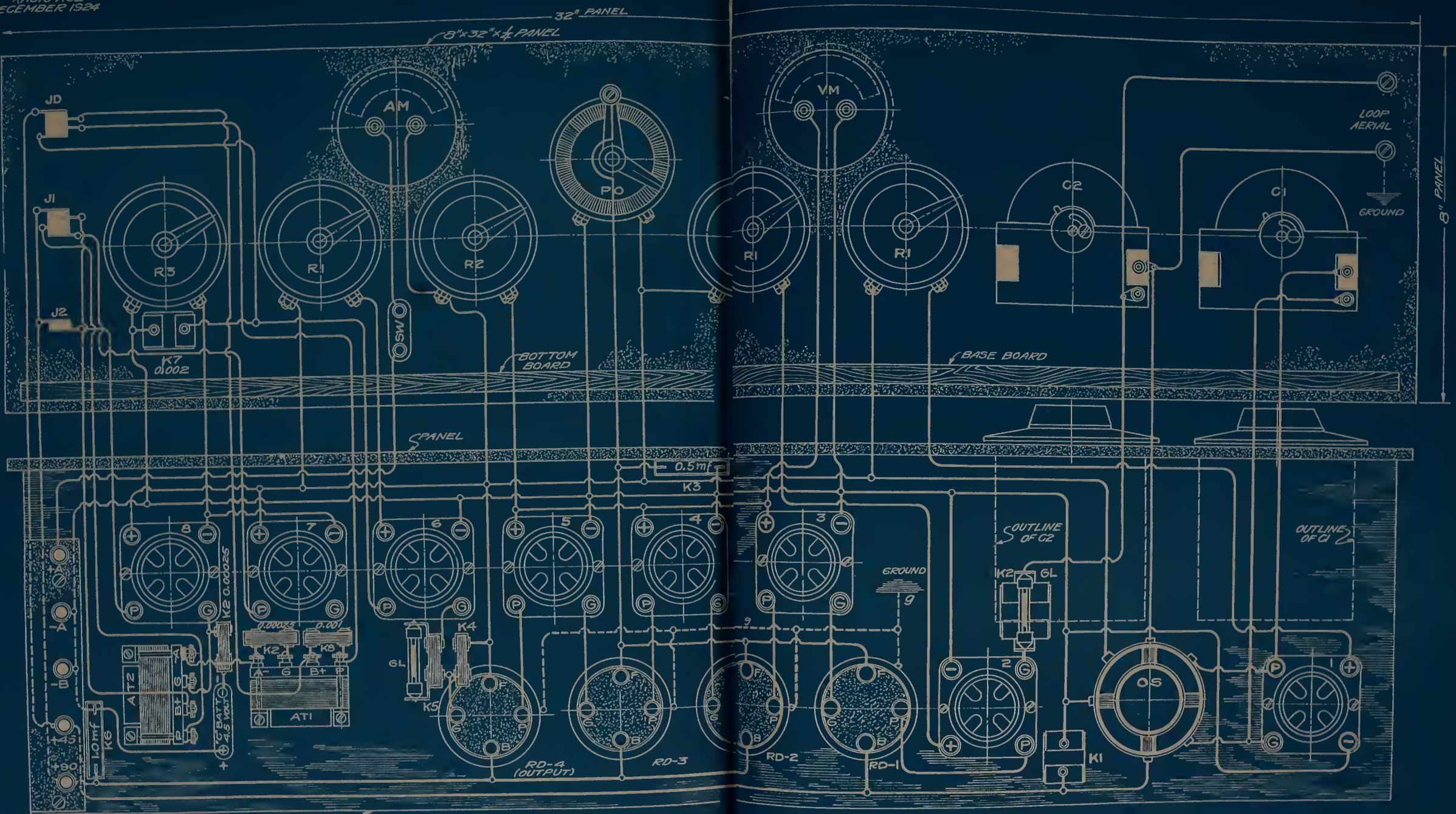


FIG. 2

THE EIGHT TUBE "A-4" SUPER-HETERODYNE

OSCILLATOR, THREE STAGES RADIO, TWO STAGES AUDIO AND TWO DETECTOR TUBES. ALL TUBES TO BE UV-201A, C-301A, OR OTHER "A" TYPES.

J.B. RATHBUN
SH-56A

CONDENSERS	
K1 -	0.005 mf
K2 -	0.00025 "
K3 -	0.5 "
K4 -	0.00025 "
K5 -	0.0005 "
K6 -	1.00 "
K7 -	0.002 "
K8 -	0.001 "

(Continued from page 43)

face of the baseboard by means of spacers or liners, say about 1/4 to 3/8 inch above the board.

For the best results all tubes should be carefully matched by the dealer before delivery, for all of the tubes in the radio frequency stages at least must have exactly the same electrical characteristics. When so many radio frequency tubes are connected up in cascade (series), and when the transformers are exactly matched as they should be, any small difference in the tube characteristics will cut down the output to an alarming extent. Matched tubes may cost slightly more than tubes taken out of stock at random, but they are well worth the money. Any one who has constructed a neutrodyne set knows how greatly tubes of the same make and type vary among each other, and how difficult it is to get dissimilar tubes to act together.

Large bypass fixed condensers must be used to shunt the radio frequency currents around the windings of the potentiometer and across the resistance of the "B" batteries. This is even of more importance with long wavelengths than at broadcasting frequencies and the capacities of the condensers must be correspondingly greater. Condenser (K3) has a capacity of 0.5 microfarad and is used to shunt the R.F. current around the potentiometer windings. Fixed condenser (K6) has a capacity of 1.0 microfarad and shunts the "B" battery. Smaller condensers should not be used.

Last are the two audio frequency stages at the extreme left of the board. Tubes (7) and (8) are the first and second audio tubes respectively, while the audio frequency transformers will be seen at (AT). In general, these two audio stages are the same as any audio stages but owing to the nature of the super-heterodyne, it is necessary to filter the output by means of certain fixed condensers so that the second stage can be worked without noise and distortion. To use these stages "straight" without filters means trouble as soon as the output is taken from the second stage through the jack (J2). Any high grade audio frequency transformer can be used for this purpose. The ratio of the first stage should preferably be from 3/1 to 4/1 while the ratio of the second stage transformer can be 5/1 to 6/1. Higher ratios are general not advisable.

Grid biasing by means of the "C" battery is most essential to the proper operation of the set. It at once promotes clarity of tone and effects a saving of "B" battery current in the audio frequency tubes. For a plate potential of 90 volts, a three cell 4.5 volt "C" battery will give the best results with the 201A tubes. There is no current drain to speak of on this battery and it can be the smallest type of three cell battery procurable. While most high grade audio transformers are well shielded, yet it is safest to place them at right angles to one another as shown in Fig. 2. This eliminates any danger of noise or interference.

Two fixed condensers are connected across the primary and secondary of the first stage audio transformer (AT1). Condenser (K4) has a capacity of 0.00025 mf. while (K8) is a 0.001 mf. size. Another filter fixed condenser (K4) is connected between the grid (G) and the (−) post of the "C" battery at (K4) and has a capacity of 0.00025 mf. This completes the audio frequency stages except for the three jacks (JD-J1-J2) which are interconnected with the stages as shown.

The Loop Connections

At the extreme upper right hand corner of the panel in Fig. 2 are the two binding posts for the loop connection. It is best to use binding posts and to avoid the use of a jack at this point as a jack introduces objectionable capacity into the circuit and also permits of some leakage of the already weak radio impulses. As explained, the set is somewhat more sensitive and selective if the lower binding post is grounded, or if the (+A) line is grounded. This ground can be made directly from the post or from some more convenient point in the circuit as at the (+A) binding post. This effect is particularly noticeable in cities where the radio traffic is congested and where the utmost in selectivity is necessary.

In regard to the "B" batteries it must be noted that the demand for plate current is very heavy and that for the best service a storage "B" battery is highly desirable. If a storage "B" is out of the question with the user, then only the largest size of dry batteries are advisable. The eight tubes will run down a small or medium size "B" battery in a very short time and in the end, the smaller dry cell batteries will prove much more expensive than storage batteries or large dry batteries. A full 90 volts should be maintained at all times for the maximum output, and much of the trouble experienced with super-heterodynes can be traced to exhausted "B" batteries which have been allowed to outlive their usefulness.

At the left of the baseboard will be seen the terminal strip of bakelite on which the battery binding posts are mounted. This is 1 1/4 inch wide and 6 inches long with a thickness of 3/16 inch. Wires to the connections run off through the side or back of the cabinet, and this makes a much neater arrangement than with the binding posts mounted on the front of the panel as we sometimes see such sets. Spacers are placed beneath the terminal strip to raise it well above the bottom board and so that the screw heads will not make contact with the wooden bottom board. Wood is not a perfect insulator and therefore we should avoid placing any current carrying parts in contact with it.

While spaghetti can be used with profit on all "A" battery and ground wires, its use is not advised on wiring which carries radio frequency currents, except at points where a short length is necessary to prevent actual short circuits. Spaghetti has a high dielectric value and increases the capacity of the circuits with attending losses.

IT GOES without saying that all joints must be soldered and that particular care must be taken where soldered connections are made to the jacks. Rosin flux must be used exclusively (no acid) and in using the rosin one must take care that the parts are actually soldered and not simply stuck together with the non-conducting rosin flux. After soldering, shake the wire vigorously to make certain that the parts are soldered. In such a complicated set, it is exceeding difficult to trace trouble when due to open joints, hence we must be vigilant during the wiring operations.

Tubes should be matched by the dealer so that all of the radio frequency tubes are electrically identical. If this is not done, then it will be impossible to secure maximum amplification in the radio stages. Much of the success with a super-heterodyne circuit depends upon the accuracy with which the transformers are matched and their agreement with the tubes. When the transformers are successively numbered from the input through to the output transformer, they must then be arranged in numerical order as shown by RD-1, RD-2, RD-3 and RD-4.

For the convenience of the builder, the "A" and "B" battery connections are made according to two different systems. In Fig. 1 the negative "B" (−B) is connected to the positive "A" (+A), and in general this will give the best results. The connections can be seen at the extreme right of Fig. 1 at the terminals. However, under certain conditions it is better to connect (−A) to (−B) as in Fig. 2. Either connection is easily had without labor by changing the cross connection or "jumper wire" at the terminal board. In the first case, the jumper in Fig. 1 runs from the (−B) terminal to the (+A) terminal. In Fig. 2 this is switched from (+A) so that the (−B) terminal is connected to the (−A) terminal. This is simple, and we should try out to find which is best.

In connecting the ammeter and voltmeter, we must observe the polarity marked on these instruments; that is, the wire from the positive bus must go to the positive terminal of the instruments. If these connections are reversed, then the instruments will have the needle come to rest on the zero stop and will not indicate the current or voltage. In connecting up the transformers, the marks on the transformer posts should be observed, the grid (G) on the transformer being connected to the grid (G) of the socket as shown in both Figs. 1-2.

Particular care should be taken to connect up the variable condensers so that the connections between the grid of the tube and the stator (stationary plates) are always observed. If the grid is connected to the rotor or movable plates, then we will have trouble from body capacity effect, as the full grid potential is then carried out to the hands through the condenser shaft. The proper connections are clearly shown in Fig. 2.

In order to absorb undesirable vibrations from the radio stages, a grid leak (1 megohm) is connected across between the negative of "C" and the grid of the last audio tube so that the leak (GL) and the condenser (K2) form the conventional grid leak and condenser. This has a notable effect in reducing noise when the second stage of audio is thrown in. The negative of the "C" battery must go to the grid (G) as shown.

RADIO AGE, INC.
DECEMBER 1924

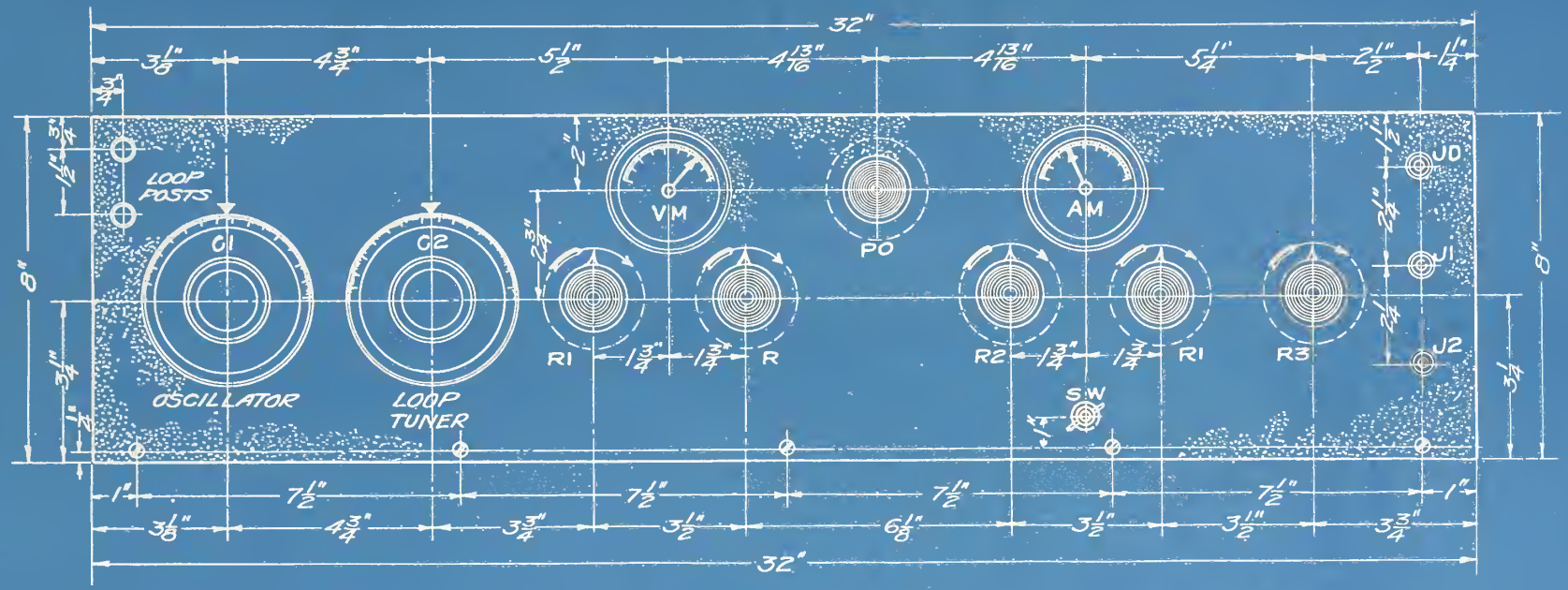


FIG. 3.

EIGHT TUBE SUPER-HETERODYNE

THE DRAWING ABOVE IS A DIMENSIONED PANEL LAYOUT (FRONT ELEVATION) SHOWING ARRANGEMENT OF APPARATUS ON FRONT FACE. USE ONLY HIGH GRADE PANELS, BAKELITE, HARD RUBBER, ETC. NO WOOD PANELS.

J. B. RATHBUN
SH-55A

Pride of the *Chicago* Radio *Show*

One hundred and eighty of America's leading radio manufacturers and twenty of the most famous wireless concerns of Europe were among the exhibitors when the Third Annual Chicago Radio Show opened at the Coliseum November 18. The exhibits, which were all of the "de luxe" variety, filled the entire massive structure, and thousands of radio fans were on hand to view the latest additions to the radio world. The show was managed by U. J. Herrman and James F. Kerr, and some of the typical sets on display are shown below.

The New "Super-Zenith" Model X. This is one of the latest developments of the Zenith Radio Corporation, Chicago, and attracted widespread attention at both the New York and Chicago shows.

The new Howard Neutrodyne. The console cabinet effect is one of the latest twists to the Howard Radio Company's line. In addition to this elaborate type of set, the Howard Company are showing all their other models in actual operation.

The popular Pfanstiehl "Model 7" with its system of non-oscillating reception. The Model 7 is a five-tube receiver of the radio frequency type, and its particular feature is a station finder on the panel which enables the novice to obtain any station he desires, so long as the wavelength is known.

A "Silver super-heterodyne" made entirely of parts on display in the exhibit of the Silver-Marshall Company, Chicago. Silver-Marshall, Inc., do not produce finished sets, but actual lessons in building sets from specified parts were given at the show.

The new Bremer-Tully "Nameless" Low Loss receiver, one of the features of recent radio shows. This hookup consists of five tubes and its success is said to have given added impetus to the "low loss" craze now spreading among American and European radio fans. Note the simplicity and clear cut method of construction

Here is the "Thermiodyne," the new six-tube wonder set manufactured by the Shepard-Potter Company of Plattsburg, N. Y. The feature of the Thermiodyne is its simplicity of control, all tuning on the entire six tubes being manipulated by the one control in the center. Great demand for the Thermiodyne is reported by the manufacturer.

Pick-ups and Hook-ups by our Readers

The material appearing under the title "Pickups and Hookups by Our Readers" in RADIO AGE, is contributed by our readers. It is a department wherein our readers exchange views on various circuits and the construction and operation thereof. Many times our readers disagree on technical points, and it should be understood that RADIO AGE is not responsible for the views presented herein by contributors, but publishes the letters and drawings merely as a means of permitting the fans to know what the other fellow is doing and thinking.

EVEN if we do say so ourselves, we've got to admit that we've compiled a keen Pickups Section this month. As usual, we are swamped with contributions. Again we're sorry to have to tell you that we can't possibly print all of them—and it is an *awful* job trying to decide just which ones to print; they're all so full of interest.

This month we have several contributions of interest. Mr. Pearne, our technical editor, contributes a circuit that has been giving unusual results. In our columns we have the word of a broadcasting station which has done a good bit of DX work. In addition, a couple of foreign fans contribute items of interest, and last but not least, we have a nice assortment of choice DX lists. Probably the prime one, (pretty close to our prediction that some bug would tear out the BC list and indicate stations he had not heard) is the contribution of a radio engineer, operating a superhet, who did tear out the list and indicate thereon the stations he had heard. While checking over the list, we had a hard time finding open spaces on stations not heard, and most of the open spaces came in the foreign list of broadcasting stations.

