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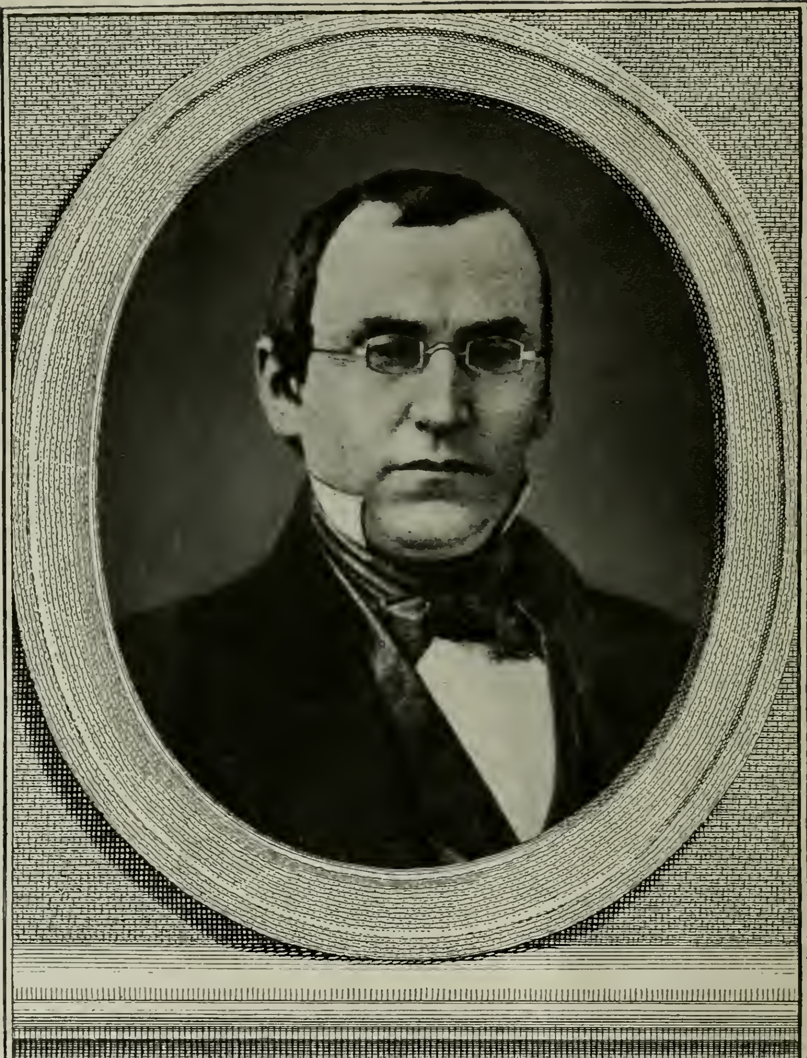
The Vision of a Blind Man



Edward Livingston Youmans
FOUNDER OF POPULAR SCIENCE MONTHLY

The Vision of a Blind Man

THE progress due to science and invention in America, which makes this Twentieth Century so wonderful, so rich, is a tribute to the vision of a blind man.

The science department in every university, the technical schools, owe more to him than to any other one personal force.

Hundreds of thousands in this generation whose success is due to him, or who are benefiting through the work he did, do not even know the name of Edward Livingston Youmans.

In his lifetime this self-taught man was recognized as the best informed intelligence in the nation, and he has been dead not thirty years.

He made science popular in the homes of America

Youmans' work can be summed up in four words: He made science popular.

In teaching himself the sciences, handicapped as he was with blindness, Youmans realized the barriers of learning within which scientific men have isolated themselves.

Since the time, more than two thousand years ago, when Archimedes discovered the lever, the pulley and the screw, since the day science was born, in fact, scientists have been an exclusive folk, a sort of high priesthood.

They share their knowledge with each other. None but the elect are permitted to enter within their circle. Their constant excuse has always been, is now, that without technical mastery there can be no science and that only the trained mind can understand technicalities.

When Youmans began his life work seventy years ago he realized his mission was that of an interpreter.

He knew that science must become a part of the daily life of human beings, if civilization was to go forward. His own experience proved to him how difficult it was to get the necessary knowledge.

The Vision of a Blind Man

With his sightless eyes he looked into the future

He saw the social and industrial revolution that science could bring about, once people understood its laws, and how these laws could be made to work for them.

There wasn't any popular demand for science in those days; it was considered something absolutely apart from the daily life of people.

Youmans, a practical man who made his dreams come true, had to make people realize a need of which they were unconscious, and then supply that need.

He invented just one device—the chart or diagram object lesson, in universal use today and as effective as it was when the "graphic" brought Youmans into national prominence.

A color chemical chart invented by a blind man

Tens of thousands learned the rudiments of chemistry by looking at a color chart devised by a blind man. This revealed, almost at a glance, the whole mechanism of chemical combinations, as it was then conceived.

Youmans supplemented this with a text book on chemistry and 150,000 copies were sold.

A friendship and business relation that lasted forty years was begun when the blind man was led into the store of D. Appleton & Co., then on Broadway below the City Hall, to borrow from a bookseller a volume he could not afford to buy and which he could not find in the libraries. Youmans' advice made Appleton's the leading publishers of scientific books in America. The editing of scientific books, his own writings, his success on the platform—Youmans was a popular lecturer for seventeen years—did not educate people fast enough to satisfy this man of action.

He could make science understandable but he could not reach people in sufficient numbers. He wanted to sell science to the whole people.

He knew that what was needed was a magazine. It is the medium that can give national publicity. It has the power of iteration; its value depends upon its success in supplying a human need.

Forty-four Years After

Herbert Spencer brought the magazine into being

While the idea was Youmans', Herbert Spencer deserves the credit for bringing The Popular Science Monthly into actual being. A warm friendship had sprung up between the two, based upon the American's admiration for the Englishman's work.

Youmans had written to Spencer that he had temporarily abandoned the plan of starting the magazine when he received the first of a series of articles which Spencer had promised to write for the new publication. The articles reached Youmans in April, 1872, and the first issue of the new magazine appeared the following month.

Thus the May issue of 1916 marks the beginning of the forty-fifth year of The Popular Science Monthly.

The Herbert Spencer articles made a sensation and the magazine was a success from the start.

Famous men who thought deeply and wrote simply

Youmans was able to get great men to write for his magazine. In addition to Spencer's there were articles by John Tyndall, Thomas Huxley, Professor R. A. Proctor, Dr. Henry Maudsley, Henry Ward Beecher and others who thought profoundly and were able to write simply.

Within a year and a half the circulation was 12,000 and that would be a big circulation for a monthly that sold for fifty cents a copy and $5 a year, even in these days of large volume.

The Popular Science Monthly became the most famous publication in America because it was as widely known in Europe as it was in this country.

Youmans edited the magazine until his death in 1887. His successors, under different ownerships, ably maintained his original policy long after this policy accomplished its work.

The Youmans policy did not enlarge with the public mind it educated. Those who continued it did not take into consideration that the thought, activities and manner of living of the whole nation had changed.

The Youmans idea is as big, as vital, as ever it was. The plan for

The Vision of a Blind Man

making it work—that is the policy of the magazine—had become moribund. There was needed a fresh interpretation, a rational interpretation, to meet conditions Youmans was instrumental in bringing about.

The reason for the change in policy is the same as was the reason for starting the publication, for in his prospectus which appeared in the first number, the founder of the magazine said:

"The growing importance of scientific knowledge to all classes of the community calls for more efficient means of diffusing it."

The more efficient means for diffusing knowledge

The change in the policy of The Popular Science Monthly means simply that a more efficient means of diffusing scientific knowledge has been proved.

There are now a thousand laboratories where there was one in the days when Youmans was a student. Instead of a propaganda for laboratories, The Popular Science Monthly now gives the news that comes from these laboratories it helped to establish.

It is perhaps the most important news of all. The quiet men at work in laboratories will decide the great war just as they decide how a farmer shall till the soil, how a laborer shall carry pig iron with his hands.

Making the big idea work to fit these big times

The laboratories are not all in the universities, technical schools and great industrial corporations.

Wherever a man has fitted up a little workshop for himself to carry out his ideas along scientific lines, that shop is a laboratory. News comes from it—sometimes the biggest news.

It is the function of The Popular Science Monthly, not only to report this news but to interpret it—to explain it in words and pictures—to make it graphic—to show how it can make the daily life of human beings easier, richer, happier.

The new device for everyday, familiar use, and the discovery that leads to the foundation of a new

WALDEMAR KAEMPFFERT

PRESENT EDITOR POPULAR SCIENCE MONTHLY

The Vision of a Blind Man

industry, come within its scope. It tells how to make and use the simplest things that make life and work easier and reports the great advances in abstract science in words any intelligent reader can understand without effort, explaining the meaning of these discoveries and just what work they will do.

Kaempffert, the editor, is scientist and interpreter

This can be done only under the direction of an editor who is himself a scientist. He must have full knowledge, complete understanding of the language in which science speaks, and be able to interpret and explain it to meet human needs—needs he must understand and sympathize with.

Edward L. Youmans had this capacity; so has Waldemar Kaempffert, the present editor of The Popular Science Monthly.

Youmans had this gift for the people of his day; Kaempffert has it for the people of this day.

Kaempffert has been interpreting abstract science, chemistry, engineering and invention for twenty years. As managing editor of The Scientific American, one of the most exact journals, he proved himself the ablest man in America in this work.

He has surrounded himself with specialists who know how to write simply, how to be interesting.

The contributors to the magazine continue to be "the ablest scientific men of different countries," to use Youmans' words. For everything that appears in The Popular Science Monthly has the stamp of authority. This is the law.

This is the first law: It must be interesting

There is only one way to make science appeal to non-scientific people and that is to make it interesting.

It is the law that The Popular Science Monthly must be interesting.

Most of us are not given to concentrated thought. We are inclined to feel and act. Our mind speeds from one topic to another, finding interest in a hundred things that really do not concern us, but seeking always for ideas.

Ideas make life worth while. All

Forty-four Years After

work is drudgery unless it is inspired by ideas.

The make-up of the magazine, which seems a haphazard affair, is perhaps the most perfect object lesson illustrating the way the mind of the average man works.

It reads as a group of people talk, flashing from one subject to another, superficially unrelated yet having an invisible bond, giving important things longer, more serious attention, touching lightly upon those merely entertaining.

Mechanical vaudeville is given at its real value

For The Popular Science Monthly is not lacking in what may be called mechanical vaudeville, and vaudeville seems to be a human need. The scientist, the engineer, the inventor are human beings after all.

But these entertaining things in the magazine are presented at their exact value, as is everything else. The reader is not even given the opportunity of taking them seriously.

The Popular Science Monthly has as many illustrations as can be crowded into the magazine because the picture is the quickest, surest way of communicating ideas.

Each month some 300 new ideas are pictured and explained—ideas that eliminate drudgery.

Drudgery is not a permanent form. It is one's attitude that makes one's work drudgery or a vocation that is interesting.

This fundamental runs through all economics.

To define the work of The Popular Science Monthly is to define civilization.

Civilization is a result of bringing to the individual the fruits of all the experiments, ideas and discoveries the whole world has accumulated.

The success with which it is doing this important work is shown by the fact that it has added ten thousand readers each month since the new policy was adopted.

The Popular Science Monthly is now growing just as fast as people are becoming acquainted with it.

It is one of the few periodicals that is an economic necessity.

That which a blind man saw in a vision forty-four years ago has become a reality.

This volume contains:

960 pages

1393 articles

2113 pictures

Popular Science Monthly

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Publish Your Ideas

The Popular Science Monthly *publishes each month about two hundred photographs and fully a hundred drawings. Nearly three hundred subjects are taken up in each issue.*

You can help to make the magazine even more diversified than it is by sending to the Editor pictures that in your opinion would interest other readers. If you have made some useful article of furniture with your own hands, if you have repaired a piece of machinery in some simple way, if you have made a tool more efficient by some addition of your own, let the Editor hear from you.

In every part of the country there is a natural curiosity about which we would all like to know. Send in a photograph of it—a photograph in which a human being appears as a standard of size. Strange accidents and queer occurrences on the farm interest everybody. Tell the Editor about them, and send him photographs.

Don't be afraid to write. Give the Editor the facts briefly and in your own way.

Your ideas and pictures will be paid for liberally if available.

Address: The Editor of the Popular Science Monthly, 239 *Fourth Avenue, New York*, N. Y.

The Greatest Oil Well Fire Ever Seen

The flames, covering an area of more than a city block, burned in the seepage surrounding the well, but from under the concrete cap twenty-five thousand barrels of oil were drawn off every day

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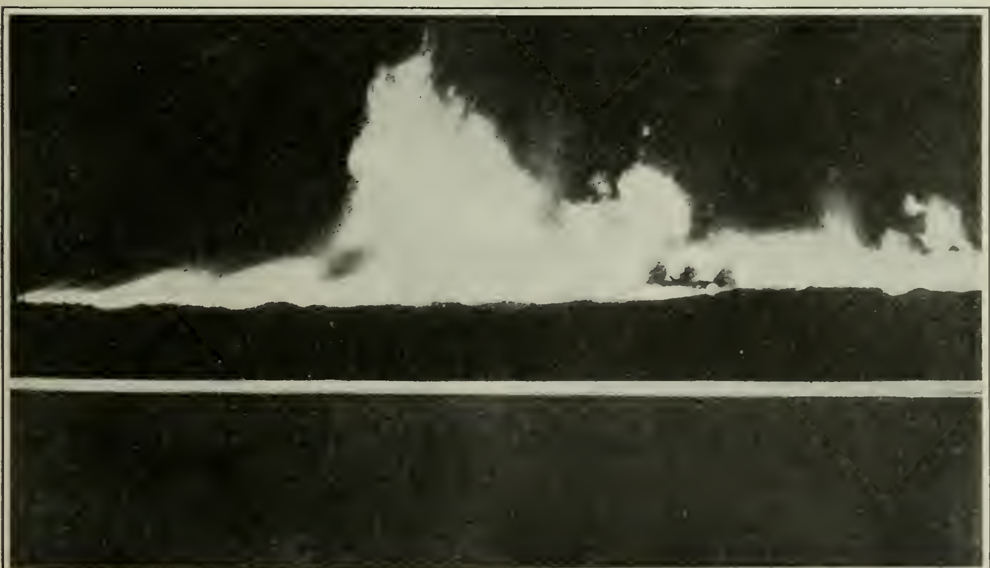
A Fire that Burned Four Months

By A. G. Fasbinder

DURING a violent thunder storm a bolt of lightning struck the oil-soaked ground near the Potrero del Llano No. 4 oil well near Tampico, Mexico, the greatest oil well in the world. For more than four months from that date, August fourteenth, 1914, the resulting conflagration resisted all efforts to subdue it. The flames, covering an area of more than a city block, swept over the mouth of the great well, but thanks to the concrete cap covering the orifice, the main body of oil did not ignite.

Upon the first outbreak of the flames, it was thought that the main well was doomed, as well as a great lake of oil containing nearly two million barrels, which was situated nearby. Twenty-five hundred men were summoned to the work of fighting the flames, and apparatus which had been successfully used at other fires of the same nature was brought to the spot. This great force of workmen labored ceaselessly day and night until the fire was conquered, four months later.

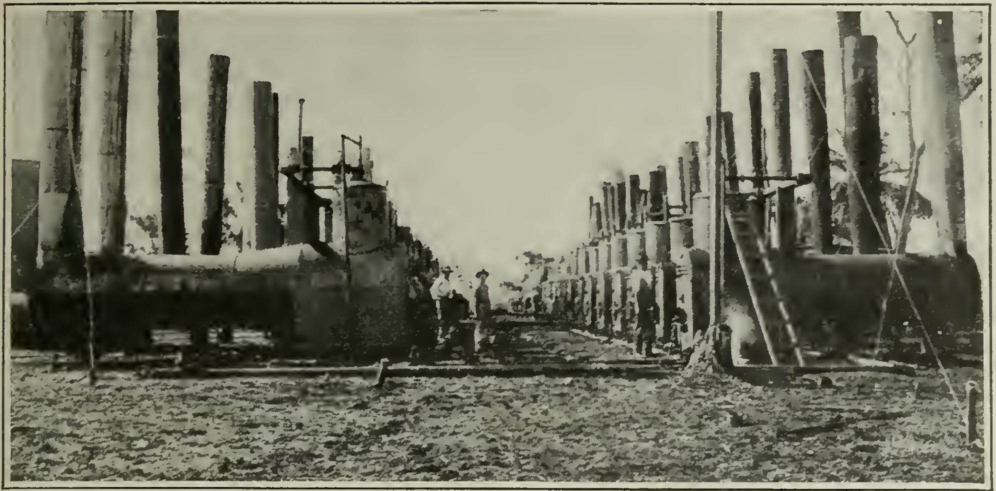
The first precaution against the spread of the flames was the erection of a retaining wall of sand and dirt



The fire mounted hundreds of feet into the air, and at night the huge red canopy over the sky drew thousands of spectators to the scene

A Parapet of Sand to Check the Flames

The first precaution against the spread of the flames was the erection of a retaining wall of sand and dirt which completely surrounded the burning area. The earth itself seemed ablaze, for the oil continued to seep through the soaked ground and furnished new fuel for the flames. Twenty-five hundred men and thousands of dollars worth of equipment were employed during the four months



The battery of fifty-three steam boilers, which pumped immense clouds of steam in a vain endeavor to smother the seething flames

which completely encircled the burning area. The earth itself seemed ablaze for the oil continued to seep through the soaked ground and furnished new fuel for the flames. The fire mounted hundreds of feet into the air, and at night a red canopy covered the sky, visible for many miles. Thousands of spectators watched the work.

A great battery of steam boilers arrived at the spot and pipes were led to the fire. The laborers worked under continuous streams of water from fire hose, for the heat was so great that without soaking themselves in water, their clothing would have burst into flames. Those playing the streams upon the workers had to direct the hose while crouching behind shields to protect themselves from the heat.

When the steam pipes were laid, the battery of boilers was fired up, and clouds of steam descended upon the fire. The effort was vain, for the area of the flames was too great for the steam to cover in order to smother the blaze. More boilers arrived until forty-three were coupled to the steam-pipes. These had no effect, however, so this method was temporarily abandoned.

A shaft was sunk into the ground, and it was hoped to fight the fire through this shaft with the aid of chemicals. This, too, proved unavailing. Spur tracks were laid from the main roalroad lines in order to rush materials more quickly to the scene. Experts were summoned from other mining and oil properties to aid in the work.

Weeks lengthened into months, and still the fire burned fiercely. Much to the surprise of experts the great well, although in the center of the conflagration, did not add its huge flow of oil to the blaze. The concrete cap withstood the intense heat and protected the main quantity of oil. One of the most remarkable features of the fire was the fact that during the time that the fire was burning, the managers were able to draw twenty-five barrels of oil daily from the well through the main flow line from the gate valve, which was well protected by concrete.

The mass of equipment that was brought to subdue the fire was truly enormous. During the four and one-half months that the fire raged, there were used forty-nine boilers of approximately fifty horsepower, twenty steam pumps, three air compressors, two centrifugal pumps, quantities of railroad tracks and ties, road building materials, tens of thousands of feet of steam pipes, etc., all of which took about three thousand men to install.

After attempting nearly every known method of subduing the flames, the engineers in charge set the laborers at work gradually pushing the retaining walls in toward the center of the blaze. Because of the intense heat this was done under the greatest difficulty. The circumference of the wall was gradually tightened, thus slowly reducing the area of the blaze.

Pipes were led to the bottom of the blazing area and oil was drawn as fast as possible from the seepage. As it was not fit for commercial use this was pumped to a safe spot nearly five miles distant from the blaze proper and then burned, making in itself a huge conflagration.

Finally during the last part of December, the five walls had been pushed in so far that the blaze was confined to a relatively small area, and everything was made ready for a last effort, greater than all previous attempts. Tons of chemicals were piled near the scene, and thousands of feet of extra steam pipes were laid from the boilers and pumps. This work lasted until about the first of January. In the first days of the new year, the attempt was made. Chemicals were heaped into the fire area and boilers and pumps poured a deluge of water and steam upon the stubborn flames. For hours this frenzied work continued, the result trembling in the balance. At last the ingenuity of man conquered the stubborn forces of nature, and the fire was out.

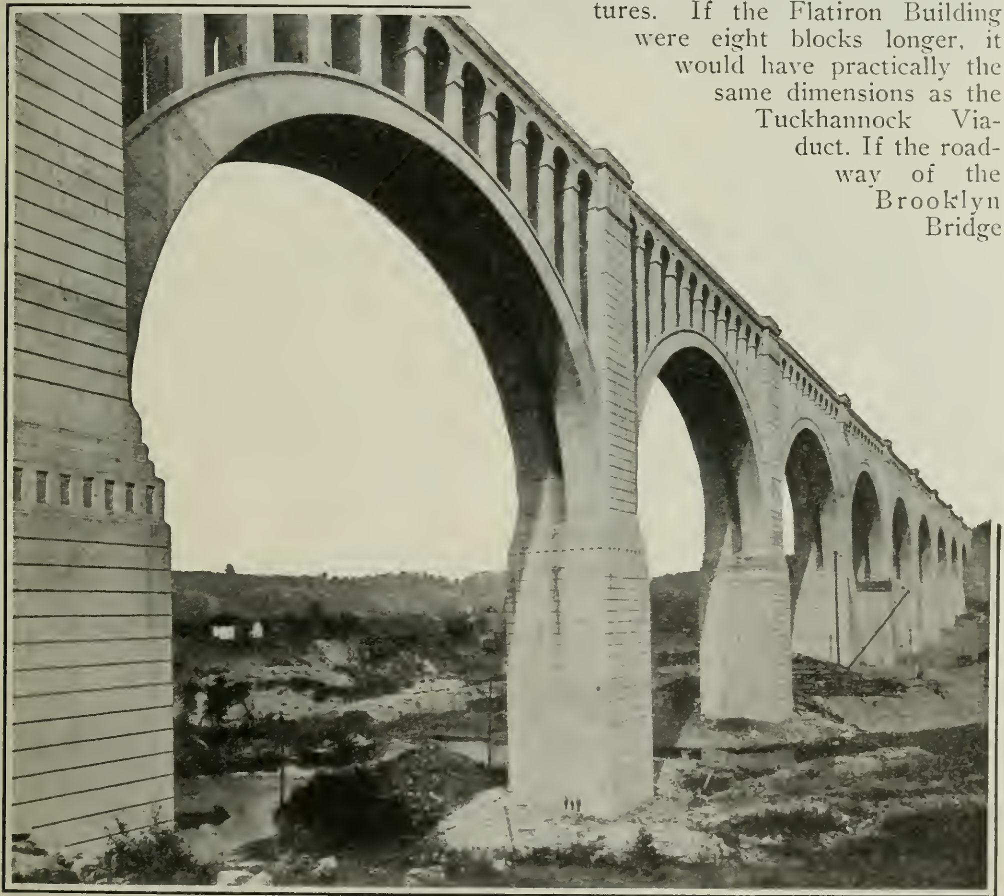
It seemed almost hopeless to attempt to calculate the damage done by that bolt of lightning. The estimated production of the great well was one hundred and fifty thousand barrels of high grade oil a day, yet for more than four months but twenty-five thousand barrels were drawn. Thousands of dollars were expended upon equipment for the fire fighters, and other thousands went for chemicals which were fed to the flames.

The fire was watched by the greatest interest by the oil trade of the world, who recalled another record-breaking fire which occurred several years ago not far from the Potrero del Llano conflagration. The Dos Bocas gusher, one of the largest in the world at that time, caught fire before being capped. For nearly a year the fire raged, and only subsided when it had consumed all the oil in the fertile pocket which it had tapped. At the present time it produces only salt water and gas.

Pushing in the retaining wall which finally conquered the flames. The heat was so intense that streams of water had to be continually played over the workers, all of them Mexican peons, who are perhaps the most sensitive of human beings to extremes of heat and cold—except in their horn-like nether extremities, which were not affected in this case

Twelve Million Dollars for Twenty Minutes Train Time

TO cut twenty minutes from the running time of passenger trains and one hour from the running time of freight trains between New York and Buffalo, the Lackawanna Railroad has invested twelve million dollars in a concrete arch half a mile long.

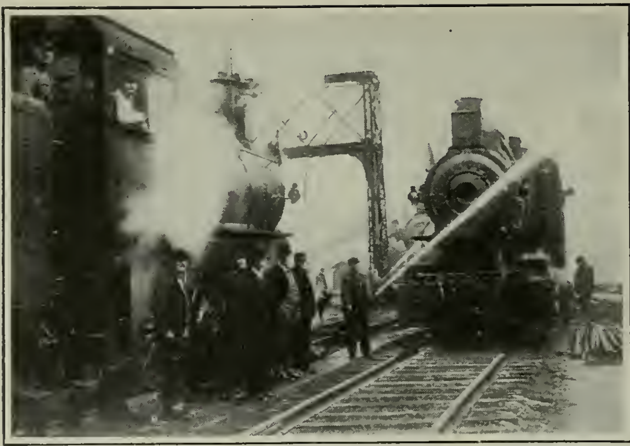


This beautiful viaduct built of concrete, cuts twenty minutes from the train time of the Lackawanna between New York and Buffalo, but it also saves miles of heavy grades

By the old, circuitous route, due to the heavy grades, five engines were required for the work that two can now do comfortably.

The new viaduct is an imposing structure crossing the Tuckhannock Valley in ten graceful arches. It is of concrete, the largest concrete structure in the world, containing more than five hundred million cubic yards of material. Some idea of its vast size can be gained by a comparison with the dimensions of better known structures. If the Flatiron Building were eight blocks longer, it would have practically the same dimensions as the Tuckhannock Viaduct. If the roadway of the Brooklyn Bridge were one hundred feet higher, it would have the dimensions of the viaduct.

Including the viaduct, the total length of the cutoff is three and one-half miles. The old route is thirty-nine miles.



The yard locomotive's great and mobile power is now turned to the task of fire fighting

Locomotives Serve as Fire Engines

ONE of the large Eastern railroads has protected its property against fire by equipping all of its yard locomotives with special fire fighting apparatus. Pumps have been installed on the engines, and lengths of hose are carried in the tender.

Each yard is divided into districts, and when a fire is discovered the nearest switch tower is notified and whistles are blown throughout the yard. By a code of signals engineers of fire fighting locomotives are told the location of the fire and are given an open track to the scene. The illustration shows a test of the apparatus on the yard engine.

An Armless Man Who Drives a Car at Racer's Speed

WITH a speed record of fifty-eight miles an hour, Frank E. Fithen, the armless motorist, holds a record in the automobile world that is unique. Not only for speed, but for long distance driving he has made a name for himself, as he has been touring the country for three years and has travelled eighty-five thousand miles. He is now preparing to visit the Northwest, and when he has passed through Oregon, Washington, Idaho and Montana, he will have entered every state in the union, driving his own car. This is a six cylinder machine, long and heavy, and of sixty horse-power.

Mr. Fithen has a few changes made in order to adapt his car to a driver without arms. The most important is the design of the steering wheel, which has a number of metal circles within the wooden rim, and these are just large enough to receive the stumps of his arms. With wonderful agility he can swing the wheel, and also manipulate the throttle, although only a few inches remain of each arm. In addition to the pedals, Mr. Fithen operates the emergency brake with his foot, shoving forward and pulling back the lever with a vigorous motion.

The accident which deprived him of both arms occurred when he was only nine years old, but instead of leaving him helpless, it developed his determination to succeed in spite of his infirmity. Mr. Fithen can dress himself and undress; he can take a pencil between his teeth and write with little difficulty; he can swim, ride a bicycle and perform feats of fancy riding and balancing on the single wheel.

An armless man's own inventions have made it possible for him to drive his motor car at top speed with perfect control

This driver need not lean out to signal an off-side turn. The artificial hand saves him that trouble

Imitation Hand Signals a Turn

AN imitation hand has been devised by a California merchant to warn traffic that his automobile is about to make an off-side turn. It is attached to one of the rods supporting the top. On the rear of the top side of the hand is an eye, to which a string is attached. Whenever the driver wishes to turn a left-hand corner he pulls the string and the hand goes up.

This device costs less than ten cents and obviates the danger of losing control of the steering wheel. The arm is painted black and the hand white.

Sea Shells for Decorating Concrete

A CONCRETE worker of Long Beach, Calif., has discovered a new use for sea shells. The accompanying illustration shows an interesting specimen of his work. It is a garden ornament constructed of solid concrete, decorated with small mussel shells. The shells, arranged in rows and squares, are imbedded in the concrete with the inside of the delicately colored shell exposed. The structure is intended to enclose a bed of flowers, and vines will be trained over the top. The same design may also be employed to surround a garden fountain.

Shells make concrete decorative in detail as well as in line

A locomotive that goes to Fairyland

The "Back Yard Limited"

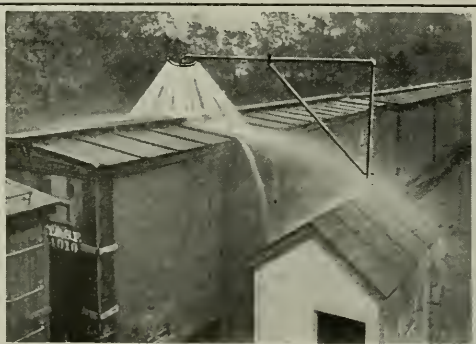
A LOCOMOTIVE was built recently by inventive youngsters. It was composed of the following parts: One barrel, two lengths of stove pipe, one soap box, tin cans and some odds and ends of lumber. While it is not capable of tearing across the prairies at the speed of a mile a minute, you must be a small boy or a little sister to imagine its possibilities. Straw smudge provides the indispensable smoke.

Sidewalk Shelters for the Trolley Patrons of Cincinnati

SIDEWALK shelters for trolley patrons are to be built at the junctions of the principal trolley lines in the city of Cincinati, Ohio. One of these structures has already been erected at a point where ninety per cent. of the trolley cars of the city pass. The innovation has received such general approval that the experiment is to be extended. Smaller sheds are to be built at several other points where trolley patrons congregate to board the cars.

Cincinnati protects her street car patrons from rain and from sun

The shelters are of metal of the umbrella or mushroom type, the characteristic of which is that the supports are in the middle of the shelter where the least number are required, so that little or no obstruction to the stream of pedestrians is offered.



This railroad does not wait for a damage suit to learn whether or not a car roof leaks

Edison's Phonograph Diaphragm to Record Only Faint Sounds

THOMAS A. EDISON has recently been granted a patent on a phonograph diaphragm which will record only faint sounds, excluding those of any great intensity. Cork or a similar material is used. Faint sounds cause the diaphragm to vibrate only slightly; greater vibrations, caused by loud sounds, are restricted by a small cylinder and plunger working on the principle of a solenoid.

Artificial Rainstorm Tests Car Roofs

AN artificial rain storm has been devised by Charles N. Swanson, superintendent of car shops of the Atchison, Topeka and Santa Fe Railroad, as a means of testing the roofs of new cars and repaired cars before they have been put into service to make sure they are rain proof. The apparatus consists of a spraying device which throws a very large quantity of water controlled from a little house at the side of the tracks. The cars to be tested are hauled under the spray twice. The cars are then entered by the inspectors and all evidences of leakage are chalked for the guidance of the repair men. When the cars have been through the repair shops they are again subjected to the rainstorm test before they are put into service. The volume of water is so great that it is possible to locate leaks in the side sheathing or ends of the cars.

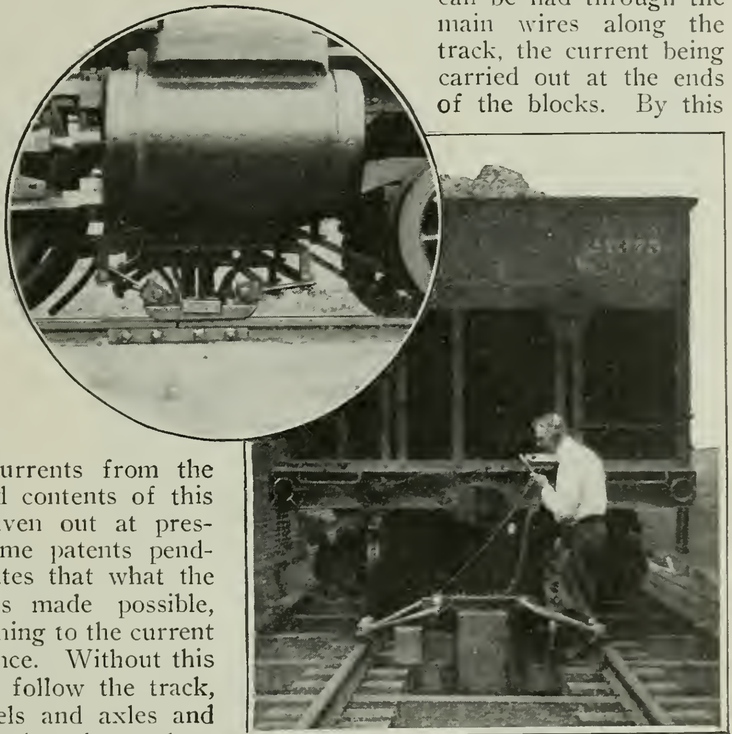
Telephoning from a Moving Train

BY means of the moving train telephone invented by A. A. Macfarlane, communication between fast moving trains may now be possible. Communication has actually been held between the experimental station and New York city. In this experiment the rails of the track were used for part of the conducting medium.

On a sidetrack near the little town of Bridesburg, Pa., experimental work has been carried on with a steel freight car. At one end of the section of track used, a two-volt battery is connected; at the other end a signaling and telephoning device is located between the tracks. The equipment consisted of a "puzzle" box and copper shoes that pick up currents from the rails. The nature and contents of this box are not being given out at present on account of some patents pending. The inventor states that what the device accomplishes is made possible, however, by his furnishing to the current a path of least resistance. Without this device, current would follow the track, run through the wheels and axles and jump to the other rail and produce a short circuit. The current simply avoids its natural outlet, follows the track until it reaches the box and shoes, where it is picked up and taken aboard the train.

Telephoning between moving trains is but a part of the importance of the invention. The real object is to produce a signaling system that will bring the danger and clear signals into the cab of the engineer. An automatic brake has also been added and tested on an engine. The device will light colored lights in the cab of the engine, as well as furnish an automatically operated block for approaching trains. Into each block current will be furnished by batteries along the track. When a train is in this block, it will short circuit the current, so that a train approaching will be automatically stopped by the brake device operated in connection with the system.

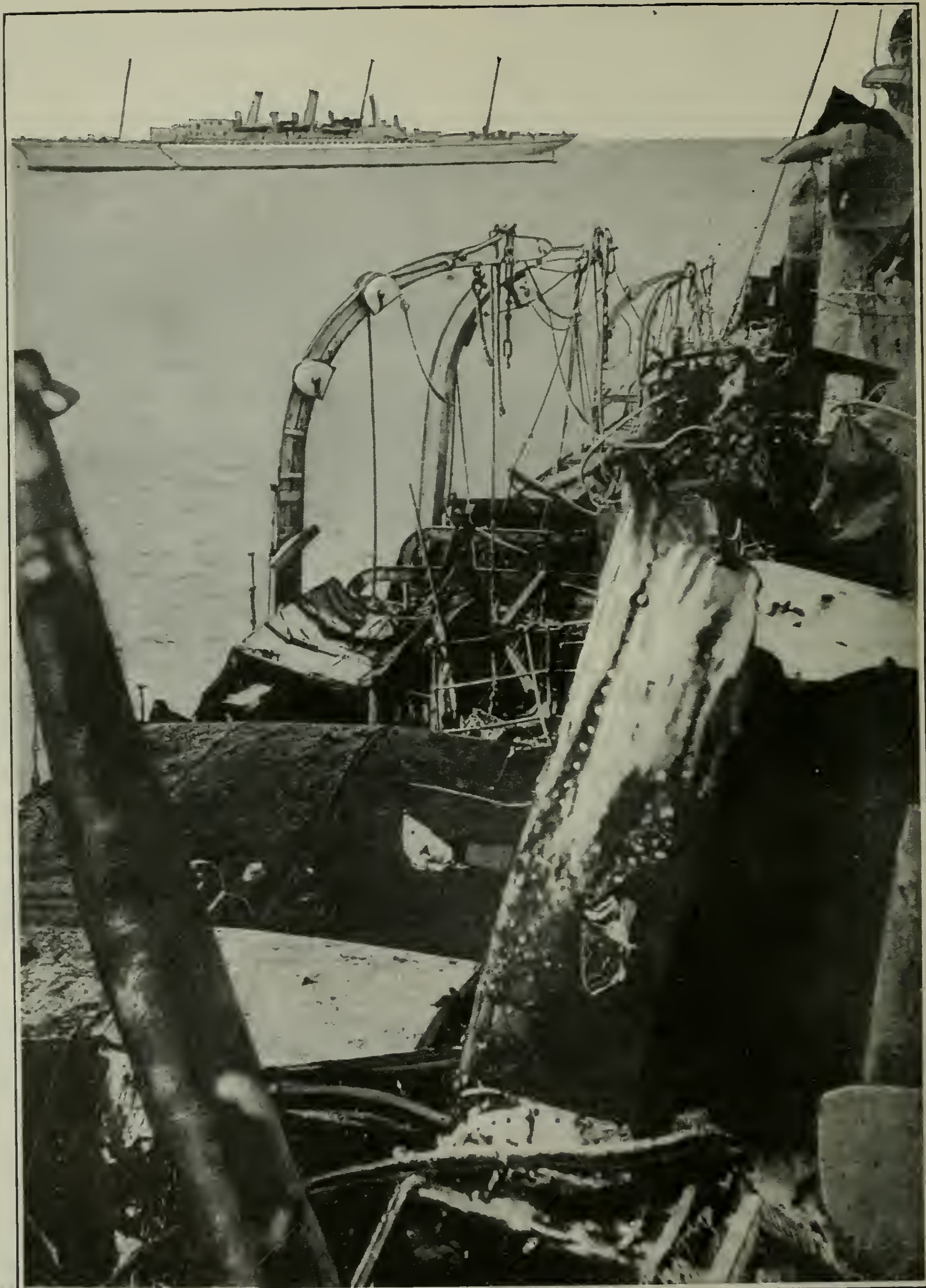
In the telephone system it will be necessary to have batteries along the track, and by the use of the shoes and box device with which the train will be equipped current will be furnished it. Then the telephone can be operated, and connection can be had through the main wires along the track, the current being carried out at the ends of the blocks. By this system, the inventor claims a moving train can be in communication with any telephone in the country.