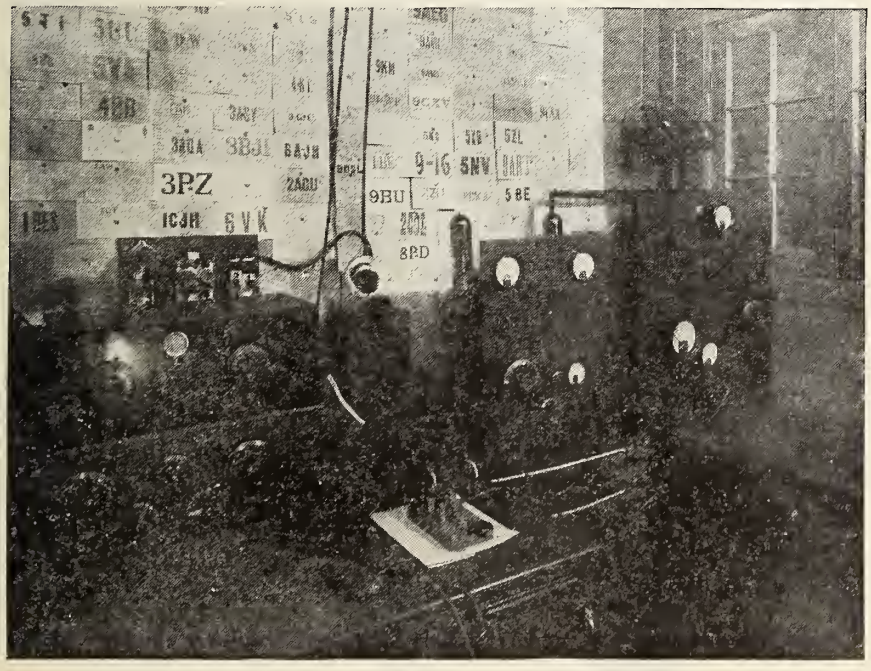
Yessir, it looks like the Dial Twisters are all steamed up and rarin' to go. We've got a hunch that the mail that's coming our way is going to make Sears Roebuck & Co., and Montgomery Ward look like a country postoffice when it comes to comparing incoming mail.

—THE PICKUPS EDITOR.

CONTRIBUTORS

W. J. POTTER, British BCL
REGINALD A. GARRATT, British BCL
L. S. LANE
FRANK D. PEARNE, E. E.
H. E. WRIGHT
A. W. TEETER, Assoc. I. R. E.
L. V. DAVENPORT, Opr. KDIV
C. W. KLENK, Radio 9AAU

Note:—The usual list of Dial Twisters for this month has been omitted due to lack of space, but buttons are being sent out to those whose letters merit them nevertheless. If your letter deserves a button, it will be forwarded, even though your name does not appear in the usual list.—EDITOR.



A PEEP INTO A REAL DX STATION.

Mr. Carl W. Klenk let us peep into his amateur radio station which operates under the call letters 9AA U. He is located at 3148 Halliday Ave., St. Louis, Mo., and is known by many amateurs in the country for his consistent DX work in both receiving and transmitting. To the right are two short wave transmitters used on code work. The receivers at the left are designed for both broadcast and amateur code work. Note all the acknowledgment cards from other amateurs tacked on the wall. They show that 9AA U has been heard in every district in the United States.

STAND BY

Since we started this international phase of the Pickups Section last month, we expect to keep it up. Hence we print the following from two of our British friends.

15, Auriol Road,
London, W. 14.
England.

RADIO AGE:
Gentlemen:

Being a keen reader of your very excellent journal, I am responding to the request on page 44 of your September issue with a complete and up-to-date list of British broadcasting stations, and am sending under separate cover a copy of the official programmes for all our stations for the present week, which I trust may be of interest to you. Should you desire it, I will keep you posted with all alterations, and would also send you from time to time any interesting information regarding radio happenings on this side.

I am very surprised not to have seen any mention in American radio papers of our new high-power broadcasting station 5XX at Chelmsford. This broadcasts on a wave length of 1600 metres and puts 40 amps. in the aerial, so you should have no difficulty in receiving it "over there."

I am afraid I cannot send a list of stations received sufficiently imposing to qualify me for your "Dial Twisters." There is a growing number of broadcasting stations in Europe, but they do not yet exceed 35, and my DX (over 500 miles) record for consistent reception on one-valve, sorry—tube, at present (Summer) is:

Berlin (Germany).....535 miles

Breslau (Germany).....700 miles
Madrid (Spain).....805 miles

This on an aerial 20 feet high and 50 feet long on the coast, where Morse is—well, you know. Straight circuit; home designed and home made. Needless to say, I hope to get some of your stations this Winter.

By the way, I should be very grateful if you would indicate on your list of American and Canadian broadcasting stations the power used. The list is quite useless to us here, as I understand many of the stations listed work on as low as 25, 50, and 100 watts. If you cannot print this, perhaps you would be good enough to send me a list with those of 1 kw. marked thereon.

With best wishes and sincere appreciation of all the American has done to further the finest of all hobbies—radio.

Very sincerely,
W. J. POTTER.

There is no need to apologize for your small amount of stations heard, Mr. Potter, because even though they are not so distant, they do show that you are getting results. We have had letter after letter from bugs who consistently report NO miles at all. And in the U. S. A. that's inexcusable.

STAND BY

And here we have another excellent and generous contribution from an English Twister. These English fans may not be so good on the DX stuff—but they write clever letters. Just look at this one:

17, Lorne Road,
Stroud Green, N. 4.
London, England.

RADIO AGE,
Gentlemen:

I am obliged to you for your letter of the 19th of September, thanking me for my appreciation of your paper and also I am very grateful to you for having made me a D. T. member, which I consider is something very fine for a mere foreigner.

You have asked me very nicely if I wouldn't give you a writeup, and so am enclosing a brief one herewith, and sincerely trust that it will not bore you.

The only thing to be secured over here is a license at 10s, when you are going to have a radio set; otherwise everything is very cheap; in fact much cheaper than some of your goods over in the states.

Let me name a few: first of all there are tubes, which are selling over here at 4 to 12 shillings, that's cheap isn't it? Antenna wire at 2 shillings for 100 feet, condensers (variable) at 3 to 15 shillings, and best of all phones and loud speakers, phones can be secured for 11 to 15 shillings, and table talkers from 25s to £6.

Now for a few hints for your readers; that is, if you would like them. These have come in very handy for us on this side of the water.

1. Cutting out the local Broadcasting Station.

The sure way to cut out any one station is to add to the valve, a crystal set. This simple crystal receiver is connected to the aerial and earth as well as the valve set. The crystal set is tuned to the *unwanted station*, when it will be found that the other station can be selected and tuned in without the least trace of the unwanted one. If a complete crystal set is not available, a coil with a variable condenser is parallel can be placed across the aerial and earth, and the local station tuned out by trial in conjunction with the valve set.

2. Losses of Emission in Dull Filament Valves.

Some people find that after some use of the above valves, they will not function properly unless 1.5 volts are applied to the filament whereas originally the voltage of 1.1 specified by the makers was quite satisfactory. The remedy is to run the valve for about half an hour with the normal filament voltage supplied by the makers and with the *high voltage battery disconnected.*

3. Improving Your Phones.

When you have finished listening, hang your phones on a nail driven in a DRY wall. Also rub the diaphragms with emery paper, thus making them slightly thinner, so that they will be more responsive to weak signals.

I also enclose what I call "A bought components set." Many people do not want to go to the trouble of winding coils, etc., so I devised a quite simple hookup. (I do not pretend that this is anything elaborate) but this will receive broadcasting stations at some considerable distance with good volume of sound, and trust that this may be of some use.

We shall be listening to some of your high power stations this Winter, all being well, and hope to have some very enjoyable times in "getting over." The only disadvantage is that we have to sit up in the early hours of the morning.

Wishing your fine paper all the best that can be desired,

I remain,

Yours faithfully,
REGINALD A. GARRATT.

STAND BY

A Good Regenerative Set

By Frank D. Pearne

The set shown is so constructed that it is a very poor radiator of carrier waves, yet it has all and more good points than the ordinary regenerative sets. The name sounds rather formidable, but this is the only complicated thing about it, and, as the builder has nothing to do with this part of it, he will find it a very simple set to construct.

Being loosely coupled, and having an aperiodic primary circuit, as shown, it will be seen that such an arrangement will not cause much interference with other receiving sets.

In the first place, the length of the aerial on which it is to be operated is not at all critical, as almost any length, from 50 to 200 feet, will be satisfactory.

It is exceedingly selective and will bring in distant stations very nicely.

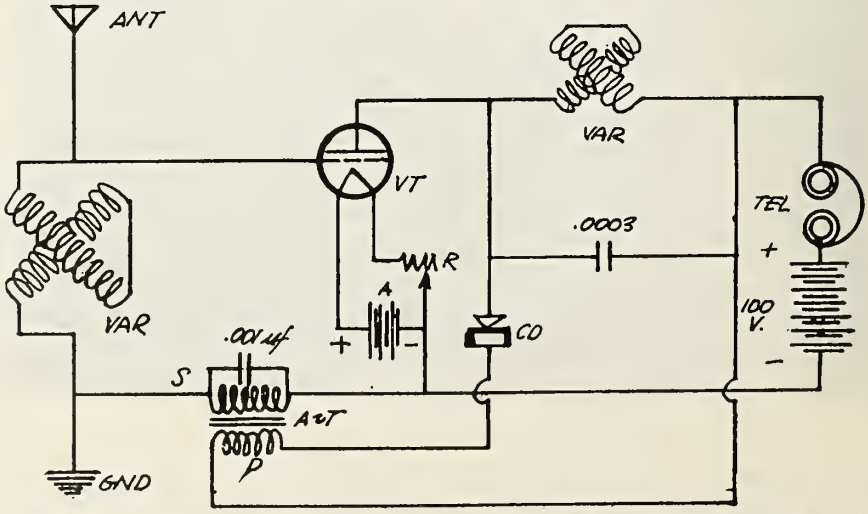
As will be noticed on the drawing, the only unusual part called for is the special coil shown at the left. All other parts are standard and may be obtained at any radio store.

Almost any standard tube may be used as a detector.

One must be careful, however, when selecting the type of tube to be used, to see that the proper rheostat is obtained. For the UV-201-A, the 25, or 30 ohm rheostat should be used, but if a standard detector tube, such as the UV-200, or the C-300 is desired, then the rheostat should have a resistance of from 6 to 8 ohms.

The tube used will also determine the voltage of the plate battery. For the UV-201-A, the plate battery should have a voltage of 45, while the UV-200 only will require 22 1-2 volts on the plate.

It will also be noted that a by-pass condenser is bridged across the phones and plate battery. This condenser should have a capacity of approximately .002 M. F., and, to be sure that no trouble will occur from overheating when soldering it to the leads, it should be of the mica insulated type. The grid leak and condenser should be of the ordinary



The "Bought Components Receiver" submitted by one of our British Dial Twisters. He says that he does exceptional work on this reflex circuit, which can be constructed from parts available at any radio store. The circuit is designed with the idea of not requiring any special parts.

values, that of the leak being 1½ megohms, while the capacity of the condenser is .00025 M. F. This should also be of the mica insulated type.

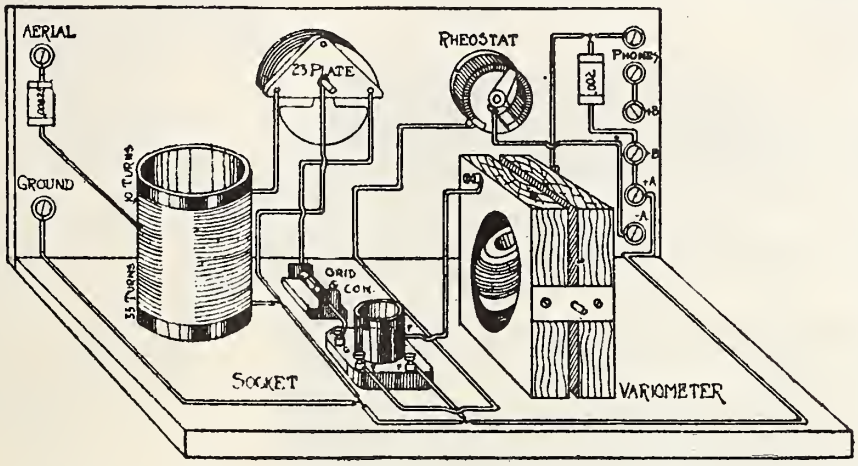
To construct the special coil shown, first procure a heavy cardboard tube four inches in diameter and three inches long. This is to be wound with forty-five turns of No. 22 double cotton or silk insulated wire. About half an inch from one end of the tube punch two small holes about a quarter of an inch apart and just large enough for the wire to pass through. These holes are used to anchor the ends of the coil.

First put the end of the wire down through one of the holes and bring itup through the other, leaving about eight inches projecting, to make connections. Now begin the winding, keeping the turns close together, so as to make a good appearance. After ten turns have been wound, bring out a tap, by making a loop of the wire and twisting it up to the tube, so that it will not pull loose when the winding is continued.

Thirty-five more turns are now wound in the same direction, the final end being anchored in the same way as the starting end. This completes the coil, which is mounted as shown in the drawing.

A panel of bakelite, 12x7x1-8 inches, will do very well for this set. A baseboard one-half inch thick and of the right size to fit into the cabinet used should be attached to the bottom of the panel, as shown. This is used to mount such apparatus as cannot be mounted on the panel.

Do not mount the grid leak and condenser on the panel, but rather locate them just as close as possible to the grid binding post on the socket. The closer they are to the socket the better will be the results, as a long lead between these points will often cause the set to howl and squeal.



A perspective sketch and wiring diagram of the regenerative receiver contributed by our technical editor, Mr. Frank D. Pearne. This set, with the exception of the coupler, uses standard parts, and can be easily assembled. From reports on this circuit, we are led to believe that it is exceptionally efficient.

STAND BY

We thought super-heterodyne operators were either all too proud to hobnob with us or else were "dead" spots when it came to disseminating information.

However, the following letter proves that that is not so; these fans are only modest and don't want to make people think they're lying when they tell the story of the stations they hear. Here's the letter from the fellow who tore out the BC list and indicated his stations thereon. And oscillating Santa Clauses —there sure were a mob.

RADIO AGE Pickups Section Broadcasting—Stand by one moment please.

81 Maiden Lane, New York City.

RADIO AGE

In view of your repeated requests for records with superheterodynes, I have taken from your last issue the corrected list of broadcasting stations and have checked those which I have heard within the last thirty days. Those marked with a line before them represent stations I have heard using a loop; those with a cross before them are stations received with neither loop, aerial nor ground—simply the batteries connected to the machine and no collective agency. This may sound rather far-fetched; however, anyone who might be interested as to whether or not this machine is as sensitive and as powerful as I claim, is cordially invited to inspect it any time by appointment.

Regarding the Station 51T Birmingham, England, this is the only station I did not receive within the last 30 days. This station was received last fall at 10:22 Sunday evening, during the time of the trans-Atlantic test; I have a confirmation from them. My length of time for holding KGO was a couple of weeks ago when I held them between 11:36 and 11:56, having full program confirmed.

Everything marked received, either on the loop or without any collective agency, was in all instances received on seven tubes, using a loud speaker in each instance.

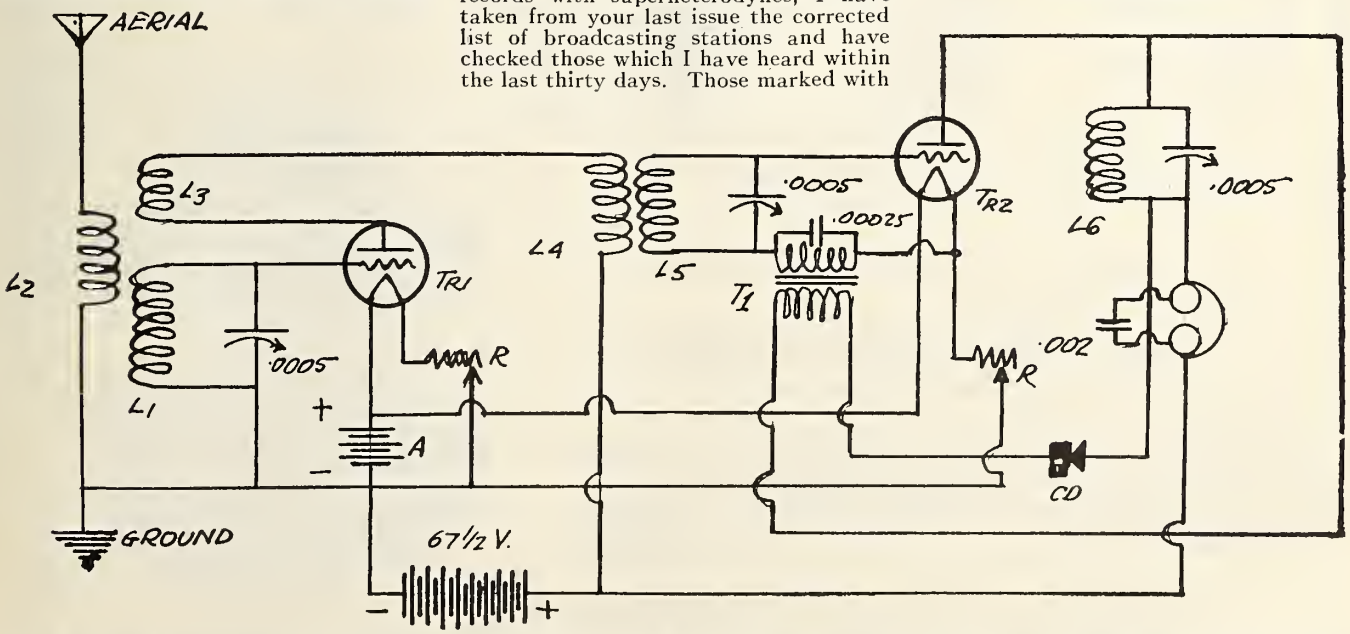
This particular circuit is a super-heterodyne of my own design, and has been pronounced by one of the leading research engineers on super-heterodynes as being the most sensitive and powerful that he has ever seen.

Very truly yours,
A. W. TEETER.
Associate, I. R. E.

STAND BY

Now, the list is so long that we'd rather not use the space to print it, and our eyesight started to fail at 125 when

(Turn to page 52)



With the receiver shown in the circuit diagram above, one of the gang has succeeded in doing some phenomenal DX listening. The set is a combination of reflex and reverse feedback, the latter as acting the control of oscillations in the tube TR1. Specifications for the coils are given in the accompanying text.

we counted the marks, so we'll let it go with the mention that the list contained 3 foreign (non-Canadian) Stations.

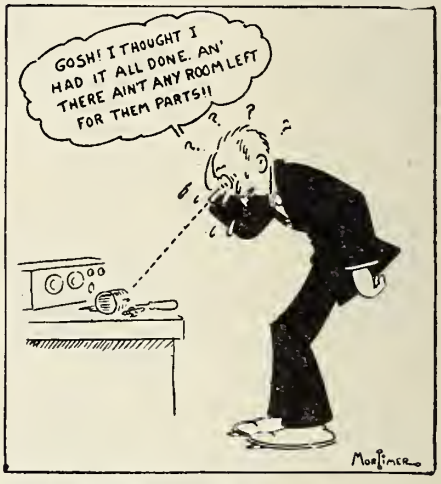
STAND BY

One of the big broadcasting stations wants to tell us about some of their DX work which they feel warrants their becoming Dial Twisters of the other kind—not the ones who listen—but transmit. Here's a piece of choice DX:

Westinghouse station KYW received a letter dated October 17, 1924, from Tacoma, Washington, and signed by L. S. Lane, Radio Operator of the Motor Ship "Hauraki" in which he has logged the following reception of KYW programs:

"On Wednesday night, or rather Thursday morning the 16th instant, I had the pleasure of listening to part of your program. Commencing at midnight, Pacific Time, I heard:

12:00 Lady singing
12:03 Man solo
12:06 Announcement KYW etc., then remarks about the visiting celebrities from other stations



12:08 Song "Remembering"
12:12 "I'm Smiling Through"
12:17 "——— Blues"
12:20 Someone kicked the microphone, the announcer said "that noise was caused by someone kicking the mike"
12:21 "Because they all love you"
12:25 Faded out

This vessel was then rounding Tatoosh Island, and I was troubled by several commercial stations and nearby shipping.

The following is a log kept by L. S. Lane during a recent trip in Australian waters: All times shown are Pacific times.

We were then within 400 miles of Auckland, New Zealand. Was using detector, 2 step and loud speaker up to 4,000 miles, then head phones—am now using detector and phones only, left amplifier in Australia.

Yours faithfully,
L. S. Lane, Radio Operator,
Motor ship "Hauraki."

STAND BY

Now if you ask us, we think that is a very creditable piece of long distance transmission and reception, and certainly deserves mention. Keep up the good work, KYW, and here's our "congrats" to the fellow who heard you.

STAND BY

H. E. Wright, of 143 E. North Ave., Baltimore, Md., wants to hand out a

(Turn to page 54)

Pickups by Our Readers

(Continued from page 52)

circuit that he thinks is pretty good: He says:

RADIO AGE,
Gentlemen:

I thought perhaps your readers might be interested in the enclosed circuit, which is the result of several months experimenting.

I find it an exceptionally good circuit, the secret of its remarkable sensitivity being in the method of stabilization, which is of the reverse feedback type. The potentiometer used in the older systems gives ise to too high losses; the reverse feedback accomplishes the same thing without the losses. Some idea of the sensitivity of this circuit may be had from the following:

From my home in Baltimore I have repeatedly heard KGO at Oakland, California with perfect clarity.

I find that the most important part of the whole circuit is the crystal, which should be very stable.

I shall be pleased to hear from any one so constructing this circuit and will gladly answer any question providing a stamped, self-addressed envelope accompanies the request.

The constants of the circuit (shown elsewhere in this department) are as follows:

L1—40 turns 24 DCC on 4 inch tube
L2—10 turns 24 DCC on same tube eight inch coupling
L3—30 turns—rotor
L4—15 turns on spider web } No. 24
L5—50 turns on spider web } or 22
L6—40 turns on 4 in. tube } DCC wire

In order to get the maximum results, all coils should be kept a good distance apart.

STAND BY

To the Pickups Editor the circuit submitted looks like it had possibilities. We have always liked the reverse feedback system of neutralization. We hope some of the fans will try it out, and report their results. Mr. Wright is to be thanked for his idea.

STAND BY

Before we print more DX records, we want to have a little talk with you Dial Twisters. You know that we've been giving you the best circuits, information and tips on radio that any book can give, and from the letters we get from all of you, we know you appreciate them. We're going to keep giving you as much good stuff as we can possibly scrape together—there's no stopping to us. We're going over big, and there won't be any QSS (fading).

The point is this. Every magazine depends largely upon its advertisers for support; we really sell you a magazine that costs more than 25c to print. You see, the advertiser makes up for the difference.

Now then. If every one of you fellows will mention RADIO AGE when you buy from one of the advertisers, it'll do us both a world of good, and you'll make the advertiser just as strong for the RADIO AGE, as you are for the Pickups Section. If the fellow you are buying your stuff from does not advertise in RADIO AGE, tell him "please send me one of your (name of part) which *I DID NOT* see advertised in RADIO AGE."

Remember, DT's, this is your book just as much as it is ours, and whatever you care to make of it you can.

STAND BY

We have a correction to make. Through an error in drawing, one of the draftsmen on the staff incorrectly indicated the connections on a diagram. We are grateful to L. V. Davenport, a keen eyed radio operator on the SS Olympic (Call letters KDIV) San Pedro, California for calling this to our attention. His correction is as follows:

SS Olympic, San Pedro, Calif.
RADIO AGE,
Gentlemen:

I purchased my first copy of RADIO AGE a few days ago and like it very well. Your blue prints are splendid. Also some of the other data contained in your magazine.

I would like to call your attention to your regenerative set published in the October issue on pages 15, 16 and 17. There are some corrections that should be made in the diagrams on pages 16 and 17. On page 16, if you will trace your F plus from the tube sockets you will find that it goes exactly nowhere. On page 17 you have left out the connection of the A minus to the rheostats. These connections while very apparent to the average might cause the novice some difficulty in getting his tubes to light.

I have had some experience with beginners in radio, teaching a "ham" school, and I find that a great majority will not even take the lead and think with their own head enough to know that the plus side of a "B" must always go to the plates. In this case they would in all probability leave both A minus and A plus leads out because both diagrams didn't agree and then condemn you because they couldn't get the tubes to light.

Sincerely yours,
L. V. DAVENPORT,
Opr. KDIV.

STAND BY

Well DT, there's another little thing we want to broadcast before we sign off. In looking through this issue, we fail to find any mention of a wish for the Merry Radio Christmas that you are going to have.

The only semblance of Christmas is on the cover; but the reason is a good one—we want to get so much good *live* stuff in the book, that space is scarce—so here's a wish for a Merry Radio Christmas to you from the Pickups Editor and the rest of the bunch.

STAND BY

By the way—have any of our DT friends heard any of the RADIO AGE musicial programs over the air? Our Editor is anxious to know how you like them. We are also interested in knowing how you are getting the Wednesday night technical talks (broadcast at about 9:15 p. m.) and how you like them. If you hear any of our talent over the air, or if any of the talks are received, drop us a card and tell us all about it. Please—thank you!

U. S. Manufacturers Get German Patents

ONE of the outstanding historical events in the radio patent field took place October 30th, when the Navy Department decided to issue licenses to approximately sixty independent radio manufacturers under 129 German patents seized by the Alien Property Custodian during the World War.

Early in 1923 application for the patents had been filed, but no decisive action was taken by the Washington authorities. About a week ago the cooperation of Congressman Fred Britten of Chicago, the National Association of Broadcasters, and the Radio Manufacturers Association was enlisted. Through the joint efforts of these what had grown to be considered a hopeless cause was quickly matured into a successful issue of wide-reaching importance.

The majority of the patents and applications involved were originally owned by the Telefunken Company, a German corporation, among which patents is the controlling patent covering tuned radio frequency—the well-known Wilhelm Schloemilch and Otto Van Bronk patent. Under a series of contracts, the first dated February 21, 1913, substantial rights in these patents and applications were assigned by the Telefunken Company to the Atlantic Communication Company, a German corporation organized under the laws of the State of New York.

The theory on which the independent manufacturers requested grant of license was that such grant would tend to advance the welfare of the people of the United States, and would promote a healthy competition in the manufacture and sale of radio apparatus; that to withhold such license would tend to injure the public welfare by tending to promote monopoly contrary to the policy declared by the Sherman Act; that the denial of the license to the applicants would make the International Radio Telegraph Company, the only licensee, which would be inconsistent with Governmental policy as to monopoly, or the principle of equality of opportunity on which this Nation is founded.

As a part consideration for granting the said license, the independent radio manufacturers agreed to grant to the United States of America, represented by the Secretary of the Navy, a non-transferable, non-exclusive license under United States letters patent which they now own or may hereafter own during the term of the agreement, to make or have made for it and use for governmental purposes, apparatus utilizing or embodying the inventions of their patents but not for sale.

One of the chief obstacles to the greatest development of the radio industry is thus removed. The complexities of the radio patent situation are now much minimized. The difficulties incident to the government sharing the use of these patents with only one American manufacturer are permanently obviated. In fact, the monopolization effected by one exclusive license amounted to unwarranted discrimination and manifestly did injury to the radio industry.

An Unselfish Regenerative Receiver

(Continued from page 28)

operation of the set. As a rule, it is customary to place this rheostat in the A— lead.

For those who prefer a circuit diagram to work from, Figure 2 is shown, which clearly gives the connections of the set. The mounting shown requires no baseboard. A 14x7x1-8″ panel makes up nicely, and allows plenty of room around all the parts.

Operation

THE operation is exceedingly simple, probably more so than the average single circuit where changes in antenna resistance and wavelength must be compensated for by tickler and antenna condenser adjustments. After the batteries and other wires have been connected, the filament is turned on and the condenser manipulated in conjunction with the tickler coil until the set hits the oscillating point. Then, keeping the tickler value just below the spill-over point, turn the condenser with different settings on the switchpoints, until a station is heard. In doing so, it is necessary to change the tickler adjustment quite frequently.

Figure 3 shows the proper connections for the addition of a two stage amplifier. It is advisable for the builder to use good low ratio transformers if clear signals are wanted.

In general, the receiver is about as efficient a receiver as one can get, when one looks at the problem from a standpoint of selectivity, sensitivity, volume and lack of radiation.

(The writer wishes to acknowledge the works of the inventor of the circuit, A. J. Haynes of 41 W. 43rd St., New York City, N. Y., as the source of his information relative to the foregoing description.)

New Charger for "B" Batteries

The Radio Rabat Company of Cleveland, Ohio, has brought out two new chemical chargers for "B" batteries. They are known as the Senior Charger and the Junior Charger.

The Senior Charger is assembled in a glass jar 4 inches in diameter and 5 inches high with the aluminum rod placed horizontally at the bottom of the jar, bringing it at the coolest point of the charging solution. This reduces incrustation. The lead rod is also placed in a horizontal position but it is attached to the rubber cork. With this manner of construction they have accomplished a unique automatic cut-out feature which insures against damage to either charger or battery.

See RADIO AGE'S special Christmas offer on page 80.

How to Build a Real Loud Speaker

(Continued from page 20)

a phone or loud speaking unit to the phonograph reproducer arm. The one I purchased looked like the illustration at "A," and is the best for the purpose. If you are unable to secure this type, the one shown at "B" will do. The small end of an adapter of this style is intended to slip over the arm after the reproducer has been removed, and the large pocket or recess holds the unit. In constructing the loud speaker, however, the small end of the adapter should be forced *inside* the mouthpiece of the megaphone, so that a small compression chamber is projecting inside the horn. The adapter at "A" fits nicely, and needs no further adjustment. But the small end of the one at "B" should be built up with layers of paper and glue until it fits the megaphone mouthpiece snugly. After putting style "B" in the magaphone, it will be wise to pour some melted sealing wax around the outside edge to hold the adapter in place.

I now had the vital parts of my loud speaker—the phone unit, the small chamber (the rubber adapter) for compressing and giving force to the sound waves, and the horn for throwing them across the room.

A Cabinet for Looks

THE equipment, of course, needed a cabinet—for the sake of appearance, to make the speaker convenient to handle, and to prevent any *vibration* of the horn. I secured two small soft wood boxes. The one used for the cabinet measured seven and one-half inches wide, six and one-half inches high, and ten inches deep. It had originally contained a celebrated brand of eating chocolate. May a tip to the wise be sufficient.

If you are handy with tools, and wish to take the time, you can, of course, build your cabinet complete from special wood, using the proportions given above.

I carefully removed the top of the box and knocked out the nails. The rest of the box I reinforced with fine wire brads. Then the top was fastened in place with four small brass screws.

With fine sand-paper I smoothed all the surfaces, and rounded the edges and corners. Then I removed the top to complete the cabinet.

A circle five inches in diameter (a half-inch less than the diameter of the horn opening) was marked in the center of one end, which was to be the front of the cabinet. A series of drill holes just inside the line of this circle enabled me to cut out the circular piece of wood, and the edge of the opening was sandpapered round and smooth. Then an end piece from the second box was used to make a snug-fitting partition, with a small hole (see directions above) in the center. This hole was of a size that would fit the megaphone near the center. Reference to the diagram will show location of the partition in the cabinet. After fitting the partition to the horn,

(Turn to next page)

and establishing its exact location, it was secured in place by wire brads driven through sides of cabinet. A small hole, large enough to pass the phone cord, was drilled in the center of the back of cabinet, about one inch above the bottom.

A Beautiful Job

THE complete cabinet was then stained. When dry, I rubbed the outside with powdered pumice and water. After cleaning off the pumice, one coat of white shellac was applied. This was repeated twice, allowing time for each coat to dry thoroughly, and I had a beautifully finished cabinet that anyone could be proud to own. If you prefer a dull finish, either wax the surface or rub down with oil and a little pumice after the final coat of shellac. Rubber headed tacks, such as plumbers use for bumpers, were placed at the four corners to serve as rubber feet on the cabinet and so protect any surface it might be placed upon. It also helps to kill any vibrations caused by the sounding board effect of a table top.

The megaphone or horn was now forced securely into place by turning or twisting it through the two circular openings—the one in front of the cabinet, and the one in the partition. The seam which most megaphones of this kind have can be placed at top and thus kept out of sight. To prevent loosening, and consequent vibration, I put a wire brad through top and bottom of cabinet (see dotted lines in diagram) until the point just rested in the fibre. Then I cut off the exposed part of the brads with a wire cutter.

The rubber adapter was forced into the mouthpiece of the horn, the loud speaker unit inserted in the pocket, and the phone cord passed through the hole in back. After screwing on the cover, my loud speaker was complete. See sketch.

For volume, tone quality, range of reproduction, and freedom from harsh or metallic sounds, I have never heard a loud speaker that could excell it. When connected to the Go-Getter circuit (described in RADIO AGE for September), with one step of audio amplification, the music from local stations can be heard all over a large house.

Another word of advice regarding your grid leak. It might seem a far cry from loud speakers to grid leaks, but it is a fact that the grid leak has an important bearing upon loud speaker reproduction. Many of the poor results obtained from loud speakers can be traced directly to improper adjustment of the grid leak. You should have either a variable grid leak in your set, or an assortment of fixed grid leaks. By proper adjustment of the grid leak you can increase your loud speaker volume and clarity, often as much as fifty per cent.

A Reliable Home Built Battery Charger

(Continued from page 14.)

the primary. It consists of ten turns of a conductor, consisting of two No. 12 dcc wires together. A tap is taken out at five turns in the middle. Make sure a good joint is made here, also using No. 12 dcc wires.

After a piece of paraffined paper has been laid over the winding, the ends of the two pieces of tape (previously mentioned) are brought up around to the top, pulled tightly and made secure. This keeps the wires in place. Put spaghetti over the primary and secondary leads and tape them down. Now slip the entire coil off the wooden form and tape, starting inside. A single layer is enough, as we must leave room for the iron core inside. Now give the entire coil a good coat of electrical black paint and place in an oven to dry. The other coil, called the secondary, will be wound in a similar fashion over the wooden form again.

It consists of 135 turns of No. 12 dcc tapped at 75, and 110 turns. The leads from both ends are brought out. These taps give respectively 15, 22, and 27 volts.

This coil is slipped off the wooden form, taped, painted, and dried. Then when both coils are thoroughly dry, they are slipped on the core. The secondary goes on one core leg, and the other coil, consisting of primary and filament windings, goes on the opposite leg. Then the fourth side of the core is added and the whole transformer is fastened securely by means of angle irons to a base.

A MOGUL socket, obtainable at any electrician's, is necessary for the tungar bulb to screw into. A piece of brass rod or stiff busbar is placed vertically alongside the bulb to make connection at the top with the plate terminal.

Figure 3 shows the wiring diagram. Once wired up in this fashion, it is only necessary to throw the switch from side to side to have the battery on charge or discharge. The rectifier is started and stopped automatically. The ammeter is an automobile type of 0-15 charge and discharge. As they are very cheap, they are almost a necessity. The fuses are six ampere; smaller will do if they can be obtained. The small three-point switch is to vary the charging current and voltage when different batteries are put on charge. Thus two batteries may be put on charge when the switch is on the tap connected to the whole secondary winding (Marked 135 in diagram.)

If the bulb does not start to rectify at once when first tried, it may be necessary to open and close the circuit several times. Once it is started, it will always function properly. When properly operating, the bulb just glows, there is a blue appearance in the bulb, and the plate may redden a bit. The filament dims down when the battery is connected. The glass is usually discolored as in the UV-201 A tube, but this does not affect operation. The transformer will hum and warm a little.

Jones Socket Now Has Bracket Mountings

Howard B. Jones, 618 S. Canal St., Chicago, manufacturer of the Jones Multi-Plug Cable for instantly and simultaneously connecting or disconnecting the ground, antenna, A and B batteries to or from a set, announces that Jones sockets may now be had with bracket mountings. The bracket mounting permits the plug to be placed inside the set on the sides or bottom of the cabinet as convenient.

It is in addition to both the Jones Multi-Plug panel mounting type, and the Jones Multi-Plug binding post type, extensively used as standard equipment on sets, and is provided with seven color coded leads for attaching to the binding posts of any set. Any Jones Multi-Plug Cable, it is stated, will fit any of the Jones sockets of the three types mentioned.

The Multi-Plug Cable now regularly supplied is eight feet long. All leads in it are coded by color to insure being properly connected to the ground, antenna, and A and B battery terminals. The ground and antenna wires are separate leads.

RADIO AGE'S BROADCASTING SCHEDULE

Every Wednesday night, 9:45, from WTAY (283) meters)—10 minute technical talk by a staff member of RADIO AGE.

Thursday evening, November 20, 9 to 10 o'clock, popular and semi-classical program from WEBH (370 meters) by RADIO AGE artists.

Saturday, December 6, and first Saturday of the month thereafter, from KYW (536 meters) Congress Hotel—Radio Age Jazz Carnival, by RADIO AGE artists. Beginning at midnight.

A Single Tube Reflex for the Novice

(Continued from page 26)

variometer terminals, from the other variometer terminal to the ground binding post and to the post marked "G" on the audio frequency transformer. The audio transformer terminal marked "F-" is connected to one of the filament binding posts on the socket and to the connection on the rheostat. One resistance terminal of the rheostat is connected directly to the negative side of the filament battery, or rather to the negative filament battery binding post. The other filament binding post on the socket is connected to the positive filament battery binding post. The plate binding post on the socket is connected directly to the post marked "P" on the radio frequency transformer and the post marked "B" on the transformer is connected to one side of the crystal and to the post marked "G" on the same transformer, also to one of the phone binding posts,

The remaining binding post on the radio frequency transformer, the one which is marked "F" is connected to the post marked "B" on the audio frequency transformer and the post marked "P" on the audio frequency transformer is connected to the remaining side of the crystal detector. The other phone binding post is connected to the positive binding post of the plate battery, the negative post of this battery being connected to the positive binding post of the filament battery, as shown.