The two rails of a track are used as wires for telephoning to moving trains. In the circle is shown the shoe by which the connection is made from rail to locomotive

Lengthens Life of Rubber Gloves

A NEW process for vulcanizing seamless rubber gloves has been brought out by which the life of the gloves is said to be considerably lengthened. Instead of vulcanizing the glove on the dipping frame after the several coatings have been applied, each consecutive layer is vulcanized as the glove structure progresses.



The Emden After the Battle—Mere Scrap Iron

The German commerce destroyer Emden was reduced to a mere hulk at a range of two and a half miles by the Australian cruiser Sydney. Part of the Emden's crew were on shore and later reached Europe after many wild adventures in tropical lands

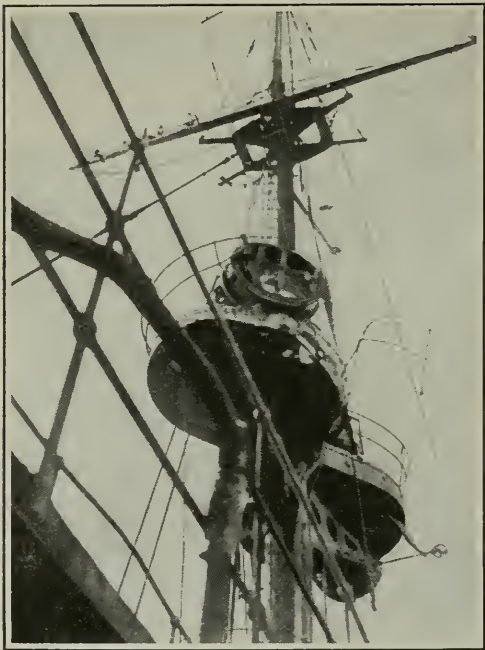
The Destruction of the Emden

By Rear-Admiral Bradley A. Fiske

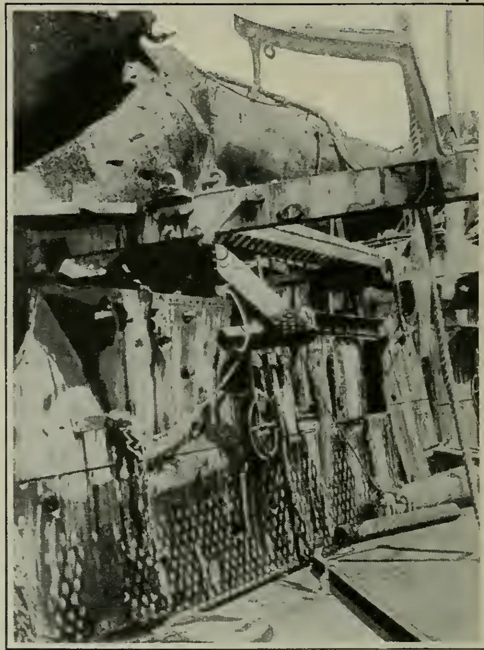
Rear-Admiral Fiske's graphic description of the battle between the Australian cruiser "Sydney" and the German commerce destroyer "Emden," is all the more interesting because it comes from an American naval officer who has distinguished himself by the invention of devices which have done much to improve American gunnery. The frightful havoc wrought by shell fire on the doomed German ship carries with it a lesson in preparedness, as Admiral Fiske points out.—Editor.

WHEN making her last raid, which was against South Keeling, an island of the Cocos group, a few hundred miles southwest of Sumatra and Borneo, and while she had three officers and forty enlisted men on shore, the German commerce-destroyed *Emden* was surprised by the Australian cruiser *Sydney* that had been told by wireless of her presence. The *Sydney* was a vessel of five thousand two hundred tons displacement, had a maximum speed of twenty-six knots and carried eight six-inch guns that fired projectiles weighing one hundred pounds. The *Emden* had a displacement of three thousand six hundred tons, mounted ten four-inch guns that fired projectiles weighing about thirty-two pounds. She had a maximum speed at that time of one or two knots less than the *Sydney*. An action ensued, the results of which are clearly indicated by the photographs here shown. The battle began at a range of about two and a quarter miles; but the range was quickly increased by the *Sydney* whose Captain took advantage of her superior speed

All that is left of the bridge from which the captain and officers were wont to direct the activities of the fast German commerce-destroyer Emden



The bridge reduced by the Sydney's shell fire to a battered wreck



The spar deck of the Emden was torn up by a veritable hail of shell

to secure a distant position, at which the smaller guns of the *Emden* could do the *Sydney* very little harm.

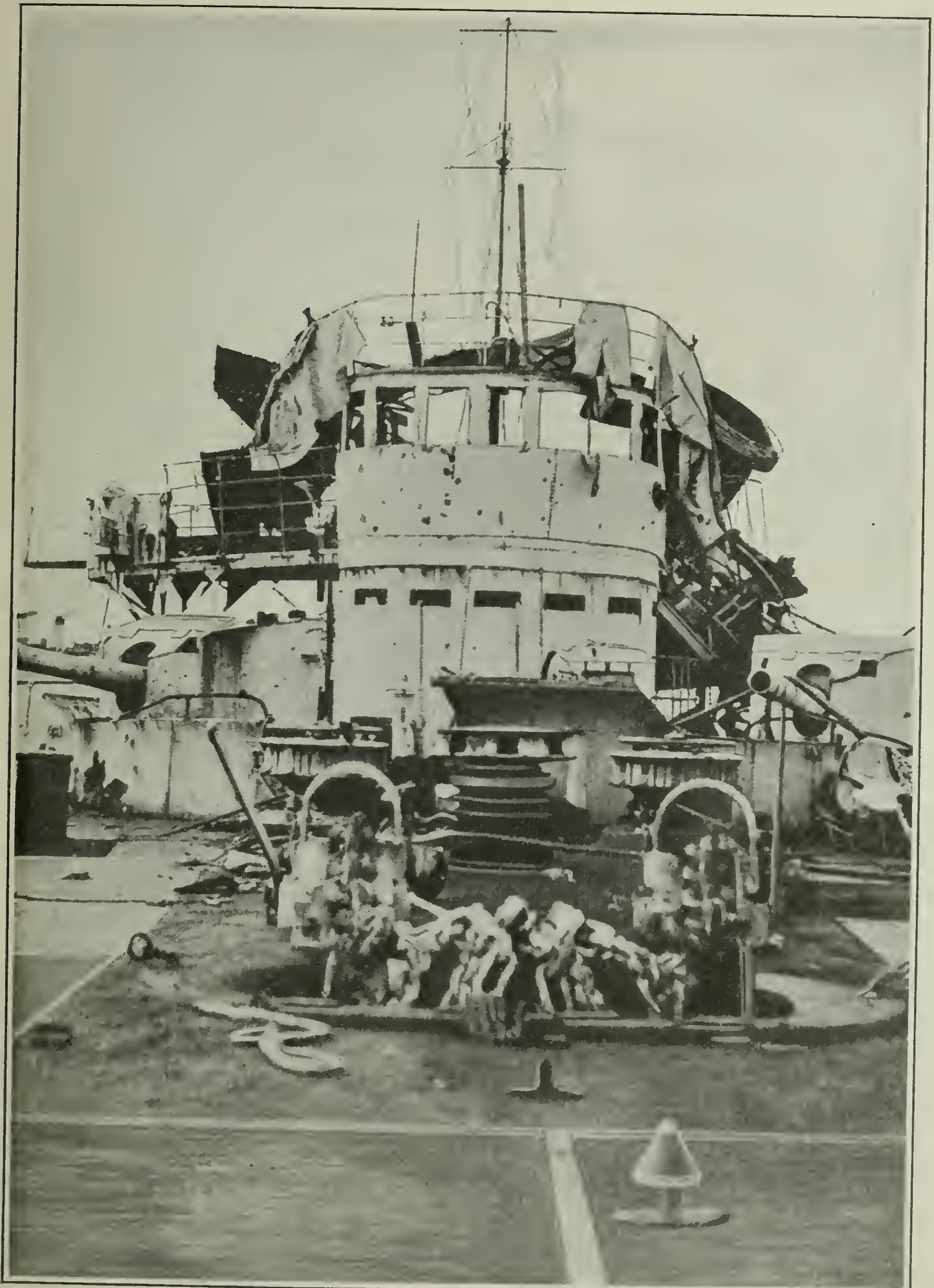
Steel Crumpled Like Paper

These photographs indicate the frightful effect of naval gunnery and suggest the tremendousness of naval power. In naval ships, large guns are installed that can be taken at great speed all over the world, and fired with great precision over long distances, and with great effect. In the photographs, we see great masses of steel, crumpled like paper; we see the ship's side penetrated; we see the bridge from which the Captain and the officers usually directed the ship, an undistinguishable wreck of iron and brass; we see the funnels made veritable scrap-iron; we see the spar-deck torn up; we see the ship itself reduced from the condition of a rapidly cruising man-of-war to that of an inert mass of torn and twisted iron. All this was done in little more than an hour.

Although the *Emden* was not a very powerful ship compared with many others she was nevertheless a strong and well-built vessel, and could not have been wrecked except by tremendous power. The power of armies is exerted for the most part by muskets, which cannot be heavier than single men can carry and by field artillery and siege artillery, intended for use against men and lightly constructed buildings of wood and stone and brick.

A Fourteen-Inch Shell is Equivalent to Sixty Thousand Muskets

The value of a bullet fired from a musket, or of a large projectile fired from a gun, is due to its ability to penetrate the resisting envelope of a man in one case, or a ship in the other case. Naturally, the measure of that power is the energy of the projectile, which energy is dependent on both mass and velocity. As was shown in the November number of the POPULAR SCIENCE MONTHLY, the energy of a fourteen-inch shell fired say from our *Nevada*, is about equal to that of sixty thousand muskets when the projectiles start. But after the musket bullet has gone a little more than a mile, it falls to the earth, its energy reduced to zero, while the fourteen-inch projectile has hardly started. If the *Emden* had been fired at by muskets at the dis-



The Work of an Hour and a Half

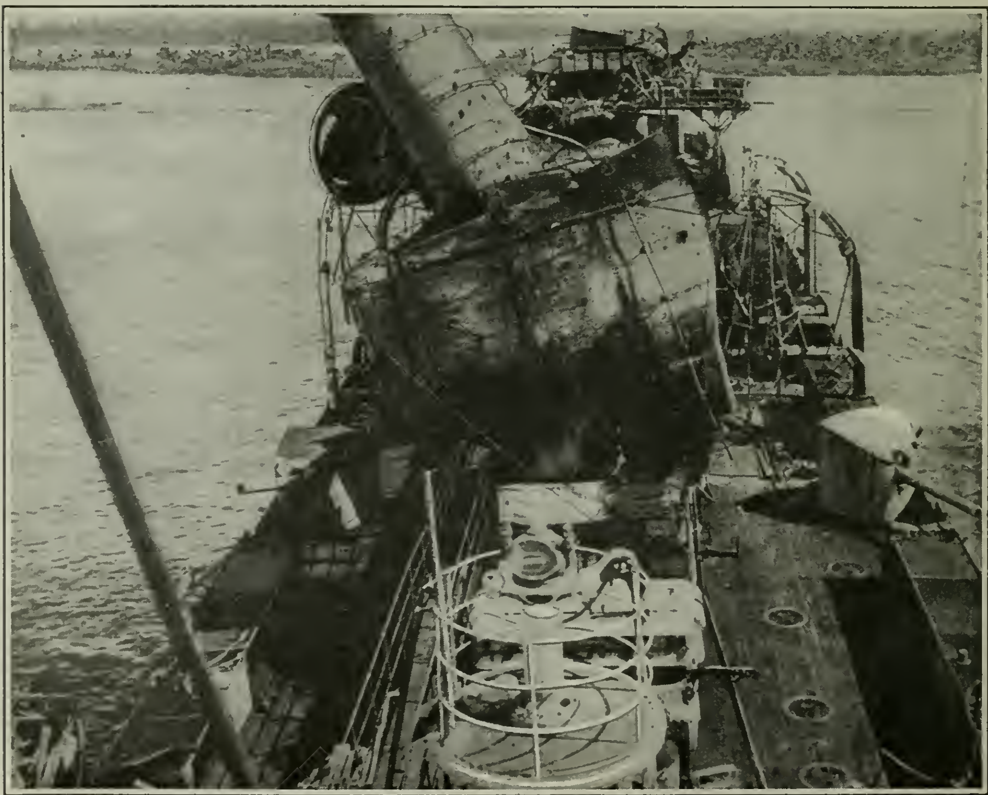
It takes tremendous power to destroy a ship of war, as Admiral Fiske points out in his article. If the Emden had been fired at by muskets from the distance at which the Sydney destroyed her, the bullets, if they reached their mark, would have rattled off harmlessly tance at which the large guns were fired in the battle the bullets would not have reached her.

It would not be possible for an army to carry around on land by any means whatever the big guns of war ships; so that the curious condition has come about that the dangerous sea, which defied for centuries the ability of man to move upon it, except very slowly and over little distances, is now contributing much more than the land to the exercise of his power.

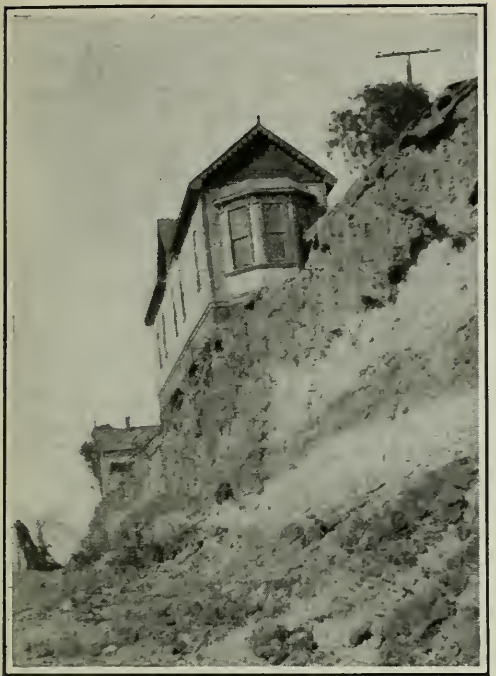
Suppose New York Had been the Target

The destruction wrought upon the *Emden,* of which these photographs give such gruesome proof, has another interest for us, of a character not philosophic, but eminently practical, because it suggests that if this damage could be done to a strong, steel structure, like the *Emden,* what would have happened to buildings, in New York, if they had been the targets instead. And it also suggests what might have been the effect if those buildings had been the targets not of the comparatively small projectiles which were fired at the *Emden,* but of fourteen-inch projectiles weighing fourteen hundred pounds, filled with high explosive, fired from a hostile ship.

The American fleet having been defeated, a single ship carrying guns able to fire projectiles fifteen miles, and protected against submarines by numerous destroyers and by other means, could, in two or three hours, fire into New York from a point beyond the reach of any of our guns, one hundred high explosive shells, which falling on our streets, power stations, subways, elevated railroads and skyscrapers, would make the vicinity of Wall street look like these pictures of the *Emden.*



In these battered funnels and this riddled deck we see the price of slowness; for the triumphant Australian cruiser Sydney was just a little faster than the Emden, whose bottom had been fouled by long cruising in tropical waters



The house rests on the brink of a city improvement, and also on the brink of destruction

An Excavation for a Road Leaves House on Brink

IN San Pedro, Calif., a "good road" boulevard is being cut through a hill. The accompanying photograph shows a house that has been left on the very brink of the excavation, and in a precarious position. The steam shovel can be seen in the background scooping deeper. The ground is an old sea-beach made up of loose sand. The owner has threatened to sue the city should the house come to harm.

Women in Europe's Machine Shops

THE tremendous demand upon the ranks of skilled workmen since the war has resulted in the surprising knowledge that women can supplant men in machine shops.

That the woman mechanic has adequately risen to her opportunity is a fact heartily attested to by scores of European manufacturers. Several of them who have made a systematized study of the woman workman's progress claim that the untried women mechanics have mastered the details of their tasks in a much shorter time than workmen require.

Another interesting point is that the traditional belief of woman's inability to invent is quite unfounded. As an example, in one machine shop where men had been employed on a certain operation for years women took up the work, and in less than a week had devised a plan whereby the time required for the operation was halved.

Shipping Pigs in Baskets.

THE lot of domestic animals in the east is not enviable, particularly when enduring transport from one place to another. Fowls are always sent to market with their legs tied, so that it is impossible for them to move. The photograph shows how live pigs are transported in the Straits Settlement by steamer or barge. They are shipped singly in wicker work baskets. The receptacle is just large enough to take a single pig. In this cramped and uncomfortable position, for the animal's legs are tied, making it nothing more than a living log, it is often shipped long distances. Water is thrown over the animals and occasionally they are allowed to drink, but nothing is given them to eat.

They know nothing of "pigs in blankets" in the Orient, but pigs in baskets are a common sight

Selling by Show-Window Telephone

THE drawback to window demonstration of any character is the inability of the demonstrator to get his "message across." He can clearly point out the talking points of the article under demonstration, but he can talk about it through the medium of lettered cards only. It is obvious that this method is very unsatisfactory. To overcome the objection and bring the demonstrator nearer his audience, an electric company has developed a loud speaking telephone equipment.

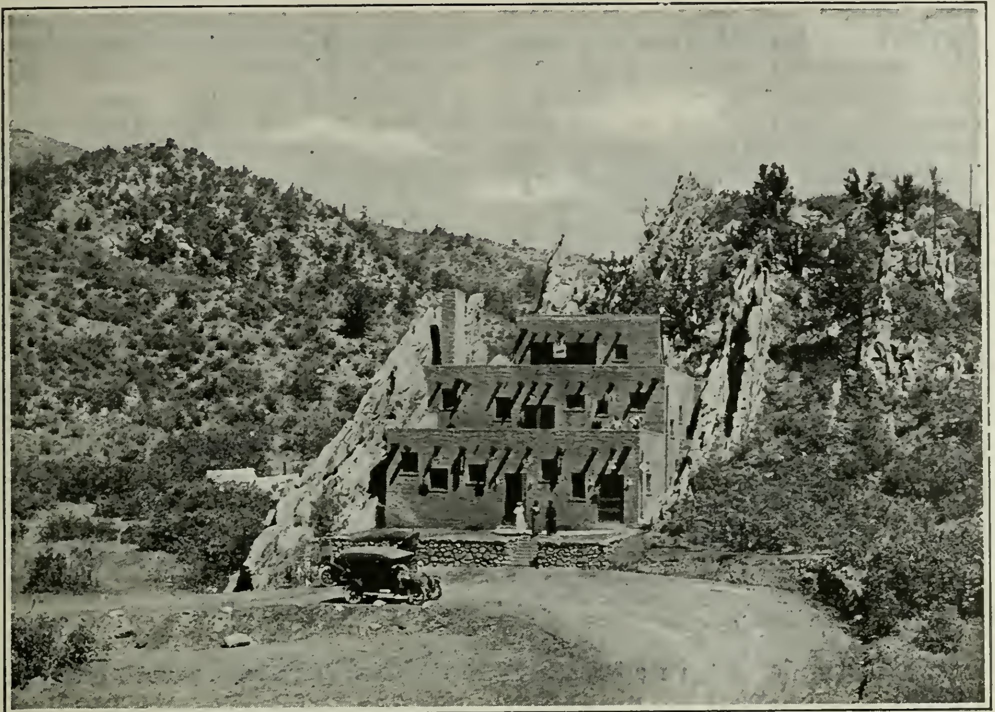
The equipment consists of a special transmitter and a pair of loud speaking receivers and horns. The operation of the system is simple. The demonstrator connects the horns and receivers on both sides of his window, just high enough to be outside the reach of mischievous youngsters. The transmitter is placed inside the window and is wired with the battery of six dry cells in series.

As the demonstrator wishes to bring out each point, he simply speaks into the transmitter and his voice is magnified by the receivers and horns and carried to the audience outside. The equipment not only brings the demonstrator and his audience into more intimate contact, but serves as an auxiliary attraction to the display itself. It has proven a success wherever used.

Oil is Cheaper than Coal

TWO large steamships, the *Finland* and the *Kroonland,* will be changed from coal to oil burners. By this change it is expected that $9,000 will be saved on fuel and $3,500 in wages on each trip. In addition, by the large space now occupied, coal may be used for the storage of freight. A total saving of $37,500 is expected on each trip.

The window salesman need no longer resort to cards and dumb-show. By means of a loud-speaking telephone he talks to his audience on the sidewalk



The new rest-house at the entrance of the Garden of the Gods near Colorado Springs is built after the style of a Pueblo village, in keeping with the primeval magnificence of the park and its traditions

A Pueblo Village for the Garden of the Gods

BUILT in the architectural style used by the Pueblo Indians of the Southwest, a novel rest house has been erected by the Colorado Springs Park Commission just within the gateway of the Garden of the Gods.

This magnificent park now has a structure in keeping with its surroundings and its traditions, as the appearance of the building harmonizes in its rugged lines with the rocky backgrounds, while the color, of a reddish tone, also corresponds with the hue of the cliffs and boulders. The terraced effect of the building is borrowed directly from the community houses such as are found in Taos and a few other primitive native towns, built in similar craggy places.

Monument Built to an Apple Tree

PERHAPS one of the most curious monuments in existence has recently been built in Ontario by Canadians. The farmers have just erected a marble pillar to mark the site on which grew a famous apple tree.

More than a century ago a settler in Canada named McIntosh, when clearing a space in which to make a home in the wilderness, discovered among a number of wild apple trees one which bore fruit so well that he cultivated it and named it McIntosh red.

The apple became famous; seeds and cuttings were distributed to all parts of Canada, so that now the McIntosh red flourishes wherever apples grow in the great Dominion. In 1896, the original tree from which this enormous family sprang was injured by fire; but it continued to bear fruit until five years ago. Then, after fifteen years, it died, and the grateful farmers have raised a marble pillar in honor of the tree which has done so much for the fruit growing industry of their land.

The story of this apple tree illustrates the African proverb that though you can count the apples on one tree, you can never count the trees in one apple.

Two Bridges with but One Approach

TWO bridges that use the same right-of-way present a study in economy that may be seen at Pasadena, California. Both bridges are of reinforced concrete, and both are for vehicular travel, each entirely independent of the other. The small bridge, running lengthwise, is directly underneath the large one, and, in fact, its approach at one end passed through two of the piers of the larger structure.

The bridge that spans this picturesque stream has two rights of way, one for the dwellers on the plateau and one for those of the valley

The large bridge, completed about two years ago, was constructed at the combined expense of the city of Pasadena and the county of Los Angeles. It has a total length of one thousand, four hundred and seventy feet, and is composed of nine spans and six girder spans, besides the usual abutments. From the lowest point in the channel bed to the roadway level it is one hundred and sixty feet in height, and the roadway that traverses it is twenty-eight feet wide, with a five-foot sidewalk on either side. Extending across what is known as the Arroyo Seco, from rim to rim, it spans not only a small mountain stream, but also a lowland of considerable extent, embracing many acres of orange groves and a number of fine homes. It is a feature of a much-traveled automobile road that connects Pasadena with the city of Los Angeles, and is of rather ornate design.

The small bridge, finished only recently, was built at the expense of private property party owners. It is composed of one long span and two short ones, and, including approaches, is about three hundred feet long. Built directly underneath the large one, it is designed to bridge the stream channel only. Owing to the skeleton-like construction of the piers of the great structure overhead, one of its approaches passes through one of these piers, and the roadway leading thereto pierces still another. The purpose of this small bridge, thus located, is to serve the property owners who reside on the level below the rims of the depression, so that they may not be required to make the long and circuitous climb to and from the larger bridge's approaches.

A Vast Tank with a Park on Top

A TWENTY-FIVE MILLION gallon concrete tank which will be hidden from view by being parked over, probably the largest of its kind in the world, has been constructed in Cleveland as a part of the new filtration plant.

The top of this one hundred and fifty million gallon tank will be a fifteen-acre park

The plant will have a capacity of one hundred and fifty million gallons a day. It covers fifteen acres.

When completed the tank will be covered with earth and become a part of the city park on which the plant is being erected.

The Making of a Submarine Mine

By John Randolph Rexford

A battery of mines electrically exploded. Here is a fiercely graphic illustration of the destructive power which is contained in the comparatively small globe or cylinder of steel whose sowing abroad in the sea is the first duty of the navy and coast defense when war breaks

ORIGINALLY all forms of apparatus designed to explode under water to destroy ships were called torpedoes, but this term is now applied only to the well-known naval weapon. Submarine mines may be divided into three groups:

1. Buoyant mines having a constant depth of immersion.
2. Ground mines which are used in shallow waters and rest on the bottom.
3. Floating mines.

The mines belonging to the first and second groups may be exploded either from land by an electric current or by automatic contact with a ship.

Electrically controlled mines are employed only for the protection of harbors and channels and may be divided into two classes: those which are entirely and those which are partially controlled from land. A mine consists generally of two perfectly watertight metal casings made of suitable shape. One of them is hollow and is intended to act as a float to maintain the mine at the required depth below the surface, while the other one is filled with the charge, which may be guncotton, trinitrotoluene or any other suitable explosive, and the detonator for firing the charge

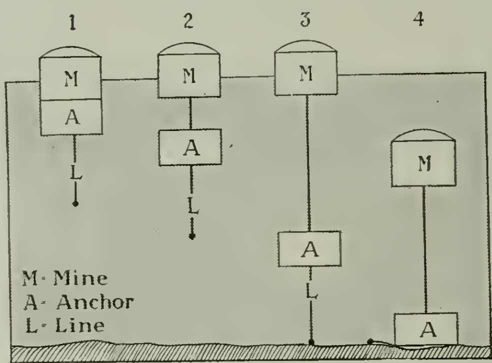
In coast defense work where electric control is employed, mines are anchored permanently in suitable positions, where hostile vessels are likely to pass over them, and are connected by means of electric cables to the shore. Where mines are entirely controlled from shore, an observer on land can fire any mine or groups of mines by closing the electric circuit the moment his optical instruments inform him that the enemy's ship is over a mine.

Firing an Electrical Mine

Mines which are partially controlled from land are anchored only a few feet below the surface of the water. When a ship strikes such a mine an electric contact is made which sends a signal to the shore station. The observer can then decide whether to fire the mine or not. An advantage of electrically controlled mines is that neutral ships can be allowed to pass over such mine fields in perfect safety. The use of such mines has, however, been considerably reduced, chiefly because salt water is one of the greatest enemies of electrical apparatus and makes it very difficult to maintain the electrical connections with the mine, and also because the permanent location of such mines could be discovered by spies.

The mines which have been chiefly used in the present war are automatic and mechanical, and are fired when the ship strikes against them.

It is by no means easy to design a satisfactory mine which shall have its firing gear carefully adjusted so as to insure explosion of the charge from the slightest shock produced by contact with the passing ship. At the same time provision must be made to prevent the premature firing of the mine either on land, on the mine laying ship, or when being launched into the mine field. Again, it is important that should one or two mines be exploded, the adjacent ones be not fired accidentally—a difficult problem, as the concussion of the water produced by the explosion tends to disturb other mines. Another essential condition is that the depth of immersion under the surface should be constant so far as the rise or fall of tides allows.



Positions assumed by a mine and its automatic anchor in water from the moment of dropping the mine overboard to the final moment of mooring

A mine consists of three parts: (1) the chamber containing the firing mechanism, the detonator and explosive charge: (2) the flotation chamber to give buoyancy to the mine, and (3) a detachable anchoring chamber provided with a winch having a paying out cable.

A mine is maintained at the desired depth in the water by means of an anchor in which the cable, one end of which is connected to the mine, is unwound from a drum suitably braked and mounted in the anchor casing. The rotation of the drum is controlled by a plumb weight attached to a short sounding line. When the plumb weight reaches the bottom of the sea the rotation of the drum is stopped and the mine is pulled down to the required depth. It is only necessary to determine at what depth below the surface it is desired to anchor the mine and to throw into the water the complete apparatus, namely the mine and anchor, whereupon the whole apparatus will take up its proper position, the depth of submersion being determined by the length of the sounding line.

The diagram on this page illustrates the working of the automatic anchor:

Position 1. After having been dropped overboard the mine is at the surface of the sea with its attached anchor immediately below the mine with the plumb weight hanging about nine feet below the anchor.

Position 2. The barrel is unwinding its cable and the anchor is descending to the bottom of the sea owing to the force exerted by the plumb weight in keeping down a lever, so that the drum is free to rotate.

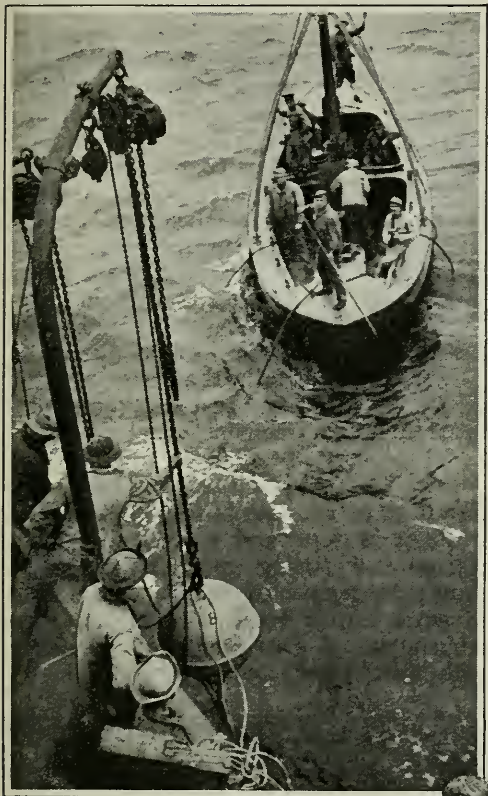
Position 3. The plumb weight reaches the bottom of the sea and the pull exerted on the lever ceases. This lever is now released and locks the drum, so that it cannot pay out any more.

Position 4. As no more cable can be paid out the anchor has sunk to the bottom of the sea and drawn the mine with it. It will be seen from the diagram that the depth of immersion depends on the length of the sounding line.

A safety device is generally introduced which is operated by the pressure of the water. The firing gear is locked by a spring which, however, is counteracted by the pressure of water. When the mine is submerged the firing gear is operative, but as soon as it comes to the surface the water pressure is gone and the mine cannot be fired. The percussion device employed is of the usual type for exploding charges of guncotton and does not differ from those ordinarily used.

The detonator is sharply struck by a ball or a lever when the mine is hit by the ship and causes the main charge to explode.

In order to make a mine field as effective as possible loose ropes are sometimes connected between different mines with the object of getting the ship's propeller entangled in the rope and thereby drawing the mine towards the ship and exploding it.



Launching a submarine mine

Mines of the type described are easily laid. When stowed away on the deck of a mine-laying ship the mine rests on the anchor which at the same time forms a little carriage to be run along the deck and simply dropped over the stern of the ship at the right moment.

Whether mines have actually been laid by submarines is, of course, known only to the naval authorities. Patents have, however, been taken out within the last few years for specially designed mines to be laid by submarines and also for providing submarine boats with a series of chambers on each side for holding and launching mines. These chambers are disposed between double walls of the submarine and are made to form a smooth outline with the hull of the boat. This provision makes it possible to carry a double cargo.

Mines Which Become Ineffective After a Certain Period

Unanchored automatic or floating mines must be dead in an hour. They are used to some extent in naval battles and are very cheap in construction. In some mines of this type clockwork is used which after an hour throws the firing gear out of action while in another type delay-action devices for opening valves to admit water are employed so that the mine is sunk after a definite time interval.

To some extent chemical methods are employed to fire the charge in floating mines, but a disadvantage is that the explosion does not take place instantaneously as is the case with a mechanically fired mine. A glass tube is attached to the mine which is broken when struck by a ship; water enters and by coming in contact with sodium or potassium fires the charge. Other chemicals such as sulphuric acid have also been used to fire the charges in floating mines.

Loading an American mine. Unanchored automatic or floating mines must be dead in an hour. Various devices are incorporated to obtain this result

A Millinery Store on Water

A RETIRED milliner of Atlantic City, who spends his winters in Florida, bought a boat at Daytona and converted it into a millinery store. The exigencies of the situation made this original store desirable, for buildings are not allowed on the shore side of the street along the beach, and therefore rents are very high on the other side of the street. With his boat scheme he combined home comforts with a fine business location. His boat is seventy feet in length and twenty feet wide, and is lighted inside and out with electricity.

Bonnets for sale on water

An Automobile Show Case

ONE of the latest features of the business world of Monrovia, Calif., is the delivery outfit devised by the proprietor of a dyeing and cleaning establishment. It has been termed the "show case" delivery outfit. It is built like the ordinary delivery case, but its two sides and back are of glass, so that the suits or cloaks inside may be plainly seen by pedestrians upon the sidewalk or the occupants of passing machines. The coat hangers are hooked over screw-hooks fastened to the roof of the case.

The owner removed the rear seat of his five-passenger car and in its place located the case. Both the case and the rear seat are "quick detachable" and one may be changed for the other in a very few moments. The floor of the case is four feet square, while it is four and a half feet high. As an advertising medium this case shows the people of Monrovia the kind of work turned out by this cleaning establishment, a plan which fits in nicely with this "show me" age.

A Sandstorm to Order

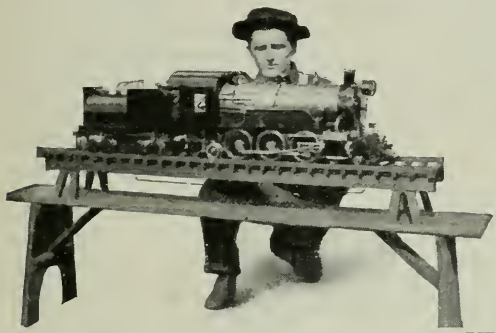
A NEW use for the aeroplane has been recently discovered. A prominent moving picture director was searching for the best method of reproducing a sandstorm on the scenery, and took his company to the government aviation school. The scenery was set up on the sandy grounds surrounding the school, and one of the aeroplanes was held fast and the motor started. When the motor was turned to full speed, the back-wash from the propeller stirred up a real sandstorm over the outdoor stage.


A California dyer displays his work in a glass delivery wagon. He took off the rear seat of his five-passenger car and in its place located the glass case in which was displayed his work on its way home to the customer

A Boy's Wonderful Working Locomotive Model

A MINIATURE railway locomotive, complete in every detail, which has attracted the attention of the railroad officials of several Pacific Coast lines, is the handiwork of Arthur Johnson, of Portland, Ore.

This tiny locomotive, only forty-five inches in length, was built to test a new invention of his on a firebox. It is operated by steam, generated by oil fuel, and is equipped with air brakes, an in-



A working model of a locomobile, built by this boy, which develops one-quarter horse power and will haul a ton

terior throttle and reverse levers and gears.

The engineering department of the Southern Pacific Company borrowed the model and figured out its weight, power, and all other statistics in the same manner that they would figure on a full-size locomotive. To their surprise they found that the tiny engine developed one-quarter horsepower, and on a level track had a haul capacity of one and a quarter tons.

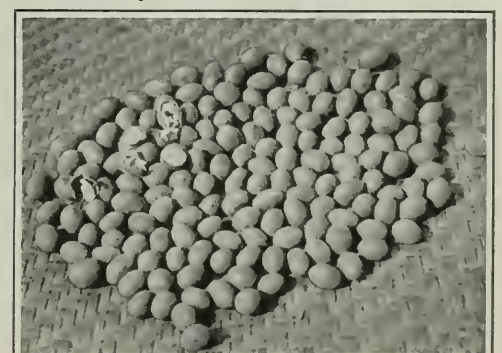
How Savages Prepare Poisoned Arrows

THE savage tribes of interior Africa have attained an extraordinary degree of skill in preparing poisons with which to make their arrow heads the dread of their enemies. Although they use a variety of substances in making the poisonous fluids, such as animal extracts, and products of decay, the most common source of the most violent poisons is found in several species of tropical plants. One of these, the Strophantus, is extensively employed by the tribes of West Africa. They boil the fruits of this plant in water for about twenty-four hours, frequently adding to the liquid heads of serpents, tainted blood and a mixture of dead frogs. When this devilish mixture has cooled to a thick mass, they dip the heads of their arrows into the poison, and then allow them to dry in the sun. They repeat this process every few months so as to retain as much of the deadly effect as possible. The action of these poisons is very violent, death resulting, with intense agony, in five or ten minutes.

Two-Year-Old Eggs.

THE accompanying photograph shows a batch of eggs on sale in the native market at Nanking, China. China like other nations, consumes a large number of eggs, but the Chinese have very extraordinary methods of preserving them, by which they are kept for long periods. Eggs can be found in various inland towns of China that were known to be two to three years old. Like those in the photograph they were almost jet black and very hard, but nevertheless eatable.

When fresh, the eggs are covered in a thin coat of clay or similar mixture and then cooked until they are quite hard. They are then immersed for several hours in water. Treated in this way the eggs may be kept almost indefinitely.



These eggs are two years old—and good

The February Popular Science Monthly will be on sale Saturday, January fifteenth. (West of Denver on Thursday, January twentieth.)

Your Feet Are Wiped When You Enter Bohemian Bakeries

IT is an old custom in Bohemian bakeries to wipe the boots of visitors as they enter. There is a good deal of wiping these days; for the government and city officials inspect the bakeries at very frequent intervals in order to see that the regulations regarding the amount of flour used in bread are carried out.

The picture shows Dr. K. Gross, the burgomaster of Prague and representatives of the city council, entering one of the bakeries of the city. The burgomaster is the man whose boots are being wiped.

How Range Finders Find the Range

ONE of the most interesting facts brought out in Germany's submarine campaign against British commerce was the accuracy with which the British guns were trained upon occasional indiscreet periscopes.