The material required consists of one 7x12x⅜ inch panel with cabinet and baseboard to suit, one 23 plate variable low loss condenser, one standard variometer, one audio frequency transformer having a ratio of 10 to 1, one standard socket, one amplifier tube, one 25 ohm rheostat, one radio frequency transformer which will operate over a wave band of from 250 to 550 meters, two 3-inch dials, one good adjustable crystal detector with mounting, eight binding posts, four No. 6 dry cell batteries, one 90 volt plate battery and enough tinned copper bus bar wire to connect up all the parts as shown.

It is suggested that the use of "low loss" parts, such as the condenser and variometer, be used if possible, as apparatus of this kind will greatly improve the reception, although they are not necessary unless one feels that he can afford the extra expense occasioned by their use.

Any type of aerial will be satisfactory, providing that it be as high as possible and a single wire about 75 feet in length is recommended. This should be carefully insulated and the lead-in should be kept as far away from the side of the building as possible and brought in through a porcelain insulator or tube.

An arrangement of this kind may be made permanent by raising a window and inserting a one inch board between the window and the sill, and mounting the insulator in this board. Thus it will not be necessary to bore any unsightly holes in the window casing.

Audio Frequency Amplification and Audibility, a Topic of Interest to the Average Radio Builder, will be the subject of an unusual article by Armstrong Perry in January RADIO AGE—on the stands about December 15.

How the VEILED *Lady* SCARES *'Em*

(Continued from page 34)

Radio stage fright, unlike the ordinary variety, is something not easily outgrown. Perhaps it's because a speaker's mind is not monopolized by a visible audience. It's there. He sees it. His mind is free to concentrate upon what he is saying. Over the radio, however, his audience isn't there. He can't see it. His only contact with it is thinking of it—wondering where it is located, what it looks like and how it is reacting to him. Thus, before he realizes it, his mind is miles from his message, and he suddenly goes blooey.

Experienced radio speakers know this and even the cleverest of them nowadays face the Lady with their remarks written out word for word—not merely notes—but the entire scroll complete with spare parts. Then they merely read the paper, deliberately interposing occasional ers and ahs to make it seem as if they are speaking extemporaneously.

Musicians rarely have any difficulty. Their music sheets are equivalent to the speaker's manuscript.

Broadcasting, as a matter of fact, is the singer's paradise. Corsets and tight collars can be parked in the anteroom and vocal joy thus be unconfined. The operatic tenor with the build of a pouter pigeon would scandalize his audience if he shed his vest and loosened his belt buckle on the concert platform.

In the studio, however, he can sing in a bathing suit if he wants to. One of the most magnificent concerts ever hurled into the ether was given by a famous baritone, who stripped down to his undershirt and sang with an ecstatic abandon that no formal audience has ever heard him display.

The Ideal Radio Voice

THE baritone voice registers best on the radio. Step-ladder tenor and subcellar bass are likely to run into wolf tones. Male voices register better than female. The saxophone is the perfection of wind instruments so far as broadcasting is concerned, and the violin is king of the strings.

No other detector known to science, not even the marvelous human ear, so quickly recognizes and so instantly glorifies a natural sweetness or pleasing resonance in the human voice. The ideal radio voice isn't necessarily one of power. The operator on the roof can supply the power.

What the operator can't supply is life, color, vivacity, and tone. These are the things the microphone demands. There must be purity and quality with no pushing or pressing, no labored breathing or furry enunciation. The Veiled Lady is fastidious to a fault.

President Coolidge has an excellent radio voice. It isn't the ideal voice because of its nasal Yankee twang, but it has timbre and tone and sincerity that registers well with the microphone. Douglas Fairbanks and Charles Evans Hughes more nearly approach the ideal. Owen D. Young, of the Dawes Commission, is considered a splendid subject and William Jennings Bryan is microphonic perfection when anchored some three feet back from the instrument.

Herbert Hoover's voice is a total loss over the radio, as is General Pershing's. Some baffling element in their tonal equipment makes registration flat and lifeless, although their speaking voices are pleasant enough.

Mrs. Izetta Jewell Brown of West Virginia, who seconded the nomination of John W. Davis with a ringing speech, is said by experts to possess the most satisfactory feminine voice that has ever yet been broadcast.

Major J. Andrew White, perhaps the best known of all the professional announcers, has a voice that is broadcastingly perfect, and the significant fact is that Major White has never once spoken above a low conversational tone when addressing a radio audience.

Must Be Grammatical

THE ideal professional announcer must have several things more than wood-wind vocal timbre and perfect diction. For one thing, he must be able to handle such names as Rachmaninoff, Tchernigov, and Carpentier without having to shout for help. For another, he must be naturally grammatical in his conversation. The slightest bungling of a syntax or the unfortunate amputation of an adverbial "ly" is sufficient to blacklist him and his station in certain homes.

All of which shows that while the man of the street must mind his p's and q's, the man of the mike must mind the entire alphabet and all its possible combinations.

When a program is on the air the studio telephone is usually constantly ringing with requests for some favorite entertainer to render some favorite selection. Sometimes there is praise for the program, sometimes bitter abuse.

Freak broadcasting has been successfully attempted. The roar of a lion, the croak of a frog, the thunder of the Atlantic City surf have all been on the air. They broadcast the song of a nightingale in England and the beat of a heart in Pittsburgh, Station KDKA performing the last-named feat.

Where will it end? Ask somebody else.

A thing that can come from nowhere in four years to pick up the squeak of a mouse or the beat of a heart and hurl it ten thousand miles is entirely too potent to tamper with.

If you'll accept a guess, here's one that in four more years some station will be broadcasting the harmony of the spheres on Tuesday and Friday nights, the original Æsop will be whispering bedtime stories, and Helen of Troy will be on the air with her personal beauty secrets each Wednesday morning at ten o'clock.

[Reprinted through courtesy of Collier's Weekly.

How to Make Your First Crystal Set

(Continued from page 25.)

assembly is only a matter of exercising a little brain work with regard to mechanical ability. If you scratch the panel during the drilling of the mounting holes, grain it by sand-papering in one direction only and then wipe off the dust with alcohol.

PROCEED to wire the set as follows: From the binding post for the aerial to the outside turn of the stationary coil (beginning end). Then wire all the remaining leads from this coil to the switch points. The switch lever is connected to the ground binding post. Connect the two flexible leads of the movable coil to the two connections provided on the variable condenser. Then from the stator plate connection on the condenser, run a wire to the one terminal of the crystal detector, and from the other crystal detector terminal to one of the phone-posts. The other phone-post should be connected to the rotary plate conection on the condenser, and after making this connection, the fixed condenser should be connected right across the two phone binding posts. You can use some of your No. 14 aerial wire to connect the set up with. Solder all connections if possible. When you have finished this, connect up the antenna, ground and phones to their respective binding posts, and prepare to listen.

Don the phones, and set the dial of the condenser at about 35. Set the switch lever on the second tap, and then give your attention to the crystal detector. Scratch the catwhisker or movable element of the crystal rectifier around at various places on the surface of the stationary mineral; one or two settings will tell which is the loudest and best.

RADIO AGE ON THE AIR!

Don't forget to tune in on RADIO AGE'S Congress Hotel Jazz Carnival from KYW, Chicago, Saturday night, December 6, beginning at Midnight. Lots of fun.

KHJ
Los Angeles, Cal.

We are glad to confirm your report of reception of our program.

John S. Daggett,
"Uncle John,"
Mgr., Times Radio Staff.

General Electric Company

Pacific Coast Broadcasting Station KGO 5555 E. 14th St. Oakland, Cal. Sept. 11, 1924.

Mr. T. J. Kennedy,
1360 University Ave., New York, N. Y.

We are glad to confirm your reception of KGO on the evening of Sept. 6 as we were broadcasting the opera "Carmen."

We always appreciate hearing from our radio listeners and hope that you will be able to pick up KGO regularly.

Yours very truly,
Jenninga Pierce,
Radio Broadcasting Pub. Dept.

KLZ Denver, Colo.

We are pleased to acknowledge receipt of your report of reception of our phone station. We have placed a tack in our map for you.

Reynolds Radio, Inc.

KFI
Los Angeles, Cal.

Thanks for your letter received. Yes, "The Minuet," by Louis Parker, was broadcast from the Anthony station during the late program.

Yours, Radio KFI.

General Electric Company

Pacific Coast Broadcasting Station KGO 5555 E. 14th St. Oakland, Cal. Sept. 4, 1924.

Mr. Vincent T. Kenney,
124 W. 96th St., New York, N. Y.

We are glad to confirm your reception of our late program from the Hotel St. Francis on the morning of August 27th.

We are always glad to answer any questions of our radio friends and hope you write in often with your comments.

Yours very truly,
Jennings Pierce,
Radio Broadcasting Pub. Dept.

2-LO, London, Eng.

We beg to acknowledge your reception of our program.

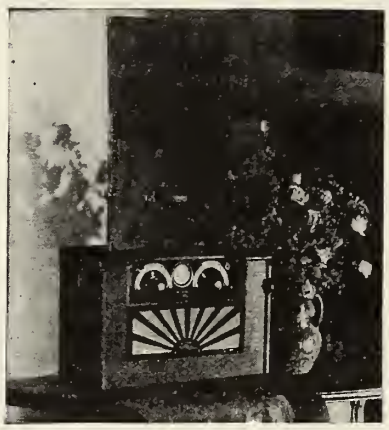
Yours faithfully for the British Broadcasting Co., Ltd.,
Jr. Director, London Station, C. C. H. King

WITH THE MANUFACTURERS

New Operadio Unique

The Operadio Corporation of Chicago are now marketing their 1925 model, which while embodying the fundamental principles of the 1924 series has many new and unique features.

The instrument is a complete, self-contained radio set, with the six tubes, loud-speaker and all connections within a compact case. No aerial or ground is required. The side and top of the carrying case take the place of the usual antenna. This makes it possible to use



The New Operadio

the set anywhere—in any part of the house, or when traveling or camping.

So compactly designed is the new Operadio that there is actually space for four of the largest "B" dry cells, as well as six "A" batteries. This means unusual power and long battery life.

The circuit employed is cascaded radio frequency, so developed that reception is remarkably efficient over the entire wave-band. Unit construction is employed, in which the three stages of radio frequency (capacity compensated) together with the detector portion, are molded into the solid unit. Likewise the two stage audio frequency amplifier is molded into a solid unit.

There are many other improvements in the set such as a safety fuse on the "B" battery circuit and a voltmeter which registers the voltage in either the "A" or "B" batteries separately.

New Anti-Capacity Panel

U. S. Anti-capacity Radio Panel is a panel of high grade hard rubber, to the back of which is attached by a vulcanizing process a thin sheet of perforated metal which serves as a shield against the effects of body capacity. In working the panel, any part of the shielding can be easily removed with a penknife. The anti-capacity shielding is furnished with panels of any size, or with full-size sheets, in black or mahogany finish, and in 1-8 inch, 3-16 inch, or 1-4 inch thickness. Manufactured by United States Rubber Company, 1790 Broadway, New York City.

The Story of the Microdyne Radio Receiver

By E. K. Oxner, M. I. R. E.

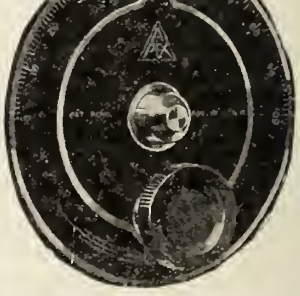
This radio receiver is one of the more recent developments in seven-tube superheterodynes.

The usefulness to the home user of such a receiver depends on several fundamentals, such as: simplicity of control, stability of operation, saving in space, its adaptability to perform with either the large storage battery type of tube and the so-called "peanut" tube.

Tuning is accomplished by two dials, both of which can be accurately logged. Master rheostat is provided to compensate for changes of battery voltage only

This stability of operation is secured by the use of the Microdyne Transformers; namely long wave, filter and audio, of Apex Electric Mfg. Company's design and manufacture. The long wave Microdyne Transformers, in particular, are of special design, brought out as the result of several year's work in the attempt to produce an entirely satisfactory Transformer for this type of receiver; i. e. a Transformer which provides a high degree of amplification, such as is otherwise secured only with the use of specially constructed tuned circuits, without the many difficulties and the extreme bulk inseparable from the latter. This design in the present Microdyne long wave transformer has been perfected to the point where the maximum amplification per tube is attained, so that the two stages used in the Microdyne receiver are sufficient to provide more than enough radio frequency amplification under any broadcast receiving condition encountered.

The price of the Microdyne 7 tube radio receiver complete with battery and loop cables, without tubes, batteries, loow or loud speaker, is $160.00 The receiver is also furnished in knock-down form at a price of $97.50.



The new Apex Vernier Dial embodies some unusual and original ideas in its design. It consists of two plates, a stationary indicator and a calibrated rotary element, which rotate with a ten to one ratio.

New Marshall Rheostat

The Marshall Electric Company, 3225 Locust Boulevard, St. Louis, have recently put on the market a new type of rheostat for filament control. The device is called the Marshall-stat and can be used with any tube or combination of tubes.

This rheostat is very compact in design. It requires only one hole in the panel of a radio set, and can be inserted in the hole from which an old rheostat has been removed. The space taken up on the back of the panel is a circle of 3-4 inch in diameter.

The chief advantage claimed for the Marshall-stat is the absolute smoothness of adjustment which may be obtained through its use. Although there is only one knob to turn and a single adjustment to make, the Marshall-stat gives vernier precision throughout its entire range, varying the resistance not step-by-step but smoothly, continuously and uninterruptedly from zero to maximum.

New Storage "B" Battery

Builders of radio sets will no doubt be interested in knowing that there is a storage "B" Battery on the market now which occupies only about one third of the space used by wet cell "B" Batteries of like capacity.

It is a 24 volt battery of 4500 milliamperes capacity and is assembled in an indestructible container. The cells are sealed absolutely tight with a special compound to prevent the leakage of acid. Vents are of hard rubber to permit their removal for refilling with distilled water.

This battery is manufactured by the National Lead Battery Company of St. Paul, Minnesota.

The National "B" Battery is only slightly more expensive than the dry battery. It is estimated that this new battery will last at least five years and as it can be recharged for less than ten cents with a very moderately priced charging outfit put out by this company, it should prove very economical.

National Transformer Unique in Design

The National Transformer Mfg. Co., 154 Whiting St., Chicago, has made several additions to its line of radio transformers. Now there is a National Transformer to meet different radio requirements. A distinctive departure from the common practice has been followed in naming the new transformers. Each is called after some type of battleship because of some characteristic of the transformer and the type of battleship after which it is named.

What all the fans are asking for! A Four-Tube Neutrodyne Receiver—Reflexed! Embodying all the features of the popular neutrodyne circuit, with a couple of additional improvements! In the January RADIO AGE.

✣ *Tested and Approved by* RADIO AGE ✣

WIRE TABLES (C-15-20)

PROPERTIES OF MAGNET WIRE

MAGNET WIRE TABLES. In the following table will be found the dimensions of covered magnet wire which will be found of use in calculating the dimensions of cells and other windings. The diameters (O. D.) taken over the insulation. As a convenience the number of turns per inch of length (N. T.) are also given. The four most common insulations are shown: Single cotton covered (S. C. C.); double cotton covered (D. C. C.); single silk covered (S. S. C.); double silk covered (D. S. C.) and enameled wire (E. W.)

MAGNET WIRE TABLE

O. D.—Outside diameter in inches. N. T.—Number of turns per inch of core.

B. & S. Guage Number	S. C. C. Wire		D. C. C. Wire		S. S. C. Wire		D. S. C. Wire		Enam. Wire	
	O. D.	N. T.	O. D.	N. T.	O. D.	N. T.	O. D.	N. T.	O. D.	N. T.
10	0.108″	9.25	0.113	8.85					0.104	9.6
11	0.097	10.3	0.102	9.80					0.0927	10.8
12	0.087	11.5	0.092	10.5					0.0828	12.1
13	0.078	12.8	0.082	12.2					0.0740	13.5
14	0.070	14.3	0.074	14.9					0.0661	15.1
15	0.063	15.9	0.067	14.9					0.0591	16.9
16	0.056	17.9	0.060	16.7	0.0528	18.9	0.0546	18.3	0.0528	18.9
17	0.050	20.0	0.054	18.5	0.0473	21.1	0.0491	24.0	0.0470	21.3
18	0.045	22.2	0.049	20.4	0.0424	23.6	0.0441	22.7	0.0421	23.8
19	0.041	24.4	0.045	22.2	0.0379	26.4	0.0397	25.2	0.0377	26.5
20	0.037	27.0	0.041	24.4	0.0340	29.4	0.0358	28.0	0.0337	29.7
21	0.0335	29.0	0.038	26.3	0.0305	32.8	0.0323	31.0	0.0302	33.1
22	0.0295	33.9	0.0333	30.0	0.0273	36.6	0.0291	44.4	0.0269	37.2
23	0.0266	37.6	0.0306	32.7	0.0246	40.7	0.0264	37.9	0.0241	41.5
24	0.0241	41.5	0.0281	35.6	0.0221	45.3	0.0239	41.8	0.0215	46.5
25	0.0219	45.7	0.0259	38.6	0.0199	50.3	0.0217	46.1	0.0192	52.1
26	0.0199	50.2	0.0239	41.8	0.0179	55.9	0.0197	50.8	0.0171	58.5
27	0.0182	55.0	0.0222	45.1	0.0262	61.8	0.0180	55.6	0.0153	65.4
28	0.0166	62.0	0.0206	48.6	0.0146	68.5	0.0164	61.0	0.0136	73.5
29	0.0153	65.4	0.0193	51.9	0.0133	75.2	0.0151	66.2	0.0122	82.0
30	0.0140	71.4	0.0180	55.6	0.0120	83.3	0.0138	72.5	0.0109	91.7
31	0.0129	77.5	0.0169	59.2	0.0109	91.7	0.0127	78.7	0.0097	103.0
32	0.0120	83.4	0.0160	62.9	0.0099	101.0	0.0118	84.8	0.0087	115.0
33	0.0111	90.0	0.0151	66.2	0.0091	110.0	0.0109	91.7	0.0077	130.0
34	0.0103	97.1	0.0143	70.0	0.0083	121.0	0.0101	99.0	0.0069	145.0
35	0.0096	104.0	0.0136	73.5	0.0076	132.0	0.0094	106.0	0.0062	161.0
36	0.0090	111.0	0.0130	77.0	0.0070	143.0	0.0088	114.0	0.0055	180.0
37	0.0085	118.0	0.0125	80.0	0.0065	154.0	0.0083	121.0	0.0049	204.0
38	0.0080	125.0	0.0120	83.3	0.0060	167.9	0.0078	128.0	0.0044	227.0
39	0.0074	135.0	0.0115	87.0	0.0055	180.0	0.0073	137.0	0.0039	256.0
40	0.0071	141.0	0.0111	90.9	0.0051	196.0	0.0069	145.0	0.0035	286.0

VACUUM TUBES (JJ-9-35)

OPERATING CHARACTERISTICS

GRID TO PLATE CAPACITY. In any triode vacuum tube the grid and the plate act like the two plates of a condenser and as a result there is a considerable capacity between these two elements. The larger the elements and the closer together these parts are installed the greater will be the internal capacitance. In addition to the true grid to plate capacity there is a second capacity due to the close proximity of the lead-in wires in the base of the tube. In the majority of tubes all four connection wires pass out at one end of the tube and being close together introduce a condenser effect. This is greatly reduced in the tubes, such as the Meyers tubes, where the connections are made at both ends of the tube and where the wires can be more widely separated.

One of the most important effects of the grid to plate capacity is the feed-back that takes place from the plate or output circuit to the grid, a portion of the plate energy in this way being transferred back to the grid circuit producing a certain degree of regeneration and tending to set up self-oscillations. For this reason, all circuits are essentially regenerative circuits even though no external inductances, capacities or ticklers are used to obtain the effect. This regeneration is small yet it exists in sufficient magnitude to cause trouble in radio frequency circuits where regeneration is not desired.

When the tubes are being used for radio frequency amplification the full amplification of the input is never possible at ordinary broadcasting frequencies because of the capacity effect. A part of the incoming radio impulses are fed directly through the capacity from grid to plate without effecting the electron stream and therefore without producing amplification, this transfer reducing the grid potential and control over the electron stream. Secondly a second transfer or feed-back takes place from the plate to the grid, thus setting up oscillations which again interfere with the amplification. The only reason for such arrangements as the Neutrodyne, Superdyne and Super-Heterodyne is to eliminate or greatly reduce the internal capacity effect of the tubes in the radio frequency stages.

In the Neutrodyne circuit a small condenser known as the "Neutro-a-don" is connected to the grids of the R. F. tubes in such a way that it directly opposes the internal capacity of the tube, thus effectively reducing the internal capaci y to zero. In the Super-Heterodyne the frequency in the radio frequency tubes is reduced thus reducing the internal capacity effects. The capacity is less at low frequencies than at high, and when we get down to about 45,000 cycles per second this capacity is practically negligible. The feed-back at the conventional 45,000 cycles used in the Super-Heterodyne is very much less than at the average broadcasting frequency of 600,000 cycles per second.

At ordinary broadcasting frequencies the grid-plate capacity varies among different tubes, owing to the varying sizes of the plates and grids and their separation. Roughly this is about as follows:

Western Electric "J," VT2, and 216A	10-12 micrmicrofarads
UV-201-A, C-301A Tubes	5- 6 micrmicrofarads
UV-199, C-299 Tubes	4- 5 micrmicrofarads
Meyers Tubes	3- 4 micrmicrofarads

In general, the lower the internal capacity, the better is the tube adopted to radio frequency amplification when no external control is provided as in the Neutrodyne. As the audio frequency currents are of very low frequency the grid-plate capacity has very little effect on audio amplification, and the tubes that show up best on R. F. are not generally as good at audio frequency. The UV-199, the Meyers tubes, and the UV-201A are the best.

THRILLS that Go with "SOS"

(Continued from page 30)

stricken vessel, we deduced that the ship had drifted on about a mile into the inky black fog before coming to a final stop. This made a long row for the boats, groping their way toward us. The single blast we were blowing on our whistle, served to show them we were not sinking and also aided them in finding us. About two hours after the smash we began to hear a splashing of oars, mingled with shouts and the murmur of voices coming to us out of the Stygian blackness.

Shortly faint "hellos" and "ahoys" rose above the commingled sounds and showed that the survivors were within hailing distance. We immediately answered, and in response to their harrassed inquiries assured them we could take all their company aboard. It was then we learned that we had rammed and sunk the steamer "Merida," back from Mexico with a capacity passenger list.

Soon after the first survivors were aboard, we also were advised that the "Merida" had a cargo consisting in part of several million dollars in gold and silver bars. Those of my readers who follow the daily press will note the latest revival of the sporadic interest frequently being shown in this cargo, now resting three hundred feet below the surface. The promoters of the expedition now being fitted out believe they have solved the problem of working under the tremendous pressures existing at such a depth.

The "Merida's" people, clamoring over the ship's side, presented a sorry spectacle. They ranged from babes in arms to be-whiskered grandees of old Mexico, and in garbs running the gamut from breeches and undershirt and no shoes to gay dressing gowns and unmated slippers of different colors. Each person carried with him exactly what he wore and no more. As our bow had torn into the "Merida's" engineroom, all machinery, including the dynamo, was immediately submerged, plunging the ship into darkness inside and out. This, by the way, rendered their wireless hors de combat, which completes the explanation of why neither of us was able to do any snappy work on the radio.

Misery Loves Company

AS THE "Farragut" could accommodate less than one hundred passengers with any degree of comfort, the "Merida's" four hundred partly clad people were soon piled eight and ten in a stateroom, Mexican greaser sharing space with New York cake eater, dark senoritas sleeping in the arms of fair American damsels and in some cases sharing the common comfort of one bath robe. Many heads were in curlers, some were loose or in braids, while disheveled boudoir and night caps were present in large numbers. Bobbed hair would have been a blessing in such circum-

stances, but not a shingle was to be seen. Altogether it was not a dress rehearsal. And when the outfit was landed at "Norfolk" that afternoon they must have felt in holiday spirits making a tour of the shops in search of new rigs.

Our "SOS" calls were sent repeatedly with one minute intervals of listening. Had we been sinking, as was the "Merida," there would have been two shiploads of survivors waiting on the great waters for the chance passing of some ship. Yet the obvious lesson—that a continuous watch should be kept on all ocean vessels—was ignored until the "Titanic's" operator found himself in a similar predicament several years later, with direful results known to all.

About 4:30 a. m. I was gladdened by the sound of the S. S. "Hamilton," call "OA," lazily calling the "OG" of the same line and giving routine directions for passing each other in the fog so as to avoid possibilities of collision. Any spark was like news from Heaven as it showed that the set was working. "OA's" op. was usually a snappy sender, but disturbed at this time of the morning for such drab duty found him rather dull on the key. The minute he stopped sending I slammed the switch and called him briskly, sticking in a couple of "SOS" to bring him to life. He had been too numb to catch my calls but the "SOS" shocked him into shape instantly, and despite the tenseness of the situation I had to chuckle to note the change in his manner of sending. "Zip! Zip!" he flashed into action. "WHO CALLED 'SOS' —WHO CALLED 'SOS'—WHO —CALLED 'SOS'—GO AHEAD AGAIN," he snapped. The story was soon told and five minutes later I handed our Captain a message from the "Hamilton's" Commander saying that he would be at our position about 9 a. m.

We had just finished this satisfactory communication when the U. S. S. "Iowa" came in, saying he had overheard the talk and that his Commanding Officer had headed his vessel toward us. The combined good news was distributed among the survivors and served to lighten the gloom a little. But the general morale was still very low. Sitting in the comfort of your library, with loud speaker at elbow, it is hard to conceive of one-tenth of one per cent of the misery hanging over the heads of several hundred refugees brooding about the decks of a ship about a third large enough to hold them, the clammy, dank fog sticking closely over all.

When Cape Hatteras "HA" shot a leisurely "GM" onto the air, I briefly informed him of the tragic happenings which had been going on a short hundred miles off his front door while he had been pawing the hay, and like the "OA's" op. he snapped into a different style pronto. As the ship operators began to come on the job and learned of the night's doings, we were flooded with offers of assistance. Many of the ships had passed almost within sight of us, being obscured by the fog, and had their operators been on duty, rescue

would have been a matter of minutes after our first "SOS."

However, we felt that we were well taken care of and broadcast the information that all offers were declined with thanks. This did not suffice to quiet some of them, however, and all morning the "UG" was being called by somebody bursting with the desire to render us succor. With the motor generator red hot from a run of many hours, and a constant stream of messages still passing between our captains and their offices ashore, I was forced to ignore these calls and tend strictly to my knitting. I recall especially the "Santa Marta," of our own line, call "UFY," calling furiously all morning. Every time I threw the switch he was in, but I simply could not take the time to get into a chewing match with him, and I did not answer him until nearly noon. Then I told him briefly that we had no use for his services, at which he was one sore op. Sitting snugly in his room away from such scenes as were going on around us he could not appreciate the situation and I certainly had no time to offer any apologies. With a brief "nothing doing; much 'bliged" I returned to working "AX," Atlantic City, who had another long dispatch for our Captain. "UFY's" operator would not speak to me for several months.

"The Hamilton" arrived on time, performing a beautiful bit of navigation by laying out a course, when we worked him at 4:30 a. m., which brought him directly on our beam at the estimated moment without the deviation of a hair.

Transfer of survivors began at once and continued until about 1 p. m., when the last sad-eyed member of the "Merida's" company was safely aboard the "Hamilton" and she continued her voyage to Norfolk. About the time the "Hamilton" left us, the "Iowa" appeared and offered to convoy us to shallow water. Our bow being practically non-existent, the open sea was pressing against a comparatively frail bulkshead. We had not moved an inch since the collision, fearing that any forward movement would add to this pressure and bring disaster. However, as we were about four hundred miles from New York or Philadelphia something had to be done and with the "Iowa" standing by we started slowly ahead, then as nothing untoward happened we increased to about one-third speed toward New York.

At 3 p. m. Saturday we arrived at Erie Basin drydock, Brooklyn, and I removed the phones from a set of aching ears and turned in. Not having batted an eye since Thursday morning, I was practically out of the habit and it was some hours before I was able to make satisfactory arrangements with the Sand Man. But once in work—oh, boy! The next thing I knew it was Sunday night.

AN IDEAL GIFT.

Give that radio-bug friend of yours a year's subscription to RADIO AGE—at a special price of $2.00. See page 80, this issue, for Christmas offer!

A Real Go-Getter Among Stations

(Continued from page 38)

according to his own ideas and obviously this does not work out well in a station which operates 24 hours a day. The dyed-in-the-wool telegraph operator seldom ever becomes sufficiently interested in the electrical or mechanical end to be very valuable.

"First of all, a prospective operator must hold a government license—this is required by law. In addition to this, he must have a good working knowledge of the electrical trade, so that he may be able to overcome difficulties which may arise within the equipment. He must be ingenious, able to think fast in emergencies and segregate and overcome troubles. He must have a good personal appearance and pleasant personality, so he may successfully meet people when outside pick-ups are used. It is desirable that the applicant also be a good Morse wire operator because most of the better stations use land line telegraph for orders between the point of pick-up and the radio station. Commercial telegraph wires are now looped through the broadcasting station so that the artists may have their applause first hand and it is a convenience if the radio operators are able to handle these messages.

"In brief, the applicant should be a diplomat, technician, telegraph operator, steeple jack, public contact man and on top of that, husky enough to carry storage batteries. In fact, a successful radio man must be nearly everything but a cook.

"The present supply of radio operators does not nearly meet the demand of the large number of new broadcasting stations. The field for radio operators and kindred pursuits is especially attractive with its rapid increase in popularity, and those young men whose ambitions follow that channel should give first thought to the requirements as set forth in the preceding paragraphs."

KYW Three Years Old

KYW entered upon its fourth year of activity on November 11th. On Armistice Day in 1921, KYW broadcast its first program from the stage of the Auditorium theater, when Mary Garden addressed the comparatively few who at that time owned receiving sets. On this same occasion Edith Mason sang a solo.

This was the birth of a broadcasting station which during the three years since has enjoyed amazing changes and wonderful growth.

On November 13, 1922, KYW commenced broadcasting grand opera, the first station to put opera on the ether. With the limited equipment then available, KYW broadcast every opera of that season from Chicago.

From this point KYW rapidly grew. In June, 1921, the present up-to-date aerial and station equipment were installed. The operating crew also grew in numbers, until today thirty-five are required to attend to the detail that only a couple men handled in the station's infancy.

Are You a WOWL?—Well, You Should Be

(Continued from page 37)

for the blind, who says I'm making a good boy out of him.

"The preacher who has his audience where they can't get away, can use subtle methods, and build up a climax. But the radio preacher must say something in every sentence."

This station feels that it must give the public what it wants. As judged from his experience with the Radio Bulletin, a station publication which was sent to listeners, Mr. Frazer knew that the public wanted something from WOAW more tangible than songs, stories, speeches and instrumental selections. So every person who had listened to at least three church services and who wished to become a member of the radio Church of the World, writing to the Woodmen of the World, received a certificate of membership. This certificate was a genuine work of art designed and drawn by an expert artist so that it would be suitable for framing and hanging in any home. And it proved popular. Over 21,000 of these certificates have been presented.

Weekly Dance Night

BUT affiliation with the radio church was not adequate in many ways. There were thousands of fans who did not belong to the church who wanted to affiliate with the station in appreciation of its nightly programs, especially its dance affairs, for every Friday evening is official dance night for station WOAW. For these dance hounds and jazz panygerists, the "WOWL" club was organized. The WOWL club signified a "Woodmen of (the) World Listener." The entire country is divided into antennas. Each antenna has a regular set of officers, on a descending scale from Grand Oscillators, Galens, Generators, Crystals, Mikerophones, to ordinary WOWLS. Membership cards signed by W. A. Frazer, the Great Grand Generator of the International Order of WOWLS, were sent to each individual who expressed a desire to become a WOWL. It was the duty of a WOWL to report each week as to how conscientiously he had listened to the programs.

Radio broadcasting always involves the human element, often in an amusing manner. One letter asks that the Woodmen of the World broadcast a request that search be made for a young man and woman who had rented a Ford for their honeymoon and failed to return it. In another instance a fierce fire was raging in the business section of Omaha. WOAW announced the particulars and one of the listeners was surprised to learn it was his store on fire. He rushed downtown and arrived at the scene almost as soon as the fire department.

I mentioned that, if for no other reason, WOAW deserve fame because it possessed a poet laureate, Eugene Konecky. He is not only well known for his own verses, but for his exceptional talent in reading the verses of other poets.

Mr. Konecky is the author of a volume of poems, "Trail of Spring," and is recognized as one of the leading writers of poetry in the Middle West, which was

shown when he was recently appointed as judge in the poetry contest by the Omaha Women's club, acting as an associate judge to John G. Neihardt, Nebraska's epic poet, who was the winner of the Columbia University prize for the best volume of poetry in 1920.

WOAW has a number of literary geniuses. G. R., known to fans as "the voice of the Woodmen of the World" in his capacity as announcer, is really Gene Rouse, who has written a play, "The Scoop." I am not informed—the play might be about journalism or the coal pile.

"Early to Bed"

L. P., another initial man to the radio-listening public, is Lester Palmer, program director. He says that he gets along by following the proverb, "early to bed and early to rise makes a man healthy, wealthy and wise." He goes to bed early in the morning and gets up early in the evening. He was a University of Illinois man and won the captaincy of the football team. As a pianist he is unequaled. He can play the most difficult scores of Rachmaninoff with his right hand while his left is busy with jazz, at the same time keeping one hand in ignorance of what the other is doing. Some trick!

Lou W. Chanskey, chief operator, finds his pleasures in the operating room where he can dissect a tube or a coil, removing an oscillation from the esophagus of a grid and operating a recalcitrant ether wave from the stomach of a generator. He's another literary inventor, having written a radio drama. They're all that way at WOAW!

Who's Who In Radio

Over 200,000 persons depend upon radio for a living. How many have made their work a profession? How many a job? E. E. Yaxley has succeeded because he has devoted himself to his profession.

By Robert Archer

IT HAS been my pleasure to talk to many men who have won a high place for themselves in business and professional life. If I were to try to sum up in one short sentence the advice of these leaders to the man on the first rungs of the ladder of success, the composite sentence would read something like this: "Choose your favorite calling, stick to it and *work*." And good advice it is.

When RADIO AGE asked me to speak to one of the leaders in this new industry of radio, I expected to listen to a different kind of story. The industry is young. It has had a remarkable growth, so remarkable that there can be few real pioneers in the field—or putting it another way, most everybody is a pioneer. I am one of the *pioneers* myself.

I sought out E. E. Yaxley, President of the company bearing his name. The visit was a real pleasure, which is one measure of a man's greatness. Mr.

Yaxley was very gracious in his welcome. He discussed radio with all the enthusiasm of a man who has made a hobby of his work. But he was equally as reticent when it came to speaking about himself and giving advice.

As we talked, however, I gathered many interesting sidelights on a life devoted to the study of transmitting sound. Truly, Mr. Yaxley is a professional man. His whole lifetime has been a study course, divided between the laboratory, developing ideas, and the shop carrying out these ideas in a practical way.

E. E. Yaxley

As with so many of our radio and telephone engineers, Mr. Yaxley received his early telephone training with the Western Electric Company.

In 1892, Mr. Yaxley designed the first automatic switchboard apparatus which was installed in a trial exchange at LaPorte, Ind. Through the following years, Mr. Yaxley was ever at work in the telephone field. In 1901, he organized the Monarch Telephone Co. and for eleven years personally designed Monarch apparatus. The reputation of the old Monarch Telephone Company for the correct design and superior construction of its equipment is due in no small way to the efforts of Mr. Yaxley.

The name Yaxley is familiar to old time telephone men who remember the patent claims advanced in favor of Gray, Cushing and Bell. Mr. Yaxley's work was so closely related to the development and improvement of telephone design and construction that he was an authority frequently consulted by telephone engineers from all over the country.

Naturally enough, when radio broadcasting first came into popular favor some three or four years ago, Mr. Yaxley turned to radio as a new field for his inventive faculties. The Yaxley Mfg. Co. started the manufacture of radio devices. The shop facilities were excellent for precise workmanship and it was not long until production on radio jacks, jack switches and other parts was under full headway.

I marveled that a man, known principally for originating and developing radio and telephone apparatus could keep such a close watch on production and could plan so well. But to Mr. Yaxley, system is synonymous with designing. He seeks the practical. It is not enough to design a piece of apparatus; it must be so designed that it can be manufactured to pass on the benefits of it to the world.