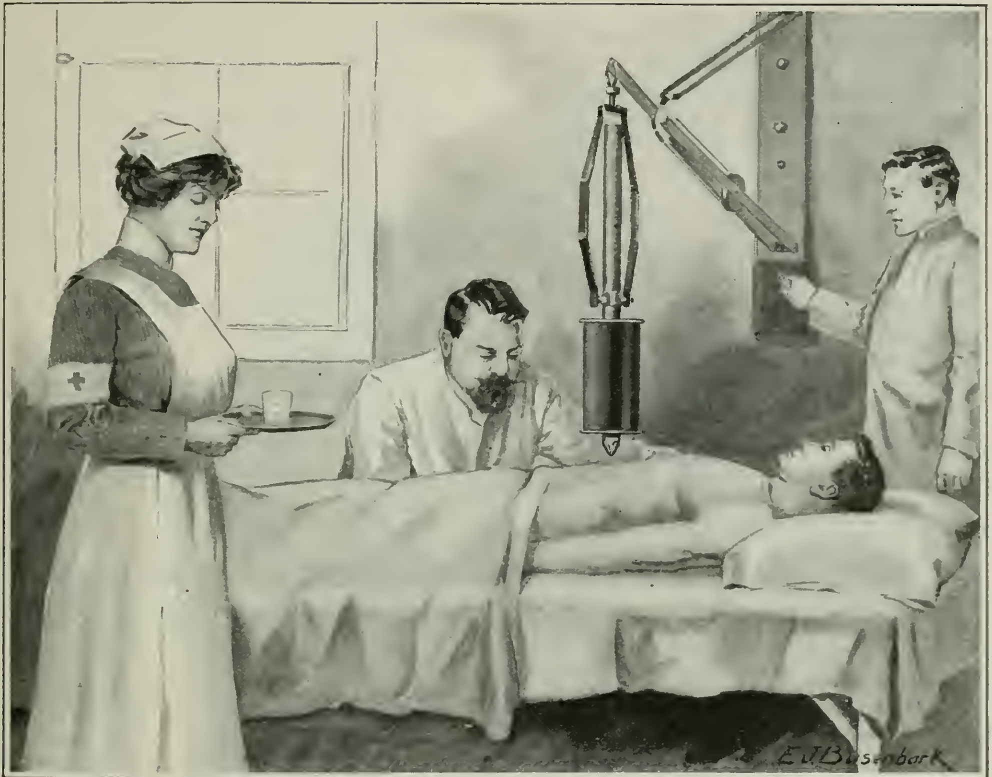
The periscope tube is small, and an especially difficult target at long range. yet on a few occasions — occasions which were so recurrent that the accuracy could not be attributed to accident —British guns have demolished periscopes, thereby rendering the submersible helpless—an easy prey when she came to the surface.

Nor can this remarkable accuracy be attributed entirely to the correctness of the gun design. The fact of the matter is that the British method of range-finding, aside from being one of the most interesting, is one of the most accurate in the world.

Whether the enemy appears in the form of a glinting periscope on the water, a black dot, or a ship on the horizon, the method of range-finding is fundamentally the same. A range-finder works on the same principle as that by which we can estimate a distance with our eyes. Lines drawn from our eyes to the object form sides of an angle. The size of this angle determines the distance. Unconsciously and automatically we reckon distances by the complicated process known as triangulation.

What we estimate roughly with our eyes, range finders determine accurately

The workman is not performing an act of homage. He is simply dusting off the shoes of the Burgomaster of Prague. It is an old Bohemian custom that the boots of all visitors to bakeries must be so wiped



The electromagnet is used with success by war surgeons to extract splinters of steel which are near the surface. When used on deeply buried missiles it has been found to make bad wounds, because the fragment tears its way out through the flesh

with lenses and measuring instruments that are wonderfully accurate.

In the Marindin range finder, which is the type most commonly used in the British infantry, an optical arrangement is used, having an equivalent of two eyes mounted thirty-one and a half inches apart. Two reflecting prisms are employed, so that the rays are brought together in a combined beam to the eye of the range officer.

A more complicated form of range finder is one equipped with magnifying lenses and an adjustable prism by means of which the instrument can be used for recording distances. When the instrument is directed towards some distant object, it will be split into unmatched halves until the prism is adjusted to the correct angle. The distance is then indicated on a dial.

Range finders used on battleships are fundamentally the same as the Maradin finder. They differ only in details.

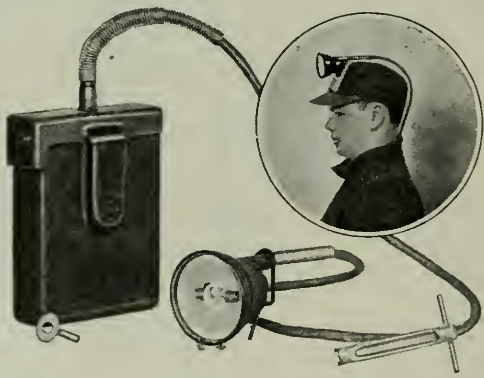
The Electromagnet in War

THE electromagnet has long been used by surgeons to extract splinters from the eye. It has not proved so serviceable when its use has been extended to other parts of the body. In the present war surgeons found that deep-lying fragments of shrapnel are literally torn out by the magnet, with the result that gaping wounds are produced which are difficult to handle. For that reason army surgeons, in Germany at least, prefer to restrict the use of the electromagnet to those cases in which the steel splinters lie very near the surface.

A NOVEL device which announces to the chauffeur any overheating of his engine is made so that a streamer is released from the radiator cap to blow against the windshield. The ribbon is made of a bright-colored material, and shows at night as well as in the daytime.

A Miner's Safety Electric Lamp

OWING to the hazardous nature of work in gaseous mines, a demand has been growing for a practical, portable electric lamp. That an electric lamp would be safe to use has been well recognized, because it would be made so that it would not ignite inflammable gases and would produce a uniform light regardless of atmospheric conditions. The perfection of the efficient tungsten lamp in miniature sizes and the development of small, efficient, light weight storage batteries has resulted in the design of the long-desired miner's electric lamp.


A miner's safety electric lamp has long been wanted. This one seems to fill the bill

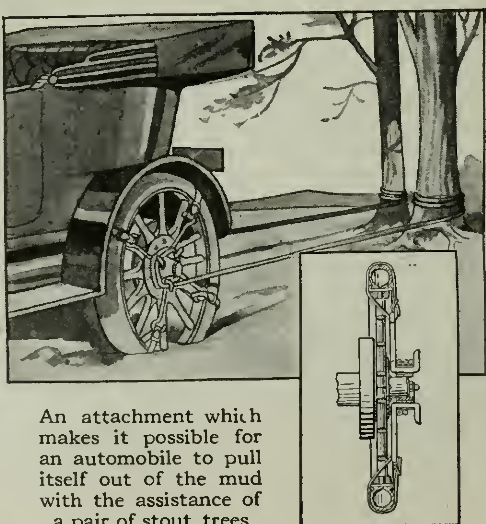
The prime feature of this lamp is that it has been made thoroughly safe to use. By adequate insulation of the entire circuit, placing all terminals and contacts inside of locked and sealed steel cases and providing automatic means for extinguishing instantly the glow of the filament, should breakage of the lamp bulb expose it to the air, this lamp has been made both safe and rugged. The outfit complete weighs but three and three-quarters of a pound, of which three and a half pounds are carried on the belt and four ounces on the cap. The battery will light the lamp twelve hours per charge and can be relied on to furnish light at least ten and three-quarter hours per charge at the end of one year's service.

The bulb is held at the focal point between contact springs, which maintain it constantly under stress, so that, in case of a blow otherwise only sufficient to chip or partly break the bulb, it will be completely shattered by the springs and will drop clear of the contact. Sufficient space is provided between the reflector and glass cover to keep broken lamp parts from short-circuiting the spring contacts. This prevents the possibility of ignition even if the cap lamp is seriously damaged amid explosive gases.

By means of this improved lamp, a miner may work amid a steady white light, and feel secure from devastating explosions.

Using an Automobile as a Winch

AN attachment for the rear wheel of an automobile, by which the automobile may be made to serve as a winch has recently been brought out. Four hooks are attached by straps to the tire. The hooks are bent at their inner ends, and a coiled spring passed through the loops thus formed, so that the hooks point towards the hub. A cable is wound about the loops and securely fastened.


An attachment which makes it possible for an automobile to pull itself out of the mud with the assistance of a pair of stout trees

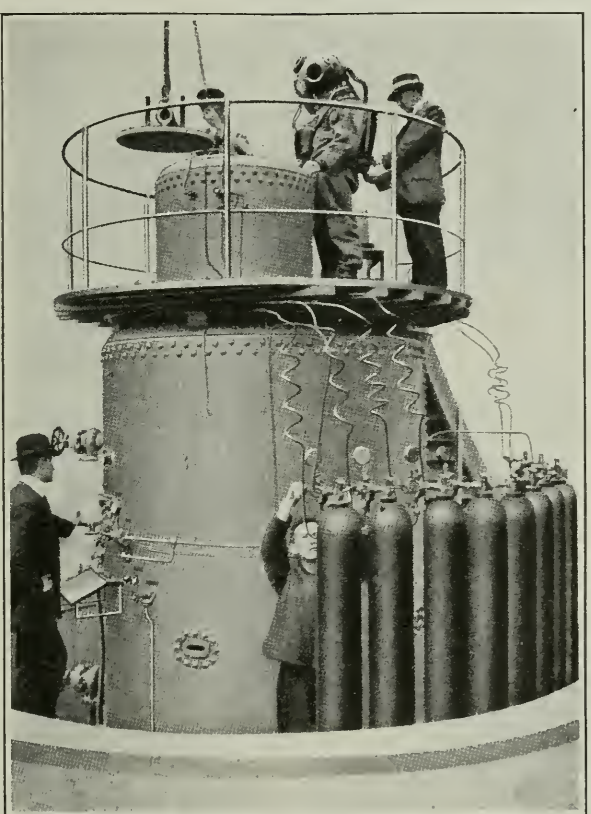
When the motorist finds himself mired, it is a simple matter to pass one end of the rope about the nearest tree or telephone post and then to start the car on the first speed. The revolutions of the wheel wind up the rope, and act as a very powerful winch. The car is soon out.

New Diver's Suit Does Away with the Hand Pump

A GERMAN has invented a breathing apparatus for divers which does away with the cumbersome hand pump and tubes. A diver can descend in the water with no other impediment than a safety rope and telephone wires, and these can be dispensed with if desired.

The feature of most unusual interest in connection with the equipment is the means of refreshing the air. Vitiated air from the lungs is forced into a tank containing several layers of potash through which it percolates. The potash cartridge absorbs the carbon dioxide. The oxygen supply is replenished from a small oxygen tube as it is required.

Caustic potash has been found to be the most satisfactory chemical for absorption purposes. In this new device it is placed in a number of shallow trays one upon the other; so that the air passes through each layer.



The air inhaled by the diver is purified chemically and breathed again and again through an apparatus which he can carry on his back. The diver is about to enter a tank in order to test the apparatus

An Ancient Wooden Leg

SOME years ago, when archeological researches were going on at Capua, Italy, the excavators came upon an ancient tomb. Upon opening it they found it to contain a rather unusual relic of the past. A skeleton was found, and with it were numerous objects supposed to have been associated with the living personage of whom this was the sepulchre. One of the objects, as to the use of which there was no doubt, was an artificial leg. One of the leg bones of the skeleton was missing, indicating that the leg had been interred with the wearer. The artificial limb, a creditable mechanical contrivance, was made of a combination of bronze, wood and iron.

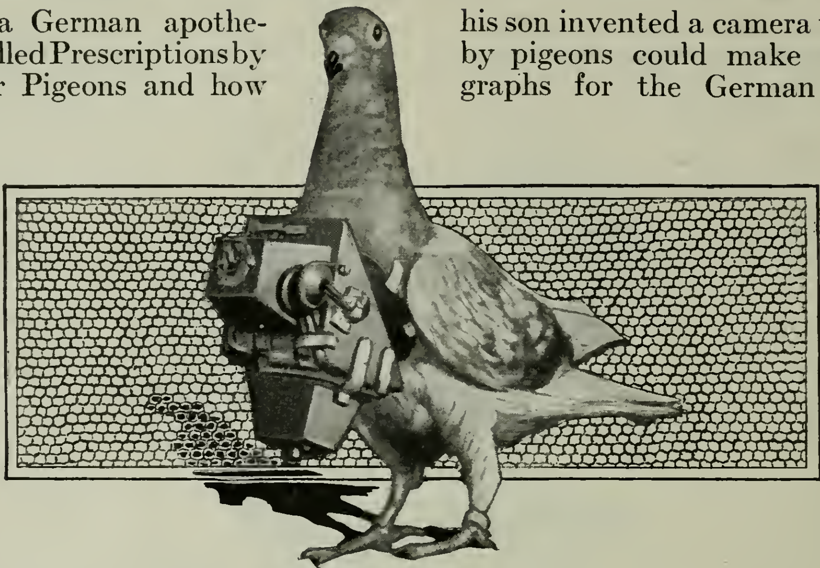
Fortunately, the tomb also contained some evidence as to the age of its contents and the period in which the wearer of the wooden leg might be supposed to have been walking on it. Three vases were found which were decided upon as being representative of the period which had ended some three centuries before the birth of Christ.

With this remote date practically fixed as a time when very advanced forms of artificial limbs were in use, an interesting light is shed on the antiquity of their invention. It is natural that there should be a considerable period of development between the first crude effort and a fairly well-finished combination of wood and two different metals.

The artificial leg here mentioned may still be seen, preserved in the museum of the Royal College of Surgeons in London. It is an evidence that archeology may teach even the surgeon.

The Pigeon Spy and His Work in War

How a German apothecary filled Prescriptions by carrier Pigeons and how his son invented a camera whereby pigeons could make photographs for the German army



ONE of the strangest phenomena of the war has been the revival during its course of methods and implements used in the warfares of medieval times and even of antiquity. We hear of slings and catapults for firing explosive bombs a short distance, of arrows shot from aeroplanes, of helmets, breastplates, and shields for the protection of the soldiers. Now, last of all, comes word that pigeons, the carriers of intelligence in times of stress in remote times, are used as photographers of the positions of the enemy. It is a strange medley, the air-ship, the last and most daring invention of man's brain, rising in the early dawn to search out and photograph the foe's movements, and the graceful pigeon, so frequently mentioned in the stories of early days, soaring, perhaps at the same moment, to act as an aerial scout.

But modern ingenuity has added something to the older roles of the carrier pigeon—and has turned him into a photographer. The only authenticated reports of this use have been found in accounts of a German invention, some of the pigeons having been brought down behind the allied lines. Whether the Allies have tried the same means of getting photographs of German entrenchments and troops is a matter of conjecture.

The story of this development of the pigeon's work goes back to 1840, and the enterprise of a German apothecary of Cronberg named Neubronner.

He gave the doctors of the surrounding country pigeons by which they could send him prescriptions needed in haste. In this way the medicine was ready by the time the messenger with the other copy of the prescription arrived. In urgent cases the apothecary, himself, sent a messenger with the preparation. This ingenious sales' service was carried on for a long while.

The apothecary's son, Dr. Jules Neubronner, like his father, also had pigeons which he used to convey orders between his house and the sanatorium of Falkenstein, or to carry small doses of medicine, for which he had telephoned to his apothecary. One of his pigeons, a few years ago, stayed away for a month, and this led the doctor to devise a plan by which he could tell where his pigeons went when they were let loose. To this end he used a small, light photographic apparatus which could take views during a flight of about sixty-five feet a minute. The apparatus is arranged to fit the breast of a pigeon to which it is held by elastic bands that pass over the back. The shutter opens automatically at prearranged intervals and the roll of film, which moves in unison with the shutter, can take thirty photographs one and a half inches square. This allows an almost continuous registry of the principal points of view during a flight of six miles. One of the engravings shows a view taken in flight by the pigeon photographer. The general staff of the German army heard of Dr. Neubronner's ingenious device and investigated its adaptability for topographic reconnaissance. The method was evidently found satisfactory, for since the present war broke out many pigeon photographers have been found back of the Allied lines either killed or stunned by the explosion of shells and firing of machine guns.

The history of carrier pigeons in war goes back to the earliest times. Pliny tells us that Decimus Brutus, one of the assassins of Caesar, used pigeons, when besieged by Antony at what is now Modena, to communicate with the Consul Hirtius who was coming to his aid. The crusaders are known to have used them at the siege of Hasar·near Aleppo, and the medieval Sultan Noureddin of Egypt is said to have established a pigeon-post with relays of pigeons. Among the noted instances of their use in modern times is the story that the London Rothschild knew of the defeat of Napoleon at Waterloo, by means of carrier-pigeons, ahead of the English government, to his great financial benefit on the Exchange. But then, this is only one of a dozen stories of the origin of the Rothschild fortune.

Photograph made automatically by a carrier pigeon in its flight

Releasing a carrier pigeon from its basket on its photographic journey

No Chance to Pass This Shop

THERE is more than one way of impressing upon the public that at a given point refreshments are for sale The accompanying illustration shows how one merchant frightened passing motorists into noticing that he had refreshments for sale by an adaptation of a railway block signal. His store is on the state highway of California in the cactus country between Burbank and San Fernando. Few drivers pass this point without glancing up at the "warning" sign, incidentally reading the words on the down board, "Hot and soft drinks."

"Frightening" the motorist into drinking lemonade

This sign is made doubly effective by the fact that a few yards from it runs the main line of a prominent railroad. The driver proceeding along this stretch of road is naturally on the lookout for warnings.

An Illinois Community with Ideas in Street Lighting

IN the village of Kenilworth, Ill., the people carry out commendable ideas in ornamenting public grounds. They employ attractive methods in hanging their street lights. One of the plans is to suspend a square frame around a shade tree. An electric bulb, strong and brilliant, hangs at each corner of the frame.


Nature built these lamp posts

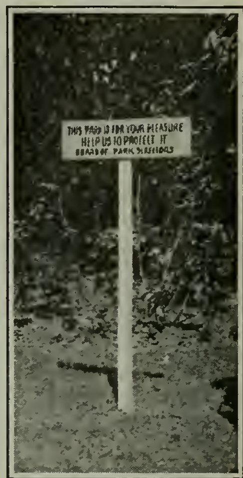
All signs and sign posts which the community finds necessary to place in the streets for the information of drivers and pedestrians are tastefully constructed.

In this village the plan of planting lawn trees in pairs and trios has been adopted. This is done to secure an immediate effect. Slender Carolina poplars are thus made to show considerable foliage in a very short time.

There is one big market and grocery store in this charming little Illinois town. The entrances to this building are banked with flowers.

Polite Sign Boards Bring Results.

A POLITE request is often more effective than a peremptory order. Hence the board of park directors tried the scheme in a small park near Lake Merritt, Calif.


Signboard that appeals to public sense of honor and civic duty

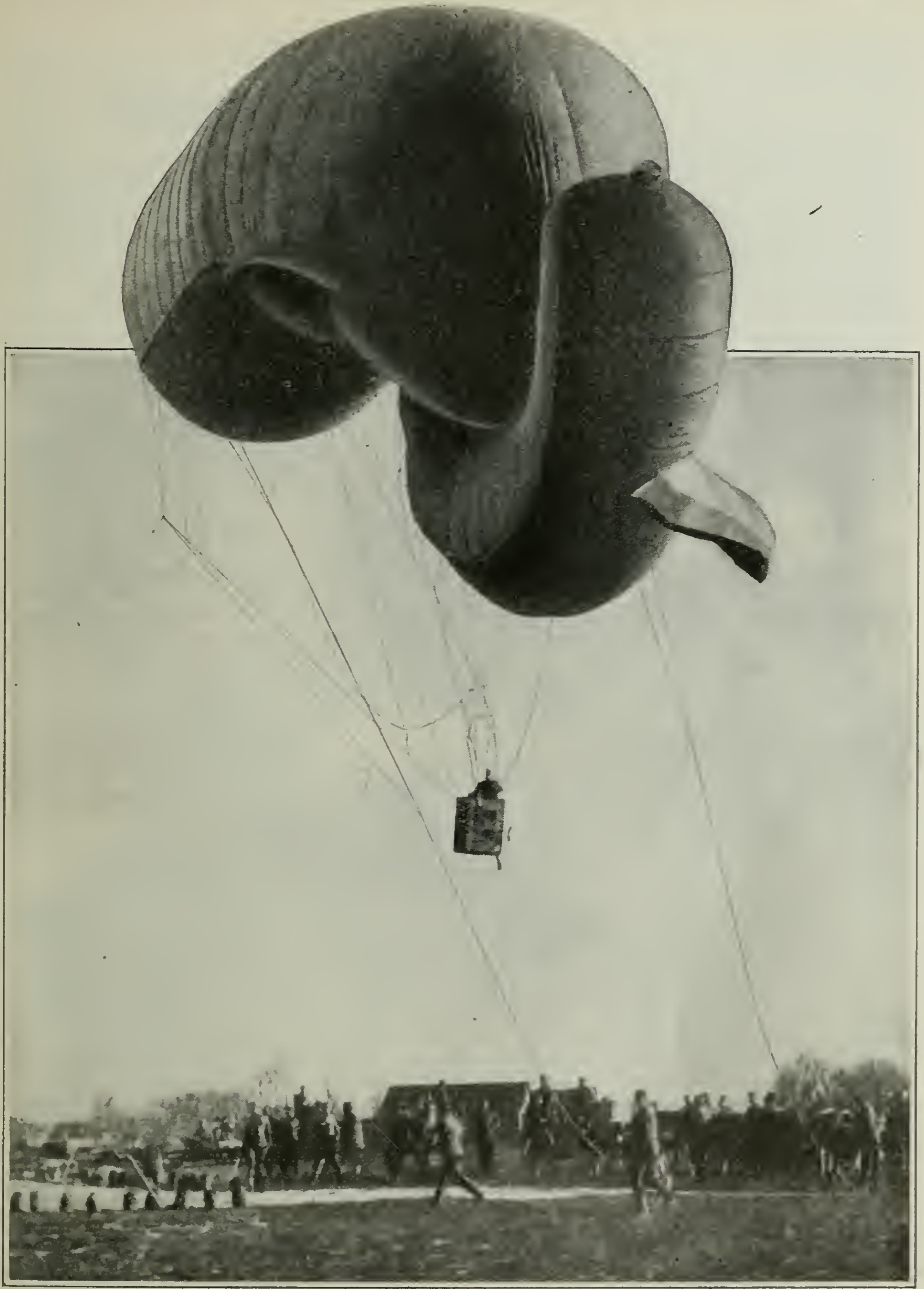
Instead of the usual order, "Keep off the grass!" or "Do not throw rubbish here!" a polite request reading, "This park is for your pleasure. Help us protect it!" has been put up on a small sign board. The directors of the park claim that it is much more effective than the old signs.

The same method is followed by the street cleaning department of New York city, where the ash carts carry continually changed signs urging the public to "Keep YOUR city clean."

Artificial Sausage Skins

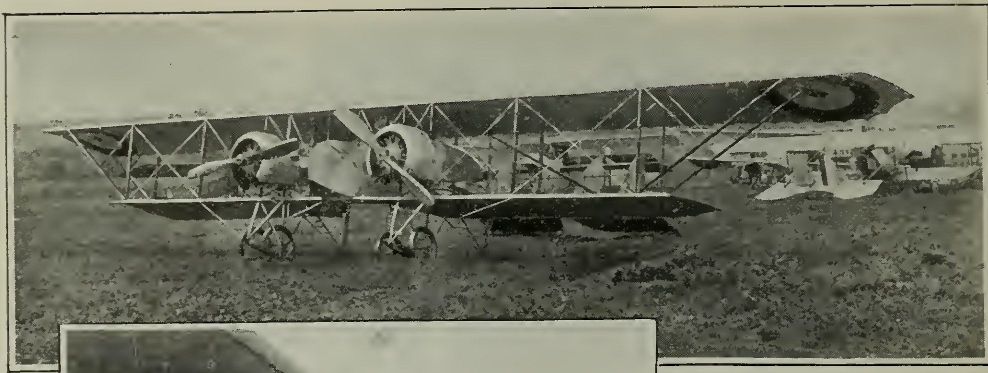
A GERMAN butcher has recently patented in this country a process for making artificial sausage skins from fibers of animal sinews. According to the inventor these fibers, which may be purchased very cheaply from abattoirs, may be cleaned more thoroughly than the intestinal skin. The sinews are digestible, and it will do no harm if pieces of the skin are swallowed.

Directing Artillery Fire from a Serbian Captive Balloon

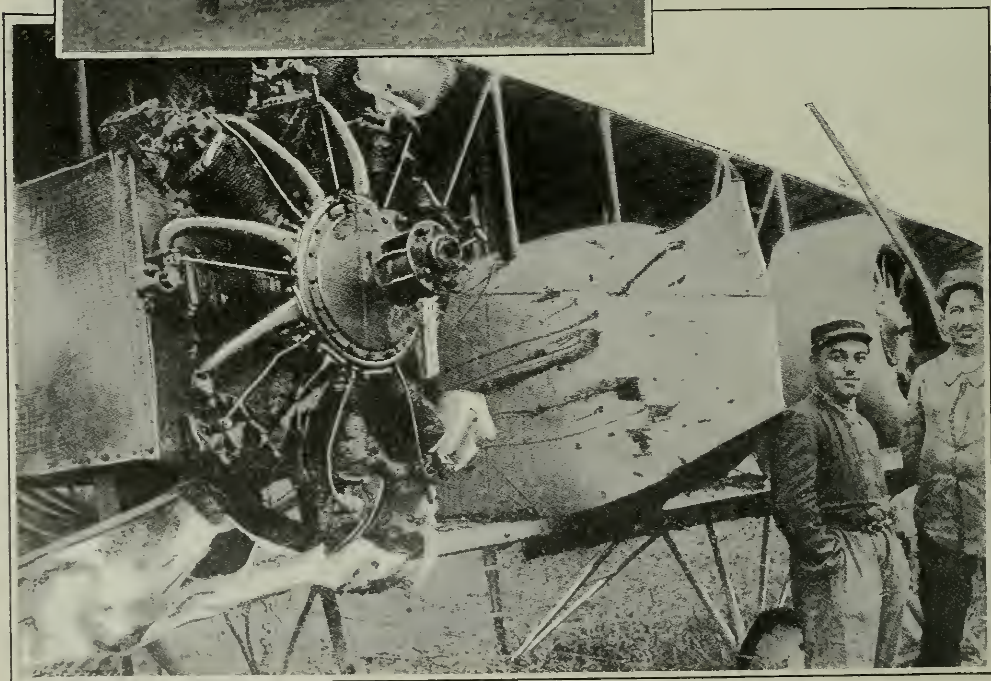


© International Film Service.

A Serbian captive observation balloon ascending for a survey of the Austro-German positions. This is built on the German Parseval plan, the sausage-like appendix to the main envelope acting somewhat like the tail to a kite, giving the balloon great stability in the air. Such balloons are almost standard in European armies



An armored French Caudron battle-plane (above), equipped with two engines, and a central fuselege which carries the pilot, observer, and a heavy machine gun. These machines are recent developments, but are giving very good account of themselves. On the left, the arrival of a biplane at Nancy



The result of a well-placed German shell, putting out of commission one of the Le Rhône rotary motors with which this machine is equipped. This is the same type of aeroplane as that shown in the illustration at the top of the page. Note the effects of the shrapnel upon the engine and the fuselege of the aeroplane

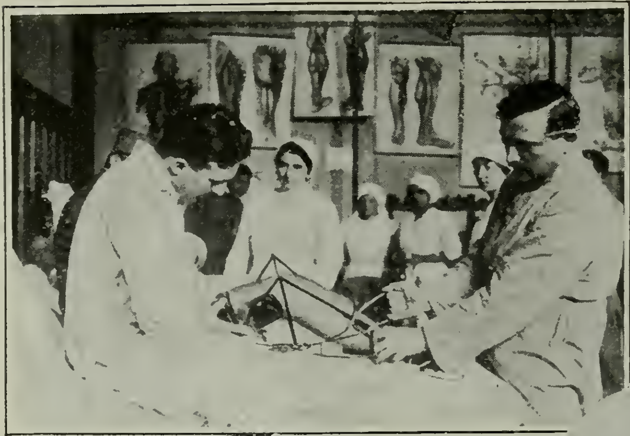
Work and Play After the Battle is Over

© Brown & Dawson

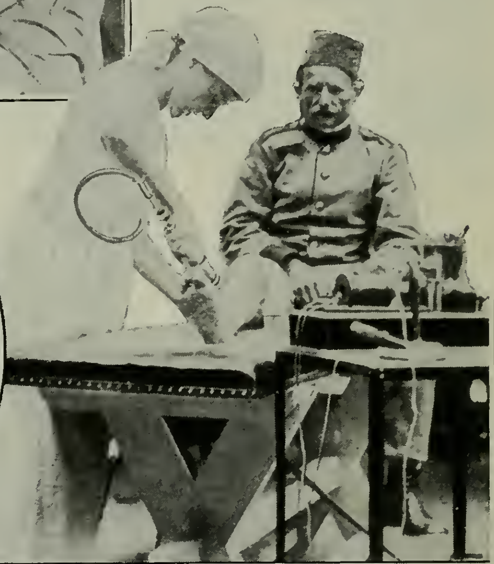
© American Press Association

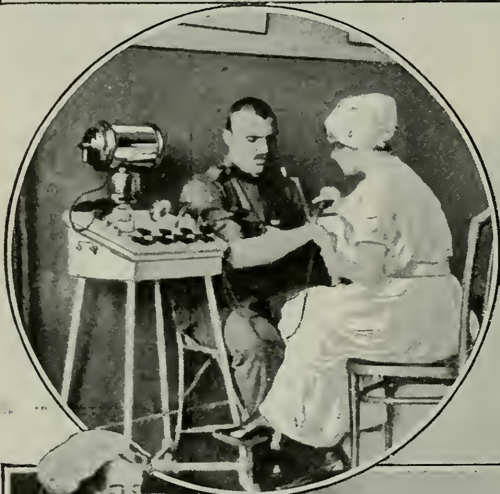
Wounded Tommies recover strength and health in the convalescent camps in which they are prepared for future work in the trenches. Above are shown Russian prisoners making uniforms for German soldiers—a less athletic employment

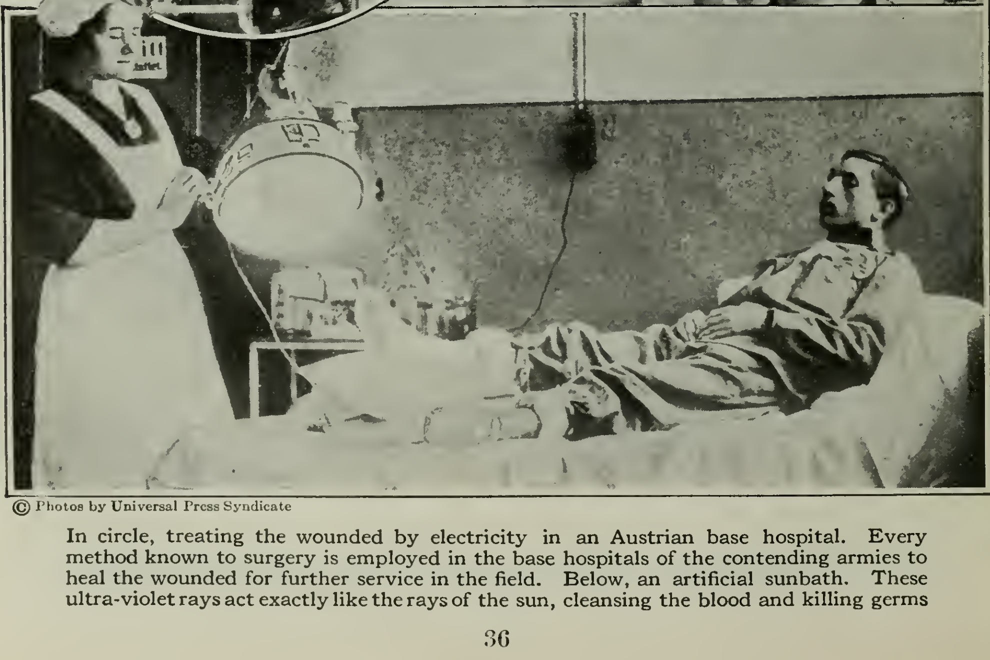
Electricity in the Hospitals



On the left, a mechanical appliance for straightening a wounded leg. In the process of healing, the leg became bent and the muscles taut, and unless straightened would be useless for life. Below, an electric massage use to restore circulation in an injured limb

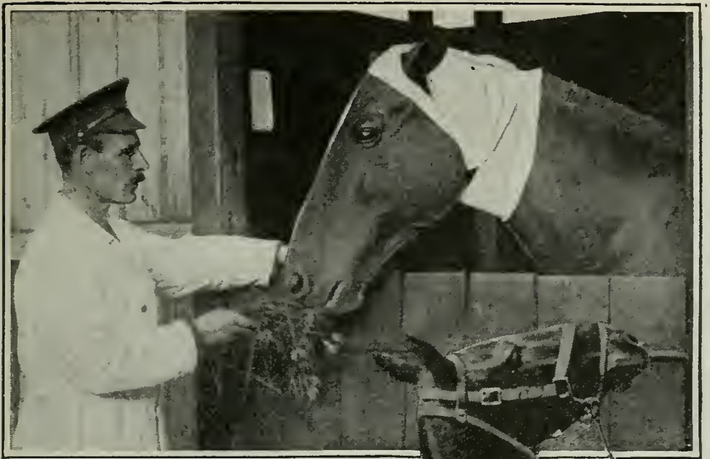




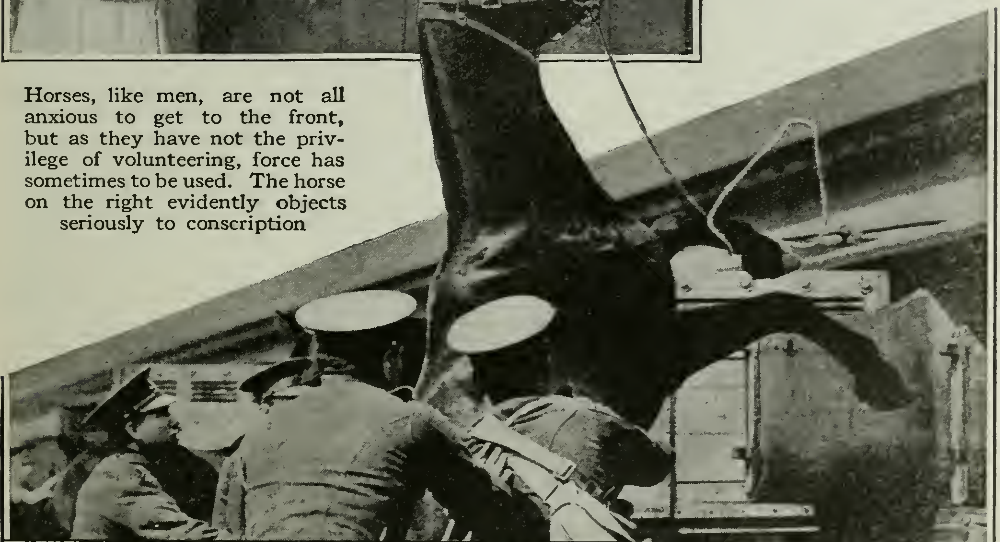


In circle, treating the wounded by electricity in an Austrian base hospital. Every method known to surgery is employed in the base hospitals of the contending armies to heal the wounded for further service in the field. Below, an artificial sunbath. These ultra-violet rays act exactly like the rays of the sun, cleansing the blood and killing germs

In the War Hospitals for Horses



A hospital has been established in Kent for victims of the war whose names do not appear on any casualty list. The inmates are horses which have been wounded or have contracted illness, and are being cared for by the Army Veterinary Corps, whose work is almost as important as that of hospitals for soldiers



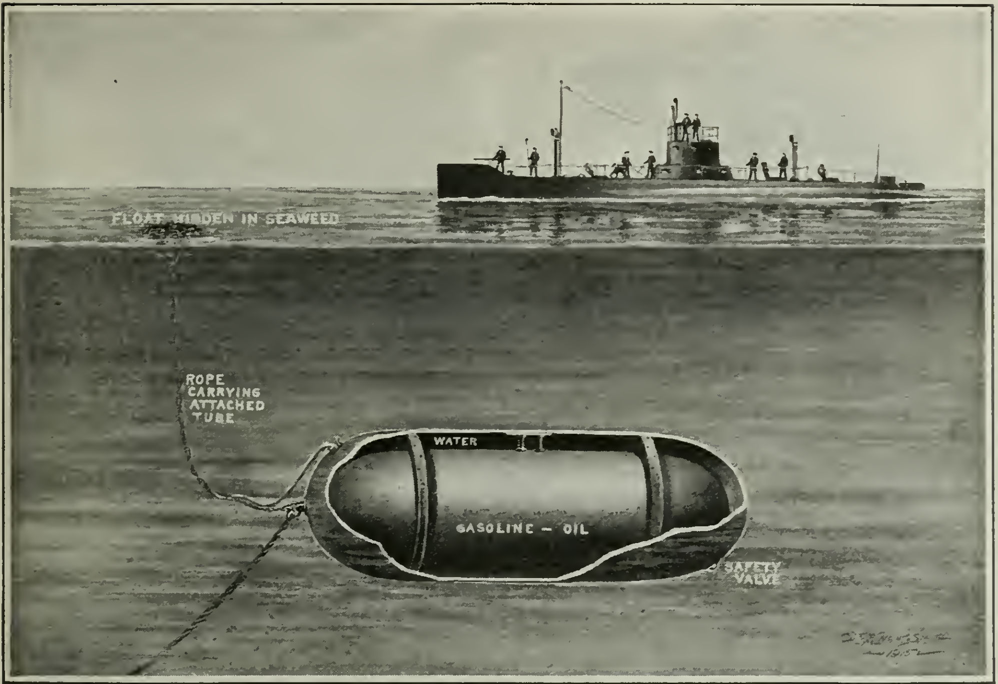
Horses, like men, are not all anxious to get to the front, but as they have not the privilege of volunteering, force has sometimes to be used. The horse on the right evidently objects seriously to conscription

In German hospitals for horses the best of care is taken of the dumb animals, and special organizations have been formed for the sole purpose of treating injured horses. The horse on the left has just undergone an operation upon an injured hoof

© Underwood & Underwood

The result of a premature charge. It is an accepted rule among the warring nations that the enemy's barbed wire entanglements shall be blown to pieces by artillery fire before the command is given to charge. These Russians have met death in the midst of the barricades defending the German positions in Poland

Secret Gasoline Supplies for Submarines



A submarine at sea can replenish its supply of gasoline or oil by means of the device illustrated. Within an outer container, a tank of gasoline or oil is placed. Between the outer container and the gasoline tank is a space filled with water. When the water is forced out by compressed air, container and tank rise to the surface

A float hidden in seaweed conceals the means of raising the tank to the surface. After the tank has been brought to the surface the submarine proceeds to replenish its supply of fuel by the simple expedient of pumping it into its reservoirs

Jack Frost, at Least, Will Be Routed

© Photos by Underwood & Underwood

In the upper pictures are shown some of the new sheepskin sleeping bags which will be served out to the allied troops. In the bottom picture, a German master tailor is applying efficiency methods to speed up the output of winter uniforms. A number of layers of cloth are put upon the cutting board, and a sharp disk swiftly follows the pattern, cutting the entire pile at the same time

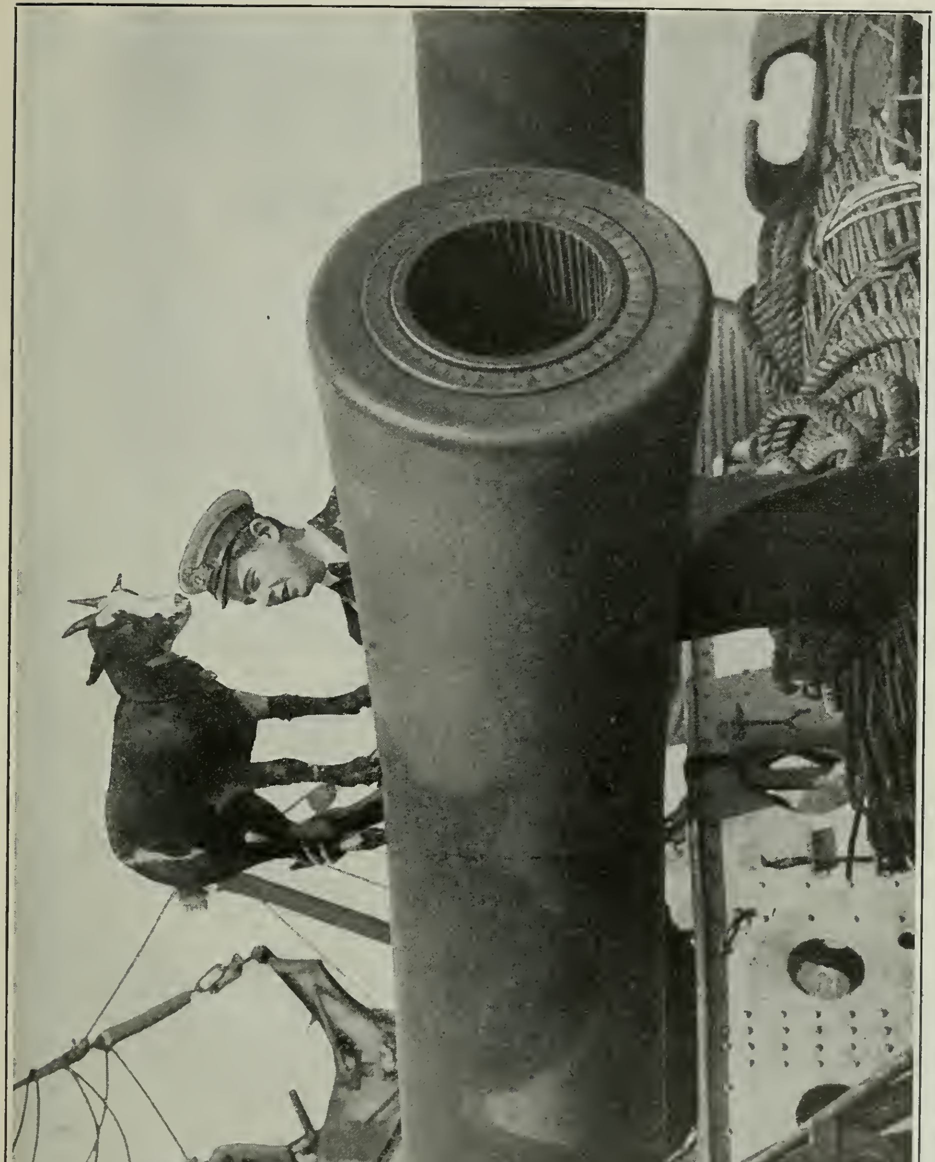
By Courtesy of Illustrated London News

A motorbus converted into a dovecote for the housing of pigeons until they are needed for service which no man or telegraph wire or wireless can perform

No, these are not chorus men. Despite their ballet skirts, tights, and fancy shoes; these Greek Highlanders are real fighters. They are seasoned campaigners, and may have an opportunity to test their prowess—but clad in more war-like garb

© International Film Service

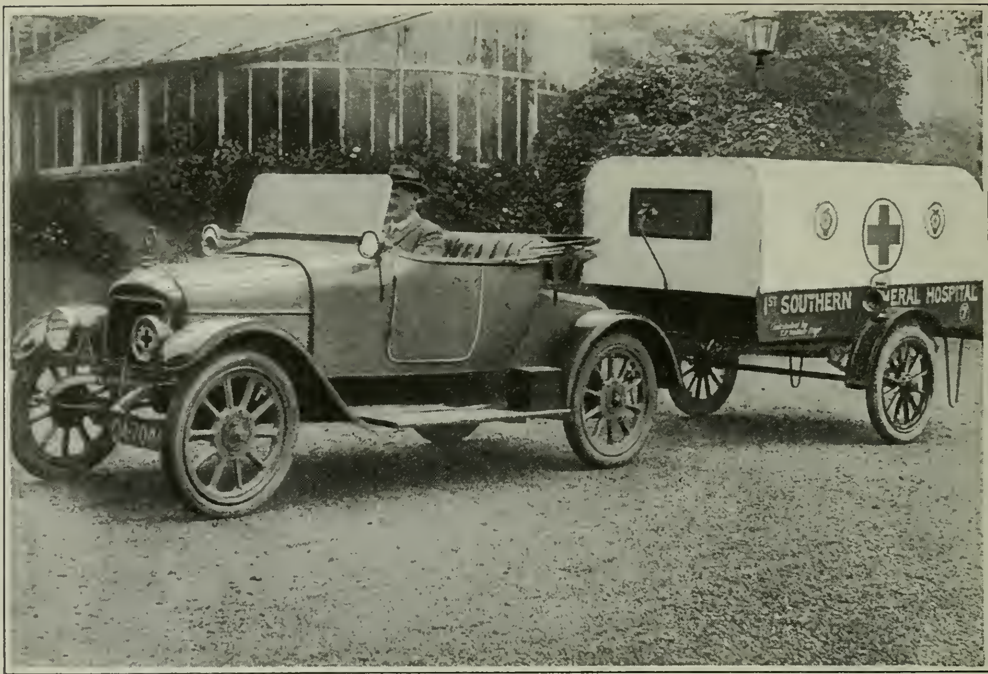
Members of the American Red Cross in Belgrade spraying Serbian soldiers with disinfectant upon their return from a long stay at the front. Serbia is still vermin-infested and disease-ridden, although typhus has been stamped out



© American Press Association

One of the twelve-inch guns on the British battleship "Canopus." Although these guns are extremely powerful, and throw a great mass of metal, a newer ship, such as the "Queen Elizabeth," could stay well out of range of the "Canopus," while with her bigger guns she could hammer her opponent to pieces without the slightest risk to herself

Extremes of the War Transportation Problem

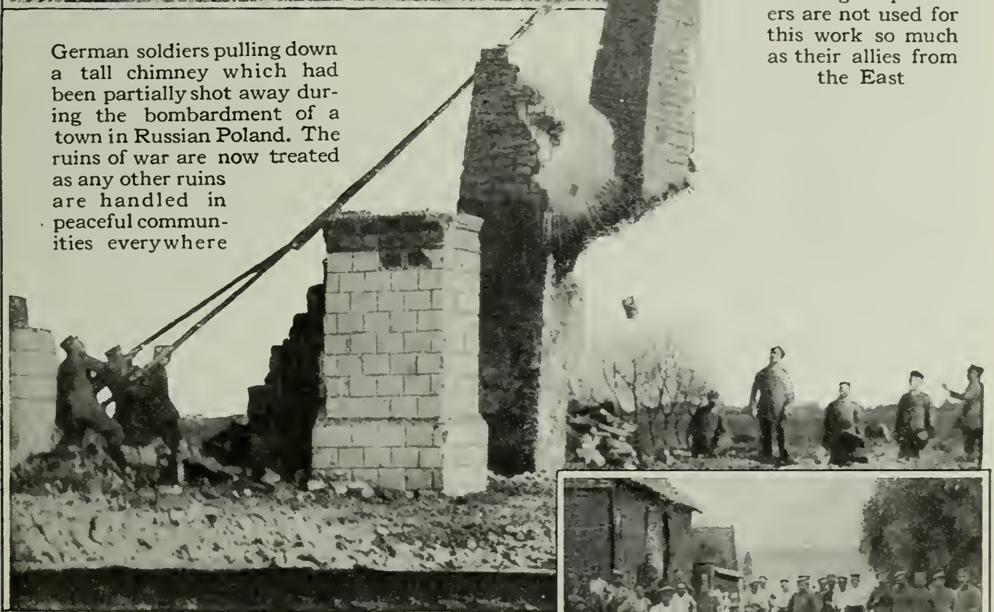


Private motorists in Great Britain are giving much of their time to volunteer ambulance work. They have supplied many of their pleasure cars with ambulance trailers as shown in the illustration and are doing useful work in carrying the wounded

Military trucks are sometimes mired in the swamps and mud holes near the front, especially on the Russian battlegrounds. Here is a German ammunition truck being pulled through a Polish swamp by a large force of soldiers

Unmilitary Phases of War

Austrian soldiers aiding Russian peasants behind the lines in gathering their harvest. By means of these harvests, the Austro-German forces are able to keep well supplied with food material. The two million Russian prisoners are probably being used to maintain the economic strength of both Germany and Austria. The French and English prisoners are not used for this work so much as their allies from the East



German soldiers pulling down a tall chimney which had been partially shot away during the bombardment of a town in Russian Poland. The ruins of war are now treated as any other ruins are handled in peaceful communities everywhere

Elephants from Hagenback's Zoo at Hamburg (on left) hard at work removing logs and timbers for the German soldiers. The trenches were only a short distance from the French town shown in the illustration, on the right, so the Germans laid underground pipes from the water supply system of the town, and thus piped fresh water into their trenches

Salving Seven Thousand Dollars' Worth of Death

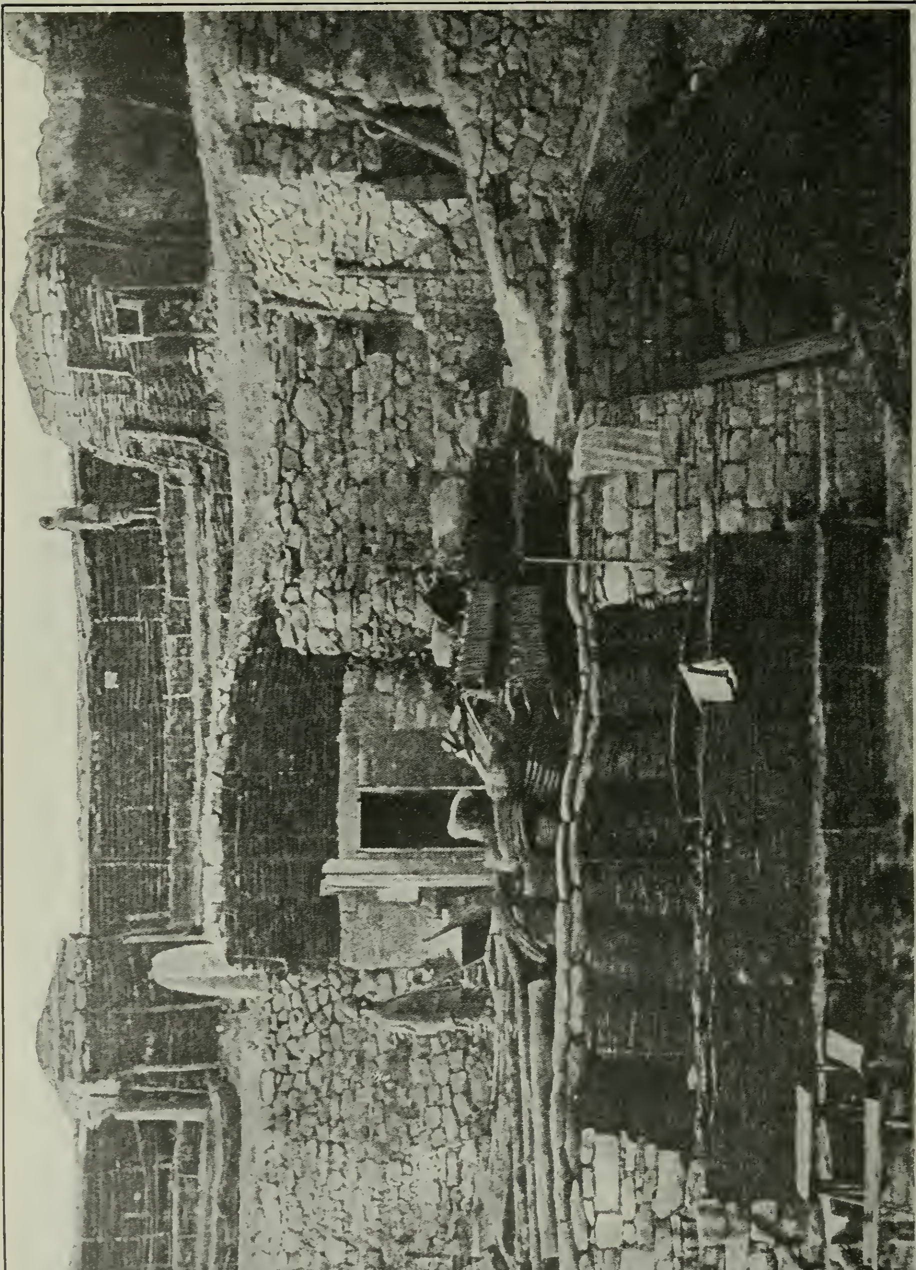
British Jackies hoisting a spent torpedo to the deck of a torpedo-boat destroyer. Torpedoes such as the one shown cost nearly seven thousand dollars, and, as may be imagined, is considered worth saving

Behind the Screens of Smoke and Sea

The British destroyer "Kennet" making a smoke screen to protect the Allied fleet from the fire of the Turkish batteries in the Dardanelles. Oil is poured on the fires and dense clouds pour forth to hide ships from the enemy. The ruse is used by all navies

Torpedoes for the submarine in the background are being filled with compressed air at a pressure of one ton to the square inch. This compressed air runs the motor which sends the projectile at express speed, as well as the gyroscope spinning devices

Not a Cliff Dwelling, But a Modern Trench



Courtesy of Illustrated London News

A three-storied French field fortification, an example of France's remarkable skill in defense-works and dug-out shelters. The walls of this huge first line trench are constructed of solid stone, and numerous sand bags and cylindrical baskets filled with earth serve to deaden the explosion of any shell which reaches the trench

What War Means to Women

Women postmen have entered the German postal service

A woman cobbler mends shoes for many residents of Berlin, while her husband is at the front

Two Berlin window cleaners starting out for their day's work

With true Teuton thoroughness, the German government has opened the ranks of labor to women so that every available fighting man may go to the war and defend his country

Mimicking the Ermine in War

As winter comes on the ermine changes his coat of brown to one of white to match the snow and escape his enemies. Soldiers of Austria's mountain battalions have torn a leaf from nature's book. They, too, garb themselves in white to escape their enemies

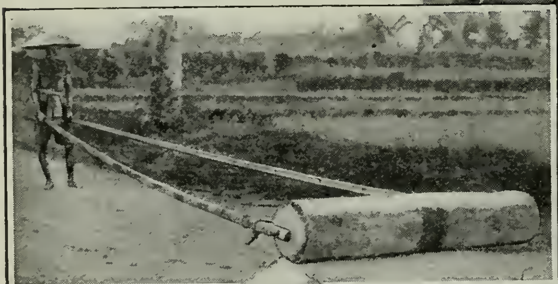
Since they must travel on snow-covered mountains the Alpinists of the Austrian army use Norwegian skiis. Austrian snow patrols often raid the opposing scouts by sliding down the mountains at a terrific rate on their skiis, shooting as they go. The momentum of such a charge is almost irresistible, and they are often able to rout a superior force by sheer weight and daring

An Indian Wedding Party

© Underwood and Underwood

A strange Indian wedding party. His Highness, the Chief of Akalkota, and guests being drawn in an omnibus-like vehicle by two huge elephants, and guarded by the Chief's Guard of Honor. Oriental splendor makes the most of all its opportunities, and a royal wedding party is second only to a coronation in the chance for display

The world's largest open-air pottery market, in Korea (above). At the right, an itinerant Korean brandy dealer, with his ample stock in trade



Taking sago to market in Java (above on left). Sago is the marrow of a palm, and to transport the palm trunks to market, the Javanese nail them to long poles and roll them over the roads. The silversmith shown in the lowermost picture is able, with his rough tools, to do work that is the marvel of the world. Even his clay stove is a work of art

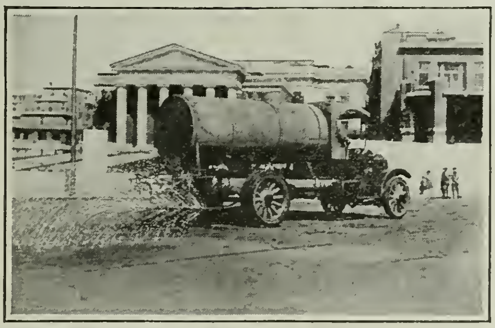
A Jack-of-all-Trades Truck

THE city of Boston has recently put into service a versatile motor truck that serves in many capacities. When equipped with a dumping body it is a most efficient ash collector, but when equipped with its nine hundred gallon tank body, however, the truck makes its best showing. In this form it may be used either as a street sprinkler, to supplant three water carts, or as a street oiler, in which capacity it covers twelve thousand five hundred square yards in the short time of eighteen minutes.

The forty regular sprinkling nozzles are assisted in their work by a rotary pump which raises the pressure to forty pounds, and this pump is also capable of removing the contents of the tank through a side opening, thus saving labor of discharging it at the top.

In cases of isolated fires, as among lumber piles, the truck with its powerful pump becomes an efficient fire fighting appliance. It throws a stream of water of equal power to the ordinary fire engine and can get to the scene of the conflagration quickly.

Authorities in the city state that the truck easily accomplishes the work of six horses and two drivers.



The City of Boston's handy motor truck, which carries dirt, sprinkles roads with water or with oil, and puts out fires with equal versatility and effectiveness

Why a Woman Can Outtalk a Man

A WOMAN can talk longer than a man, and does so because she uses less force by a larger percentage than a man does. A German professor has proved by actual and very delicate measurements that the baritone singer uses far more energy than either. The range of voice differs greatly, so the percentage varies to the same extent, but as a general result it was proved that a tenor uses only from one-seventh to one-sixteenth of the lung power of the baritone or bass. The difference in the force used by the contralto and soprano is very marked, and the contralto who sings in very deep tones uses at least ten times the force of the soprano.

The explanation is so simple that it is surprising that it was not thought of long ago. It has long been known that the tenor or soprano brings the vocal chords together and keeps the edges vibrating only by the emission of air. The bass or contralto leaves the space between the chords wider open, and has to vibrate much more of the membranes.

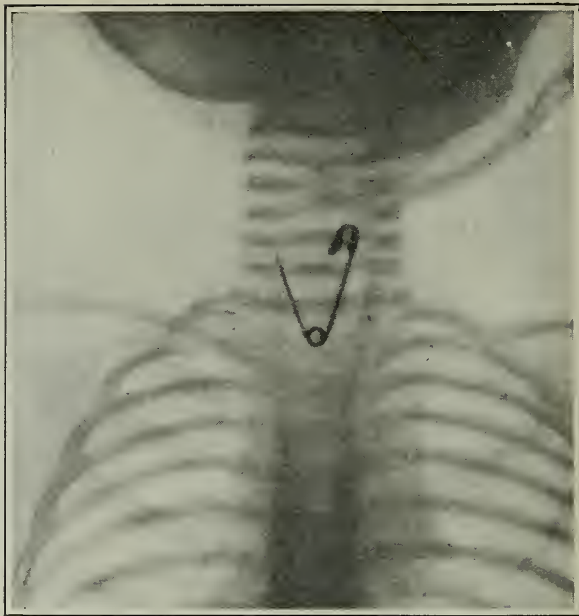
A Need for Electric Rickshaws

ACCORDING to advices from India, there is no reason why small electric vehicles should not replace the rickshaw in hill stations, where these are now in general use. The overall dimensions of the vehicle need not be over eleven feet by five feet.

X-Ray Finds Safety Pin in Baby's Throat

REMOVING an open safety pin which was swallowed by a seven-months-old baby with the sole aid of X-rays and a snare, was the remarkable operation recently performed by Dr. G. S. Otrich, of Belleville, Ill.

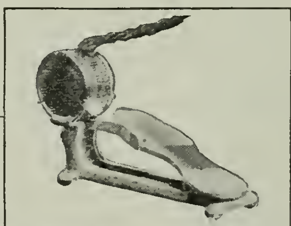
When an X-ray photograph was taken of the child, it was discovered that the open pin was lodged in the esophagus, with the point sticking upward towards the child's mouth. The X-ray tube was arranged beneath an ordinary table, so as to throw the light upward, and the child placed so that the light from the tube would be in a direct line. A fluoroscope was adjusted directly over the child, and the obstruction became clearly visible. The doctor passed a small snare into the esophagus, and with infinite care passed it slightly beyond the pin. After withdrawing it until the pin seemed to be engaged, he closed the snare. On the first attempt the pin was closed and withdrawn.

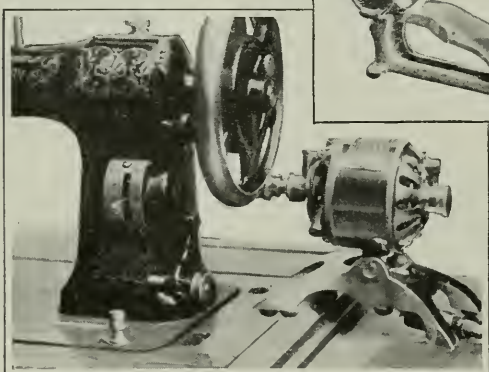


This open safety pin was extracted with a snare by the aid of the X-ray and a fluoroscope

A Foot-controlled Sewing Machine

MOTORS for driving sewing machines have been improved so that they can be carried about by a seamstress and used in any house that is wired for electricity and attached to any machine in half a minute. The motor is equipped with feet so that it can be set on the stand and applied to the flywheel of the sewing machine without the use of any screws or arms. In addition it is governed by a pedal which controls the speed, from a stitch a minute to eight hundred stitches a minute.





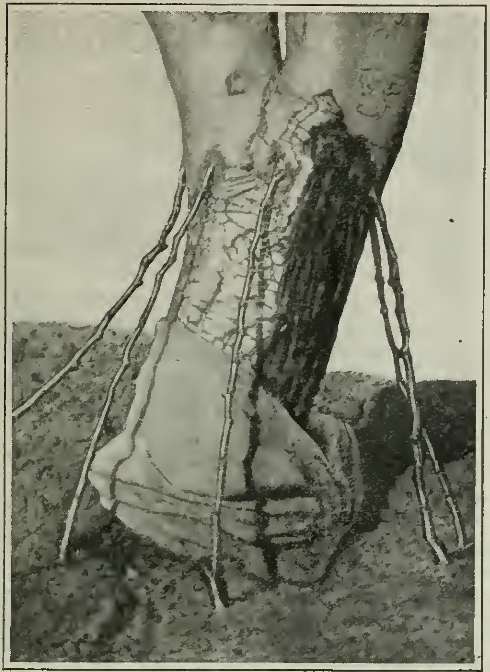
The foot still controls this sewing machine, but a motor does the real work

The motor stand is simple, depending on the weight of the motor and its rubber feet for stability. The little ledge of the sewing machine itself forms a brace so that permanent attachments are not needed.

The pedal sends the current through a rheostat of varying resistance to obtain the different speeds required by the operator of the sewing machine. Thus the sewing machine can be electrically driven wherever there is a light socket.

The motor and its attachments are light enough to be easily carried from house to house.

By using it the work of a dressmaker is lightened by at least a half, and the physical tire of working is almost completely eliminated.



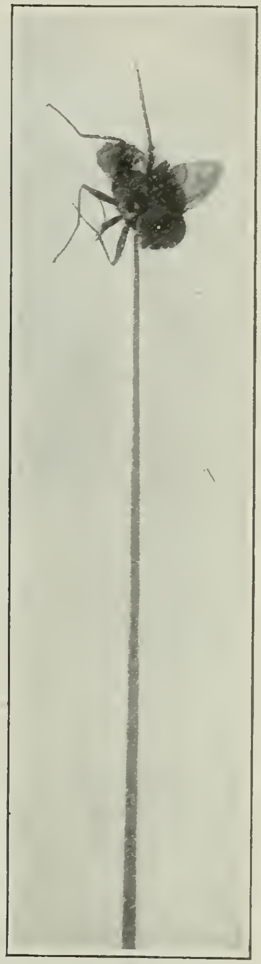
Roots instead of branches were grafted to this pear tree, and with the fresh life brought to it by the healthy young suckers, the old tree returned to its previous record crops

Giving a Pear Tree New Roots

THE startling operations performed upon human bodies by advanced surgical methods find their counterpart in tree surgery. How a pear tree was supplied with new roots after its own had been destroyed, is an example. The disease which required the drastic treatment of removing the roots of a well-grown tree is "pear blight," which can be eradicated only by cutting away all affected parts. So dangerous is this tree disease that even the knife which is used in cutting away the bark, wood or roots must be sterilized after each use, in order to prevent the contagion from spreading to sound parts of the tree.

Should the disease attack the roots, as in the instance shown in the photograph, it is necessary to supply nourishment to the tree by grafting to the trunk a number of healthy young "suckers." These are well rooted and are set into the ground about the diseased tree, while the upper ends are grafted upon the trunk, so as to carry the sap from the ground by healthy channels.

Fly Impaled by Spear of Grass



ONE of the most interesting accidents that has ever come to the attention of zoologists is shown in the accompanying illustration. While lying in the tall grass near Fire Island, N. Y., waiting for game birds, Dr. A. L. Goodman, a New York physician, saw a fly perching upon a spear of grass near him, and entirely unafraid of the hunter, for it never moved. After watching the fly for nearly half an hour, Dr. Goodman's curiosity was so aroused that he got up and, upon examining the insect, found that the sharp point of the grass had pierced the fly's frail body.

The insect had evidently been flying against the wind, when a sudden gust blew it down against the blade of grass, which had swayed with the wind. Dr. Lutz, of the American Museum of Natural History, says that in the fifteen years that he has collected specimens he has never seen a similar accident, nor has he ever read of such an occurrence.

Hammering Spine to Cure Sick Heart

AS a remedy for enlargement of the heart, Dr. Meyer Solis-Cohen hammers the spine with a rubber-tipped hammer. The tapping should be done on the protruding vertebra in the spine at the bottom of the neck, a little above the shoulderblade. It immediately livens the valves of the heart.

A Three Million Dollar Automobile Scenic Highway

By Fred W. Vincent

HIGH masonry walled roadways clinging to precipitous mountain sides and so cunningly built that no cement enters into their composition; bridges of solid concrete spanning deep mountain gorges, and tunnels through living rock are only a few of the features of the Columbia Highway, a two hundred mile three million dollar roadway that Oregon is rapidly driving through the heart of the Cascades and Coast Range mountains, down the Columbia River, from The Dalles to the Pacific Ocean.

For two years the work has been underway, guided by engineering experts who first spent months in Europe studying the famous mountain roadways there with the sole object of not duplicating, but of bettering the best the Old World had to offer.

From the Dalles, where it connects with the trunk roads leading into the interior and the East, the highway follows the south bank of the Columbia—second largest river in the United States—and plunges into the rugged and picturesque Cascade Mountains. Here on one side for more than fifty miles is the river, on the other a rock wall rising sheer for heights varying from a few hundred to thousands of feet. It is through this majestic water carved gorge that the engineers faced and solved their hardest problem.

Their instructions were to build a roadway not less than twenty-four feet in width and with a grade not to exceed five percent at any point. A railroad had possession of what little shoring there was along the river, and for this reason the construction force faced miles on miles of cliffs, long reaches of slope deep with slide rock, and a timbered wilderness with earth pitched ready to slip.

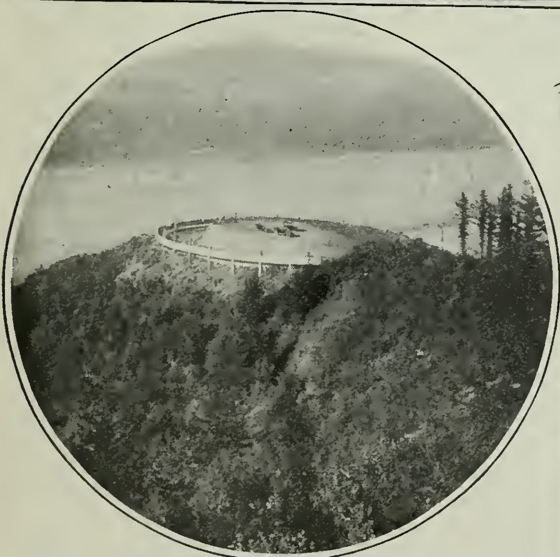
The first work called for tunnels and the highway builders were compelled to make several bores through imposing rock points that rushed skyward hundreds of feet as straight as a plumb line. One tunnel at "Storm Point" is more than three hundred feet long. To insure proper light, arches have been cut through on one side to overlook the river at regular intervals.

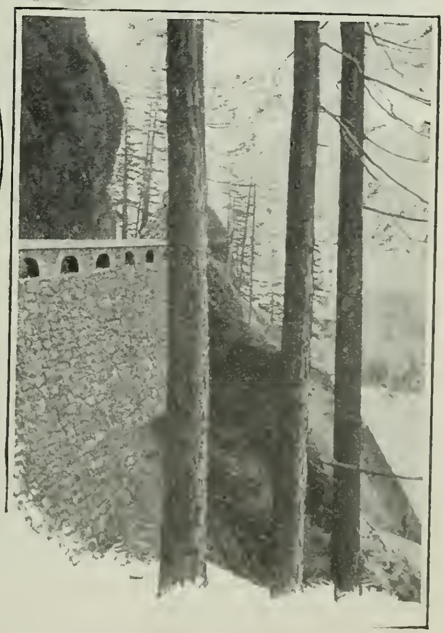
Here in the mountains has been worked into perfection the ancient art of dry masonry wall construction. There are approximately two miles of the highway built atop such wall work and all along steep mountain sides. In them each stone was cut to fit and to stay for all time where put.

Instead of the usual steel, reinforced concrete was resorted to in building the bridges that span the numerous torrents. One spanning Moffat Creek is the largest flat arch monolithic bridge in America and the largest three-hinged arch in the world. The clear space of the span is one hundred and seventy feet and the arch rises only seventeen feet in that distance. Another bridge that crosses over a canyon two hundred feet in depth is three hundred and sixty feet long.

One of the biggest problems was encountered in the construction of the highway over slopes where slides threatened. This included work over an immense bed of broken lava rock so restless that it is called "Crawling Mountain." For half a century it alone had prevented a permanent roadway to conect the Inland Empire with western Oregon. The engineers conquered the slides by sinking pillars through the loose super-rock and anchoring to bedrock. On the pillars they built a concrete viaduct just high enough for the slides to thunder harmlessly underneath.

The highest point above the river is attained at Crown Point, a cliff more than seven hundred feet straight up almost from the Columbia.





Oregon's magnificent highway, extending for two hundred miles through the heart of the Cascade and Coast Ridge Mountains, was built by engineers who first spent months in Europe studying famous mountain roadways there. The roadway is nowhere less than twenty-four feet in width and has a grade not exceeding five percent at any point. It is built to last for ages and is considered one of the finest examples of good roadmaking to be found in the country. In the circle above is shown a loop in the road affording a wonderful outlook over the Columbia River, on which the road opens vistas from time to time as it curves through the hills

Oregon Built a Scenic Highway for Motorists

Cripple Makes a Fortune with Tri-Car; Then Runs for City Council

SEVERELY hampered by a disease of the hip which makes him a cripple from his waist down, a resident of Los Angeles has begun life all over again in middle age, succeeding in a new business under a handicap which would have made most men quite willing to depend upon charity. The disease developed to an alarming extent and made crutches essential. At the same period, the physicians declared that life in the open air was the only thing that would save their patient.

So C. E. Ellsworth dropped his former name and for business purposes adopted that of "Handy Andy." He had always liked to tinker with things, and

This cripple made a comfortable fortune as a handy man, and then ran for the Los Angeles city council

the skill of his hands was unimpaired. He was able to outfit a little second-hand car as a traveling machine shop, equipping it with emery wheels, vises and a big grindstone. In this machine he buzzed around town, doing odd jobs for housewives and sharpening knives for butchers.

After some years of hard work, "Handy Andy" bought a neat tri-car well equipped for the work in hand. Now he has succeeded in earning enough to buy a block of flats, and not long ago he entered into a political campaign, winning many votes for a place in the city council, although he failed of election.

Gangway Life-Saver Prevents Crushing of Life Boats

THE hazardous method of lowering life boats into rough water alongside ships in disasters has inspired many inventors to perfect life-saving apparatus that would be really safe.

Among the scores of such inventions that have been submitted to the patent office, is a long net gangway which projects from the side of the vessel upon the surface of the water, being supported at the lower end by large air tanks. The poles which support the gangway are hinged to the ship's side, and when not in use are carried in long pockets below the rail of the first open deck.

The chief advantage of this gangway-life saver is that the life boats never approach near enough to the ship's side to be crushed by waves. The boat is held close to the gangway by means of gaff hooks.

A New Device for Recording Sounds

AN apparatus for recording sounds has been devised which, while incorporating some well known principles, has several features of decided originality. The fact that it is possible to retain sounds by other mediums than the phonograph record is not generally known. One device, however, which departs radically from the wax record, is the telegraphone which was brought out several years ago. The telegraphone is a magnetic apparatus, which impresses sounds in their relative strength magnetically on a wire.

The new invention makes use of the telegraphone principle to a certain extent, in that it is magnetic. But it combines a new principle as well—that of photography. A diaphragm alters a shaft of light falling on a moving strip of sensitized paper. When the reel of paper is used, it is copied photographically on a strip of iron. The iron is then etched—in much the same way that half tone plates are etched—and when it passes in its completed form between highly sensitive magnets, the variations in sounds are accurately reproduced in a telephone receiver.

Loading Lifeboats Safely on the High Seas

A canvas gangway let down from the side of a ship, and supported on floats, is designed to allow the loading of passengers without the danger of smashing the boats against the ship's side—an accident very apt to occur

A Really Greater New York

By Dr. T. Kennard Thomson, Consulting Engineer

Dr. T. Kennard Thomson, whose description of his project of a "Really Greater New York" is published herewith, is considered an authority of note on pneumatic caissons. He has designed and built pneumatic caissons for important bridges over many of the great rivers of the country, in addition to having been retained as a consulting engineer in the construction of over twenty New York skyscrapers. During his experience he has underpinned buildings as high as eighteen stories, putting in new foundations with the slightest possible settlement, although sometimes the new foundations were sixty feet under the old. Dr. Thomson was one of the board of five consulting engineers in charge of the New York Barge Canal in 1914-15, and is also the man who conceived the project of building a new dam in the Whirlpool Rapids, near Niagara Falls, which we described in our November issue. —EDITOR.

Dr. Thomson is an engineer who thinks in large masses, and then arranges his detail to solve the problem he has created

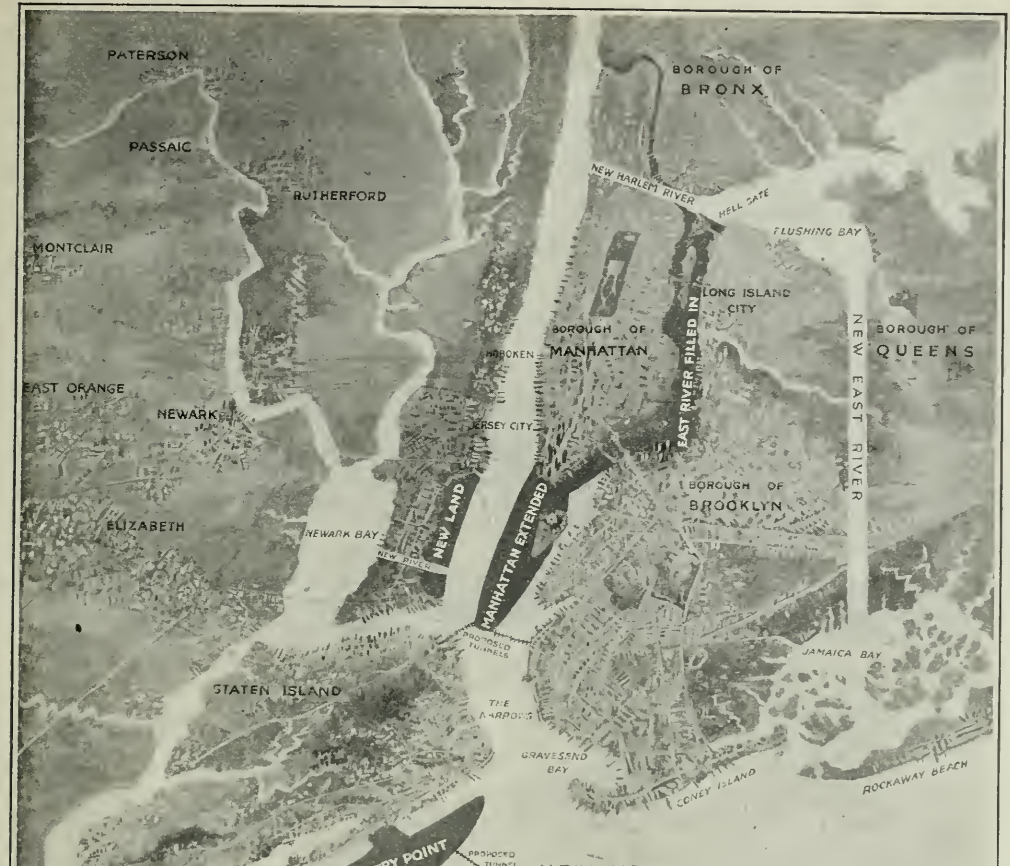
AT first glance, a project to reclaim fifty square miles of land from New York Bay, to add one hundred miles of new waterfront for docks, to fill in the East River, and to prepare New York for a population of twenty million, seems somewhat stupendous, does it not?