Corrected List of Broadcasting Stations

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh	326
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	270
KDPT	Southern Electrical Co.	San Diego, Calif.	244
KDYL	Newhouse Hotel	Salt Lake City, Utah	360
KDYM	Savoy Theatre	San Diego, Calif.	280
KDYQ	Oregon Institute of Technology	Portland, Oreg.	360
KDZB	Frank E. Siefert	Bakersfield, Calif.	240
KDZE	Rhodes Department Store	Seattle, Wash.	270
KDZI	Electric Supply Co.	Wenatchee, Wash.	360
KDZR	Bellingham Publishing Co.	Bellingham, Wash.	261
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	360
KFAE	State College of Washington	Pullman, Wash.	330
KFAF	Western Radio Corporation	Denver, Colo.	278
KFAJ	University of Colorado	Boulder, Colo.	360
KFAR	Studio Lighting Service Co. (O. K. Olsen)	Hollywood, Calif.	280
KFAU	Boise High School	Boise, Idaho	270
KFAW	The Radio Den (W. B. Ashford)	Santa Ana, Calif.	280
KFAY	Virgin's Radio Service	Medford, Ore.	283
KFBB	F. A. Buttrey & Co.	Havre, Mont.	360
KFBC	W. K. Azbill	San Diego, Calif.	278
KFBE	Reuhen H. Horn	San Luis Obispo, Calif.	242
KFBG	First Presbyterian Church	Tacoma, Wash.	360
KFBK	Kimball-Upson Co.	Sacramento, Calif.	283
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	Trinidad Gas & Electric Supply Co. and the Chronicle News	Trinidad, Colo.	280
KFBU	The Cathedral	Laramie, Wyo.	283
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFCF	Frank A. Moore	Walla Walla, Wash.	360
KFCL	Leslie E. Rice	Los Angeles, Cal.	236
KFCP	Ralph W. Flygare	Ogden, Utah	360
KFCV	Fred Mahaffey, Jr.	Houston, Texas	360
KFCZ	Omaha Central High School	Omaha, Nebr.	258
KFDD	St. Michaels Cathedral	Boise, Idaho	252
KFDH	University of Arizona	Tuscon, Ariz.	368
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	360
KFDX	First Baptist Church	Shreveport, La.	360
KFDZ	South Dakota State College	Brookings, S. Dak.	360
KFEZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank Co.	Portland, Oreg.	248
KFEK	Augsbury Seminary	Minneapolis, Minn.	261
KFEL	Winner Radio Corp.	Denver, Colo.	254
KFEQ	J. L. Scroggin	Oak, Nebr.	268
KFER	Auto Electric Service Co.	Fort Dodge, Iowa	231
KFEY	Bunker Hill & Sullivan Mining and Concentrating Co.	Kellogg, Idaho	360
KFFB	Jenkins Furniture Co.	Boise, Idaho	240
KFFE	E. H. Smith,	Hillsboro, Oreg.	229
KFFP	First Baptist Church	Moberly, Mo.	266
KFFR	Nevada State Journal (Jim Kirk)	Sparks, Nev.	226
KFFV	Graceland College	Lamoni, Iowa	280
KFFY	Pincus & Murphey Music House	Alexandria, La.	275
KFGB	Heidbreder Radio Supply Co.	Utica, Neb.	224
KFGC	Louisiana State University	Baton Rouge, La.	254
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	273
KFGL	Suell & Irby	Arlington, Oreg.	234
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFGX	First Presbyterian Church	Orange, Tex.	250
KFGZ	Emmanuel Missionary College	Berrien Springs, Mich.	286
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHD	Utz Electric Shop Co.	St. Joseph, Mo.	226
KFHH	Ambrose A. McCue	Neah Bay, Wash.	261
KFHJ	Fallon & Co.	Santa Barbara, Calif.	360
KFHR	Star Electric & Radio Co.	Seattle, Wash.	283
KFI	E. C. Anthony, Inc.	Los Angeles, Calif.	469
KFIF	Benson Polytechnic Institute	Portland, Oregon	360
KFIO	North Central High School	Spokane, Wash.	252
KFIQ	First Methodist Church	Yakima, Wash.	242
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIX	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	240
KFIZ	Daily Commonwealth and Oscar A. Huelsman	Fon Du Lao, Wis.	273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	Seattle Post Intelligencer	Seattle, Wash.	270
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	252
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg.	252
KFJK	Delano Radio and Electric Co.	Bristow, Okla.	233
KFJL	Hardsacg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	280
KFJQ	Valley Radio, Div. of Elec. Constr. Co.	Grand Forks, N. D.	280
KFJR	Ashley C. Dixon & Son	Stevensville, Mont. (near)	258
KFJX	Iowa State Teacher's College	Cedar Falls, Iowa	280
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	246
KFJZ	Texas National Guard, One hundred and twelfth Cavalry.	Fort Worth Texas	254
KFKA	Colorado State Teachers College	Greeley, Colo.	273
KFKB	Brinkley-Jones Hospital Association	Milford, Kans.	286
KFKV	F. F. Gray	Butte, Mont.	283
KFKQ	Conway Radio Laboratories (Ben H. Woodruff)	Conway, Ark.	250
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	341
KFKZ	Nassour Bros. Radio Co.	Colorado Springs, Colo.	234
KFLA	Abner R. Willson	Butte, Mont.	283
KFLB	Signal Electric Manufacturing Co.	Menominee, Mich.	248
KFLD	Paul E. Greenlaw	Franklinton, La.	234
KFLE	National Educational Service	Denver, Colo.	268
KFLQ	Bizzell Radio Shop	Little Rock, Ark.	261
KFLR	University of New Mexico	Alhuquerque, New Mexico	254
KFLU	Rio Grande Radio Supply House	San Benito, Texas	236
KFLV	Rev. A. T. Frykman	Rockford, Ill.	229
KFLW	Missoula Electric Supply Co.	Missoula, Mont.	234
KFLX	George Roy Clouch	Galveston, Tex.	240
KFLZ	Atlantic Automobile Co.	Atlantic, Ia.	273
KFMB	Christian Churches	Little Rock, Ark.	254
KFMQ	University of Arkansas	Fayetteville, Ark.	263
KFMR	Morningside College	Sioux City, Iowa	261
KFMT	Dr. George W. Young	Minneapolis, Minn.	231
KFMW	M. G. Stieren	Houghton, Mich.	266
KFMX	Carleton College	Northfield, Minn.	283
KFNF	Henry Field Seed Co.	Shenandoah, Iowa	266
KFNG	Wooten's Radio Shop	Coldwater, Miss.	254
KFNJ	Warrensburg Electric Shop	Warrensburg, Mo.	234
KFNL	Radio Broadcast Ass'n	Paso Rohles, Calif.	240
KFNV	L. A. Drake Battery and Radio Supply Shop	Santa Rosa, Calif.	234
KFNY	Montana Phonograph Co.	Helena, Montana	261
KFNZ	Royal Radio Company	Burlingame, Calif.	231
KFOA	Rhodes Department Store	Seattle, Wash.	455
KFOC	First Christian Church	Whittier, Calif.	236
KFOD	Radio Shop	Wallace, Idaho	224
KFOJ	Moberly High School Radio Club	Moberly, Missouri	246
KFOL	Leslie M. Schafbush	Marengo, Iowa	234
KFON	Echophone Radio Shop	Long Beach, Calif.	234
KFOO	Latter Day Saints University	Salt Lake City, Utah	261
KFOP	Rohrer Elec. Co.	Mrshfield Ore.	240
KFOQ	Ora William Chancellor	Galveston, Texas	240
KFOR	David City Tire & Electric Co.	David City, Nebraska	226
KFOT	College Hill Radio Club	Wichita, Kansas	231
KFOU	Hommel Mfg. Co.	Richmond, Calif.	254
KFOX	Board of Education, Technical High School	Omahn, Nebraska	248
KFOY	Beacon Radio Service	St. Paul, Minn.	226
KFOZ	Leon Hudson Real Estate Co.	Fort Smith, Ark.	233
KFPB	Edwin J. Brown	Seattle, Wash.	224
KFPG	Garretson and Dennis	Los Angeles, Calif.	238
KFPH	Harold Chas. Mailander	Salt Lake City, Utah	242
KFPL	C. C. Baxter	Duhlin, Texas	242
KFPM	The New Furniture Co.	Greenville, Texas	242
KFPN	Missouri National Guard	Jefferson City, Mo.	242
KFPO	Colorado National Guard	Denver, Colo.	231
KFPP	G. & G. Radio & Electric Shop	Olympia, Washington	236
KFPR	Los Angeles Co. Forestry Dept.	Los Angeles, Calif.	231
KFPT	Cape & Johnson	Salt Lake City, Utah	268
KFPV	Heintz & Kohlmoos, Inc.	San Francisco, Calif.	236
KFPW	St. Johns M. E. Church	Carterville, Mo.	268
KFPX	First Presbyterian Church	Pine Bluff, Ark.	242
KFPY	Symons Investment Co.	Spokane, Wash.	283
KFQA	The Principia	St. Louis, Mo.	261
KFQB	The Searohlight Publishing Co.	Fort Worth, Tex.	254
KFQC	Kidd Brothers Radio Shop	Taft, Calif.	227
KFQD	Chovin Supply Co.	Anchorage, Alaska	280
KFQE	Dickenson-Henry Radio Laboratories	Colorado Springs, Colo.	224
KFQF	D. A. Boult	Minneapolis, Minn.	224
KFQG	Southern Calif. Radio Ass'n	Los Angeles, Calif.	226
KFQH	Radio Service Co.	Burlingame, Calif.	231
KFQI	The Thos. H. Ince Corp.	Culver City, Calif.	234
KFQJ	Harbour-Longmire Company	Oklahoma City, Okla.	236
KFQK	Democrat Leader	Fayette, Mo.	236
KFQL	Oklahoma Free State Fair Assn.	Muskogeo, Okla.	252
KFQM	Texas Highway Bulletin	Austin, Tex.	268
KFQN	Third Baptist Church	Portland, Oro.	283
KFQO	Meier Radio Shop	Russell, Kans.	261
KFQP	G. S. Carson, Jr.	Iowa City, Ia.	224
KFQR	Walter LaFayette Ellis	Oklahoma City, Okla.	250
KFQS	Dickenson-Henry Radio Lahoratories	Manitou, Colo.	246
KFQT	Texas National Guard	Denison, Texas	252
KFQU	W. Riker	Holy City, Calif.	234
KFQV	Omaha Grain Exchange (Portable)	Omaha, Nebr.	231
KFQW	C. F. Knierim	North Bend, Wash.	248
KFQX	Alfred M. Hubbard	Seattle, Wash.	233
KFQY	Farmers State Bank	Beldon, Neb.	273
KFQZ	Taft Radio Co.	Hollywood, Calif.	240
KFRI	The Reynolds Radio Co. Inc. Portable Station	Denver, Col.	224
KFRJ	Guy Simmons, Jr.,	Conway, Ark.	250
KFSG	Angelus Temple	Los Angeles, Calif.	278
KFSY	The Van Blaricon Co.	Helona, Mont.	261
KGB	Tacoma Daily Ledger	Tacoma, Wash.	252
KGG	Hallock & Watson Radio Service	Portland, Oreg.	360
KGO	General Electric Co.	Oakland, Calif.	312
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach	360
KGW	Portland Morning Oregonian	Portland, Oreg.	492
KGY	St. Martins College (Reb. Sebastian Ruth)	Lacy, Wash.	258
KHJ	Times-Mirror Co.	Los Angeles, Calif.	395
KHQ	Louis Wasmer	Seattle, Wash.	360
KJQ	C. O. Gould	Stockton, Calif.	273
KJR	Northwest Radio Service Co.	Seattle, Wash.	283
KJS	Bible Institute of Los Angeles	Los Angeles, Calif.	360
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	360
KLX	Tribune Publishing Co.	Oakland, Calif.	509
KLZ	Reynolds Radio Co.	Denver, Colo.	283
KMJ	San Joaquin Light & Power Corp.	Fresno, Calif.	248
KMO	Love Electric Co.	Tacoma, Wash.	360
KNT	Walter Hemrich	Kukah Bay, Alaska	263
KNX	Los Angeles Evening Express	Los Angoles, Calif.	337
KOB	New Mexico College of Agriculture & Mechanic Arts.	State College, N. Mex.	360
KOP	Detroit Police Department	Detroit, Mich.	286
KPO	Hale Bros.	San Francisco, Calif.	423
KQP	Apple City Radio Club	Hood River, Oreg.	360
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	270
KQW	Charles D. Herrold	San Jose, Calif.	360
KRE	V C Battery & Electric Co.	Berkeley, Calif.	275
KSD	Post Dispatch (Pulitzer Pub. Co.)	St. Louis, Mo.	546
KTW	First Presbyterian Church	Seattle, Wash.	360
KUO	Examiner Printing Co.	San Francisco, Calif.	360
KUY	Coast Radio Co.	El Monte, Calif.	256
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	360
KWH	Los Angeles Examiner	Los Angeles, Calif.	360
KYQ	Electric Shop	Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	536
KZM	Preston D. Allen	Oakland, Calif.	360
WAAB	Valdemar Jensen	New Orleans, La.	268
WAAC	Tulane University	New Orleans, La.	360
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	360
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	286
WAAM	I. R. Nelson Co.	Newark, N. J.	263
WAAN	University of Missouri	Columbia, Mo.	254
WAAW	Omaha Grain Exchange	Omaha, Nebr.	286
WABB	Harrisburg Sporting Goods Co.	Harrishurg, Pa.	266
WABD	Parker High School	Dayton, Ohio	283
WABE	Young Men's Christian Association	Washington, D. C.	283
WABH	Lake Shore Tire Co.	Sandusky, Ohio	240
WABI	Bangor Railway & Electric Co.	Bangor, Me.	240
WABL	Connecticut Agricultural College	Storrs, Conn.	283
WABM	F. A. Doherty Automotive and Radio Equipment Co.	Saginaw, Mich.	254
WABN	Ott Radio, Inc.	LaCrosse, Wis.	244
WABO	Lake Avenue Baptist Church	Rochester, N. Y.	283
WABP	Robert F. Weinig	Dover, Ohio	266
WABQ	Haverford College, Radio Club	Haverford, Pa.	261
WABR	Scott High School, N. W. B. Foley	Toledo, Ohio	270
WABU	Victor Talking Machine Co.	Camden, N. J.	226
WABW	College of Wooster	Wooster, Ohio	234
WABX	Henry B. Joy	Mt. Clemens, Mich.	270
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	263
WAHG	A. H. Grebe & Co.	Richmond Hill, N. Y.	316
WBAA	Purdue University	W. Lafayette, Ind.	283
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAN	Wireless Phone Corp.	Paterson, N. J.	244
WBAO	James Millikin University	Decatur, Ill.	360
WBAP	Wortham-Carter Publishing Co. (Star Telegram)	Fort Worth, Tex.	476
WBAV	Erner & Hopkins Co.	Columbus, Ohio	423
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	254
WBAY	Western Electric Co.	New York, N. Y.	492
WBBD	Barbey Battery Service	Reading, Pa.	234
WBBG	Irving Vermilya	Mattapoisett, Mass.	248
WBBH	J. Irving Boll	Port Huron, Mich.	246
WBBL	Grace Covenant Preshytorian Church	Richmond, Va.	283
WBBM	Frank Atlass Produce Co.	Lincoln, Ill.	226
WBBN	Blake, A. B.	Wilmington, N. C.	275
WBBP	Petoskey High School	Petoskey, Mich.	246
WBBR	Peoples Pulpit Asso.	Rossville, N. Y.	273
WBBS	First Baptist Church	New Orleans, La.	252
WBBT	Lloyd Brothers	Philadelphia, Pa.	234
WBBU	Jenks Motor Sales Co.	Monmouth, Ill.	224
WBBV	Johnstown Radio Co.	Johnstown, Pa.	245
WBBX	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Infantry Co. "B" 118th Inf.	Charleston, S. C.	268
WBBZ	Noble B. Watson	Indianapolis, Ind.	227
WBL	T & H Radio Co.	Anthony, Kans.	254
WBR	Pennsylvania State Police	Butler, Pa.	286
WBS	D. W. May, Inc.	Newark, N. J.	260
WBT	Southern Radio Corp.	Charlotte, N. C.	360
WBZ	Westinghouse E. & M. Co.	Springfield, Mass.	337
WCAD	St. Lawrence University	Canton, N. Y.	280
WCAE	Kaufmann & Baer Co.	Pittsburgh, Pa.	462
WCAG	Clydo R. Randall	New Orleans, La.	268
WCAH	Entrekin Electric Co.	Columbus, Ohio	286
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	283
WCAK	Alfred P. Daniel	Houston, Texas	263
WCAL	St. Olaf College	Northfield, Minn.	360
WCAO	Sanders & Stayman Co.	Baltimore, Md.	360
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C.	469
WCAR	Alamo Radio Elcctric Co	San Antonio, Tex.	360
WCAS	W. H. Dunwoody Industrial Institute	Minneapolis, Minn.	280
WCAT	State College of Mines	Rapid City, S. Dak.	240
WCAU	Durham & Co.	Philadelphia, Pa.	286
WCAV	J. C. Dico Electric Co.	Little Rock, Ark.	360
WCAX	University of Vermont	Burlington, Vt.	360
WCAZ	Carthage College	Carthage, Ill.	246
WCBA	Charles W. Hcimbach	Allentown, Pa.	280
WCBC	University of Michigan	Ann Arbor, Mich.	280

CLASSIFIED ADVERTISEMENTS

Don't overlook the value of RADIO AGE'S classified advertisements. Many such messages have paved the way to independent incomes.

The classified advertising rates are but ten cents per word for a single insertion. Liberal discounts are allowed on three, six and twelve -time insertions, of five, fifteen and thirty per cent, respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates and no advertisement of less han ten words will be accepted.

RADIO SALESMEN WANTED—Make $50.00 weekly selling standard, well advertised radio sets and parts. No investment required. Write for free outfit. Desk 27, WAVELAND RADIO COMPANY, 1027 N. State St., Chicago.

FOR SALE

Silver Wire—Most perfect Conductor known. No Loss of Current. Easy to Solder. In 25-foot Coils. Per Coil $1.25. Aragon Radio Co., 222 N. State St., Chicago.

RADIO JOBS

If you want to turn your knowledge of radio into dollars, insert an ad in the classified section of RADIO AGE at 10 cents a word. You will find that manufacturers and radio dealers are looking for radio men like you.

RADIO CIRCUITS

SPECIAL FOR DECEMBER

The Reinartz Radio Booklet, by Frank D. Pearne, fully illustrated, and RADIO AGE, for $2.50. Price of booklet alone is 50c. Send check, currency or money order to RADIO AGE, 500 N. Dearborn Street, Chicago.

MISCELLANEOUS

158 Genuine Foreign Stamps. Mexico War Issues. Venezuela, Salvador and India Service. Guatemala, China, etc., only 5c. Finest approval sheets, 50 to 60 percent. Agents Wanted. Big 72-p. Lists Free. We Buy Stamps. Established 20 Years. Hussman Stamp Co., Dept. 152, St. Louis, Mo.

AGENTS

Do you want to earn money in your spare time? We have a wonderful offer to make ambitious men and women; no previous experience necessary; no money required; write today for plans. American Products Co., 2131 American Bldg., Cincinnati, Ohio.

CASH IN ON RADIO! Build and sell sets for us. No trouble to earn $5 an hour in spare time at home. Auburn Radio Co., Dept. N, Cincinnati, O.

AGENTS

90c an hour to advertise and distribute samples to consumer. Write quick for territory and particulars. American Products Co., 2130 American Building, Cincinnati, Ohio.

Man wanted for this territory to sell wonderful value men's, women's, Children's shoes direct, saving consumer over 40%. Experience unnecessary Samples supplied. Big weekly permanent income Write today Tanners Mfg. Co., 1334 C. St., Boston, Mass

BUSINESS OPPORTUNITIES

DEALERS—Write for our illustrated catalog of reliable Radio Merchandise. Rosaiter-Manning Corporation, Dept. D, 1830 Wilson Ave., Chicago, Ill.