One hundred years ago Gouverneur Morris, Simeon De Witt and John Rutherford spent four years laying out New York, and went on record as saying that "the country north of One Hundred and Twenty-first Street would never be covered with houses for centuries to come." Now apartment houses extend to Yonkers, to White Plains and to New Rochelle. New York's overflow has made of Brooklyn a great city. New subways are constantly being built, yet are inadequate when they are completed. Twenty-five years ago New Yorkers felt sure that their water-front would be sufficient for their purposes for many years. Today engineers are searching for some method to cut the Gordian knot of New York's harbor congestion problems.

It is hard to realize the enormous strides of the past century, and still more difficult to comprehend the needs of the future.

Now I propose to add, by a series of engineering projects, fifty square miles to Greater New York's area and port foothold. At the same time this will mean an addition of one hundred miles of new water-front. New York's City Hall would become the center of a really greater New York, having a radius of twenty-five miles, and within that circle there would be ample room for a population of twenty-five millions, the entire project to be carried out within a few years. Many have said "It can't be done." The majority of engineers, however, have acknowledged the possibility, and I have received hundreds of letters of encouragement.

Although this would mean an expen-



An Engineer's Plan to Make New York Bigger

A bird's eye view of the Really Greater New York as it will appear if Dr. T. Kennard Thomson's project is completed. The black spaces show new land of immense value recovered from the harbor and the East River diture of a great deal more than the sum involved in the construction of the Panama Canal, the returns would quickly pay off the debt incurred, and then would commence to swell the city's money bags, until New York would be the richest city in the world.

By carrying out this vast project in stages, each complete in itself, the returns would pour into the city treasury even while the engineers were working, and thus save much money to the taxpayers.

The first step would be to build parallel coffer dams, about half a mile apart, extending from the Battery to within about one mile from Staten Island, and then connect the ends of these coffer dams by another coffer dam. The box-like space formerly these three coffer dams and the Battery would then be filled with sand up to about the low water level.

A clear, vertical space of at least fifteen feet should be left above this level, and below the street level, for sets of real rapid transit subways, conduits for electric power service, trunk sewers and all of those underground pipes which are an important part of the city's welfare, so that it will never be necessary to tear up the street to get at these necessary arteries of our city life.

Imagine the value of this new land for docks, warehouses and business blocks! The tax assessments alone would make a fortune!

From the new Battery, I would build a set of tubes and tunnels to Staten Island, bringing that land almost as close to New York as Jersey City is at the present time. Today the assessed value of Staten Island is about $50,000,000. With the completion of the land reclamation, the property value would not fall short of $500,000,000. This would help pay the expenses of the project.

The next stage would be the construction of a large island flanking the tip of Sandy Hook. Next I would make upon Old Orchard Shoal the first of two extensive areas which, when joined to Staten Island, would form a large enclosed basin, and in addition to this would afford protected dock frontage on several sides. The shallows just within and contiguous to Sandy Hook would be filled in, making a large new area.

The projects I have just mentioned would reclaim some forty miles of new land, which would be a maritime Pittsburgh, the greatest export manufacturing center in the world. In this new harbor, protected from the ocean by the new island off Sandy Hook, there would be docking facilities for the world's largest ships. There would be dock yards, dry docks, ship yards, coaling stations, which would make all of Staten Island a great industrial beehive.

Naval authorities agree that the East River is no place for the Brooklyn Navy Yard. In Newark Bay, after the completion of the operation, would be a great, protected Navy Yard, with ship yards and dry docks enough for the dreadnoughts of the future. A new river, cut straight through to Newark Bay, would form an ample entrance to the new Navy Yard.

My next step would make still greater changes in the topography of New York. I would construct a new East River, forty feet deep and one thousand feet wide, from Jamaica to Flushing Bay. While this is under construction, I would lay tunnels and rapid transit tubes beneath it. There would be no bridges over the new river. On the same plan I would cut a new Harlem River from Hell Gate to the Hudson. By means of these straight and wide rivers, our entire fleet of battleships could proceed from the new Navy Yard into Long Island Sound within a short space of time. At present they have to steam all the way around Long Island, as they cannot go through Hell Gate safely.

I would build a dam at Hell Gate and another just above the Bush Terminals. Heavy concrete coffer dams would prevent the land from slipping when the water was pumped out. Where rock is within a reasonable distance from the surface, and the bed of the river has been laid bare, I would not fill it with earth, but from the basic rock of the river bottom I would make concrete pillars carry highways and business blocks much after the fashion of the Grand Central Terminal.

In the space below the street level I would leave ample space for subways, for sewers and pipe lines. No digging

The rows of trenches are not structures built by warring soldiers, but are the terraced rice-fields of industrious Filipino farmers

would have to be done, they would simply be laid on supports, and great subsequent expense would be saved.

As a result of this construction it would not be much harder to get to Brooklyn than to cross Broadway. Indeed, New York and Brooklyn would be as much one big city as are the East Side and the West Side. New York would expand logically. At present most of the expansion is to the north of the city, and forms its chief problem.

This practically completes my scheme. I do not urge the simultaneous attack of the entire project. It should be carried through section by section, and this would involve an annual expenditure of from fifty to one hundred million dollars.

When these facts are understood there will be no difficulty in obtaining the necessary authority to start work. Then, after the section between the Battery and Staten Island has been laid out on paper, enough land can be sold to start the work, which would proceed just as fast as the proceeds of the sale justified, and a really great debt-free New York would result.

Farming on a Precipice

ON mountain slopes so steep as to appear quite worthless for agriculture, the rice growers of the Philippine Islands are producing crops upon made-to-order farms. These famous terraces of the Mountain Province extend as far as the eye can reach, a work of patience rivalling the pyramids. Imagine a whole mountain laid out in ledge above ledge, the walls almost perpendicular, the strip of field graded just enough to allow the water to flow from one terrace to another without violence, so that every acre is irrigated but not washed out by the current.

As the photograph indicates, the work appears too vast to be the work of human beings. In fact it might better represent some great upheaval of the earth's crust.

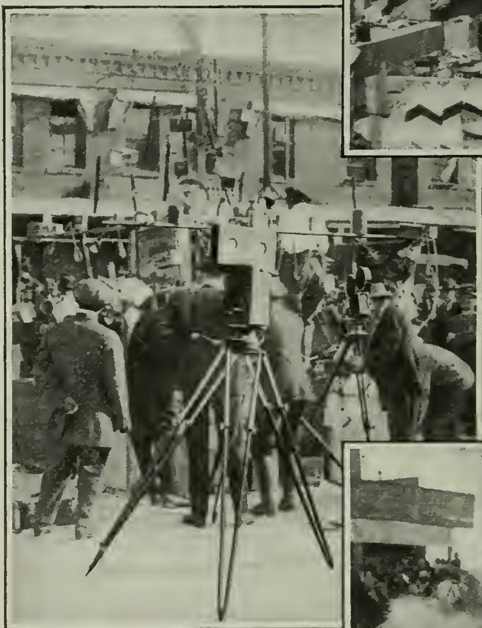
EXPERIMENTS are being carried on in Cuba with the fiber of a plant locally known as *malva blanca*, which is said to produce an ideal fabric for sugar bags.

The February Popular Science Monthly will be on sale Saturday, January fifteenth (West of Denver on Thursday, January twentieth).

Five Thousand Dollars a Minute.

AFTER a crusade of about six months, the police of Los Angeles, Calif., have destroyed the results of their successful raids on opium dens in an immense $25,000 bonfire, the flames of which were fed by confiscated marihuana, contraband opium and "hop" pipes. This strange fire was ignited by inspectors for the State Board of Pharmacy at the Plaza in Los Angeles, Calif.

The motion picture companies all sent men to the spot. A battery of cameras was set up. One of the accompanying pictures shows three cameras busily taking "close ups" just before the match was applied. Several more cameras are in the background.



Half a dozen cameras lined up to film the big little fire

One ton of marihuana or "Indian hemp" was put on the fire. Marihuana is a weed with narcotic properties, is closely akin to hasheesh, and is smoked when dry. It is in particular favor with Mexicans. A ton of it at retail prices would bring $16,000. A great number of tael cans of opium appraised at about $7,000 furnished additional fuel. Among the confiscated goods were fifty opium pipes.

One was taken from an old Chinaman who had smoked since he was a boy. He was convicted in court and paid his fine without a murmur. But when the officers told him his pipe would be confiscated, tears came to his eyes. He offered first $50 for its return, and then by jumps of $50 each brought the price up to $400.

Hundreds were at the scene of the fire, some drawn by curiosity, others to take a farewell look at the precious burning dream-stuff.

The officers placed big wooden boxes in a square and then set pipes,

Hundreds of heartbroken "dope fiends" watched the preparations. In the picture below the flames are reaching for the precious opium pipes, destroying the lottery tickets and filling the air with the soothing fumes of opium and marihuana

cans, bottles, trays and small boxes of the "dope" on them.

Wires were strung around the square and the pipes were hung in a row. On the boxes also, were scattered paper slips with Chinese characters on them. These were confiscated lottery tickets.

The officers poured on coal oil and applied the torch. In five minutes it was a pile of tin cans and ashes.

Risking His Life to Make a Motion Picture Play

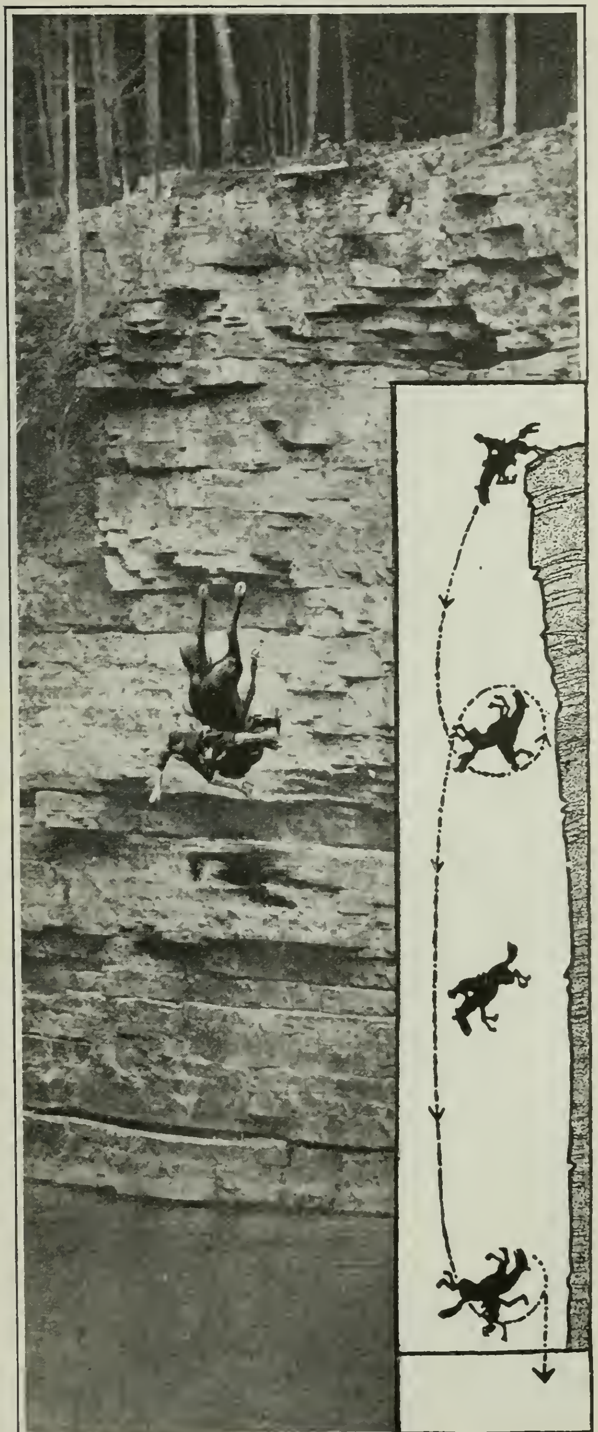
ONE of the most spectacular feats ever shown on the films was recently recorded when a horse and its rider dived eighty-three feet from the top of a cliff into a pool of water. This performance was invented by a director who wished to inject realism into the film version of "Carmen." The results in the picture were highly satisfactory, but the results to the actor were unfortunate.

The plot of the story demanded that Carmen's lover should commit suicide by diving with his horse from a high cliff. One of the most daring of the actors was selected for the feat. After a long search a suitable spot for the act was found in the Adirondack Mountains. The cliff chosen towered eighty-three feet above a pool of water, the bottom of which was studded with sharp rocks.

The actor, when all was ready for the filming, with a battery of camera men waiting on the opposite bank, drove his horse to the edge of the precipice and urged the frightened, trembling animal over the brink. The horse was wiser than the actor, however, for he could not be driven to make the plunge. At last another steed was chosen, this time, a trained diving horse.

Even the horse trained to the work refused at the last minute to make a clean dive, and while it hesitated on the edge the daring driver spurred him over. The fall was not a clean one, and the horse somersaulted twice during the long drop.

The catapulting drop made it impossible for the actor to throw himself away from the horse, and the two struck together on their backs and disappeared from sight.



The perilous feat of a motion picture actor and his horse. The horse was not hurt by the 83-foot drop, but the actor was seriously injured

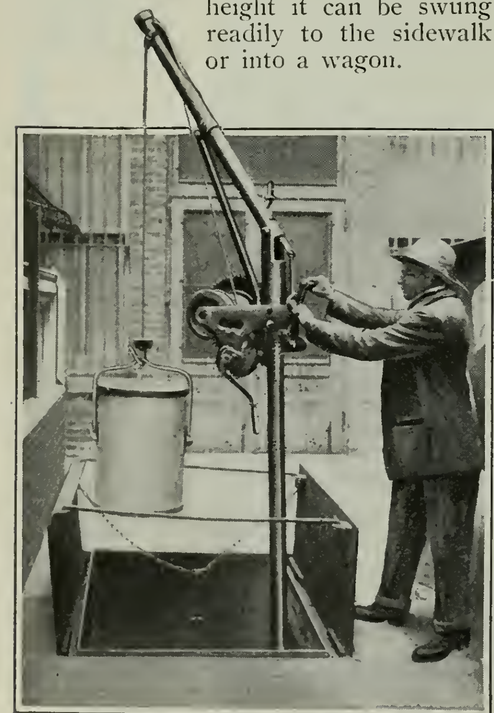
From Cellar to Sidewalk

HANDLING ashes, ice and boxes between the sidewalk and the basement is often attended by much heavy lifting and the usual employment of two men, or is done with a clumsy elevator. With a new hoist shown in the illustration this work is accomplished by one man and more rapidly than it could be done even with an elevator.

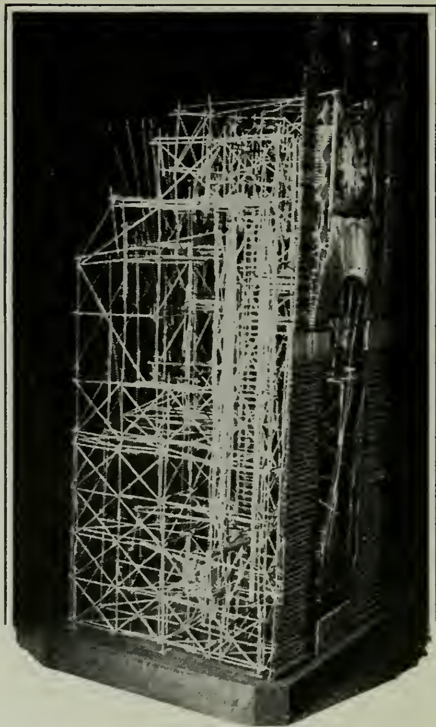
When not in use the hoist mast telescopes and is wholly contained below the basement doors. When it is to be used, a handle in the basement is turned and the mast automatically raised to the required height where it locks itself.

The operator can now raise ashes or other heavy articles out of the basement by turning a handle on the side of the hoist within easy reach from the sidewalk level. A pressure of seven pounds on the handle will raise one hundred pounds on the end of the cable.

The upper part of the hoist is on ball bearings so that when the weight is raised to the proper height it can be swung readily to the sidewalk or into a wagon.



Rubbish removal is slowly being modernized. Here is the newest form of collapsible derrick for city houses



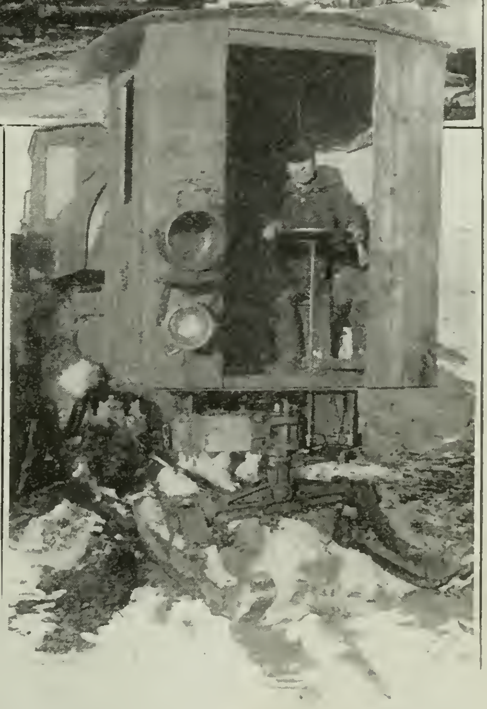
This clock, built entirely of straw, manages to keep accurate time in spite of its flimsy fabric

A Clock Made of Straw

A CLOCK made in Germany is constructed of nothing but straw. Not even a piece of stiffening cardboard or a drop of glue has been used. It is six feet high and is two feet square. There are eight pendulums which allow speed regulation. By pressing a button which comes out automatically on one side, the clockwork is wound up and runs for five hours. By pushing another button, the hands can be set. The dial, figures, pendulum, hands, even the chain, weight gears and the skeleton are of straw. The chain is fourteen inches long and endless. In the construction of this clock, thousands of stalks of straw have been used, mostly three and four fold to give greater strength.

Shooting at Jupiter

IT is reported from France that Jupiter, which has been especially brilliant lately, has often been mistaken for an enemy airship flying over Paris, and that guns have been trained on it.



A steam tractor helps reduce logging costs in the Maine forests. Caterpillar wheels support the tractor on the snow

Logging with Tractors in the Maine Woods

LOGGING has remained for generations the most primitive of all modern operations. The logging railroad is a comparatively recent development, but even that falls far short of being an active agent in reducing the vast waste necessitated by the fact that only such timbers can be moved out as will pay for expensive transportation. In the tropics a mahogany log worth hundreds of dollars in New York is valued at only a few demonetized dollars as it stands in its forest, and almost priceless hardwoods are left to rot or burned up in the clearing of ground simply because they cannot be "squared" to the formal size, about one foot on each side.

To a lesser degree the same problem faces the timber cutter in the forests of our own country. The long hauls through the woods to streams or roads, even to the roughest sort of logging roads, is discouragingly expensive, and from there to the railroad or mill entails another long haul with primitive means, either oxen or horses.

Modern power appliances are, however, slowly coming into use as they prove their worth. In certain sections of the Maine woods, where logging is the winter occupation of farmers from nearby sections, tractors are now in use. The drive on these engines is by caterpillar wheels, broad enough to keep from sinking into the snow, and the forward part of the tractor is mounted on sleigh runners, which are turned by hand to guide the tractor and its train of logging sleds.

The tractor is crude in a way, but it can reach sections of forest country to which even the ordinary logging railroad, with its clumsy engine, cannot readily penetrate.

In the tractor shown here, the runners at the front make steering easy and accurate. The unwieldy front wheels of the ordinary tractor would hardly serve in the forest.

Mercury Poisoning and Deafness—The Price of a Derby Hat

By A. M. Jungmann

WHEN you pay five dollars for your fine derby hat do not imagine you have paid the price of the hat. The real price is paid by the unfortunate victims of "hatters' shakes" who contract mercurial poisoning while engaged in preparing the fur and making it into your hat.

There are many trades which are dirty and hazardous but it would be difficult to find one as objectionable as the hatters' fur trade. From the moment the fur receives a scrubbing with a solution of nitrate of mercury until the hat is finally completed, mercurialism is a constant menace to the workers.

Conditions found in various factories differ greatly. In some, every effort is made to protect the workers and in others the welfare of the operatives is neglected. The Department of Health of New York city recognized that thousands of workers in our industries are subjected to conditions which endanger their health. As a means of protecting the workers and raising the standard of the public health, the Department opened an Occupational Clinic and concentrated its energies first of all on the fur and hatters' fur trades.

In the preparation of the hatters' fur used for the manufacture of felt hats, rabbit, coney, nutria, muskrat and hare skins are put through a number of processes. The skins are received in the factories just as they have been stripped from the animals by the trappers. They are stiff and full of natural animal grease and dirt. The skins are first cut open by unskilled laborers. They are then combed and brushed by hand. The brushes used for this purpose have fine wire bristles. With this brush the workman frees the fur from particles of dirt. Anything which is not readily removed by the combing and brushing process is removed with the aid of a very sharp knife. In some cases the skins are brushed by machines supplied with suction devices. Where the work is done by hand the air is full of fine dust and particles of fur. It is the usual practice to have a man employed all day in sweeping up the accumulated dust and dirt from the floor with results that can be imagined.

After the skins are combed, they are dampened and the long hairs are clipped or plucked. In the case of hare skins the plucking is done by machinery; with coney skins it is done by hand. The hand plucking creates an immense amount of dust, hair and fluff in the air.

Frequently the workers stand in a mass of hair, which covers the floor to a depth of several inches. The skin is fastened over a leg stump by means of a loop of clothesline which is held taut by another loop through which the plucker places his foot, as in a stirrup. This causes the worker to assume what would

The occupational clinic where the workers in trades which give rise to occupational diseases are examined by the New York City Department of Health seem to be an almost impossible posture. The toes of the left foot, which is in the stirrup, barely touch the floor and the worker is forced to lean foward and press his abdomen against the upper pole of the stump that he may retain his balance.

In the case of plucking machines much of the danger to health is eliminated because the plucking machines are supplied with suction devices which carry off the loose particles of fur and dust.

The next treatment to which the skins are subjected is the most dangerous one. It is known as carroting. The pelts, with what fur remains on them after the long hair has been removed, are placed on a table and scrubbed with nitrate of mercury solution. This gives a brilliant yellow color to the light parts of the fur. Hence the name. In some instances this work is done by hand and in others by machinery. When carroting is done by hand the workman holds the pelt on a table and scrubs it with a brush which he dips in the mercury solution. When it is done by machinery he holds the pelt on a revolving brush which passes through a bath of mercury. In either case it is necessary for the workman to wear strong gum gloves to protect his hands from the mercury solution.

The carroted fur is now taken to drying rooms where it is placed on racks and dried in ovens. When the mercurial solution has been volatilized the skins are put through the shaving process. Machines cut the hair from the skins and deposit it on metal trays. Girls sort out the hair of the various parts of the animal's body and place it in groups. The skins, when they are denuded of hair, are used to make glue.

Combing rabbit skins to remove particles which may be lodged in the fur. A good workman combs twelve hundred of these skins a day

"Carroting," or scrubbing the rabbit pelts with nitrate of mercury solution. It is the use of this nitrate of mercury which constitutes the greatest hazard in the fur felt trade

It is impossible to describe the noise of the cutting machines. Unless a person has leathern lungs he cannot make himself heard in the cutting rooms, even if he shouts close to your ear. The girls who sort the fur are for the most part young. The workers suffer from defects of hearing brought on by the unearthly clatter. Some of the workers who were found to be perfectly devoid of hearing told the doctor at the clinic that if they remained at home for two days they generally regained some of their ability to hear. If Dante could have visited a cutting room he might have described another torment in his inferno. In looking over a roomful of young girls whose deft fingers never falter in sorting out the fur one is astonished that they can retain their composure in that unspeakable bedlam. And one wonders, after all, if any felt hat is worth years of deafness.

But, deafness is not the only danger, for every one who handles the fur after it has been carroted faces the menace of mercurial poison. Three hundred and fifty employees of the hatters' fur trade were examined through the Occupational Clinic. Of these fourteen per cent. were indisputably suffering from mercurialism. Many have violent tremors of the hands, face and tongue. Unfortunately most of the workers fail to realize the danger of their occupation, and it is exceedingly difficult to get them to observe the first principles of self-protection against the hazards of the trade. In some instances it was found that the employer had to lock the carroting rooms and the drying rooms at noon time to prevent the employees from eating their lunches there.

The constant breathing of dust and fur-laden atmosphere affects the nose, throat and lungs of the workers. This could be obviated by sweeping after hours or by the employment of a vacuum device. But no matter how much may be accomplished through cleaning up the factories and installing safety devices the condition of the workers cannot be very greatly improved until they themselves are made to understand the peculiarly dangerous character of their work.

The use of mercury in the hatters' fur trade causes much suffering among the workers but it is something which must be tolerated until such time as someone invents a felting process which is as good and as cheap as that dependent on mercury. Only mercury can roughen up and flare out the laminae of the fur fibres which causes the fur to snarl readily and to form felt satisfactorily.

Street Corner Directories That Tell You Everything

WHEN you are in Los Angeles, Calif., and Seattle, Wash., and you want to know the location of office buildings, etc., you have only to go to the nearest street corner to find a directory on the side of the building giving the location of business houses, office buildings, and a list of street cars which pass the corners within three blocks from that point, and their routes and destinations.

The street corner directories of Los Angeles know almost as much as a policeman. The buildings within a radius of two blocks, the car lines that pass the corner, and where they go, are all set forth graphically

These directories are changed or added to every month. They are large cards covered with glass and in a metal frame.

Over one hundred of them have already been placed and the list is being added to rapidly. This system relieves the traffic policemen stationed at the intersections of the streets, leaving him free to attend to the regulation of the automobiles.

Band Concerts from an Electric Light Bulb

By George F. Worts

MUSIC that ranges from the piercing wail of a taut violin string to the grumbling bass of a monster horn has been added to the remarkable achievemnts of an electrical instrument so small and so insignificant in appearance that it could be passed by scores of times without arousing so much as a lingering glance.

Despite its innocent appearance, however, its technical name is more than formidable. Scientists know it as the "oscillating vacuum tube," although this name has been changed and shortened to a simple compound word, "audion." "Audion" is derived from audio, to hear, and ion, the tiniest division of electricity; in other words, to make audible the action of ions. This, in a word, is exactly what the oscillating vacuum tube accomplishes.

Before proceeding directly to a discussion of the latest marvel of the audion,—electrical music—let us pass hurriedly over some of the achievements that have preceded it, which, in a round-about way, have led to the discovery.

Amateur and professional wireless operators know the audion well, although numbers of them are not aware that it has other uses than the reception of radio signals.

Connected with the proper wireless instruments, the audion will receive and strengthen the weak signals of a distant radio station to a degree several times as loud as any other detector. But its ability in this direction does not stop there. If several of the tubes are connected in the correct way and adjusted with great care, the wireless signals will be increased in loudness several hundred times. This arrangement is known as the Audion amplifier.

In both of these uses, the construction and operation of the audion are practically the same. In fact, for all of the uses to which the audion is put, its fundamental structure, apart from size, does not vary. In appearance it closely resembles an ordinary electric lamp bulb. There is a brass base with threads, so that it can be screwed into a socket, a round glass bulb and a filament burning brightly in a partial vacuum. But beyond this point, the audion and the electric light are strangers.

Built into the bulb close to the filament are two metal electrodes. One is a tiny replica of the grids that are used in coal stoves . . . . and it is called a grid; while the other is a small plate. The grid and the plate are connected to the other apparatus in such a way that a perfect balance, electrically speaking, is maintained between them. When an outer influence, such as an incoming wireless wave, is brought into the bulb, this balance is disturbed, and in a strengthened form, the disturbance is heard in the telephone head receivers as the dots and dashes of the wireless code.

Dr. Lee DeForest, inventor of electrical music, and his audion bulb

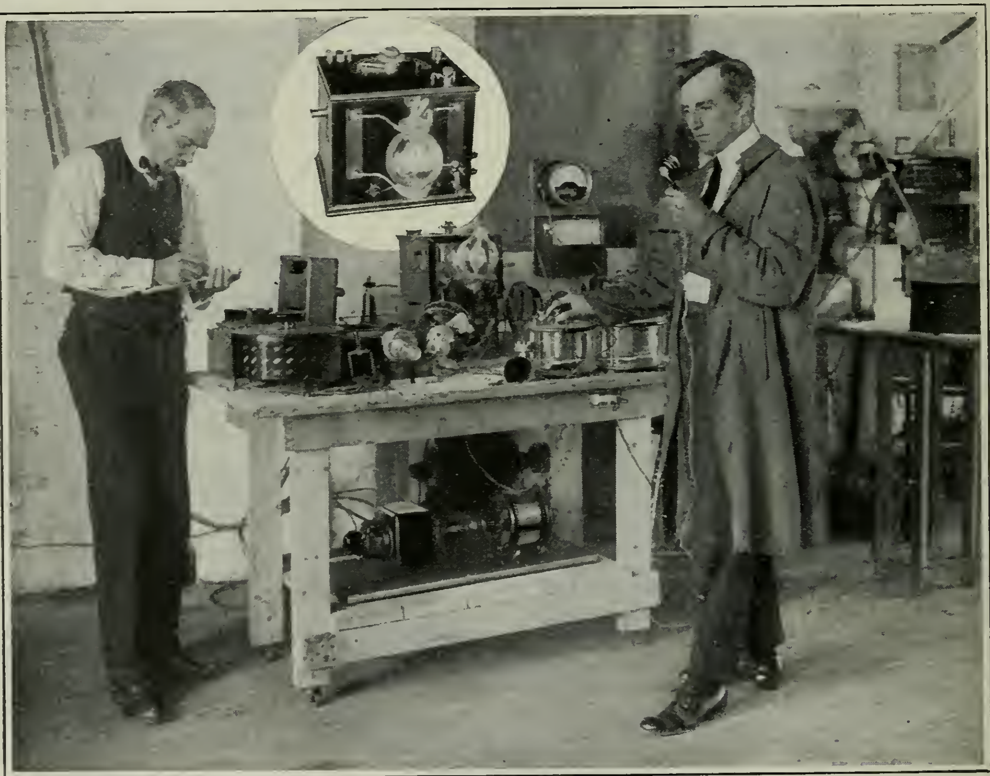
Strange to say, this same balancing principle is made use of in another application directly opposite in nature to the foregoing, when the vacuum tube is employed as a wireless telephone. Hundreds of the bulbs are connected to a powerful battery or dynamo. The voice spoken into a telephone transmitter connected in the circuit so disturbs the electrical balance of the bulbs that powerful waves are created. The most striking example of this application was the recent feat of telephoning wirelessly from Washington to Hawaii.

Another use of the audion is in relaying the current that carries the voice over long distance telephone lines.

The other applications of the audion are of a laboratory nature. One of these applications is transforming electricity. By throwing a small lever, the outgoing current can be varied from fifty to more than a million vibrations a second.

By the combination of some of the foregoing properties of the vacuum bulb, the uncanny but delightful result, electrical music, is attained. The idea of converting the silently flowing electric current into strains of the most bewitching music is not entirely new. Many readers will recall the telharmonium, which was built at great cost several years ago and with which electrical concerts in the home were prophesied. But the telharmonium required dynamos of such variety and size that it was eventually given up because of the prohibitive cost. Music from electricity—or music from light, to be exact—goes back many years before the telharmonium. Legendary Egyptian history, three thousand years old, tells us that the rays of the descending sun, would strike weird music from the face of the statue of Memnon.

Incredible as this tale may seem to



In appearance the audion closely resembles an ordinary electric lamp bulb. Built into the bulb close to the filament are two metal electrodes which are connected in such a way that a perfect electrical balance is maintained between them. When the wireless wave disturbs this balance, the disturbance is heard in the telephone receivers us now, the present day accomplishment of electrical music is hardly less astonishing. To an ordinary audience, the fact of most striking importance would be the quality of the music. It is quite possible to imitate the mellowest tones of a Stradivarius violin, but more interesting still, it is possible to create music of a tone and timbre that no one in this world has ever heard before. No less strange than the quality of the music is the means by which it is obtained. The variations produced in an electrical circuit by inserting a lead pencil line drawn on paper will cover not only the complete octave, but will include the most infinite shadings in tone.

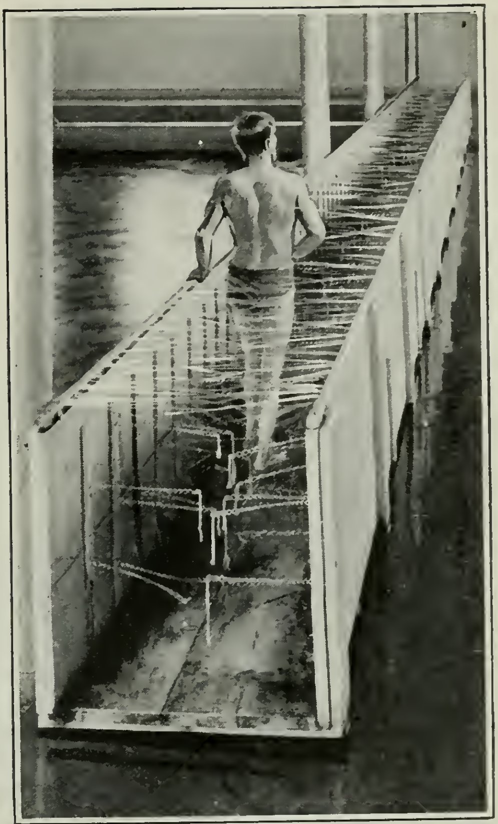
Dr. Lee DeForest, the discoverer of this type of electrical music, claims that with an arrangement of four or five bulbs and suitable adjusting apparatus and keys similar to those of a piano keyboard, he can easily obtain notes ranging in pitch through as many octaves as are desired and a tone quality identical with that of all musical instruments now in use as well as qualities never before produced.

The volume of sound depends upon the adjustment, the number of batteries that are used and the size and number of electric horns which project the sound. The horns can be distributed in various parts of the room or grouped together.

The basic principle involved in creating music by a vacuum bulb, Dr. DeForest does not attempt to explain. Nor does anyone else. Perhaps it is due to the unbalancing action caused by interference with the flow of the current. In this case, the tiny particles of electricity loosened, bombard the grid and the iron plate in musical rhythm. At all events, the action is probably highly complicated, and it may involve some new principle of electricity that we have not yet learned.

A Walking Leg Bath

AN interesting and unusual way of using water as a curative measure is represented by the "walking leg bath" evolved by a Battle Creek sanitarium and included in its list of helpful apparatus.



Tingling streams of cold water bring the blood rushing to impoverished muscles as a patient walks through this leg bath

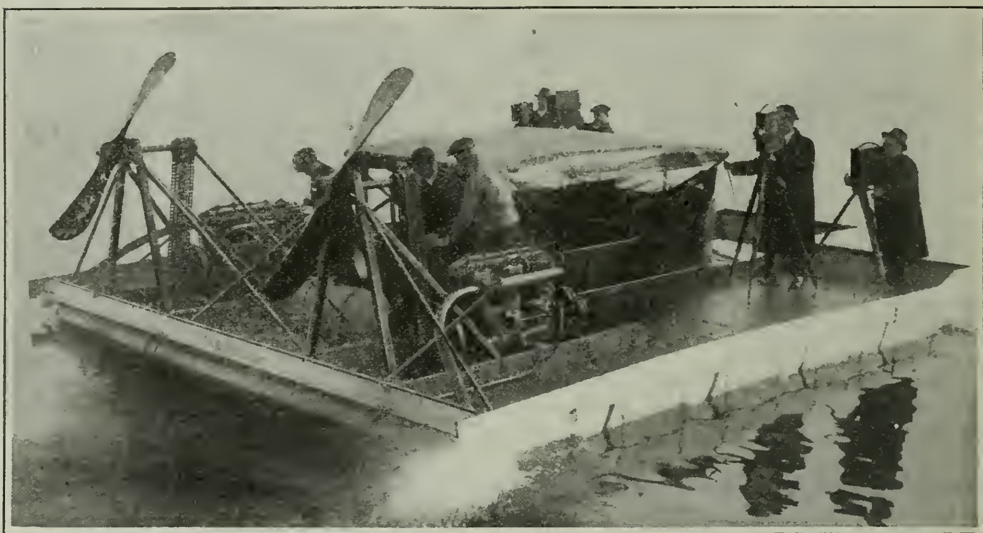
The walking leg bath is a simply constructed frame, lined with a number of woven wire springs and equipped with two water pipes, perforated at inch spaces to permit a horizontal shower. This strikes the legs at the moment when the muscles are in action and most open to benefit.

The patient is told to walk through the bath briskly, and by the continued performance of that act alone he improves his condition, the wire springs against which he must brush in passing, insuring a brisker circulation. The needle-like streams of water—at varying temperatures—forced against his legs by air pressure heighten the effect. It is one of the most exhiliarating of the modern "cures."

The walking leg bath is recommended in certain forms of rheumatism, varicose veins and other maladies affecting the lower extremities.

Gliding Boat for Tropical River Mail Service

A GLIDING boat that speeds over the water at the rate of fifty miles an hour has been built for transporting mails on the Magdalena river in Columbia, between the Carribean coast and the capital city, Bogota, a distance of six hundred miles. On her trial trip, from the factories at Nyack, N. Y., to the foot of Ninety-first Street, New York, a distance of twenty-two miles, the "Yolanda II" covered the distance in less than a half hour.



This gliding boat, which takes its power from the displacement of air instead of water by its propellers, was built in New York for use on a tropical river, where weeds make the use of screw propellers in the water impossible

Two gasoline engines of one hundred and fifty horsepower each are connected to an air propeller. It is impossible to use screw propellers in the Magdalena, as the sea weeds and grass are so thick.

The Yolanda II draws three inches of water while speeding at a rate of fifty miles an hour, and five inches while at rest. She was designed by Gonzalo Mejia, an engineer of Columbia. The problem of transportation on tropical rivers, where the shallow draft of encumbering sea weed, makes a draft of more than a few inches impracticable, has engaged the attention of native engineers for years. Mr. Mejia's boat is one of the best devices yet built to meet the problem.

The Steam Engine in War

THAT the Lanz locomobile, the name by which a remarkable portable superheated steam engine is known, is equally as successful for war as well as peace purposes is convincingly shown by its behavior during the past year on the various battle fronts.

One of the most interesting applications of the locomobile is for power purposes in connection with field equipment, such as wireless telegraph sets. One locomobile is supplying energy to a two hundred horsepower field wireless equipment. The locomobile is used extensively in operating pumps directly behind the firing line. A more extensive use is in supplementing the power plants of ammunition factories.

In one plant two locomobile units of five hundred horsepower each were added; in another, which, before the commandeering of the fuel oil supply, had been employing oil engines, a single one hundred and twenty horsepower locomobile engine supplanted the entire power equipment.

Among other applications of the locomobile are hauling guns and ammunition trains to the various batteries, and in heating hospitals and prison camps with the hot water from its boilers.

A motorcycle on runners is a novelty, but its practicability has been proven

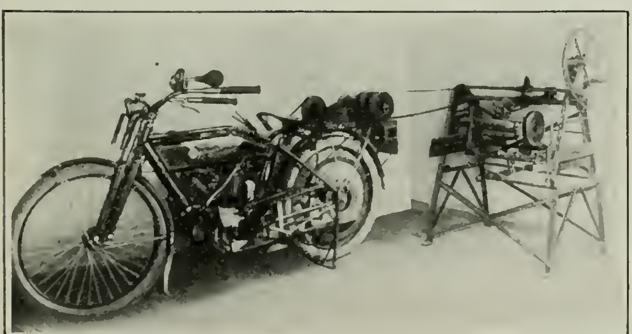
A Sleigh Motorcycle.

ALTHOUGH it is possible with little snow on the ground to run a motorcycle with its rubber tires, it has been found impossible to do so when the fall measures several inches, and a resident of Galt, Ont., has solved the problem thus presented.

The rubber tires were taken off the front wheel of the machine, and off the wheel on the side car, and runners were fitted on, and bolted to the rims of the wheels. The rubber tire remains on the rear wheel of the machine for driving purposes, but the runner on the front wheel makes the rut, thus permitting the use of the one tire.

Keeping the Motorcycle Busy

BY applying a belt and pulley device to his motorcycle, a mechanic who runs a grinding establishment has been able to double his output in the last season, the motorcycle supplying the power to grind lawn mowers, and the like. Fans driven by the same power keep the engine cool, so that it can run many hours without overheating.

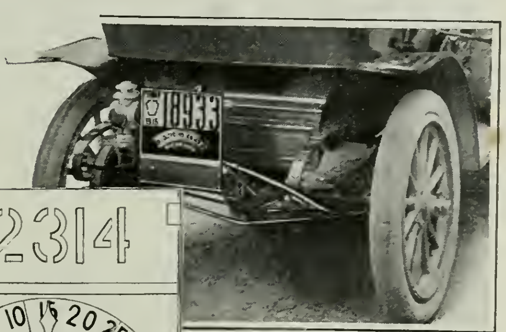


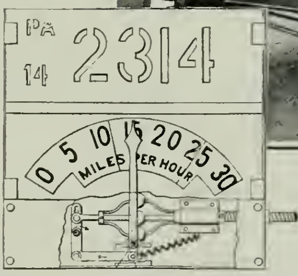
The mechanic owner of this motorcycle keeps it at work in his shop turning a lathe

The device was constructed by W. M. Conover in his shop in Gettysburg, Pa., and is a complete success. Of course the motorcycle is of value to him in securing business, and the belt and pulley attachment can be removed with no trouble in a few minutes' time.

Indicator Tells Pursuing Police Speed of Automobile

LAW-ABIDING motorists who have had the disagreeable experience of being arrested when they were well within the limit of the law will doubtless greet, with delight, the new invention of a Pennsylvania inventor. By means of a speed indicator, similar to the indicators which are found on the instrument boards of nearly every car, the inventor has made a combination license tag holder and speed indicator which shows clearly to the public the number of the car, as well as the exact speed at which the car is traveling.



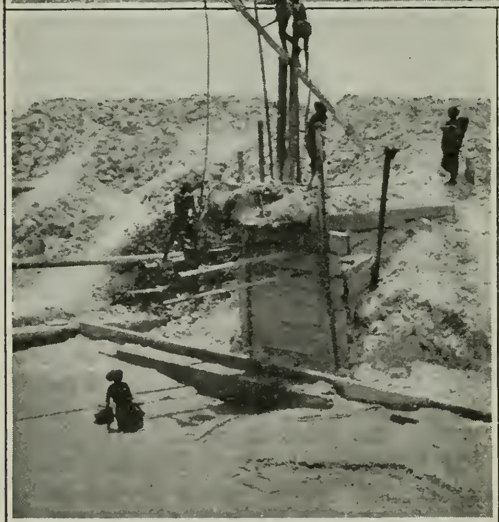


Here is a chance for the honest motorist to tell everybody how fast he is running

A semicircular plate, with the numbers in multiples of five up to thirty miles an hour, is equipped with a pointer, which indicates accurately the speed of the car. Both the license tag and the indicator plate are perforated, and are illuminated at night by means of a light placed behind them.

Where Men Are Still Cheaper Than Machinery.

GREATEST good to the greatest number makes some strange customs in India. The inhabitants are numbered by millions, and they are so pinched for money that a little has to go a long way. The companies operating gold mines there find it the best policy to hire all the labor they can, both because it is cheaper than installing labor saving machinery and because by that means they can save many from starvation.



Machinery would be used to sift ashes and pump slime in modern communities, but in India hand work is cheaper

Wages are extremely low and workmen are often very intelligent, performing exceptionally good work. Raw material is cheap, too, and the combination effectually bars out modern progress. For instance, the trains of ore cars are hauled by bullocks. An aerial tramway was installed by an enterprising manager, but he soon found that his maintenance charges were much greater than the total freight costs when the bullocks were used. Back came the bullocks and their native drivers.

Instead of using machinery, women and girls are employed to sift the ashes and recover small particles of unburned coal. The system is cheap and effective. So is the handling of slime pulp from the mills. This is a fine, slimy mud which is settled in big stone tanks in order to recover the water from it.

In progressive countries heavy pumps are used to empty the settled mud from the tanks, but in India they use native laborers and a primitive mechanism which takes much more time, uses more labor, and is not nearly so satisfactory, but it is cheaper and keeps many natives in food. A woman scoops the mud into a basket, two men raise it on the end of a long lever sweep, another empties it into a trough while a woman pushes it with a long stick to give it impetus enough to move along to its destination.

The spectacle would drive a modern efficiency expert to distraction, but he would reconcile himself to it when he figured out the relative cost of machinery and men.

Ingenious Slide Rule for Motorists

A SLIDE rule has been devised by which a motorist can compute accurately the ratios which exist between the number of revolutions of the engine and the mileage of the car per mile; the corresponding ratio of gear reduction, etc. It can also be used to ascertain the theoretical horsepower by the knowledge of the cylinder dimensions, and the reciprocal relations between various parts of the machinery. It is intended that the device will bear the name of some automobile manufacturer and be used as an advertising novelty.

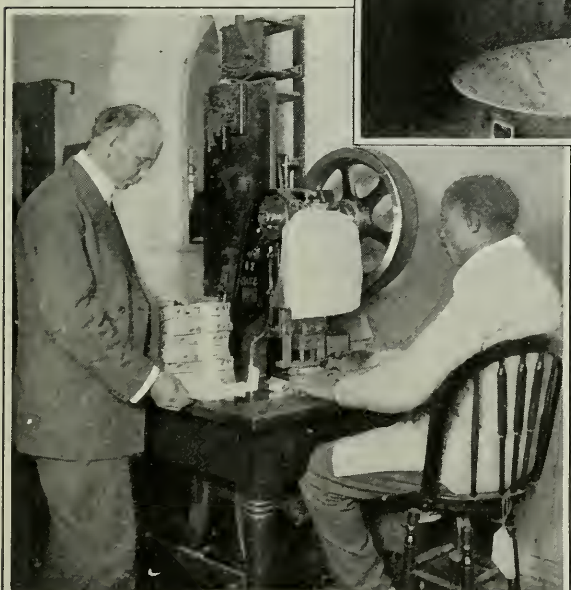
A Machine That Chews Money

FIVE million dollars a day in worn-out paper money was destroyed by machinery in the Treasury Department, at Washington, during the last fiscal year. Two tons of this redeemed paper, amounting to over three hundred and fifty million bank notes, with a face value of more than a billion and a half dollars, passed through the macerating machinery, new money being issued to take the place of that which was destroyed.

This money, after being sent to the Treasury for redemption, is carefully counted, made into piles, first punched and then cut in half, after which a committee of treasury employees sees that it is chewed up in a machine made for the purpose. It is said that the average life of a one-dollar bill is one year.

The great growth of this work since the days of the Civil War, when paper money was first issued, is indicated by comparison with figures for the fiscal year 1865, when seventy million pieces of redeemed currency were destroyed, of a face value of one hundred and forty-four million, two hundred and nineteen thousand, nine hundred and twenty dollars, which included a large amount of fractional currency.

The chief duty of these treasury employes is to see that all old paper money is thoroughly destroyed



The first step in the destruction of worn-out paper money is to bind the bills solidly and compress them into packages

The government first issued paper money in connection with the Civil War finances, and Secretary Chase's regulations for the destruction of notes unfit for circulation were issued as a result of an act of Congress. In Secretary Chase's time paper money and securities were destroyed by burning. Experience showed that this was not the safest plan in connection with the destruction of distinctive paper, because it is difficult to burn bundles of money, and undestroyed pieces may escape through the chimney. For this reason the act of June 23, 1874, authorized the destruction by maceration. The destruction of these once valuable bits of paper has always been witnessed by a joint committee, appointed for the purpose.

by a joint committee, appointed for the purpose.

Secretary McAdoo has recently modified the work of destroying the paper money so as to meet present conditions better. Now each member of the committee will check the money and securities delivered as well as witness their destruction. In the past, one member of the committee has usually verified the amount and the whole committee merely witnessed the destruction. The new regulations are designed to simplify the work and throw greater safeguards around the destruction of money and securities. The record shows that the paper money destroyed in 1915 had a total weight of five hundred and ninety tons.

One reason why half a paper bill is worthless. The treasury department cuts the returned bills into two pieces lengthwise as a preliminary to its total destruction

How Gulls Help the Farmer

THE term "gull" is usually associated in the popular mind only with long-winged swimmers seen along the salt water shores and in coast harbors. There are represented in the United States, however, twenty-two species or subspecies of gulls, including the gull-like birds known as skuas and jaegers. Of these some are true inland birds, frequenting prairies, marshes, and inland lakes. Flocks of gulls on the waters of our harbors or following the wake of vessels are a familiar sight, but not every observer of the graceful motions of the bird is aware of the fact that gulls are the original "white wings."

As sea scavengers they welcome as food dead fish, garbage, and offal of various sorts, and their services in cleaning up such material are not to be regarded lightly. It will, however, surprise many to learn that some of the gull family render important inland service, especially to agriculture. At least one species, the California gull, is extremely fond of field mice, and during an outbreak of that pest in Nevada in 1907-8 hundreds of gulls assembled in and near the devastated alfalfa fields and fed entirely on mice, thus lending the farmers material aid in their warfare against the pestiferous little rodents.

In Salt Lake City, is a monument surmounted by two bronze gulls, erected by the people of that city "in grateful remembrance" of the signal service rendered by these birds at a critical time in the history of the community. For three consecutive years—1848, 1849, and 1850—black crickets by millions threatened to ruin the crops upon which depended the very lives of the settlers. Large flocks of gulls came to the rescue and devoured vast numbers of the destructive insects, until the fields were entirely freed from them.

Motor Car Mows Railroad Weeds

A PRACTICAL railroad man has invented a weed cutting machine, which derives its energy from the source that runs the gasoline-driven handcars running up and down sections of every track.

There are a number of advantages in the new weed destroyer. The cost of labor has been cut enormously. A section crew with scythes working all day can cut no more than a mile. The usual price for this work is $1.75 per man per day. Thirty cents is the cost of cutting the same amount of weeds with the motor weed cutter, which mows down heavy weeds and grass at the rate of a mile every twenty minutes, averaging twenty-five miles a day.

Cutter bars are so arranged at the sides of the car that they can be raised by the operator in case of obstruction on the roadbed, but when down follow the angle of the ground perfectly. The blades can be stopped or started without raising, and the little gasoline driven traveler can pull itself along whether it is on or off the track.

Traveling at the rate of three miles per hour the gasoline scythes cut a swath six feet wide on each side of the track. If the lay of the ground varies on either side of the track, as is often the case, the blades can be handled by the operator to conform to this condition.

A regular crew of three men is required, and this number accomplishes the work that formerly required one hundred men.

Three men on this motor hand-car can mow as many weeds in a day as a hundred men working in the old way

With this simple device the sun's rays are utilized to heat water

Using the Sun's Heat to Heat Water

IN the Southwest, where the sun at noontime is extremely warm, all sorts of heaters have been invented to catch and utilize the sun's rays. In the case illustrated here, the coils of pipe, which are connected with the water system in the house, are arranged on a framework in a position where they are exposed to the sun during the hottest part of the day, and so great is the heat that the water becomes warm in a short time.

Still Enough Coal

ACCORDING to the International Geological Congress, there is coal enough yet unmined to last the world nearly six thousand years at the present rate of consumption. There is a reserve of unmined coal estimated at 7,398,561,000,000 tons, of which two-thirds are in the eastern United States.

Hospital Work on the Firing Line

UNITED STATES field hospitals, the least understood divisional units in the United States army, have been newly equipped in order that they may be more mobile during battle. The field hospital service of our army, as it is constituted today, is one of the best in the world.

Contrary to popular opinion, field hospital men are trained soldiers. They do their most important work under fire, and in war, their dead and wounded rank next to infantry in number. While the officers of field hospitals are surgeons and while the privates have been instructed thoroughly in first aid work, the real duty of the field hospital men during battle is to keep the front clear of savable wounded men. The field hospital problem is one of rapid transportation. During the past four years, since the system conceived by Tripler during the Civil War has been put into operation, every scheme to make it possible for field hospital officers and men to work swiftly has been resorted to.

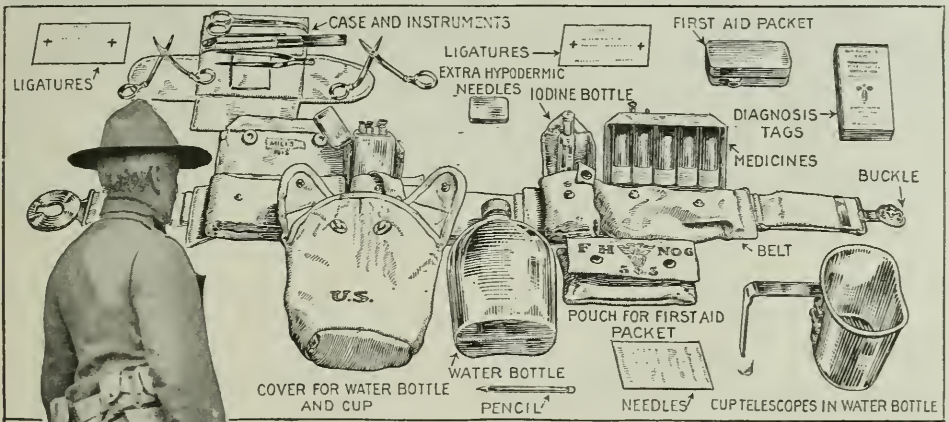
Officers and men of the hospitals are walking dispensaries. The officers carry surgical instruments, extra hypodermic needles, needles, ligatures, medicines, first aid packets, large iodine bottles, large water bottles and cups, diagnosis tags. During battle the officers can spend little or no time in dressing wounds or in "cooling the fevered brows" of fallen soldiers. Their time is occupied in directing the bearer-men, or littermen, who carry wounded soldiers to the field hospitals just outside the line of fire. While doing this transportation work, the stretcher bearers are really more under fire than the fighting soldiers.

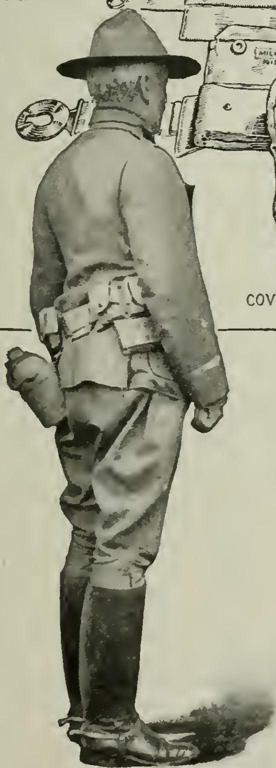
The new equipment furnished the field hospital men is as compact and as light as possible. Each man carries a meat can, a bacon bag, knife, fork and spoon, a water bottle, ten first aid packets, iodine swabs, five plain gauze bandages, safety pins and adhesive plaster, corrosive sublimate gauze, diagnosis tags and pencil, a large water bottle, instrument cases, forceps, scissors, and a hatchet. The enlisted men are thoroughly trained in the uses of the instruments they carry. When they have time, they administer first aid treatment to wounded men, but if they are pressed for time in the heat of battle, they devote all their energy to getting savable wounded men to a point where they may be in comparative safety while awaiting surgical treatment.

The men are taught that their work is to protect Uncle Sam's fighting material. They are not permitted to spend any time at the front with fatally wounded men, but to strain every nerve in saving wounded men who can be patched up to fight again. No nurses are permitted at the front. They are at the base hospitals, usually out of range of the enemy's guns. It is possible to take down and pack up on mule-drawn ambulances the entire camp equipment of a field hospital in two hours.

Ordinarily, that is, in time of peace, the camp tentage of a field hospital is as follows: five small pyramidal tents for officers, nine large pyramidal tents for soldiers, five tropical hospital tents for kitchen, stores, mess, dispensary and operating room, six ward tents each concontaining thirty-six beds, and tents for officers', patients', and men's latrines, with one for the men's bath. In field service the large pyramidal tents are not carried, and one thousand four hundred and ninety-eight pounds of weight are saved. No tent furniture or cots are carried.

The field hospital equipment for service weighs eight tons and is transported on eight four-mule wagons, which are used for ambulances. The army is now experimenting with motor cars to supplant the mule-drawn ambulances, since a similar equipment serving with the American Ambulance on the French front has proved remarkably successful. Fifteen horses—seven for the officers, two for the major, and eight for enlisted men—go with the field hospital equipment. The organization carries three days' rations, three pounds to a man, or eight hundred and ten pounds, and one thousand three hundred and sixty-eight pounds of forage for the animals.





A Walking Dispensary

The hospital corps of the United States army is learning much from the developments of the war in Europe. It is likely that the old ambulance mule, among other things, will at last give way to the swift light automobile

This ancient water wheel in Syria pumps the river up into the aqueduct at its top. Thus a wide territory is watered by other aqueducts and canals

Immense Water Wheels Which Lift Their Own Water.

HAMA, in Northern Syria, referred to in the Old Testament as Hamath the Great, is justly famous for its huge water wheels. The city lies some one hundred and ten miles northeast of Damascus on the River Orontes, and upon its banks are four huge water wheels used for drawing water for irrigating purposes and also for supplying the town. The wheels are driven by the flow of the river on what is known as the undershot principle; that is to say, the wheel is moved by water passing beneath it.

The largest, shown in the accompanying photograph, has a diameter of seventy-five feet. Upon its outer rim is a series of buckets which raise the water and deposit it in the aqueduct at the top. Like its companions, the wheel is built of mahogany, with an axle of iron. The creaking of the wheels is incessant, day and night, year in and year out, for they never stop.

It is interesting to note that wheels built on this same principle are in actual use in this country, in one of the fertile valleys of California, as described in the December issue of the Popular Science Monthly.

A Golf-Tee Fertilizer

AMONG the hundreds of patents issued every week occasionally one stands out above all others as being entertainingly original and ingenious. Such a patent is one issued recently for a golf tee. It is intended that the tee shall be shattered to tiny fragments when the ball is struck, and to act as a fertilizer after having been broken.

The tee is manufactured in a conical shape with a cupped top, into which the ball fits. It is made of green gelatine, so that, contrary to the condition which exists in the paper and rubber tees, the golfer can keep his eye on the ball without the usual distraction. When the club strikes the ball, the gelatine tee is simultaneously struck and shattered to a veritable powder. These small green fragments scatter on the grass and are dissolved at the earliest rain.

As gelatine is an excellent fertilizer, the shattered tee serves a very useful secondary purpose.

Why There are Defective Babies and Monsters

A cretin, aged forty-two

It is not our purpose in this article to comment upon the ethical right of a physician to permit a defective infant to die. What can science do to prevent Bollinger babies from being defectives? Why are defectives born from apparently normal and healthy parents? The subject has been studied by many scientists and their results are here summarized.—Editor.

A defective who is almost an idiot

BOTH in Sinbad, the sailor, of Arabian Nights' fame, and Homer's Odyssey, there are narrated, strange tales of a monster with one eye in the middle of its head, who was so gigantic and so voracious that he ate two men for breakfast and two for supper, besides emptying three bowls of wine. This creature was called Cyclops or Polyphemus. Another strange formation described in tradition as a "Winged Horse" was Pegasus, the steed of the Muses, which was faster than ordinary horses, because of its wings. Unicorns or horses with spear-like horns are also mentioned in ancient histories as are other human, animal, and plant pedigreed prodigies.

Side-shows, dime museums, fairs and the circus have special departments devoted to exhibitions of Jo-Jo, the Dog-Faced Boy; the Bearded Lady, Siamese Twins; two-headed calves; four-legged hens, and various animal and human monstrosities. The manner in which the odd, contorted creatures are formed, whether they are inherited, like club foot, color blindness, and webbed fingers, or are suddenly caused before birth as the little Chicago baby's deformities were traced to the prospective mother's typhoid fever, has been a much debated medical point.

A twin egg monster before development

Dr. E. I. Werber, of Princeton and Yale Universities, has undertaken experimentally to ring the changes on all theories, doubts and opinions by finding exact facts upon which to base the whole problem. It is now possible to attempt an explanation of the strange malformation of the little Bollinger baby born in the Chicago German-American Hospital on Friday, November 12, 1915, which created such widespread interest, because Dr. H. V. Haiselden, the German surgeon, refused to operate to save its life. The principal physical deformities in that much-discussed case were the closure of the intestinal tract, paralysis of the nerves of the right side of the face, the absence of the right ear, blindness of one eye, and malformation of the shoulders. The brain was only slightly subnormal, but the cranial nerves were absent or undeveloped.

"If he grew up he would be a hopeless cripple and would suffer from fits," said the doctor.

Many of the visitors at the hospital treated the baby, which lay in a little bundle in a private room, as if it were uncanny. Dr. Haiselden alone treated it like a human being. He looked into the little twisted face and patted its cheeks.

"It would be a moral wrong to let it live. It seems to me that a city which allows a Blackhand outrage a week, a thousand abortions a day, and an automobile accident every round of the clock is hardly in a position to criticize a man who holds that death is preferable to life to a defective."

Dr. John B. Murphy, former president of the American Medical Association, and physicians and professional men generally, took sides with Dr. Haiselden. But his critics were just as numerous.

Dr. Rosalie M. Ladova commented: "A life is a life and I wish Dr. Haiselden had stepped out and let someone else operate."

Should these children ever have been born? To the left is a cretin; beside her a type technically known as a Mongolian idiot; next comes a micro-cephalic, who is a burden to himself and to the institution in which he is confined; the last on the line is a water-brained (hydro-cephalic) girl for whom society has no use

Can Science Prevent Defectives?

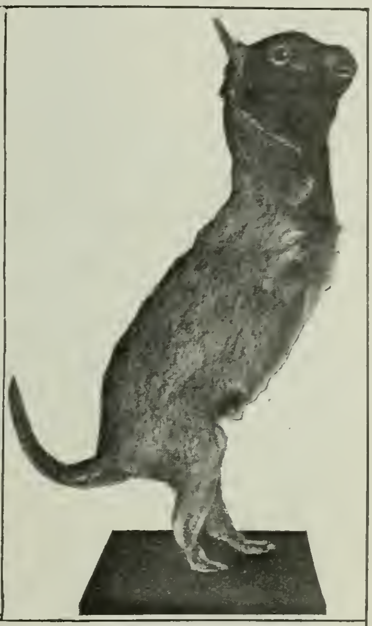
The most serious question, however, is how to prevent just such monstrosities as the unhappy Bollinger infant and to this end Dr. E. J. Werber, and independently Professor F. E. Chichester of the Zoological Department of Rutgers College, New Brunswick, New Jersey, have directed their experiments and discoveries.

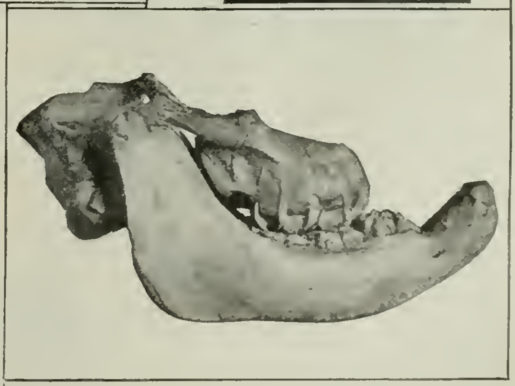
Before the eggs are made fertile and begin to form the unborn baby, colt, puppy, or other animal, these investigations proved it to be possible to induce such changes in the eggs or early embryos by inoculation into the blood stream of the mother the poison of diabetes, of kidney diseases, of typhoid fever, and other poisons and waste materials, so that deformed offspring would be developed and born. With two substances, butyric acid and acetone, chemicals that are produced in the blood of those who have sugar disease and sugar in the flowing lymph and serum, a great variety of monsters were born in the experiments of Professor Werber.

These experiments yielded defectives and monstrosities, similar to the Bollinger baby, to mythical Cyclops, to Siamese twins, and to creatures without legs, without necks, minus eyes, with absent ear or entire faces, with open spinals, open brains, with tails and without tails, armless, and even clubbed feet. Hydrocephalus, in other words waterlogged head, where the upper part of the head is so elongated as to resemble an Atlas, was produced by alcohol and other poisons in many embryos. In many, parts of the organs were lost, shrunken or undeveloped. Sometimes only half of the body developed. Some eggs were found to have one eye de-

A calf which started to grow a second body

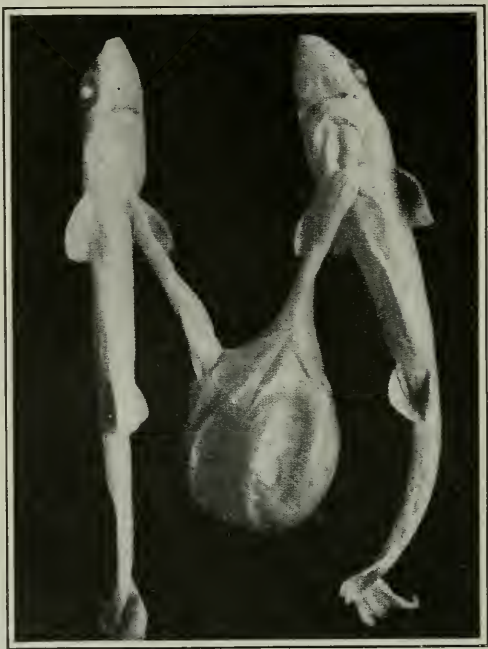
A puppy born without fore legs. It lived six weeks





The skull of a defective pig. The animal had but one eye and no face. To the left, a two-headed calf, one of the common freaks of the old-fashioned "side show" veloped so large as to crowd out the rest of the body.

The various acids, chemicals, and bacterial poisons used seem to act upon the multiplied egg, after it has subdivided many times into a compound egg. These are fragments broken off by the poisons in the blood of the mother, and the particular divisions which are poisoned cause the malformations and freaks.



A twin dog-fish, the result of some chemical effect upon the egg

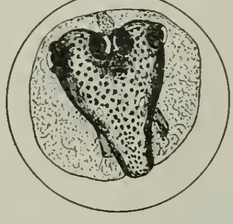
Making Hens Lay Double Eggs

Examples of eggs within eggs have been attributed to the serpentine movements of the flexible canal through which they pass. Hens frequently lay several double eggs in succession. Fere, a distinguished investigator, claims that he succeeded in producing double eggs in a hen which normally laid single eggs, simply by drugging her with belladonna. Glaser, another biologist of note, has described the ovary of a hen which habitually laid double eggs and concludes that fusion is the explanation of some double eggs.

The one which Professor Chichester wishes to record is a "gourd-shaped" egg. Professor Hargitt studied one, which was not preserved carefully, and on account of evaporation, the condition was such that he could not be certain of the presence of yolk in the smaller end. He assumed that the egg was comprised of about normal parts in the larger end, and that the smaller consisted of only albumen, "its yellowish tint having resulted from the evaporating process which had taken place."

A twin fish starting to develop

How quadruple eyes grow



A double head in process of formation

TADPOLE MONSTERS

Many cases of twins and double monsters in fish have been recorded but no case of apparent modification of structure by chemical means in one of the twin fish mentioned. Dr. Chichester fertilized the eggs from several female Funduli by the sperm of one male and at the proper stage, he added a dilute solution of ether in plain sea-water. Many of the eggs died. Two days later the water was changed for fresh sea-water and a few of the dead eggs were removed. Three days from the beginning of the experiment the dead eggs were picked out, and the remaining few were placed in fresh sea-water. The living eggs numbered two hundred and fifteen, and the uncounted dead eggs about six hundred. At the end of six days' time the normal embryos were separated from the abnormal.

In the first lot

there were a pair of cyclops, one pair of twins and one hundred and ten normal. In the second lot there were nine typical cyclops and seventy-eight normal. The twin Funduli were most closely observed and were killed and preserved on the sixteenth day only because it was evident that they were about to die. The cyclops was the smaller of the two; the eye on the right side was apparently lacking.

One-Eyed Animals and Men

Dr. Chichester also describes three instances of Cyclops in mammals, one in a rat, and the third in a man.

The man had an hour glass eye in the center of his forehead. The rat had no external or internal indications of an eye; the pig had no eye-ball nor lens, but had three lids, the two upper ones being fused almost completely. Neither the pig nor the rat had a proboscis.

Obviously, monsters and freaks are now in a fair way to be explained without cursing nature for a visitation, which is experimentally traceable to human ignorance, accidents, disasters, and the circumstances that interfere with the natural gravitation of living things toward an even keel, a symmetrical development and the stability of health and a balanced figure.

Maude, the Motor Mule, on Our Cover

"MAUDE, the Motor Mule," whose portrait appears on this month's cover, is an automobile which has been performing the latest dances upon various racetracks over the country. Before the racers commence their whirlwind circling of the speedways, the band plays a tango or a one-step, and "Maude" appears upon the track, rearing upon two wheels and cavorting to the tempo of the music.

A photograph and a brief article were reproduced in the December Popular Science Monthly, but a few additional details of "Maude's" way of working will be interesting here. The car was built especially for exhibition purposes. Running beneath the body is a small track upon which moves a heavy weight. Another weight is fixed on the overhang behind the rear axle. When the driver, Roy Repp, pulls a lever, the heavy weight beneath the car moves forward or back as desired, the center of gravity is upset, and the car, suddenly stopped or slowed down, rears up on its hind wheels. The counterweights are so delicate that the car may be run while balancing upon the rear wheels, as shown on the cover.

Each of the rear wheels is fitted with a separate brake. When one of these brakes is engaged the wheel is locked, and the differential gear drives the opposite wheel alone, causing the car to swing. By means of these independent brakes the car may be made to wheel and dance in time to the music.

Six hundred pounds of almost pure silver

Nature's Horde of Solid Silver.

RECENT development at some of the mines of the Cobalt district of Ontario, Canada, has resulted in the production of more of the wonderfully rich silver ores for which the camp was famous during the days of its first working. At the Temiskaming mine there has been found some rock which makes a special record for high value.

The six hundred pound slab shown assays about ten thousand ounces of silver per ton, being therefore about one-third pure silver. There is no gold in the ore, that being one of the general peculiarities of the ores of the Cobalt district.

A Real Sultan's Strange Body-Guard

OF Eastern monarchs none retain such a strange and picturesque bodyguard as the Sultan of Dyokja, one of Java's few remaining native rulers. Surrounded by hordes of strangely uniformed retainers, consisting of soldiers, musicians, singers, dancers, bearers of the royal fan and umbrella, pipe, and betel-box, his court presents an extraordinary spectacle, recalling a comic opera on a colossal scale.

The time to visit this court is during one of the many native festivals. Then one may witness a sight which for Oriental pomp and grandeur and startling effect has certainly no equal. On that occasion the troops appear in the weirdest of costumes. There are uniforms of every shade and color—black, white, blue, pink, and green—uniforms made up of several colors, striped uniforms, and uniforms enriched with gold lace and other trimmings. Some take the form of tightly-

The general of the Sultan of Dyokja's army

The sultan of Dyokja, in Java, maintains a court which must be the envy of the comic opera librettists. The uniforms are all queer, and the etiquette is individual and very Javanese, especially in minor matters of oriental deportment fitting tunics, others possess a distinct Western cut, while others again wear loose-fitting gowns, reminding one of a lady's tea gown.

The headgear is equally as varied, that of the Sultan's personal bodyguard consisting of a highly embellished pyramid shaped hat with a wide brim in front and two laps that fall down over the ears. So far as the weapons are concerned, they are about as varied and wonderful as the uniforms. Some men are armed with long pikes, others with lances, still others with old-fashioned, long-barreled muskets bearing ludicrously long bayonets.

Was This the Tower of Babel?

It is doubtful if there is any place in the world so rich in ancient remains as the valley of the Euphrates, in Mesopotamia. The result is that to archaeologists and scholars the place is a veritable "Tom Tiddler's ground," and new "finds" are constantly being reported. When it is remembered that tradition places the site of the Garden of Eden here, while amongst its many ruins are those of ancient Babylon, the promising nature of the valley to the scientific excavator becomes apparent.

It is near the ruins of Babylon that we find what many scholars believe to be the remains of the Tower of Babel—an immense cube of brick work, called by the natives Birs Mimrud. Recent exhaustive examination of the strange pile and its site has revealed the fact that the tower which once stood here consisted of seven stages of brick work on an earthen platform, each stage being of a different color. The tower boasted of a base measurement of nearly six hundred square feet, and rose to an unknown height. Even to-day the ruins rise some hundred and sixty feet above the level of the surrounding plain.

A lonely pile, worn by ages of weather is the world's only claimant to the honor of being the Tower of Eabel

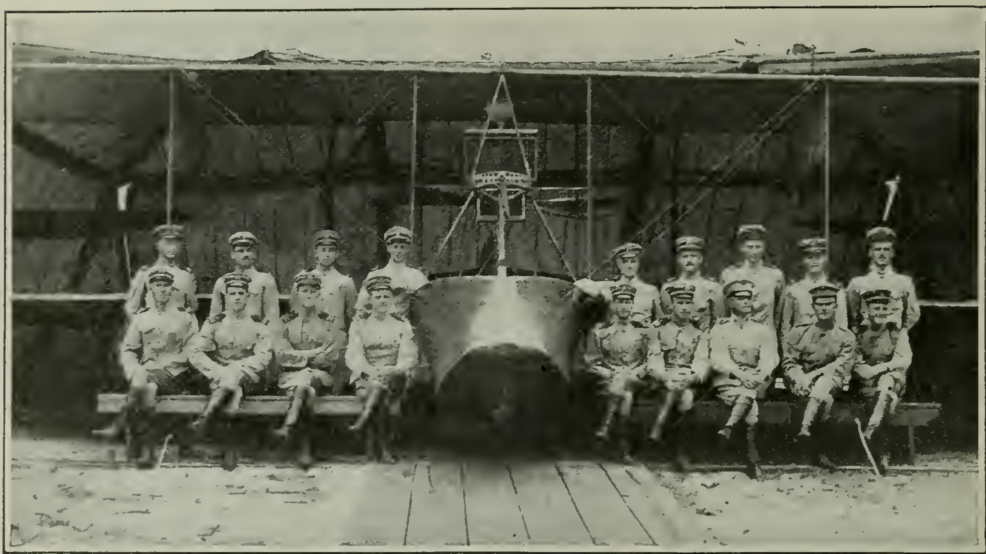
Piles of Walnut Logs for Gun Stocks

This pile of logs represents about one-fourth of the material needed to fill a large war order received by an Iowa sawyer. His mill has a capacity of one million gun stocks a year. These walnut logs are valued at about sixty thousand dollars, and will make two hundred and fifty thousand gun stocks. Five car loads is the daily capacity of this part of the plant. Each tree is inspected by an agent of the company before it is cut.

Here is one reason why walnut furniture is likely to be popular and expensive before long. This pile of American walnut logs is waiting to be cut up into gunstocks for the soldiers of Europe

The Death Toll of Our Misspent Aeronautic Appropriation

By Eustace L. Adams



These officers are asking, "Which of us will be next?"

THE terrible and increasing mortality rate among our Army and Navy aviators is proportionately greater than in the flying corps of any large nation in the world in times of peace. Death after death among some of the finest officers in the Army and Navy seems to be necessary to shake the officials and people of the country into a realization of facts that have been repeatedly brought to their attention.

In the fulfillment of his duties, officer after officer has flown in antiquated and patched-up aeroplanes, knowing that the machine was unsafe and likely to collapse at any minute. These young men, splendid types of American manhood, have bravely sacrificed their lives that the United States may at last look the issue squarely in the face. Their death seems cruelly necessary to drive home the fact that the Army and Navy must be supplied with sufficient modern aeroplanes.

As this article is being written, the Army and Navy have, together, twenty machines. Of these twenty, six are in actual flying condition. The rest are out of commission, some temporarily, many permanently. We have now about fifty officer-aviators who are actually capable of flying a machine; yet Montenegro, a nation so small that we seldom hear of it, although it is at present fighting in the World War, has an aeronautical corps of fifty machines, and more than two hundred first-class aviators.

Our aeroplanes are, for the most part, hopelessly out of date. They are patched and worn. Some of them are two or three years old. Each officer should have one machine, which he—alone—should fly. If he breaks a part, he should supervise its repair, and when he takes it into the air again, he should know its condition. As it is, several officers fly the same machine. Students are taught to fly in it, and the result is usually much breakage. Everyone or no one supervises the repairs. Consequently the officer who is called upon to fly never knows the exact condition of his machine.

"Another Army Aviator Killed"—how often we see that headline. It must not be supposed that these men are killed while attempting to perform circus feats, such as looping-the-loop. Despite many newspaper reports to the contrary, they are usually killed during the performance of their duty—nothing more.

What effect has all this on our aeronautical corps? The officers of the Army and Navy, detailed to aeronautical work, are dissatisfied and disappointed, but still hopeful. Some of them, who have seen too many of their brother officers and friends crash to their death, have voiced their opinions. One officer is now being court-martialled for refusing to fly machines which he knew were unsafe.

At the last session of Congress, one million dollars was appropriated for aeronautics. But, is the outlook better? Will new machines be bought, a permanent foundation built for the fleet of aeroplanes that the United States must and eventually will have? How was this needed appropriation spent? A few machines were bought, and a few more may be ordered. Although aeroplanes cost slightly more than a good automobile, we have little to show for the appropriation in the way of flying machines.