WANTED:—A Chicago organization desires radio proposition of merit from manufacturers, that should prove profitable sellers, direct to the consumer or from jobbing standpoint. Merchandise of established trade name considered, but propositions providing for the use of our own trade name preferred. Give full details first letter. Address Box 112, RADIO AGE, 500 N. Dearborn St., Chicago, Ill.

FOR SALE

BLUEPRINTS—Make your own set from proven original and up-to-the minute blueprints. The following are merely three of a choice of almost one hundred different types:

HT-1-3—Five tube neutrodyne—50c.
FB-6—Three-honeycomb regenerative—35c.
D10-4—Diode single circuit—25c.
All three of above, for $1.00.

These tested blueprints are all made up in easily read circuit drawings. MIDLAND PRODUCTS COMPANY, 1413 Hood Ave., Chicago, Ill. Ask for our complete list, No. R11.

100 VOLT EDISON TYPE "B" BATTERY, knocked down. Parts and plans—complete, $12.50. Lane Mfg., 2937 W. Lake, Chicago.

Classified ad copy for the January issue must reach RADIO AGE not later than November 25.

Marv-O-Dyne R. F. Circuit

The Marv-O-Dyne incorporates two special unique features, one known as the Fil-A-Meter, which permits keeping under control through the use of a Weston Meter, the amount of filament voltage required.

There are but three tuning dials on the receiver, and because of the accurate design of the radio frequency coupling coils, these dials can be calibrated, and are so matched that all three dial settings correspond in setting for a given wavelength. This is of value to the layman, who need know nothing of tuning to enable him to obtain distance reception practically the first night he operates the set.

The very fine selectivity obtained with the set is due in a large part to the design of the inter-tube coupling coils. These are especially wound by machine in the familiar spider web form, said to be the most efficient type of winding, with a capacity far below other winding methods.

Tested and Approved by RADIO AGE

WCBD	Wilbur G. Voliva	Zion, Ill.	345
WCBE	Uhalt Radio Co.	New Orleans, La.	263
WCBF	Paul J. Miller	Pittsburgh, Pa.	236
WCBG	Howard S. Williams (Portable)	Pascagoula, Miss.	268
WCBH	University of Miss.	Oxford, Miss.	242
WCBI	Nicoll, Duncan & Rush	Bemis, Tennessee	240
WCBJ	J. C. Maus	Jennings, Louisiana	244
WCBK	E. Richard Hall	St. Petersburg, Fla.	266
WCBL	Northern Radio Mfg. Co.	Houlton, Me.	280
WCBM	Charles Swarz	Baltimore, Md.	229
WCBN	James P. Boland	Ft. Benj. Harrison, Ind.	266
WCBO	The Radio Shop, Inc.	Memphis, Tenn.	250
WCBQ	First Baptist Church	Nashville, Tenn.	236
WCBR	C. H. Messter	Providence, R. I.	246
WCBT	Clark University, Collegiate Dept.	Worcester, Mass.	238
WCBU	Arnold Wireless Supply Co.	Arnold, Pa.	254
WCBV	Tullahoma Radio Club	Tullahoma, Tenn.	252
WCBW	George P. Rankin, Jr., and Maitland Solomon	Macon, Ga.	226
WCBX	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	233
WCBY	The Forks Electrical Shop	Buck Hill Falls, Pa.	268
WCBZ	Coppotelli Bros. Music House	Chicago Heights, Ill.	248
WCCO	Washburn-Crosby Co.	Twin Cities, Minn.	417
WCK	Stix-Baer Fuller D. G. Co.	St. Louis, Mo.	360
WCX	Free Press	Detroit, Mich.	517
WDAE	Tampa Daily Times	Tampa, Fla.	360
WDAF	Kansas City Star	Kansas City, Mo.	411
WDAG	J. Laurence Martin	Amarillo, Tex.	263
WDAH	Trinity Methodist Church (South)	El Paso, Tex.	268
WDAR	Lit Brothers	Philadelphia, Pa.	395
WDAS	Samuel A. Waite	Worcester, Mass.	360
WDAU	Slocum Kilburn	New Bedford, Mass.	360
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	244
WDBA	Fred Ray	Columbus, Ga.	236
WDBB	A. H. Waite & Co., Inc.	Taunton, Mass.	229
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WDBD	Herman Edwin Burns	Martinsburg, W. Va.	268
WDBF	Robert G. Phillips	Youngstown, Ohio	246
WDBH	C. T. Scherer Co.	Worcester, Mass.	268
WDBI	Radio Specialty Co.	St. Petersburg, Fla.	226
WDBJ	Richardson Wayland Electric Corp.	Roanoke, Va.	229
WDBL	Wisc. Dept. of Markets	Stevens Point, Wis.	278
WDBN	Electric Light & Power Co.	Bangor, Me.	252
WDBO	Rollins College Inc.	Winter Park, Fla.	240
WDBP	Superior State Normal School	Superior, Wis.	261
WDBQ	Morton Radio Supply Co.	Salem, N. J.	234
WDBR	Tremont Temple Baptist Church	Boston, Mass.	256
WDBS	S. M. K. Radio Corp.	Dayton, Ohio	283
WDBT	Taylor's Book Store	Hattiesburg, Miss.	236
WDBU	Somerset Radio Co.	Skowhegan, Maine	258
WDBV	The Strand Theatre	Fort Wayne, Ind.	258
WDBW	The Radio Den	Columbia, Tenn.	268
WDBX	Otto Baur	New York, N. Y.	233
WDBY	North Shore Congregational Church	Chicago, Ill.	258
WDBZ	Boy Scouts, City Hall	Kingstown, N. Y.	233
WDM	Church of the Covenant	Washington, D. C.	234
WDZ	J. L. Bush	Tuscola, Ill.	278
WEAA	F. D. Fallain	Flint, Mich.	250
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	492
WEAH	Wichita Board of Trade	Wichita, Kans.	280
WEAI	Cornell University	Ithaca, N. Y.	286
WEAJ	University of South Dakota	Vermillon, S. Dak.	283
WEAM	Borough of North Plainfield (W. Gibson Buttfield)	North Plainfield, N. J	286
WEAN	Shepard Co.	Providence, R. I.	273
WEAO	Ohio State University	Columbus, Ohio	360
WEAP	Mobile Radio Co.	Mobile, Ala.	360
WEAR	The Evening News Publishing Co.	Baltimore, Md.	261
WEAU	Davidson Bros. Co.	Sioux City, Iowa	275
WEAY	Iris Theatre (Will Horowitz, Jr.)	Houston, Texas	360
WEB	Benwood Co.	St. Louis, Mo.	273
WEBA	Electric Shop	Highland Park, N. J.	233
WEBC	Walter Cecil Bridges	Superior, Wis.	242
WEBD	Electrical Equipment and Service Co.	Anderson, Ind.	246
WEBE	Roy W. Walker	Cambridge, Ohio	248
WEBH	Edgewater Beach Broadcasting Station	Chicago, Ill.	370
WEBI	Walter H. Gibbons	Salisbury, Md.	242
WEBJ	Third Avenue Railway Co.	New York, N. Y.	273
WEBP	E. B. Pedicord	New Orleans, La.	280
WEBT	The Dayton Coop. Industrial High School	Dayton, Ohio	270
WEBU	DeLand Piano & Music Co., 139 Boulevard St.	DeLand, Fla.	258
WEBW	Beloit College	Beloit, Wisc.	283
WEBX	John E. Cain, Jr.	Nashville, Tenn.	263
WEBY	Hobart Radio Co.	Roslindale, Mass.	226
WEEI	The Edison Electric Illuminating Co.	Boston, Mass.	303
WEV	Hulbert-Still Elec. Co.	Houston, Tex.	263
WEW	St. Louis University	St. Louis, Mo.	280
WFAA	Dallas News & Dallas Journal	Dallas, Texas	476
WFAB	Carl F. Woese	Syracuse, N. Y.	234
WFAM	Times Publishing Co.	St. Cloud, Minn.	273
WFAN	Hutchinson Electric Service Co.	Hutchinson, Minn.	286
WFAV	University of Nebraska, Department of Electrical Engioeering.	Lincoln, Nebr.	275
WFBB	Eureka College	Eureka, Ill.	240
WFBG	The Wm. F. Cable Co.	Altoona, Pa.	261
WFBH	Concourse Radio Corporation	New York, N. Y.	273
WFBJ	St. John's University	Collegeville, Minn.	236
WFBW	Ainsworth-Gates Radio Co.	Cincinnati, Ohio	309
WFI	Strawbridge and Clothier	Philadelphia, Pa.	395
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa.	248
WGAN	Cecil E. Lloyd	Pensacola, Fla.	360
WGAQ	Youree Hotel	Shreveport, La.	252
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGI	American R. & R. Co.	Medford Hillside, Mass.	360
WGL	Thos. L. J. Howlett	Philadelphia, Pa.	360
WGN	The Tribune Co.	Chicago, Ill.	370
WGR	Federal T. and T. Co.	Buffalo, N. Y.	319
WGY	General Elec. Co.	Schenectady, N. Y.	380
WHA	University of Wisconsin	Madison, Wis.	275
WHAA	State University of Iowa	Iowa City, Iowa	484
WHAD	Marquette University	Milwaukee, Wis.	280
WHAG	University of Cincinnati	Cincinnati, Ohio	222
WHAH	Hafer Supply Co.	Joplin, Mo.	283
WHAK	Roberts Hardware Co.	Clarksburg, W. Va.	258
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y.	283
WHAR	SeasideHouse	Atlantic City, N. J.	275
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	360
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	380
WHB	Sweeney School Co.	Kansas City, Mo.	411
WHK	Radiovox Company	Cleveland, Ohio	283
WHN	George Schubel	New York, N. Y.	360
WHO	Bankers Life Co.	Des Moines, Ia.	526
WIAB	Joslyn Automobile Co.	Rockford, Ill.	252
WIAC	Galveston Tribune	Galveston, Texas	360
WIAD	Howard R. Miller	Philadelphia, Pa.	254
WIAK	Journal-Stockman Co.	Omaha, Nebr.	278
WIAQ	Chronicle Publishing Co.	Marion, Ind.	226
WIAS	Homo Electric Co.	Burlington, Iowa	283
WIK	K. & L. Co.	McKeesport, Pa.	234
WIL	Continental Electric Supply Co.	Washington, D. C.	360
WIP	Gimbel Bros.	Philadelphia, Pa.	509
WJAB	American Electric Co.	Lincoln, Neb.	229
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	360
WJAG	Norfolk Daily News	Norfolk, Nebr.	283
WJAK	Clifford L. White	Greentown, Ia.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAN	Peoria Star	Peoria, Ill.	280
WJAR	The Outlook Co. (J. Samuels & Bro.)	Providence, R. I.	360
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	286
WJAX	Union Trust Co.	Cleveland, Ohio	390
WJAZ	Chicago Radio Laboratory	Chicago, Ill.	268
WJD	Denison University	Grantville, Ohio	229
WJJD	Supreme Lodge, Loyal Order of Moose	Mooseheart, Ill.	278
WJY	Radio Corp. of Ama.	New York, N. Y.	405
WJZ	Radio Corp. of Ama.	New York, N. Y.	455
WKAA	H. F. Paar	Cedar Rapids, Iowa	278
WKAD	Chas. Looff (Crescent Park)	East Providence, R. I.	240
WKAF	W. S. Radio Supply Co.	Wichita Falls, Texas	360
WKAN	United Battery Service Co.	Montgomery, Ala.	226
WKAP	Dutee W. Flint	Cranston, R. I.	360
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	360
WKAR	Michigan Agriculture College	East Lansing, Mich.	280
WKAV	Laconia Radio Club	Laconia, N. H.	254
WKBF	Duteo Wilcox Flint	Cransten, Rhode Island	286
WKY	Wky Radio shop	Okla City, Okla.	360
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn.	417
WLAH	Samuel Woodworth	Syracuse, N. Y.	234
WLAL	Naylor Electrical Co.	Tulsa, Okla.	360
WLAP	Wm. V. Jordan	Louisville, Ky.	286
WLAQ	Arthur E. Shilling	Kalamazoo, Mich.	283
WLAW	Police Dept., City of New York	New York, N. Y.	360
WLAX	Putnam Electric Co.	Greencastle, Ind.	231
WLB	University of Minnesota	Minneapols, Minn.	360
WLBL	Wisconsin State Dept. of Markets	Stevenspoint, Wis.	278
WLS	Sears Roebuck & Co.	Chicago, Ill.	345
WLW	Crosley Mfg. Co.	Cincinnati, Ohio	423
WMAC	J. Edw. Page (Olive B. Meredith)	Cazenovia, N. Y.	261
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	360
WMAH	General Supply Co.	Lincoln, Nebr.	254
WMAK	Norton Laboratories	Lockport, N. Y.	273
WMAL	Trenton Hardware Co.	Trenton, N. J.	256
WMAN	First Baptist Church	Columbus, Ohio	286
WMAQ	Chicago Daily News	Chicago, Ill.	448
WMAV	Alabama Polytechnic Institute	Auburn, Ala.	250
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	280
WMAZ	Mercer University	Macon, Ga.	261
WMC	Commercial Appeal	Memphis, Tenn.	500
WMU	Doubledal-Hill Elec. Co.	Washington, D. C.	261
WNAC	Shepard Stores	Boston, Mass.	278
WNAD	University of Oklahoma	Norman, Okla.	254
WNAL	Omaha Central High School	Omaha, Nebr.	258
WNAP	Wittenberg College	Springfield, Ohio	275
WNAR	First Christian Church	Butler, Mo.	231
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa.	360
WNAW	Peninsular Radio Club (Henry Kunzmann)	Fort Monroe, Va.	360
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNYC	Dept. of Plant and Structures	New York, N. Y.	526
WOAC	Page Organ Co.	Lima, Ohio	266
WOAE	Midland College	Fremont, Nebr.	280
WOAF	Tyler Commercial College	Tyler, Texas	360
WOAG	Apollo Theater (Belvidere Amusement Co.)	Belvidere, Ill.	273
WOAI	Southern Equipment Co.	San Antonio, Texas	385
WOAN	Vaughn Conservatory of Music (James D. Vaughn)	Lawrenceburg, Tenn.	360
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	360
WOAR	Lundskow, Henry P.	Kenosha, Wis.	229
WOAT	Boyd M. Hamp	Wilmington, Del.	360
WOAV	Pennsylvania National Guard, 2d Battalion, 112th Infantry	Erie, Pa.	242
WOAW	Woodmen of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Ia.	484
WOI	Iowa State College	Ames, Ia.	360
WOO	John Wanamaker	Philadelphia, Pa.	509
WOQ	Western Radio Co.	Kansas City, Mo.	360
WOR	L. Bamberger and Co.	Newark, N. J.	405
WOS	State Marketing Bureau	Jefferson City, Mo.	441
WPAB	Pennsylvania State College	State College, Pa.	283
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	360
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College	Agricultural College, N. D.	283
WPAL	Superior Radio & Telephone Equipment Co.	Columbus, Ohio	286
WPAM	Auerbach and Guettel	Topeka, Kan.	275
WPAR	Ward Battery and RadioCo.	Beloit, Kans.	236
WPAU	Concordia College	Moorhead, Minn.	286
WPAZ	John R. Koch (Dr.)	Charleston, W. Va.	273
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	360
WQAC	E. B. Gish	Amarillo, Texas	234
WQAE	Moore Radio News Station (Edmund B. Moore)	Springfield, Vt.	275
WQAF	Sandusky Register	Sandusky, Ohio	240
WQAM	Electrical Equipment Co.	Miami, Fla.	283
WQAN	Scranton Times	Scranton, Pa.	280
WQAO	Calvary Baptist Church	New York, N. Y.	360
WQAQ	Abilene Daily Reporter (West Texas Radio Co.)	Abilene, Texas	360
WQAS	Prince-Walter Co.	Lowell, Mass.	266
WQAX	Radio Equipment Company	Peoria, Ill.	248
WQJ	Calumet Rainbo Broadcasting Co.	Chicago, Ill.	448
WRAF	The Radio Club (Inc.)	Laporte, Ind.	224
WRAL	Northern States Power Co.	St. Croix Falls, Wis.	248
WRAM	Lombard College	Galesburg, Ill.	244
WRAN	Black Hawk Electrical Co.	Waterloo, Iowa	236
WRAO	Radio Service Co.	St. Louis, Mo.	360
WRAV	Antioch College	Yellow Springs, Ohio	242
WRAW	Avenue Radio Shop (Horace D. Good)	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRBC	Imanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corp. of Ama.	Washington, D. C.	469
WRK	Doron Bros.	Hamilton, Ohio	360
WRL	Union College	Schenectady, N. Y.	360
WRM	University of Illinois	Urbana, Ill.	360
WRR	Police and Fire Signal Department	Dallas, Tex.	360
WRW	Tarrytown Radio Res. Labs.	Tarrytown, N. Y.	273
WSAB	Southeast Missouri State Teachers College	Cape Girardeau, Mo.	360
WSAC	Clemson Agricultural College	Clemson College, S. C.	360
WSAD	J. A. Foster Co.	Providence, R. I.	261
WSAI	United States Playing Cards Co.	Cincinnati, Ohio	309
WSAJ	Grove City College	Grove City, Pa.	258
WSAP	Seventh Day Advontist Church	New York, N. Y.	263
WSAR	Doughty & Welch Electrical Co.	Fall River, Mass.	254
WSAU	Camp Marienfeld	Chesham, N. H.	229
WSAV	C. W. Vick Radio Construction Co.	Houston, Tex.	360
WSAY	Irving Austin (Port Chester Chamber of Commerce)	Port Chester, N. Y.	233
WSAZ	Chas. Electric Shop	Pomeroy, Ohio	258
WSB	Atlanta Journal	Atlanta, Ga.	429
WSL	J. and M. Elec. Co.	Utica, N. Y.	273
WSOE	School of Engineering	Milwaukee, Wis.	246
WSY	Alabama Power Co.	Birmingham, Ala.	360
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	248
WTAC	Penn Traffic Co.	Johnstown, Pa.	360
WTAF	Louis J. Gallo	New Orleans, La.	242
WTAJ	The Radio Shop	Portland, Me.	230
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	390
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gordon & Son	Osseo, Wis.	220
WTAR	Reliance Eectric Co.	Norfolk, Va.	280
WTAS	Charles E. Erbstein	Elgin, Ill.	286
WTAT	Edison Electric Illuminating Co.	Boston, Mass. (portable)	244
WTAU	Ruegg Battery & Electric Co.	Tecumseh, Nebr.	242
WTAW	Agricultural & Mechanical College of Texas	College Station, Tex	280
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAY	Oak Leaves Broadcasting Station	Oak Park, Ill.	283
WTAZ	Thomas J. McGuiro	Lambertville, N. J.	283
WTG	Kansas State Agricultural College	Manhattan, Kans.	273
WTX	H. G. Saal Co.	Chicago, Ill.	268
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	360
WWAE	The Alamo Ball Room	Joliet, Ill.	242
WWI	Ford Motor Co.	Dearborn, Mich.	273
WWJ	Detroit News (Evening News Assn.)	Detroit, Mich.	517
WWL	Loyola University	New Orleans, La.	260
WWOA	Michigan College of Mines	Houghton, Mich.	244

Angling for Long Distance with a DX-Catcher

(Continued from page 23)

finish on; cut it, leaving an end of about six inches. Then start another coil of the same type, winding 10 turns. The 50 turn coil is the secondary while the 10 turn coil is the antenna coupling inductance. The ends of these coils are shown at A and B (primary terminals) and C and D (secondary terminals). Their connection can be easily traced in both perspective and circuit diagrams.