An aeronautic base *de luxe* was built at Pensacola, Florida. This station consists of a navy yard and a naval reservation, containing two villages, the civilian population of which totals one thousand and sixty-nine people. As this station is as large as some of the large navy yards in full operation throughout the country, many of the officers who had been detailed for flying service were assigned to administrative and executive duty in order to keep up and maintain this expensive plant. All this for half a dozen aeroplanes of doubtful worth and a new and costly dirigible of an antiquated type! Fine for the people of Florida, but

Landing stage at the Pensacola aero base. Many of these fine appearing machines are antiquated and unsafe, fit only for the junk-heap expensive in the lives of many splendid young men.

What is the remedy for this shocking condition? During the present session of Congress there must be an appropriation which will insure the purchase of a great number of new machines. When we have at least five hundred machines as a start in the right direction, then, and not until then, will the Pensacola Aeronautical Station be of real benefit and be worth the money that has been spent on it.

With the requisite number of efficient aeroplanes, and money enough to maintain flying schools, the aviators of our Army and Navy will have to confront only the ordinary dangers incidental to flying, which they are ready and willing to face.

Photographs of the War

THE photography of the war has been, until recently, one of the great disappointments of modern journalism. In the first months of the great conflict, few pictures of any real interest filtered through the hands of the censors, but since the beginning of the second year, American photographers have managed to find their way to the fronts and have taken pictures which while inocuous in the eyes of the censor, had that striking news value which has made American journalistic enterprise the criterion of the world.

In the first rank of these photographers is Albert K. Dawson, of Brown & Dawson, Stamford, Conn., whose picture of a German 42-centimeter cell which pierced the walls of a Przemysl fort but failed to explode, is one of the most striking war photographs to reach this country. This photograph, which as published in our November issue, was mistakenly credited to Underwood and Underwood, but the credit of the achievement should go to Brown & Dawson, who copyrighted the picture.

Hearing the Stones on a River's Bed

A MICROPHONE installed in a sounding lead is used in taking soundings to determine the character of the Ohio river bed. An armored cable leads from the microphone to the trawler, terminating in a telephone receiver and dry batteries. The ship is propelled at a rate of from two to six miles an hour. When the sounding lead drags over the mud bottom, a dull groaning sound is heard in the receivers, while a stony or pebbly bottom will cause a series of sharp, staccato raps.

Brightening the Baby's Path

FRANK PEIRCE, of Edwardsville, Ill., an electrical experimenter, devised a way of lighting the path for his baby's buggy. He thought of the plan when the baby objected to riding in the dark and being jolted about because of striking unseen objects. The light and reflector of a flashlamp are arranged in the top, a four-volt light being used and giving about sixty candlepower. It is connected with two dry cells in the bottom of the baby carriage, under the seat.

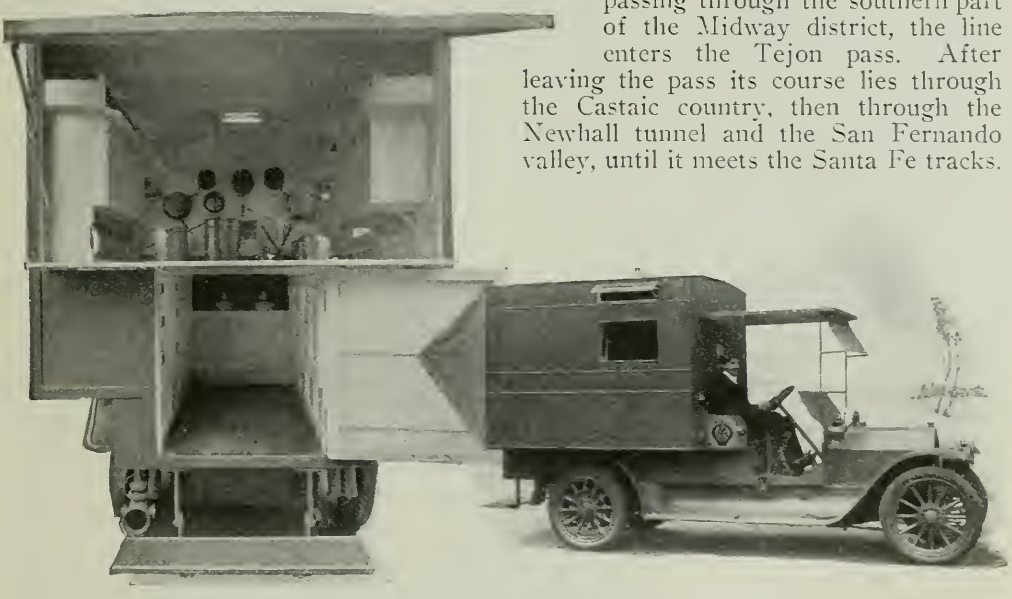
An electric light in the hood of his carriage brightens this baby's way at night or in the evening dusk

The light throws a ray fifteen to twenty feet ahead of the buggy. It may be easily adjusted to keep the rays from the child's eyes at all times. A plug and socket arranged in an inconspicuous place is used to light and shut off the current.

A Gasoline Field Kitchen

AMONG the useful and interesting devices of which the origin is directly traceable to the war, the automobile field kitchen in the illustrations is one that is made necessary by the swiftness with which armies in the field are transported and by the promptness with which these armies must be supplied with food. In this field kitchen the army cook raises the canopy on the rear end. Behold! A kitchen of the most compact, yet of the most complete kind, is revealed.

Four high-pressure burners furnish the heat; cleverly concealed pumps force water from the fifty-gallon tank in front of the car to the enamelled sink in the kitchen; and a variety of utensils, such as jugs, plates, meat-choppers and fish-slicers are provided for the rapid and clean preparation of food. Like most modern kitchens, too, this one boasts of ventilators, both at the sides and in the roof of the car. Indeed, it would seem as if the English firm which invented this motor-kitchen simply made a practical, miniature edition of a most approved and modern type of hotel kitchen.



The army—and the circus—field kitchen, sprawling over rods of ground, and using its coal out of a load dumped hastily in a pile, is a thing of the past. The modern equipment travels by automobile, and its stoves are all inside, fed by gas at high pressure

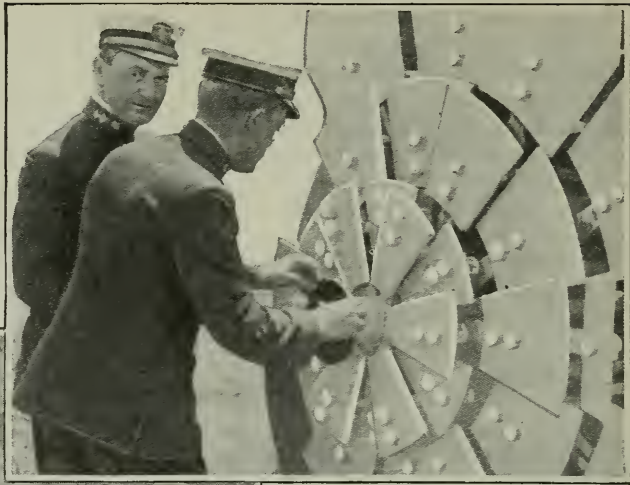
The Longest Pipe Line in America

One of the greatest pipe-laying projects ever brought to a successful conclusion in the western part of this country, and possibly in this entire land, was the laying of one hundred and fifty-three miles of eight-inch steel pipe from the Midway oil fields to Vernon, California, at the expense of three million, five hundred thousand dollars. This line has a daily capacity of between twenty and thirty thousand barrels of oil and represents capital of three nations.

The actual route of the pipe line is as follows: Beginning at Pentland and passing through the southern part of the Midway district, the line enters the Tejon pass. After leaving the pass its course lies through the Castaic country, then through the Newhall tunnel and the San Fernando valley, until it meets the Santa Fe tracks. Thence it proceeds to Vernon, where there is a double topping plant capable of treating about twenty thousand barrels a day, and finally on to the sea. Along the route there are eleven high-pressure and one low-pressure pumping stations, and beside these there are three chief storage stations and two loading stations. One of the storage stations, consisting of four fifty-five thousand-barrel tanks, is at Pentland, another made up of the same number of tanks is at San Fernando, and a third, consisting of six fifty-five thousand-barrel tanks, is beside the ocean.

Seeing Your "Hits" Half a Mile Away

The electric target of steel is shown on the right. The bulls-eye is black and the outer circles are set behind it, in lapping arc-shaped leaves. When a shot hits, an electrical contact is closed and indicators show automatically the exact section of the target where the shot struck thus rendering it unnecessary to post men at the target to signal back the hits



As each shot is fired, the electric contact registers, and the marksman can see at once not only in what ring he struck, but whether it was to the right, left, above or below the bulls-eye, so that he can correct his range or his aim to suit. The interest which is thus aroused and the greater advantage to the marksman in knowing exactly the direction in which he was "off" make the new target exceptionally valuable in training marksmen

Saving Steps at Target Practice

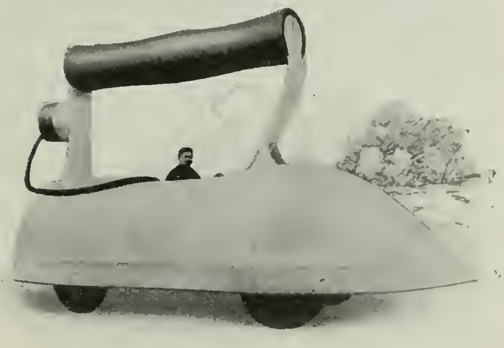
AN electrical target that signals the exact accuracy of the marksman to an indicator on the firing line has been installed on the shooting range of the United States marines at San Francisco, Calif. The method of signaling the accuracy of shots which is now employed on nearly all government ranges is not at all satisfactory, as it is difficult to convey to the man on the firing line the explicit information of the closeness of his shot to the bull's eye.

An elaborate system of flag and disc signalling is usually employed. This requires, at least on the long distance ranges, the use of field glasses. When the marksman fires a shot at a target, the "spotter" in the distant pit lowers the target and raises a signal to denote the numerical accuracy. A white disc denotes a bull's eye; a red flag, a miss, with other emblems to denote whether the bullet pierced ring No. 4, 3 or 2.

This procedure requires a large corps of men both in the pits as spotters, and on the range behind the individual marksman, as scorers. Moreover, it is confusing, and there is no satisfactory way of signalling whether the bullet which missed the bull's eye went too far to the left or right; too high, or too low.

The electrical target, as it is called, corrects a great many of these faults, although its installation cost is considerably higher. In appearance, it resembles a number of large ventilating fans superimposed one upon the other, each one smaller than the one beneath it. The bull's eye is a thick metal disc, painted black, which extends in front, of the blades. Steel plate is used in the construction. Behind the plates are electric contacts.

On the firing line is an electric indicator, which, in design, is a replica of the target. Each leaf of the target is represented by a miniature electric lamp on the indicator. When a bullet strikes one of the blades of the target, the contact made closes an electrical circuit consisting of batteries, a cable to the indicator and one of the lights on the indicator. The action is immediate, the marksman knowing instantly not only his score but the exact place on the target where the bullet struck, so that he can adjust his rifle sights to conform with wind and temperature conditions. The target and indicator are marked to resemble a clock face, following a long established practice on rifle ranges.



The enormous electric flat-iron float has taken its place as an important feature of all civic parades

An Electric Flat Iron Float.

A FLOAT that was conceded to be among the best of the one hundred and seventeen in a recent parade held by the business men of Liberty, N. Y., was a representation of a popular electric iron. It was mounted on a small runabout.

Following the business men's parade, the Firemen of Liberty held a parade and the "Iron" float was selected for participation as one of the best decorated in the previous event.

Realizing the advertising advantage, the company which made the float has had it mounted on the roof of the power house where it can be seen from all parts of the city.

The February Popular Science Monthly will be on sale Saturday, January fifteenth (West of Denver on Thursday, January twentieth).

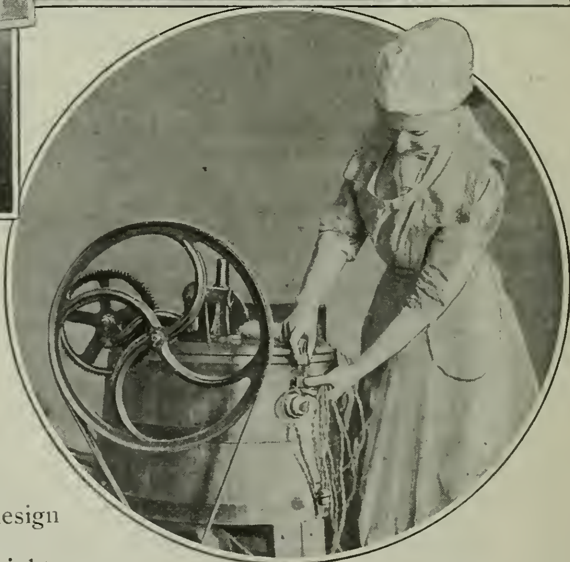
Monday Mechanics

IN the good old days when the only way to wash clothing was to carry it to the riverside and sop it up and down and rub it upon stones, there was good reason for calling the first work day of the week blue or drab or even black. To-day, however, fortunate home laundresses have at their disposal excellent mechanical helpers. The pity of it is, that these helpers fall far short of the mark because of lack of knowledge upon the part of women of how to operate them efficiently and because of really blame-worthy stupidity upon the part of the men who design and install the equipment.

The amount of energy used in running a hand washer is as disheartening as it is unnecessary

For instance, notice the upper right-hand photograph, taken in the "convenient" laundry of an ordinary home. It is not an isolated instance. There are hundreds like it in other houses and apartment buildings. The bottoms of the set tubs are but fourteen inches above the floor. The average height for women is five feet four inches. Can she see the washboard? No; it has sunk out of sight because the tubs are too deep.

A third fault is that the tubs are poorly lighted. Number four is that the tubs are against a wall and also in a corner, accessible from too few points. The only artificial light is a single electric bulb, a sixteen candle-power carbon, hung near the ceiling in the center of a very large basement room. Then the water inlets are flush with the back of the tub, so it is not feasible to attach a



Above, the back-breaking hand tubs found in most houses. Below, the electric washer which pays for itself before it begins to wear out hose for filling either the wash boiler or a washing machine. This means the arduous carrying of water in buckets.

The remedy is a complete change. The tubs should be out in the room instead of in a corner. There should be more window lighting and a stronger lamp located above the tubs. The laundry trays themselves should be shallower in form and their bases six or eight inches higher. There should be faucets suitable for hose attachment and set high above the rim of the tubs to be out of the way of the washing.

The laundry stove should adjoin the tubs at their left, so that the boiled clothes can be lifted directly into the rinse tub, for the washing processes are usually rounted from left to right. If a washing machine is used, however, it may be desirable to give this location to it. The best location for a washer depends upon the type of the machine and upon the style of wringer, if it be stationary or sliding or swinging.

If one uses portable tubs the bench should be slightly higher than is usual, the exact height being determined by individual experiment. Twenty-four inches is right if the tubs are for rinsing only. If one uses a washboard, twenty to twenty-two inches is preferable. Galvanized iron is better than wood because it is much lighter to handle and because wooden tubs shrink and leak if not used for a period.

When washing in the kitchen it is well to have an elastic mat to stand upon, for this lessens weariness. If a cement floored basement is used a little slatted framework of laths is good to stand upon not only to save weariness but also to keep the feet dry and warm.

If one can possibly afford it a washer is to be substituted for the back-breaking washboard. A hand power washer entails as much wearisome work as hand rubbing. Test it by attaching a spring-balance to the lever of a hand power washer filled with water and clothes. Pull on the balance instead of direct on the lever. The handle moves through an arc of twenty-eight inches and the pull is twenty pounds as the balance will show. Multiplying two and one-third feet (the arc of movement) by twenty (the pounds of pull) you get forty-six and two-thirds foot-pounds of work for every stroke of the handle. The average is thirty strokes per minute. This means fourteen hundred foot-pounds every minute. An ordinary washing is seldom less than three fillings of the machine at ten minutes per filling.

The real advantages of a washer are that scalding, sterilizing water can be used and the boiling process can be omitted, and that the application of power can be taken from weary woman's back and arms and tranferred to the stronger muscles of a man, or to mechanical power.

Some form of power washer is what every home laundress deserves. The cheapest is water power and this is available only in cities where there is unlimited water under high pressure. These do not have a motor wringer.

The woman of the farm or village can attach her hand power washer adding the proper wheel to carry a belt, to the farm gasoline or oil engine. This, too, means wringing with a wringer turned by hand. For twenty dollars to thirty-five dollars a splendid power washer is available with an attached, motor-driven wringer. The higher priced ones have also a wash bench. The power wringers are stationary, swinging or sliding.

The city woman can have that best of all servants, electricity. A one-sixth horse power motor can be attached by a belt to a hand-power washer. This is shown in a photograph on the foregoing page. Machine, motor and accessories, without wringer,cost twenty-eight dollars.

For forty-five dollars to one hundred dollars one can get excellent electric washers with power wringers included and the saving of woman-power for higher uses will justify the investment. The cost of current is very small, usually two to four cents an hour. A fifty dollar washer should last at least ten years, which is five dollars a year for depreciation. Counting interest on the investment of fifty dollars this is three dollars yearly. Current cost varies but ten cents a week, a generous allowance.

Motor Car Bodies of 1916—Good and Bad

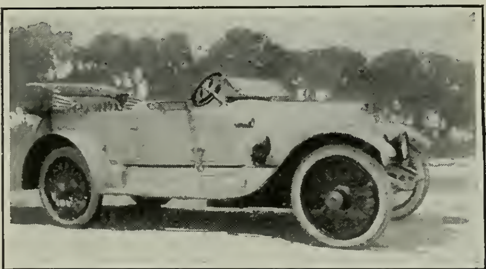
By John Jay Ide

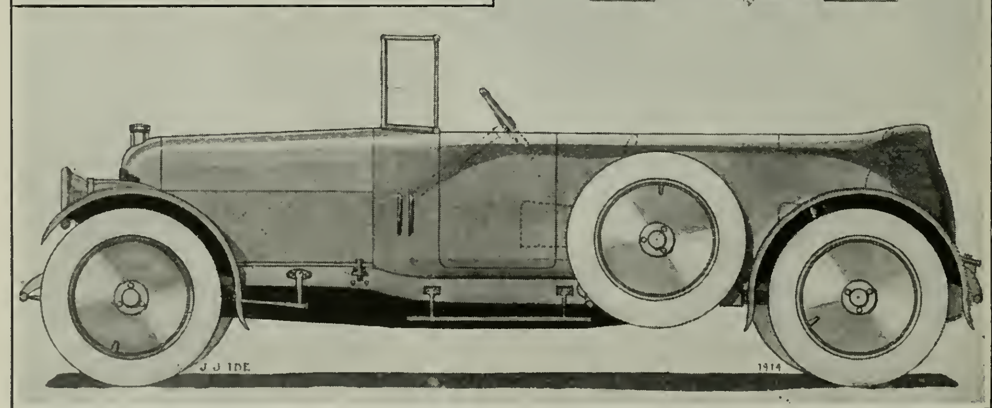
THE average American automobile manufacturer has finally grasped some of the essentials of streamline form as far as open bodies are concerned. There are now only a few makers who cling to such features as the wide radiator, straight-sided hood and bulging cowl, low body sides affording little protection to the occupants, and upholstery protuding above the top rail. Of the cars offending in the respects mentioned several are splendid productions mechanically. One would think that the makers would be ashamed to mount coachwork of such antiquated design on their chassis.

Fortunately, these are extreme cases; the average body is a credit to the American industry. Strange to say, some of the cheaper cars are better looking than their higher priced competitors, although the palm for beauty must be awarded to a fairly expensive machine produced in Ohio. The builders of this car introduced the double cowl into stock body design last year and its effect may be seen in the number of double cowl bodies offered to the public for 1916. In fact, this type bids fair to become more popular than the body with an aisle between the front seats. In this connection it may be remarked that in December, 1912, the writer designed what is believed to be the first double cowl body mounted on an American chassis. A photograph of the car is shown on this page.

Among the features adopted on some 1916 cars is the "concealed" door, having no mouldings around it. As the hinges are not exposed, the streamline effect is heightened, but, unless the workmanship is very good, the joint between the door and body widens so that in time the door is concealed only in name.

For years the windshield of the aver-





A sporting type body designed by the author. Notice the high sides, pointed windshield, concealed top and disk wheels. In insert, above, a double cowl body designed by the writer in December, 1912. The two rear seats are divided by an arm age American was distinguished by massive stay rods, attached to the frame and fairly successfully blocking access to the motor. Now, however, except in one or two cars it is made strong enough to stand alone. Many screens appear to have been attached to the body as an afterthought. This is the result of fitting ready made shields instead of designing them at the same time as the bodies.

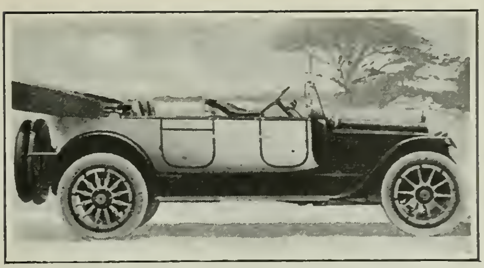
The ugly filler board at the base of the windshield is not considered as indispensable as formerly, but one well-known car continues it in the guise of a ventilator. On some machines the sides of the screens curve in at the bottom. This is not only ungraceful, but also inefficient, as the front seat occupants are not so well protected as they would be if the screen was its full width at the base. The slanting windshield was introduced last year, but has not yet been much copied.

Auxiliary seats, instead of folding against the side of the car, now often disappear into recesses behind the front seats. The double cowl lends itself well to this construction.

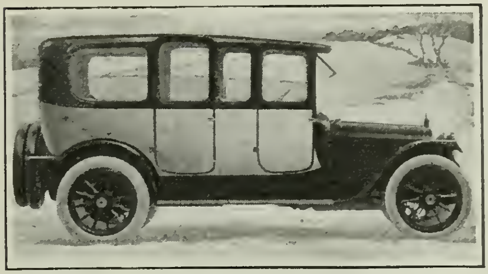
Most cars have crowned mudguards but a few are equipped with the more advanced domed type. Domed guards not only look better, but also can be moulded in one piece with the aprons, thus removing a possible source of squeaking. Many mudguards are not carried far enough down behind the rear wheels to protect the spare tires or trunk from mud. Also, the clearance between top of the wheels and the guards is often absurdly great, even when the car is fully loaded.

The detachable top for winter use was brought out last year and is now supplied by a number of makers. It gives some of the advantages of a sedan for a few hundred dollars. A bad feature is the impossibility of opening any windows except those in the doors. Very rarely does a detachable top look anything but what it is. The veriest novice would not be deceived.

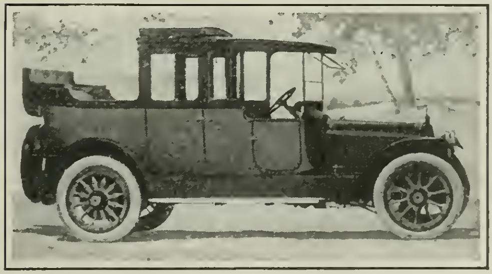
In the average American car the top of the frame is about twenty-six inches above the ground and the running board is eighteen inches. And yet the manufacturer wonders why he cannot obtain that



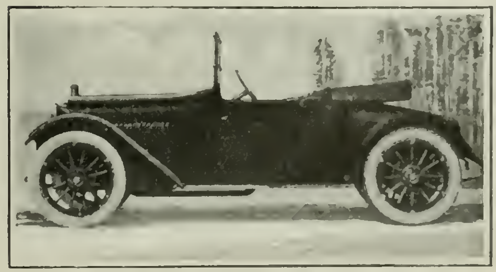
This body builds up too much towards rear. Frame and running boards are too high. Exposed upholstery and windshield stay rods are relics of the past



Height is too great. Windows when lowered clear down, are little more than half way. Curved door top breaks sweep of roof. In spite of these demerits the appearance is good



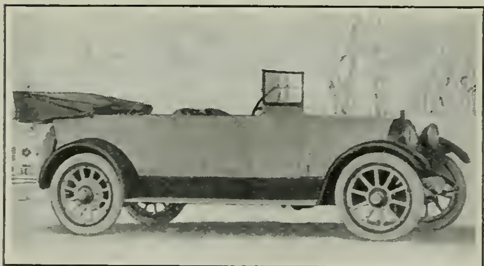
Fine, large rear side lights. Windows open only partially. Handle of front door should be concealed as it is not on level with the rear one



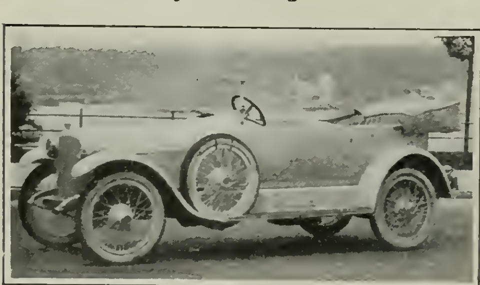
Clearance between front of rear whee and mudguard is insufficient. Rear deck terminates ungracefully. Otherwise the car is successful

Wheelbase is too short. Front seat with its imitation of a double cowl cuts down effective opening of rear door. Back mudguards poorly designed

Radiator too low, requiring excessive taper of hood. Clearance of rear wheels and mudguards is enormous, emphasized by light colored undersides of guards



Compare mudguard clearance of this with above. Hood, with low joint and slanting vents, is the least successful part of design



If folded top were lowered, spare wheel moved forward and rear hinges concealed, it would be handsome despite ugly radiator

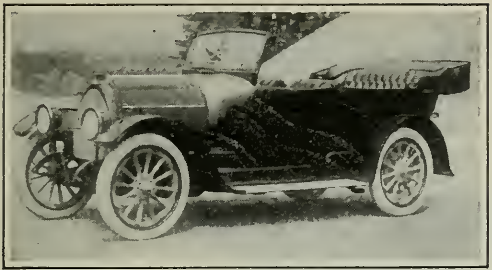
much-admired low-hung appearance, typical of the foreign car. Some day he will realize that sufficient ground clearance can be obtained with frames well under two feet high.

The unnecessary frame height is partially responsible for the ponderous appearance of many of our closed cars. Some limousines are actually between seven and eight feet high. There is no excuse for this even in a seven-passenger body where lack of foot room requires high seats.

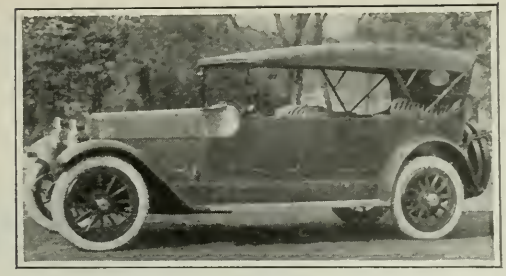
The most glaring fault in closed body design is the impossibility of lowering the windows all the way. With a rear seat accommodating three people it is admittedly difficult to drop the rear side light completely owing to the wheel housings. English coachmakers have accomplished this by curving the window slots. Why the door lights should not drop remains a mystery.

Owing to the fact that many motor car owners are dissatisfied with the appearance and comfort of stock models, there has arisen a demand for custom made bodies. The only way of obtaining collapsible bodies of the phaeton, landaulet and double cabriolet types, except on one or two chassis, is to have them made to order. If these bodies were brought out as standard models they would prove extremely popular. That is, granting that they were well made, as nothing is more exasperating than a collapsible body which rattles.

In conclusion the writer may be permitted to describe a sporting body which incorporates some novel points in design. As seen on page 98, the sides are very high, properly protecting the occupants. The plan shows the positions of doors and spare disk wheels. The seats are isolated from the body sides and back, and are adjustable fore and aft and as to inclination. The wind shield is pointed, thus harmonizing with the radiator. The top folds down into a permanent case under which is a large compartment for luggage. Domed fenders are attached to the stub-axles instead of the frame, and they follow the movement of the wheels. With this construction the fenders and wheels are concentric and the clearance between them is reduced to a minimum.

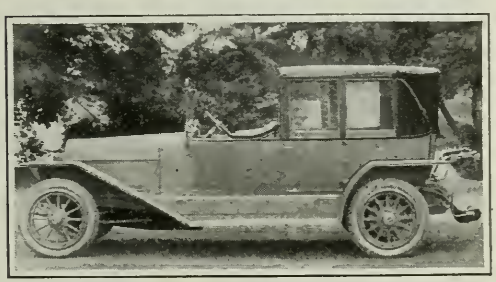


Has advantages of double cowl and aisle types. Hood tapers insufficiently, causing excessive swelling. Apron should extend up to the body

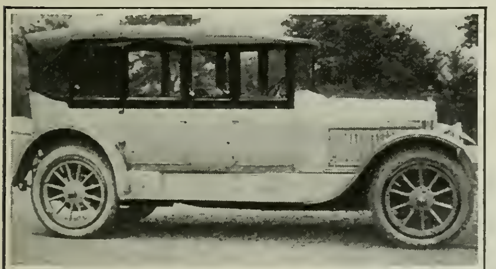


A handsome body whose appearance is not improved by mouldings on mudguards and hood. The extra seats obstruct the doors

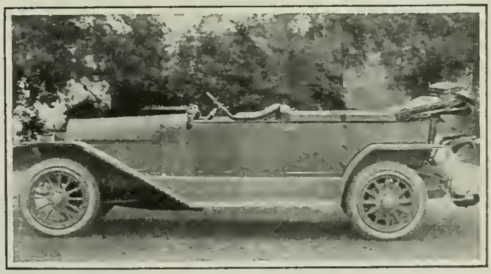
Handsome town landaulet. It can be opened rearward of the door with little overhang, as the roof over the window swings forward



Closed position of French double phaeton landaulet. An extension top (not shown) covers the driver. Taper of hood changed from stock model (above)



Closed position of stock "semi-touring" body. Almost the only one of its type on the market, but probably one of the important changes of the future

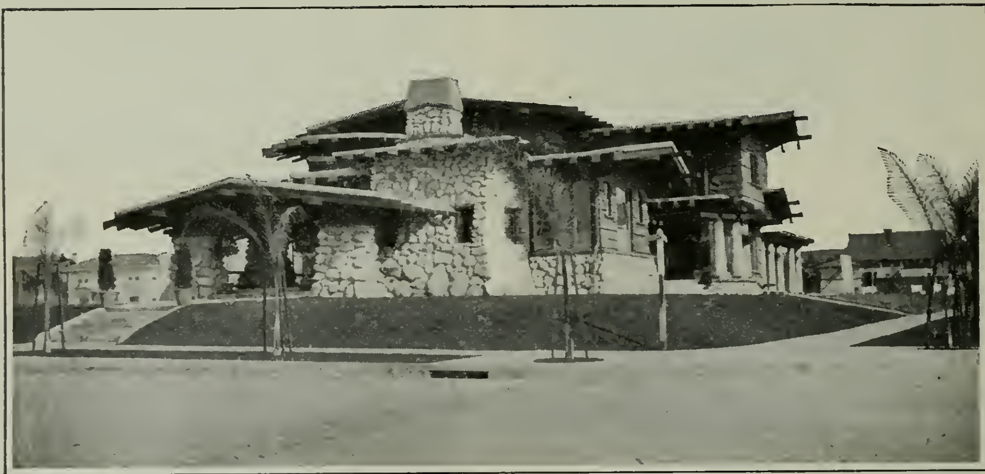


Open position of double phaeton landaulet. Top folds up like an accordeon and glasses in all windows drop completely. Mudguards very ungraceful

Open position of above body. The enormous mass of the top when folded down is unfortunate. Otherwise a most successful design

A well designed model. Drive protected by extension top. Windshield is not handsome. Handles of front door are concealed, as they should be

Building With Cobblestones



Some of the most beautiful houses in the world are built from stone carved only by the hand of Nature in the mills of the moraines through the grinding of ice-floes century after century

COBBLESTONES combined with cement are used extensively in the West for all kinds of ornamental and utilitarian construction. From ornamental urns and corner markers to fountains, bandstands, bridges and even such large structures as two-story houses, churches and even an observatory, may all be found in California, built of the cobbles that are removed in clearing.

The resulting edifices are of remarkably artistic appearance. The economy of this type of building is well shown by the fact that in the citrus belt near Los Angeles thousands of tons of cobblestones are dug up by the Hindu laborers and piled in great heaps between the groves. These cobble piles are often fifteen feet high and twenty feet broad, and extend for many rods between the cleared fields. They are literally cheaper than dirt.

It is but natural that many of the best specimens of cobble construction are found in that district. The rounded stones merely encumber the ground and most owners are willing to help pay for their removal to a building site.

Boulders and cobblestones always make attractive flower-urns

In the citrus section may be found an observatory in the grounds of Pomona College, which is a splendid bit of architecture.

Near by is one of the most attractive homes in the West, a great rambling bungalow of field stones, which has for its main interior feature a sun parlor or glass-roofed patio. This is a most attractive detail of a charming home, with ferns and flowers growing as in a conservatory, but in a temperature suited for its use as a general living room.

In Azuza may be found a decidedly artistic cobblestone church, with only a few roughly-squared stones used in connection with the natural shaped boulders and field stones. San Diego has two large two-story houses formed of this material, and the suggestion of permanence as well as rustic charm is made by the utilization of the big pebbles.

In the larger cities there are countless specimens of public as well as private construction formed of this rough-and-ready material. The parks contain splendid examples of the decorative possibilities of cobblestones. The bridge in Ganesha Park is far more in keeping with its surroundings of trees and shrubs than a more formal structure would be, and this applies to the bandstand in the same park and to the drinking fountain in Eastlake Park, Los Angeles.


Nothing gives a finer touch to a bungalow than an outside chimney of cobblestones

In Glendale may be found lamp posts of cobbles. Great masses of rough stone surmounted by graceful electroliers make lighting standards that harmonize with the homes which surround them, and in some instances they are used as well for resting places at the street corners, with rustic benches and drinking fountains enclosed in the massive walls. Hollywood makes use of an unusual form of corner marker, a tall cylinder of cobbles topped by a sphere, and in this is a socket to carry flag poles for festive occasions. This is one of the most difficult types of cobble construction shown, though by no means the most artistic. Staircases and culverts are frequently built of this material, to good advantage, while chimneys, flower boxes, supports for pillars and verandas are found to be attractive when formed of rough stones and used in conjunction with frame or brick construction.

Among the strictly utilitarian buildings made of this cheap but satisfactory material may be mentioned barns, garages and even pumping stations, such as house the machinery for electrically operated irrigating apparatus in California. They are far more durable than the wood or metal so frequently used, and form an attractive detail in a well-kept country home, instead of being an eyesore.

Perhaps the most remarkable bit of cobblestone construction is an exceedingly light and graceful triple arch in the town of Huntington Park. This consists of two seven-foot arches spanning the path to the house from the street, while a third arch rests upon the other two, springing lightly from the crest of each and extending over the sidewalk. This is the pride of the owner, who has surrounded his grounds with extensive walls and flower urns of the same building material, found on his own place.


This simple but interesting barn owes most of its charm to its cobblestones


Even churches gain a new dignity when fashioned from boulders

Electric Heater Resembles Desk Telephone

AMONG the new electric heating devices being brought out is one which looks like a desk telephone. It consists of a round, transmitter-like device, about six inches in diameter, containing the usual electric coils, and with a cage in front. This is mounted on the side near the top of a standard such as is used for the electric fan.

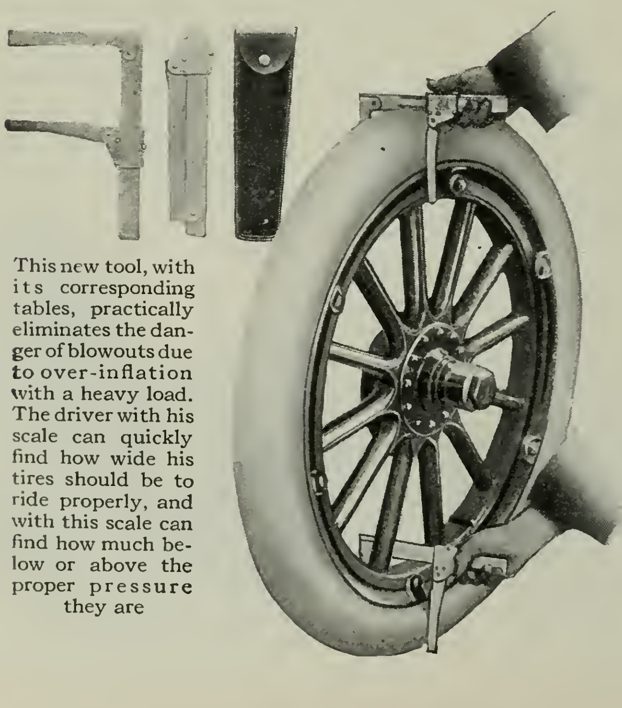
The heater is supplied with eight feet of cord so that it may be moved around and placed either on the floor or on a table. It is made in two styles; one having two heating units, and the other having but one. The latter, of course, is less expensive to buy and uses less current. The double unit one, however, gives off sufficient heat to warm a room of considerable size. This heater can be used not only to heat a room but can be placed in such a position that it will warm the feet only.

A desk heater which radiates its comfort to the spot where it is wanted, and is still an attractive bit of furniture

Adapting Tire Inflation to the Load

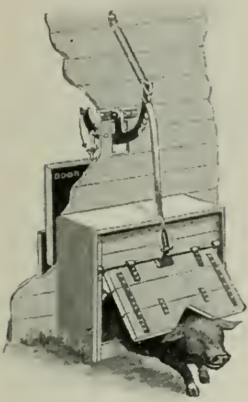
CALIPERS have been devised for measuring air pressure in automobile tires in relation to the load carried. A touring party before starting on a trip may use the new tool to establish correct pressure in the tires for the load of people and trunks, and by keeping this pressure constant tires may be greatly economized. The device is simple, small and compact, and may be used in a few seconds. The tool has a size scale and a load scale. The size of the tire at the top is measured on the size scale, and the slide moved along to the same size on the load scale. The tool is then placed over the bottom of the wheel, and if it fits easily over the tire the pressure is correct. If it does not fit, the tire is inflated or deflated to the correct point.

Blowouts can usually be traced to faulty inflation, so this tool can be expected to pay for itself.