Now we want these coils to be absolutely perfect, so get one of the condensers out (the variable ones,) and put a dial on the shaft. Connect the ends of the 10 turn coil to the antenna and ground, and the secondary wires to the terminals of the variable condenser. Now connect a crystal detector and a pair of phones in series, and shunt them across the variable condenser. Tune in a signal, and look up the wave-length. Then remove turns from the secondary coil until a 500 meter station comes in at about 76 on the condenser dial (which should be set at zero when all the plates are out of engagement). A 360 meter station should come in at about 35 on the dial and if you hear about a 400 meter station, it should come in from 48 to 52. This applies to a dial that has readings from 0 to 100. Other dials are proportionate with regard to the setting. By this method you can make your condenser dial to cover the reading of from 220 meters up to 550 without the trouble of not being able to hear the low or high wave fellows. The secret lies in juggling the number of turns on the secondary coil until it suits your condenser. Remember, it is always best to not use the last first or last five degrees on the dial, for logging purposes.

When you have found the right number of turns, tie up the coils firmly but not too tightly. I find that tieing it in about 5 places keeps it together until I can weave it. The weaving consists of threading the string in and out of the humps formed by the wire bent around the rods, and tying the ends. You can get an idea of what is meant by referring to the perspective sketch, where you will notice the zig-zag effect the string has on the coil appearance. The primary (shown in darker lines) is tied together with the secondary.

USING the same system and same size wire as the coupler, you next wind the plate coil, and proportion the size by the same procedure. If you do this, you can make the anode condenser and secondary condenser read alike.

The feedback coil is wound on a similar form, which can be made easily. I drove 17 finishing nails through a 1-inch board in a circle having a 2½ inch in diameter, the 17 nails being set at even intervals along the circumference of the circle. This feedback coil should have about 35 turns of number 20 DCC or DSC wire to start with. Its final number of turns is determined by actual trial and it varies greatly with different tubes. I found that using one tube as detector

(Continued on page 79)

End your Radio Troubles for 30c in Stamps

We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed hookups to be found in these issues. Select the ones you want and enclose 30c in stamps for each desired. The supply is getting low, so enrich your store of radio knowledge by laying in an ample stock of copies NOW!

May, 1922
—How to make a simple Crystal Set for $6.

September, 1922
—How to make a Regenerative Set at a low cost.

October, 1922
—How to make a Tube Unit for $23 to $37.
—How to make an Audio Frequency Amplifying Transformer.

November, 1922
—Design of a portable short-wave radio wavemeter.

May, 1923
—How to make a portable Reinartz set for summer use.

June, 1923
—How to build the new Kaufman receiver.
—What about your antenna?

December, 1923
—Building the Haynes Receiver.
—Combined Amplifier and Loud Speaker.
—A selective Crystal Receiver.

January, 1924
—Tuning Out Interference—Wave Traps—Eliminators
—Filters.
—A Junior Super-Heterodyne.
—Push-Pull Amplifier.
—Rosenhloom Circuit.

February, 1924
—How to make a battery charger.
—Single Tube Heterodyne.
—Adding two audio stages to selective receiver which began as a crystal set.
—Superdyne receiver.

March, 1924
—An Eight-Tube Super-Heterodyne.
—A simple, low loss tuner.
—A Tuned Radio Frequency Amplifier.
—Simple Reflex Set.

April, 1924
—An Efficient Super-Heterodyne (fully illustrated).
—A Ten-Dollar Receiver.
—Anti-Body Capacity Hookups.
—Reflexing the Three-Circuit Tuner.
—Index and first two installments of Radio Age Data Sheets.

May, 1924
—Construction of a Simple Portable Set.
—Radio Panels.
—Third Installment of Radio Age Data Sheets.

June, 1924
—Important Factors in Constructing a Super-Heterodyne.
—A Universal Amplifier.
—A Sure Fire Reflex Set.
—Adding Radio and Audio to Baby Heterodyne.
—Radio Age Data Sheets.

July, 1924
—A Portable Tuned Impedance Reflex.
—Operating Detector Tube by Grid Bias.
—A Three-Tube Wizard Circuit.
—Data Sheets.

August, 1924
—Breaking Into Radio Without a Diagram.
—The English 4-Element Tube.
—Filtered Heterodyne Audio Stages.
—An Audio Amplifier Without an "A" Battery.
—Data Sheets.

September, 1924
—How Careful Mounting Will Improve Reception.
—One Tuning Control for Hair's Breadth Selectivity.
—Four Pages of Real Blueprints of a New Baby Heterodyne and an Aperiodic Variometer Set.
—Data Sheets.

October, 1924
—An Easily Made Super-Het.
—Two Radio and Two Audio for Clear Tone.
—A Simple Regenerative Set.
—The Ultradyne for Real DX.
—Real Blueprints of a 3-Tube Neutrodyne and a Midget Reflex Set.

November, 1924
—Blueprints of a Single Tube Loop Set and a capacity Feedback Receiver.
—A 3-Tube Low Loss Regenerator.
—Mastering the 3-Circuit Tuner.

RADIO AGE, Inc. 500 N. Dearborn St., Chicago

THE RADIO AGE BUYERS' SERVICE

What do you want to purchase in the radio line? Let the staff of RADIO AGE save you time and money by sending in the coupon below. Enter the number of the article you would like to know more about in the spaces provided in the coupon.

1 "A" Batteries
2 Aerial protectors
3 Aerial insulators
4 Aerials
5 Aerials, loop
6 Amplifiers
7 Amplifying units
8 Ammeters
9 "B" batteries
10 Batteries (state voltage)
11 Batteries, dry cell
12 Batteries, storage
13 Battery chargers
14 Battery clips
15 Battery plates
16 Battery substitutes
17 Bezels
18 Binding posts
19 Binding posts, insulated
20 Books
21 Boxes, battery
22 Boxes, grounding
23 Bridges, wheatstone
24 Broadcasting equipment
25 Bushings
26 Buzzers
27 Cabinets
28 Cabinets, battery
29 Cabinets, loud speaker
30 Carbons, battery
31 Cat whiskers
32 Code practisers
33 Coils
34 Coils, choke
35 Coils, coupling
36 Coils, filter
37 Coils, grid
38 Coils, honeycomb
39 Coils, inductance
40 Coils, Reinartz
41 Coils, stabilizer
42 Coils, tuning
43 Condenser parts
44 Condenser plates
45 Condensers, antenna coupling
46 Condensers, by-pass
47 Condensers, coupling
48 Condensers, filter
49 Condensers, fixed (paper, grid, or phone)
50 Condensers, variable grid
51 Condensers, variable mica
52 Condensers, vernier
53 Contact points
54 Contacts, switch
55 Cord tips
56 Cords, for head sets
57 Couplers, loose
58 Couplers, molded
59 Couplers, vario
60 Crystal alloy
61 Crystal holders
62 Crystals, rough
63 Crystals, mineral
64 Crystals, synthetic
65 Crystals, unmounted
66 Crystals, mounted
67 Desks, radio
68 Detector units
69 Detectors, crystal
70 Detectors, fixed crystal
71 Dial, adjusters
72 Dials, composition
73 Dials, hard rubber
74 Dials, rheostat
75 Dials, metal
76 Dials, vernier
77 Dials with knobs
78 Dies
79 Drills, electric
80 Dry cells
81 Earth grounds
82 Electrolyte
83 Enamels, battery
84 Enamels, metal
85 End stops
86 Eyelets
87 Experimental work
88 Fibre sheet, vulcanized
89 Filter reactors
90 Fixtures
91 Fuse cut outs
92 Fuses, tube
93 Generators, high frequency
94 Grid choppers, rotary
95 Grid leak holders
96 Grid, transmitting leaks
97 Grid leaks, tube
98 Grid leaks, variable
99 Grinders, electric
100 Ground clamps
101 Ground rods
102 Handles, switch
103 Head bands
104 Head phones
105 Head sets
106 Honeycomb coil adapters
107 Hook ups
108 Horns, composition
109 Horns, fibre
110 Horns, mache
111 Horns, metal
112 Horns, wooden
113 Hydrometers
114 Indicators, polarity
115 Inductances, C. W.
116 Insulation, molded
117 Insulation material
118 Insulators, aerial
119 Insulators, composition
120 Insulators, fibre
121 Insulators, high voltage
122 Insulators, cloth
123 Insulators, glass
124 Insulators, hard rubber
125 Insulators, porcelain
126 Irons, soldering
127 Jacks
128 Filament control
129 Jars, battery
130 Keys, transmitting
131 Knobs
132 Knock-down panel units
133 Laboratories, testing
134 Lever, switch
135 Lightning arresters
136 Loosecouplers
137 Loud speakers
138 Loud speaker units
139 Lugs, battery
140 Lugs, terminal
141 Measuring instruments
142 Megohmeters
143 Meters, A. C.
144 Meters, D. C.
145 Mica
146 Mica sheets
147 Milliammeters
148 Minerals
149 Molded insulation
150 Molybdenum
151 Mountings, coil
152 Mountings, condenser leak
153 Mountings, end
154 Mountings, grid leak
155 Mountings, honeycomb coil
156 Mountings, inductance switch
157 Name plates
158 Neutrodyne set parts
159 Nuts
160 Ohmeters
161 Oscillators
162 Panel cutting and drilling
163 Panels, drilled and undrilled
164 Panels, fibre
165 Panels, hard rubber
166 Parts
167 Paste, soldering
168 Patent attorneys
169 Phone connectors, multiple
170 Phonograph adapters
171 Plates, condenser
172 Plugs, coil
173 Plugs, telephone
174 Pointers, dial and knob
175 Poles, aerial
176 Potentiometers
177 Punching machines
178 Reinartz set parts
179 Regenerative set parts
180 Receiver caps
181 Rectifiers, battery
182 Resistance leaks
183 Resistance units
184 Rheostat bases
185 Rheostat strips
186 Rheostats, automatic
187 Rheostats, battery
188 Rheostats, dial
189 Rheostats, filament
190 Rheostats, potentiometer
191 Rheostats, power
192 Rheostats, vernier
193 Rods, ground
194 Rotors
195 Scrapers, wire
196 Screw drivers
197 Screws
198 Schools, radio
199 Sets, receiving—cabinet
200 Sets, receiving—crystal
201 Sets, receiving—knock-down
202 Sets, receiving — Neutrodyne
203 Sets, receiving—portable
204 Sets, receiving—radio frequency
205 Sets, receiving—reflex
206 Sets, receiving—regenerative
207 Sets, receiving—Reinartz
208 Sets, receiving—sectional
209 Sets, receiving—short wave
210 Sets, receiving—super-regenerative
211 Sets, transmitting
212 Slate
213 Shellac
214 Sliders
215 Socket adapters
216 Sockets.
217 Solder
218 Soldering irons, electric
219 Soldering paste
220 Solder flux
221 Solder salts
222 Solder solution
223 Spaghetti tubing
224 Spark coils
225 Spark gaps
226 Stampings
227 Stators
228 Stop points
229 Switch arms
230 Switch levers
231 Switch points
232 Switch stops
233 Switches, aerial
234 Switches, battery
235 Switches, filament
236 Switches, ground
237 Switches, inductance
238 Switches, panel
239 Switches, single and double throw
240 Tone wheels
241 Towers, aerial
242 Transformers, audio frequency
243 Transformers, filament
244 Transformers, modulation
245 Transformers, power
246 Transformers, push-pull
247 Transformers, radio frequency
248 Transformers, variable
249 Transmitters
250 Tubes, vaccuum—peanut
251 Tubes, vacuum—two element
252 Tubes, vacuum—three element
253 Tuners
254 Variocouplers, hard rubber
255 Variocouplers, molded
256 Variocouplers, wooden
257 Variometers, hard rubber
258 Variometers, molded
259 Variometers, woodcn
260 Varnish, insulating
261 Voltmeters
262 Washers
263 Wave meters
264 Wave traps
265 Wire, aerial
266 Wire, braided and stranded
267 Wire, copper
268 Wire, insulated
269 Wire, Litz
270 Wire, magnet
271 Wire, platinum
272 Wire, tungsten

RADIO AGE BUYERS' SERVICE, 500 N. Dearborn St., Chicago, Ill.
Please see that I am supplied with buying specifications and prices on the articles numbered herewith:

150														

I am a— ☐ Dealer ☐ Jobber ☐ Mfgrs.' Rep. ☐ Manufacturer

Firm [If identified with Radio industry] .....

My Occupation ..... My Name .....

Address ..... City ....., State .....

The Stars Are Your Radio Pilot

WHEN the mariner or the forest ranger loses all other means of directing his way, he may always turn to the stars as a never-failing guide.

The stars included in many of the advertisements in this issue of RADIO AGE may just as certainly be followed by the buyer of radio products. Sometimes he has been confused by the variety of sets and parts offered, and it is regrettable that he has often been misled into purchasing inferior apparatus.

Whenever an asterisk is used the reader may accept it as evidence that experts associated with the RADIO AGE Institute have tested the merchandise offered and found it to be good. *Apparatus not passing these tests will not be approved and advertising exploiting such apparatus will not be accepted by RADIO AGE.*

In those instances where the asterisk does not appear in advertisements, it is to be understood by the reader that the products therein described have not as yet been submitted for laboratory tests, or that such tests have not been completed. The presence of any advertisement is evidence of the fact that RADIO AGE has confidence in the maker of the goods.

Wherever the asterisk appears, it means that the manufacturer is entitled to use our official approval seal and that his goods have been

Tested and Approved by RADIO AGE.

the set would oscillate nicely with only 23 turns as a feedback coil, while again another tube of the same make requires 34 turns on the same form.

All coils are wound in a clockwise direction.

The feedback coil mounting is accomplished by using a standard variocoupler shaft in connection with a hard rubber block drilled to fit the shaft. The little illustration on the accompanying sheet shows the mechanical detail of the arrangement. The block with the shaft hole drilled through it is screwed to the panel.

After determining just how far the shaft is to protrude outside of the panel, it is marked with a file at the point where it comes out of the rubber block. A groove, deep enough to accommodate a turn of stiff brass wire is filed in the shaft, and after the wire is firmly single turned in the groove, it is made fast to the rubber block with screws. This keeps the shaft at the right distance.

The other coils are mounted with pegs and strings, as shown, and are virtually hung in air. And it certainly makes them low loss.

The remainder of the circuit is standard. All you have to do is to follow the circuit, exercise a little ingenuity if need be, and then get results.

I did. The first week I had it up, I heard Oakland, California (KGO) four consecutive nights, while WSAI was going full blast just 3 meters away. And I live in Chicago.

KYW, RADIO AGE, JAZZ!

All three will collaborate on Radio Age's Congress Hotel Carnival from KYW December 6 at midnight. Tune in on 536 meters for this Frolicsome Jazz Party.

DEVICES

displaying this seal have been tested and approved by the RADIO AGE INSTITUTE.

The apparatus illustrated and described below have successfully passed our tests for December, 1924.

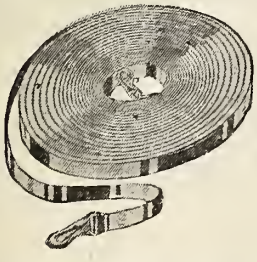
RADIO AGE INSTITUTE — TESTED AND APPROVED BY RADIO AGE — TEST NUMBER — SEAL OF APPROVAL

Radio Age Institute

Manufacturers' Testing Service

MEMBERS of the staff of RADIO AGE will be pleased to test devices and materials for radio manufacturers with the object of determining their efficiency and worth. All apparatus which meets with the approval of various tests imposed by members of the technical staff of RADIO AGE will be awarded our endorsement, and the seal shown to the left will be furnished free of charge. Materials for testing should be sent to

RADIO AGE INSTITUTE
504 N. Dearborn Street, Chicago, Ill.



Test No. 23. ANTENNA RIBBON. Made by the Colonial Brass Company of Middleboro, Mass. It is plated with a non-corrosive agent that is specially prepared to withstand corrosion and grime. The product is known as the Silver-Tone Antenna, and is sold in 50, 75 and 100 foot lengths. Was received in good condition and satisfactorily passed the tests of the RADIO AGE Institute.

Test No. 24. REGENERATIVE RECEIVING SET. Made by the Zenith Radio Corporation, 332 S. Michigan Blvd., Dept. RA, Chicago, Ill. The receiver is a three circuit regenerative receiver, employing three tubes, one as a detector and two as low frequency amplifiers. The receiver has an adjustable semi-aperiodic primary tuning control, variable with taps. The secondary circuit is capacity tuned and reaction is accomplished by the employment of a rotary tickler. The receiver itself is one of beautiful workmanship, the panel being of the slanting console design with exceptionally artistic engraving. Wavelength range amply covers the broadcast allocations. Arrived in excellent condition and packing. Tested and approved by RADIO AGE Institute.

Test No. 25. STORAGE PLATE BATTERY. Made by the Main Electric Company of Cleveland, Ohio. A large size of rechargeable B battery, having a 3000 m. a. h. rating. The battery is well designed, having exceptionally good rubber caps, so designed to eliminate the nuisance of electrolyte collecting on the tops of the rubbers. The plates are sturdily made, and the glass containers are exceptionally heavy. Built in 24 and 48 volt units and equipped with a strong and durable black tray. Arrived in good conditions and excellent packing. Tested and approved by RADIO AGE Institute.

Test No. 25. PHONOGRAPHIC RELAYING DEVICE. Better known as the Dulce - Tone Phonographic Loud speaking Device. Made by the Teagle Company of Cleveland, Ohio. The Model V tested by the laboratory was found to be a good unit for transferring the electrical energy to sound energy at the same time making use of the acoustic qualities of the phonograph. Music after adjustments was faithfully reproduced. Tested and approved by RADIO AGE Institute.

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Write for the name of the nearest dealer from whom you can obtain a demonstration of this outstanding marvel of the radio world.

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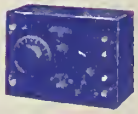

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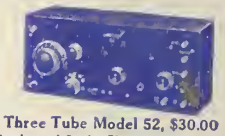

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