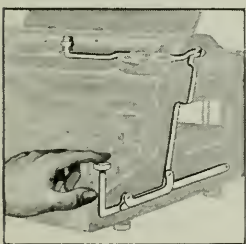
This new tool, with its corresponding tables, practically eliminates the danger of blowouts due to over-inflation with a heavy load. The driver with his scale can quickly find how wide his tires should be to ride properly, and with this scale can find how much below or above the proper pressure they are

A Hog-Pen That Counts Hogs



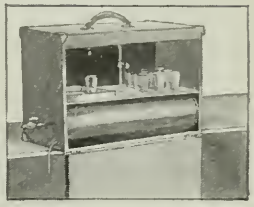
A DOOR for a hog-house that will admit only a predetermined number of animals has been invented by a Wisconsin farmer. On many stock-farms where there are a number of animal houses difficulty often arises when hogs endeavor to frequent one house instead of apportioning their numbers to the various shelters. This difficulty is overcome by the invention of a door which will admit a certain number of animals, and then no more. The door is hinged at the top. A lever communicating with a rachet above the door slips down one notch on the rachet every time the door is opened. When the last spur of the rachet is reached, the door cannot be opened.

Erasing Attachment for Typewriters



AN erasing attachment for typewriters has been brought out which does away with the timeworn practice of searching for a lost eraser when a typographical mistake is made. A key projects from the body of the typewriter, resembling the tabular key, back spacer, and similar refinements which have found their way into typewriter structure in recent years. Pressing the key operates a series of levers and arms which terminate in a rubber eraser, and rub it upwards and downwards on the paper, so that the particular error is removed. Although an erasing attachment of this kind would hardly prove suitable for business correspondence, it would probably find a wide field in newspaper or other offices where absolute neatness in typewritten matter is not so essential.

Soda Fountain in a Suitcase



A SODA fountain which can be carried with reasonable ease is the subject of a patent of interest to the men who make a living selling palatable beverages on the sidewalk. One of the ingenious features of this invention is that no one would ever suspect that the innocent appearing hand case is really a soda fountain. The case contains two separate compartments, in one of which the carbonated water is contained, and in the other, the glasses and various syrups. An inconspicuous faucet projects from the soda water tank for the purpose of replenishing the supply.

A Finger-Knife for Egyptian Corn

THERE has recently been patented a new style of knife or cutter for harvesting Egyptian, Broom, Milo Corn and similar grains. It is now in use in California.

The knife is strapped to the hand as shown in the illustration. When the stalk is grasped the fingers naturally close and off goes the head of grain, to be tossed into a wagon or bin immediately. The implement is very sharp and strong, so that it will cut practically any size stalk which will enter between the knife and guard. With an instrument on each hand a person can do twice as much work, thus saving half the cost of harvesting the crop. Before this invention appeared a cutter had to hold the stalk with one hand and cut it off with a knife in the other. It is now possible to cut the heads off the grain as fast as the hands can be opened and closed.

The blade is the part between the fingers, the dull back of the knife blade protruding rearwardly through the fingers and being held there solid by a small leather strap around the two center fingers.

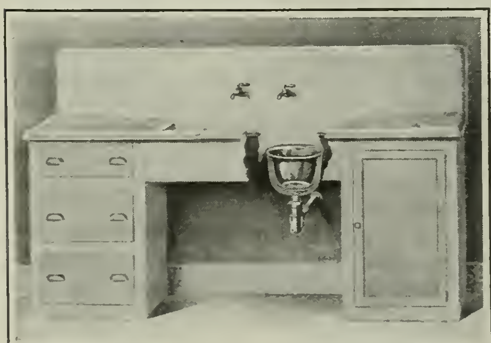
This baby's bath is soft and safe—and he can splash safely

A Tub Within a Tub for the Baby

HIS MAJESTY, THE BABY, can have a royal bath every morning in a soft little tub designed to fit inside the large tub of his elders. A seamless, waterproof fabric is supported by a rigid frame across the top of the regular bathtub. The small tub is located at the front of the frame, so that the nurse need not reach across it. The fabric goes over the bars to make a soft bumper, and it can be removed easily and laid flat for cleansing. When not in use the frame can be hung upon a hook on the bathroom wall.

Preventing the Clogging of the Sink

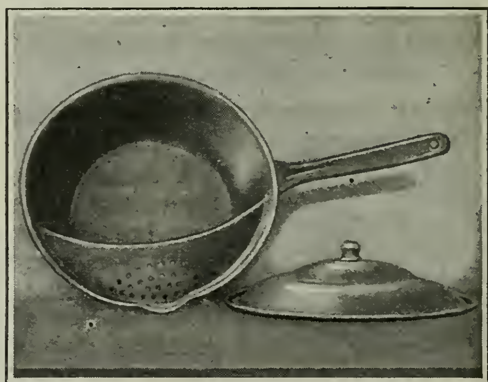
A NEW sanitary device is installed in many of the new homes and apartment houses, in Los Angeles, California. It does away with the danger of having clogged drain pipes in the kitchen. The device consists of a removable pail with a fine strainer trap in the bottom. The enamel sink is constructed so as to receive this pail, which fits snugly into place, leaving no room for bits of food to collect. The dishes are rinsed off under the faucet, and all the scraps go into this receptacle. As the strainer is finer than in the usual type of sink, all the small particles are caught in the trap and do not flow into the drain pipes. The strainer is removable so that all the grease which has been retained in the trap can be cleaned off.



This strainer is built into the sink itself

A Saucepan Which Is Also a Strainer

A SAUCEPAN which may also be used as a strainer is one of the latest additions to kitchen equipment. Pouring boiling water from a saucepan and holding the cover on to avoid losing some of the vegetables is always dangerous. The new saucepan has a strainer equipped with a rim on the pouring side of the kettle in which holes have been punched. In use, the cover is removed, the pan picked up by the handle, and the water poured out. The rim prevents the food from spilling, but allows the water to run.



No need to scald fingers in draining vegetables from this saucepan

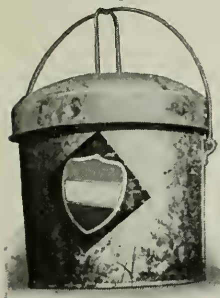
The pan is especially useful for boiling potatoes in their jackets, since the operation can be accomplished so quickly that when the cover is put back, enough steam is retained to burst the jackets. The main qualification of the new saucepan, is that the housewife is less likely to burn her hands than with the ordinary utensil.

A Tea Kettle Which Does Not Burn

A SAFETY-first tea kettle has only recently been placed on the market. It may be filled under a water faucet without the danger of burning the hand with steam. The device, which makes the kettle safe to handle, is a separate filling top, in front of the usual top, and outside the handle.

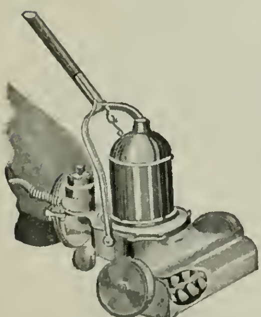
This separate top is manipulated by a pressure of the thumb on a small handle. The escaping steam cannot burn the hand, since it rises a couple of inches forward of the handhold.

A Garbage Can Which Cannot Spill



GARBAGE cans with covers that lock on are essential, especially to women in the country, where there are prowling dogs. The one shown has a handle which presses tightly against an arch of wire on the lid, holding the cover securely on the bucket. It can be removed by jerking the handle over one of the humps in the arch. The same principle is applicable to pots and pans for kitchen use.

Combining a Brush and a Suction Pump in a Cleaner



A ROTARY carpet sweeper and suction cleaner combined is the subject of a patent recently issued to a man in Ohio. Heretofore, carpet cleaners have been of one of two types, the one employing the rotary brush and the other relying upon an inrush of air. This latter type is the well-known modern vacuum cleaner. In the new invention the revolving brush serves to loosen threads and other clinging objects from the carpet, while the vacuum attachment removes fine dust.

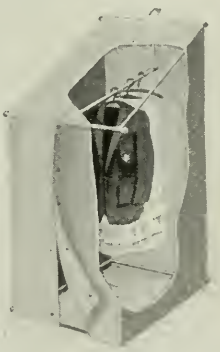
Simple Way to Clean Vegetables

IT is no longer necessary to waste much time in thoroughly washing vegetables. One of the simplest yet most effective devices for cleansing them quickly is illustrated herewith.

It consists merely of a pan the bottom of which is covered with a fine wire screen. The pan is suspended from a faucet over the sink. When the water is turned on, the dirt is dissolved and drained off.

The screen-bottomed pan is much more effective than a colander for this use, as the drainage is complete and immediate.

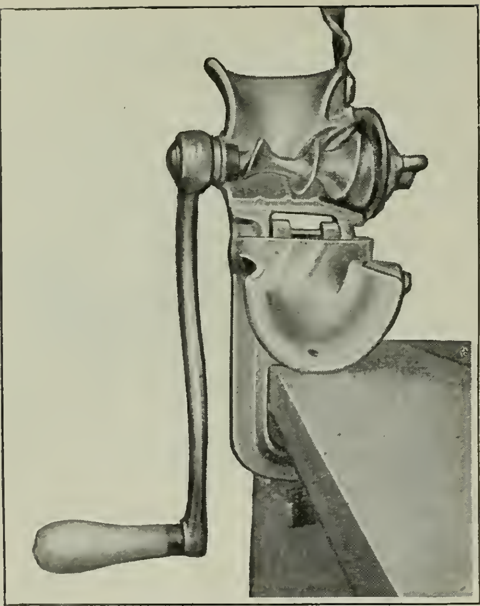
A Collapsible Wardrobe



A PORTABLE wardrobe for protecting garments consists of a canvas covering suspended from a folding frame. A rod extends from front to back of the frame, near the top, and from this rod clothes hangers are suspended. A wardrobe of this type is desirable in places where a permanent clothes closet is not necessary.

Bottle Corks Made From Blood.

A NEW process for making the thin cork layers which are used to seal hermetically bottles having metal tops involves the use of blood. Granules of cork are bleached and compressed in turpentine, glycerine and blood, from which the white proteid has been removed. A low heat is first used. After it has dried, the temperature is raised to 240 degrees for one hour. The mass is then pressed in the discs.



Here is a meat chopper which opens on the side and has no secret corners for germs to hide in

A Meat Chopper Which Opens Like a Book

A NEW meat grinder which is easy to clean, opens like a book, leaving no hidden recesses. One of the chief faults of the old grinders was the difficulty of cleaning them thoroughly. The new one will be a great labor-saver for that reason.

The hopper is split in two, and though when closed resembles the ordinary ones, one side when unlocked drops down, leaving the entire hopper and mechanism exposed. The lock is a lever which, when raised, allows the side of the hopper to drop. The hinge at the bottom of the food receptacle is merely a steel rod passing through holes in two projections, which turn on the rod, allowing one side of the chopper to drop.

A Spanish Lesson in Aeronautics

THE Spanish Government has established an aviation school which well serves as a model for a similar institution in this country.

On the first of October the new Spanish aerodrome about five miles outside the city limits of Madrid was opened to the public. The Spanish Government assists those receiving instruction. The number of pilots instructed at the same time is twelve, who have to pay ninety-seven dollars and fifty cents to cover cost of fuel, breakage, etc. The fee for mechanicians is but forty-eight cents.

The cost of these lessons ought to be well above ours, since most of the machines were brought from this country, and the price of gasoline is more than double what we have to pay. Yet the cost of learning to fly in this country is from three hundred and fifty dollars to five hundred dollars.

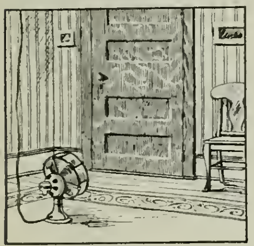
Ice Cannot Fall Out of This Water Pitcher

AN ice-water pitcher, resembling a coffee-pot, has a top of glass which locks on securely so that water may be poured from it without causing the ice to fall into the tumbler. The top resembles that of certain teapots, for it has little projections which fit into hollows made for them. Hence, when the top is slightly turned the projections are under the ledge at the top of the pitcher, thus locking it fast. Such annoyances as are caused by pieces of ice falling out, flooding the tablecloth with water, and filling the tumbler with ice instead of water, are impossible with the new pitcher. In addition the lid is a protection against flies in warm weather. Being made of annealed glass, the pitcher will withstand any degree of heat.

The ice cannot fall into the glass when water is poured from the pitcher

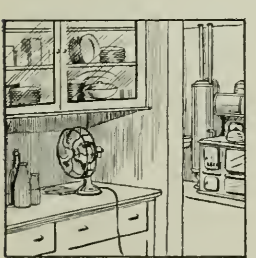
Winter Uses for the Electric Fan

HAVE you ever thought of the various uses to which the electric fan in your home can be placed other than lowering the temperature and making it comfortable in the room when the thermometer is high outside? How really indispensable it is in innumerable ways, and how much it does in preserving health in the home by keeping the rooms cool and fresh?



Drying Paint

If you have just finished painting a door, wall or window sides, let your electric fan run in the room for two or three hours, and the paint will not only dry faster, but it will be free from the dust that often sticks to wet paint. If you have varnished your floor, place your electric fan so that the air it stirs up will have free access to the wet varnish. Your floor will look brighter than if permitted to dry in the usual way.



Keeping Milk Cool

If you have used enamel paint to give your bathtub a new and bright appearance, use your fan to dry the enamel; the surface will be much smoother and of greater firmness.

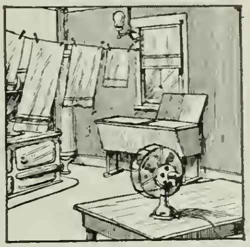
It is a wise plan from the sanitary viewpoint to allow your electric fan to run for at least a quarter of an hour in the bed chamber before you retire. It cools and freshens the air, making the chamber both more comfortable and healthful for the night.

Before you work in your office, library or den, let your fan run a half hour. You will not be liable to the slight headache, so often felt after a brief time at work in a place where the air is close.

Dust cannot accumulate where there is a free circulation of air, especially fresh air, and it is very noticeable that a room in which an electric fan is allowed to run seldom has dust. Since dust breeds germs, the prevention of dust likewise prevents germs.

The electric fan keeps the temperature of drinkables down. Open a cupboard in which there are milk, wine, or beverages of any kind and allow your electric fan to run immediately in front of it, so that its cooling blast will strike the bottles. The temperature drops rapidly.

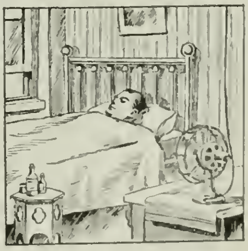
The electric fan has other offices in the home. The wise housekeeper will place her laundry after its return from the wash for an hour or two where the electric fan can "blow" on it. Any dampness remaining after drying and ironing at the laundry is removed, any odor of soap is destroyed, and a fresh sweetness imparted to the linen. Fine linens and laces preserve their whiteness better if dried by the fresh air; artificial hot drying injures expensive materials, and in damp weather they cannot be dried properly merely by being suspended in a room where there is little circulation of air.



Drying the Wash

If there is an odor in the room, due to fresh paint, varnish or recent papering, turn on your electric fan and note how soon this odor will disappear. This is also true of smells from furnaces, ovens, or stoves.

In the sick room fresh air is of paramount importance. A free access of pure air is often the safeguard against those ministering to the wants of the sick.



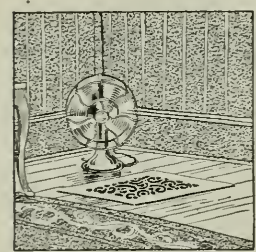
Airing the Sick Room

There is indeed no season of the year in which its usefulness cannot be proven, and winter is no exception.

Most important to the shopkeeper is the use of the electric fan in show windows to keep the frost off the glass. Unless some special arrangement is made to secure excellent ventilation of the show window, it will become so heavily coated with frost on cold days that the exhibits cannot be seen from the street. A fan in the window, however, will keep the air circulated so that the moisture that tends to gather upon the window will be evaporated.

Clearing a show window

The fan is very useful in aiding the heating system in the home, especially where a hot air system is employed. Every one who has ever tended one of these furnaces knows that it is frequently impossible to make the hot air rise through certain pipes when the wind is blowing in the wrong direction. A fan placed directly in front of the register will draw the hot air through the pipes and heat the room very quickly. The writer knows of a number of cases where the cold air intake pipe is so arranged that a fan may be placed inside, thus increasing the circulation of the furnace. Who has not gone to his furnace to find it cheerless and depressed with hardly a spark visible? In such cases the most drastic arrangement of drafts will fail to save the fire, but if there if any life left in the fire pot whatever, a fan placed in front of the lower door will soon have the coal blazing merrily.



Helping heat a room

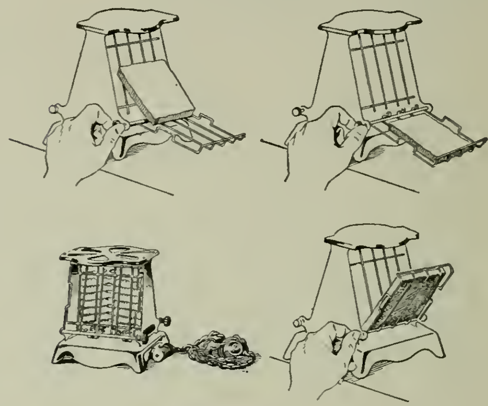
When the kitchen is filled with smoke from an unruly range an electric fan placed in the window will quickly clear the atmosphere without drawing in a large volume of cold air.

Many women use a fan to dry their hair after a shampoo by placing it upon a radiator and sitting in the draught.

Electric Toaster Eliminates Burnt Fingers

TO those who have frequently burned their fingers while turning over the toast on their electric toaster, the new toaster recently added to the electric devices now on the market will prove an interesting improvement.

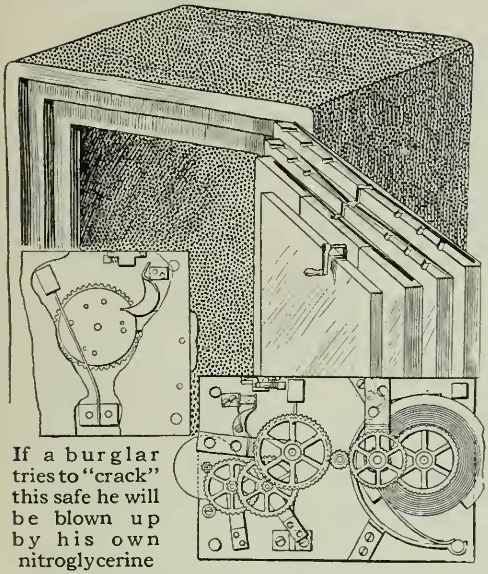
By turning the knob near the bottom, the frame holding the slice of bread to the heater coil is thrown outward, while wire catches at the bottom trip the toast so that it slides along the frame, browned side down. On turning the knob back again, the toast is raised to a vertical position with the fresh side toward the heater. By this ingenious arrangement it is not necessary to touch the toast with the fingers until it is ready for buttering.



The new electric toaster and sketches showing how it turns the toast without picking up with the fingers

Don't Decarbonize Aluminum Pistons

OWNERS and drivers of automobiles in which the pistons are of aluminum alloy, should be very careful in using "decarbonization" methods. Unless all experiments are wrong, it is bad policy to use the oxygen-acetylene flame for this purpose. Aluminum oxydizes much more rapidly than iron, under the influence of oxygen, and in the extreme heat of the oxy-acetylene flame still more rapid oxidation is probable. Until exact tests show that the oxidation is not fast enough to worry the motorists, the latter should steer the safe course and use some other method.



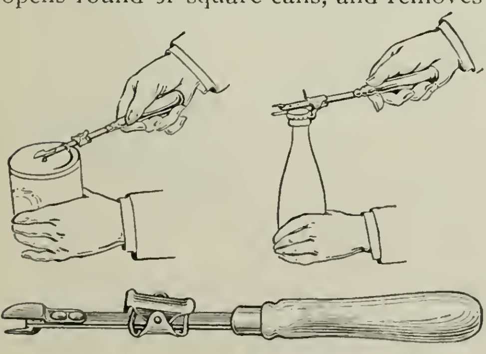
If a burglar tries to "crack" this safe he will be blown up by his own nitroglycerine

Foiling the Safe Blower

GROOVES are made in the upper edge of the safe door, so that in case nitro-glycerin is poured into the crack of the door, it will flow through these grooves to an element which may be destroyed without injuring the rest of the safe. Upon disintegrating, this element sets free a spring motor mechanism which operates a rotating hammer. The hammer strikes a succession of blows upon a percussion pin. Thus the nitro-glycerin is exploded prematurely and the successful blowing of the safe is prevented.

This Can-opener Cannot Slip

A NEW can opener, which locks fast so it cannot slip and cut the hand, has been placed on the market. It also opens round or square cans, and removes metal caps from bottles and tins. The tool is prevented from slipping by an adjustable lock, which can be moved back and forth and made to fit any size can. This lock is composed of a cutting edge fastened to a movable clip. The cutter is adjusted for the can to be opened. It operates on a central pivot as in one of the old-fashioned can openers.

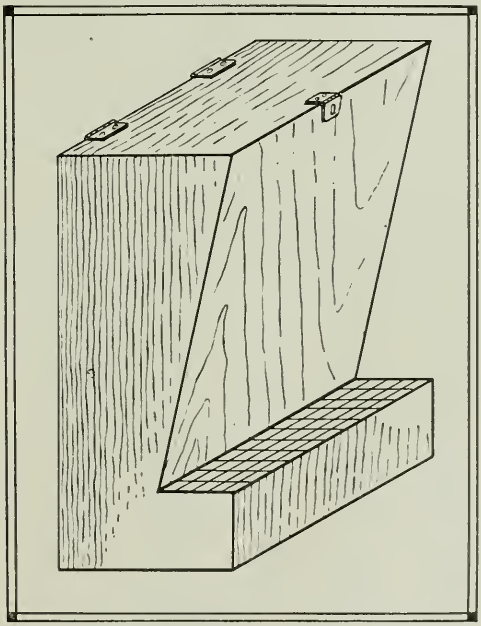


This new can opener does not cut fingers. It opens bottles as well as cans

Square cans are opened by this tool with a cutting knife of the other type, also arranged so that it cannot slip. A hooking device is attached for removing metal capping corks for bottles.

A Feed Hopper for Chickens.

A FEED hopper for chickens can easily be made by sawing the sides of a laundry soap box as indicated. A lid is fastened on the top by hinges, and the feed is poured in at the top. The front slants, which keeps the feed always sliding down as it is taken out of the opening. The opening is covered with chicken wire to keep the fowls from stepping into the feed and fouling it. The dotted lines show the original construction of the box.



The slanting front of this hopper is sufficient to keep the supply of grain in the screened feed box constant

Left-handed Watches for Left Handed People

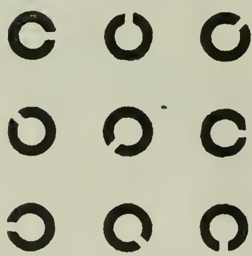
A WATCH for left-handed people has been invented by a Kalamazoo jeweler, who believes that the left-handed look at things in a "left-handed" fashion. The left-handed watch runs backward. The dial is arranged so that the numeral 1 is on the left hand of 12 instead of on the right as in the case of the ordinary watch.

The hands also run from right to left instead of in the usual fashion. Mechanically, with the exceptions given, the left-handed watch differs very slightly from the ordinary time-piece.

The inventor constructed the unusual watch for the benefit of his daughter, who is left-handed.

An International Test for Vision

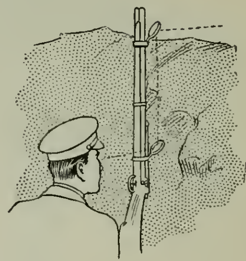
THE International Ophthalmic Congress at Naples, in order to introduce uniformity in methods of measuring vision, has adopted the broken ring of Landolt as the best possible international test for visual acuteness. But as no efforts have been made to use it as cards with test letters are used, it has had little practical value.



However, Dr. Edward Jackson, of Denver, has found that if the broken rings are arranged in a symmetrical group and printed, as here illustrated, on a card that can be turned with any edge uppermost, it constitutes a test independent of a knowledge of letters. The test is placed five meters from the patient. If the direction of the break in the rings is recognized at full distance, full acuteness of vision is demonstrated. If at four and a half meters, the vision is one-tenth defective, and so on.

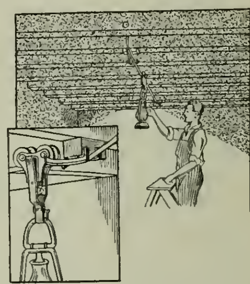
A Pocket Periscope

ONE of the interesting inventions which the war in Europe has stimulated is a very small, but none the less serviceable, pocket periscope. The soldier, concealed behind an intrenchment, can quickly attach this tiny instrument to the barrel of his rifle, to a pole, or to a trench-digging tool, and can readily observe, by means of the two circular mirrors, the movements of his antagonists in the distance without exposing himself to any tance without exposing himself.



A Trolley for the Stable Lamp

THE problem of carrying an oil lantern while at work in a barn or garage is an old and perplexing one, but it has been ingeniously solved by an inventor in South Dakota. Instead of depositing the lantern on the floor, on an upturned box, where its light is usually shed to the least advantage, he has devised a simple but effective overhead trolley system. A stout wire is extended across the ceiling between braces, and the lantern suspended on a small wheeled truck from it.



Non-Rolling Nursing Bottle

SO many babies these days are bottle-fed that mothers will be interested to know of a new feeding bottle which is flattened at the sides to prevent its rolling over either when baby is feeding or when the mother is washing the bottle. The ounces are scaled upon one side and the rim of the neck is so sloped that the nipple is easily put on.

The Home Craftsman

An Extra Drainboard for the Kitchen Sink

A SUPPLEMENTARY drainboard combined with a handy utensil cabinet can be attached to a kitchen sink which has only one inadequate drainboard. One end of the new drainboard rests upon the edge of the sink, while

The extra drainboard and cabinet is easy made and fills a space that is not needed as a rule

the other is supported by legs constructed as shown in the accompanying drawing. Beneath the drainboard, shelves for plates and tinware can be installed and a curtain hung in front of them to improve the appearance.

To Lengthen the Life of a Necktie

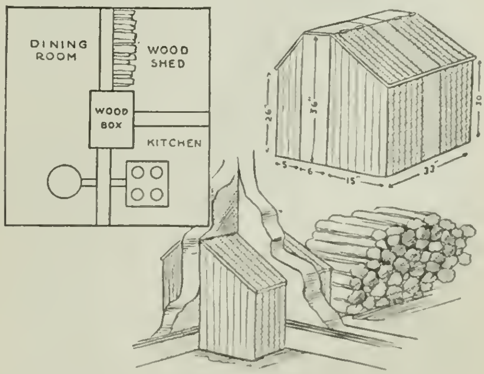
A GREAT many people who are users of four-in-hand ties are more or less bothered by the tie's becoming useless after it has been worn a few times.

Take the wide end of the tie with seam up and lay it flat upon a table. Then thrust in the finger and seize the lining. Take the silk cover in the other hand and pull it over the lining, about half of its length. A hot iron is then run over the lining to straighten it out.

To bring back the silk to its original shape is very easy. Lay the tie flat upon a table and pull the silk cover back very gently. Then after the tie is back to its original shape a hot iron is run over the whole.

Wood Box Arrangement Saves Many Steps from the Dining Room

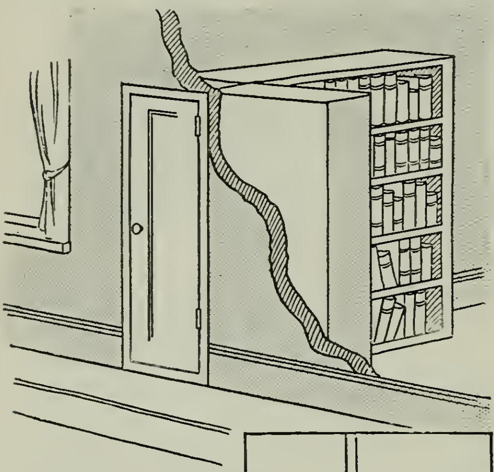
THE task of bringing in wood for several stoves, which is supposed to have caused anguish to almost every small boy, can be solved in an ingenious way, provided the woodshed adjoins the house. If a houseowner is fortunate enough to have an arrangement of rooms, such as is indicated in the drawing, he can save many steps, by the expedient suggested here. At the juncture of the two walls a hole large enough to accommodate a kindling wood box should be sawed. The box may or may not be provided with lids, as desired. When wood is needed for the stoves in either the dining room or kitchen it can be taken from the box. The box can be easily replenished from the woodpile.

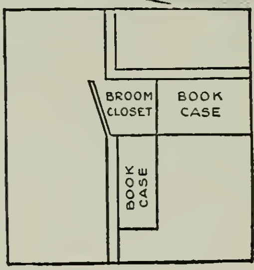


How a wood box can be built into a house and connected with the wood shed, so as to save useless walking from room to room

Broom Closet Utilizing Waste Space

In a Chicago house book cases are built in around one corner of a living room. At the joining of the two cases there is a small waste space, not to be utilized for shelves and covered at the top by a broad shelf which finishes off





The corner inside two bookcases can be utilized as a broom closet by cutting a door. Thus a waste cubby-hole is converted into a useful space at a very slight cost

the cases five feet above the floor. As the kitchen is immediately behind the room this little waste "cubby hole" has been "tapped" by a narrow door opening into the rear room. It is just large enough to hold the broom and dust cloths.

A Cheap Septic Tank

A PERFECT septic tank can be built at a small cost by following the plan here illustrated. A tank six feet long by three feet square (inside measurement), will answer the requirements of a family of six people.

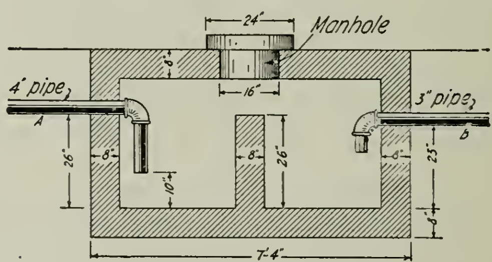
After digging the hole, and before placing the form, fill the bottom of the hole with 8″ of concrete, mixed five to one. Then place the form upon the concrete making sure that there is a space of no less than 8″ between the form and the sides of the hole. Set the form so that the top is level; then fill all around with concrete. Tamp the concrete in well, being sure not to use any large stones, as the tank must be water tight.

Next comes the top. Cover the form over with boards, leaving a hole in the center sixteen inches square for the manhole. Build a box around this eight inches high. Then cover the top of the tank with concrete, being sure to have it smooth around the hole.

The concrete work should all be done at one time, so there will be no seams in the work.

For the cover of the manhole make a frame twenty-four inches square and four inches deep; fill this with concrete and let it stand until dry and hard. The cover must be set in cement to insure an air tight joint, for unless the tank is air tight it will not work. After the concrete has set, remove all the forms from the inside. It is best to use a good rich mixture of cement around the inlet and outlet pipes to insure a good tight joint.

For A, the inlet, use common four-inch tile, and from B, the outlet, use three-inch tile. The tile may be run to a cesspool or may be branched out in two or three directions and used to irrigate a small garden spot. The tank can be set underground just far enough to have sufficient dirt over it to make



This form of home-made septic tank can be used with success by a family of six people

a lawn, as it will not freeze in cold weather. If it is air tight it will not have to be opened after putting in operation. It is a good plan to fill the tank full of water and let it stand a day or two, to be sure that it does not leak, before cementing the cover on.

A Craftsman Desk Chair

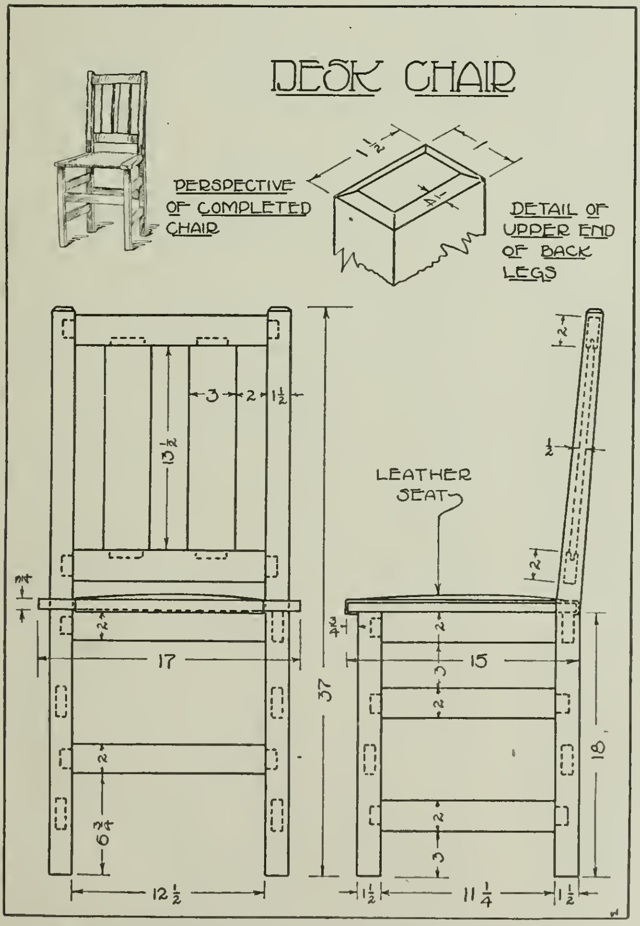
By Ralph F. Windoes

IN the October issue of POPULAR SCIENCE MONTHLY, the author presented a craftsman desk table. The chair herein described is its companion piece, but it would serve equally as well as a dining or an occasional chair.

The mill-bill for this chair is as follows, all pieces to be planed and sandpapered to exact dimensions at the mill. Of course, the lumber should be of the same kind and quality as was purchased for the desk:

2 pcs.	1½″ x 1½″	x 18″..	front legs
2 pcs.	1½″ x 3″	x 37″..	back legs
6 pcs.	¾″ x 2″	x 14½″.....	rails
6 pcs.	¾″ x 2″	x 13½″.	side rails
1 pc.	¾″ x 15″	x 17″.......	seat
2 pcs.	½″ x 3″	x 14½″	back slats

On one of our drawings a detail of the back legs is given. They are cut from the 1½″ piece, that is, 3″ wide, and should be very carefully laid out and worked up, as they are, in reality the most difficult part of the construction. If the craftsman desires, he may take this drawing with him to the mill, lay out these legs there, and have them sawed out on a bandsaw, which would save a great deal of the time and expense; otherwise they must be ripped out of the planks by hand. In smoothing them, plane as far as practical, and spokeshave the balance. Be very sure that you keep the edges square.



Elevations, showing dimensions, of the craftsman desk chair as the parts come from the mill

Selecting your working faces — noticing that the back legs are paired and that the mortises are not cut in the same face of each—lay out these mortises in pencil. Also, lay out the mortises in the front legs and compare the four in their proper position with respect to one another. As the tenon detail shows, the mortises will be 1½″ wide, 1″ deep, and 1½″ long.

Cut these mortises and fit their corresponding tenons in place. In the lower edge of the top back rail and the upper edge of the bottom, cut mortises for the slat tenons.

Next glue and clamp these sections together, placing the back slats first. Attach the seat by screwing into it through the side rails that it rests upon. The seat must be cut out around the back legs.

Clean it up and apply the same finish that was used on the desk table.

The seat is covered with leather, padded over curled hair, as the detail shows. First the hair is carefully picked apart, and placed. Then a piece of cloth slightly smaller than the leather is tacked tight over the hair, and finally the leather is placed. It runs under the front and back edges, where common tacks are used, and along the edges on the top it is fastened with gimp tacks. These edges may be turned under, or a piece of gimp braid used under the tacks to cover the cut edges of the leather.

As this is the first project of this series that has required the use of leather, a few words on this very interesting subject will not come amiss.

Leather is the skin of any animal that has been tanned and cured. *Cloth* covered with any substance, and finished in any way is *not leather.* Thus we differentiate between *genuine leather* and its *imitations.*

There is no imitation that is better than genuine *grain steer* or cow hide leather, but there are a number of imitations that are better than some split leathers. A question that has been asked in printed matter circulated throughout the country is, "How many hides has a cow?" This question, written by a manufacturer of a leather substitute, was concocted to start the public thinking upon the subject of split leather. In itself, the question is certainly foolish, but it has undoubtedly accomplished its purpose. If the one hide of a cow were to be tanned and curried, it would be too thick to use for tufting loose cushions—in fact, any branch of furniture upholstering. Therefore it is necessary that the leather be split. As to "how many" times it can be split, there is some doubt. One leather manufacturer claims that he is able to split one steer hide into fifty whole parts, each about as thick as a sheet of tissue paper. Of course, such sheets of leather have no commercial value, whatever, but a performance such as this would serve to answer the foregoing question.

The usual method of splitting a hide, is as follows: First, the "top grain"—the best part of the leather, is removed; second, "special deep buff"—not as serviceable as top grain; third, "extra split"—used for very cheap leather furniture; and fourth, a "slab" that is left, of uneven thickness—used for inner soles of shoes, etc. This, the usual procedure, varies exceedingly in practice with the different manufacturers and the different kinds of hides. Comparing these with substitute leathers, we are very much of the opinion that no imitation will ever approach "top grain" in points of beauty, utility, and service. "Special deep buff," properly grained and enamelled, is, no doubt, much better than any imitation now on the market, but this is a debatable question, and we will leave it with the manufacturers to settle. An expensive imitation surpasses "extra split," especially for furniture purposes, but the cheaper, thin grades, are not to be recommended for any purpose. Of course, the "slab" is of no account for furniture work, and hence we will not consider it.

The making of good furniture leather is an interesting process. The green hides come to the leather manufacturer from slaughter houses in a wet salted condition. First the eye holes, nose, lips, ears and leg shanks are trimmed—these trimmings being later sold to manufacturers of soap greases and glue. The hides are next washed in clear water to remove the salt and dirt, and soften the texture. The fat is now removed from the meat side, and shipped to manufacturers of neat's-foot oil. Following this the hides are limed; that is, worked in a lime bath for a number of days in order to dissolve the fatty hair roots which will permit the hair to be easily removed. This by-product goes to makers of cushion fillings, etc. Next, the fleshy material remaining on the meat side is scraped off—this being sold for glue stock—and the hides are thoroughly cleansed of all lime and bacteria.

Now the hides are ready to be tanned. They are placed upon pivoted frames which are constantly agitated in a weak solution of tan liquor—oak bark, usually. Each day the strength of this liquor is increased, until on the eighth day the hide has received sufficient tanning to be called leather." The excess water is now removed, and the skin "stoned," i. e., rubbed and ironed until the wrinkles are all removed.

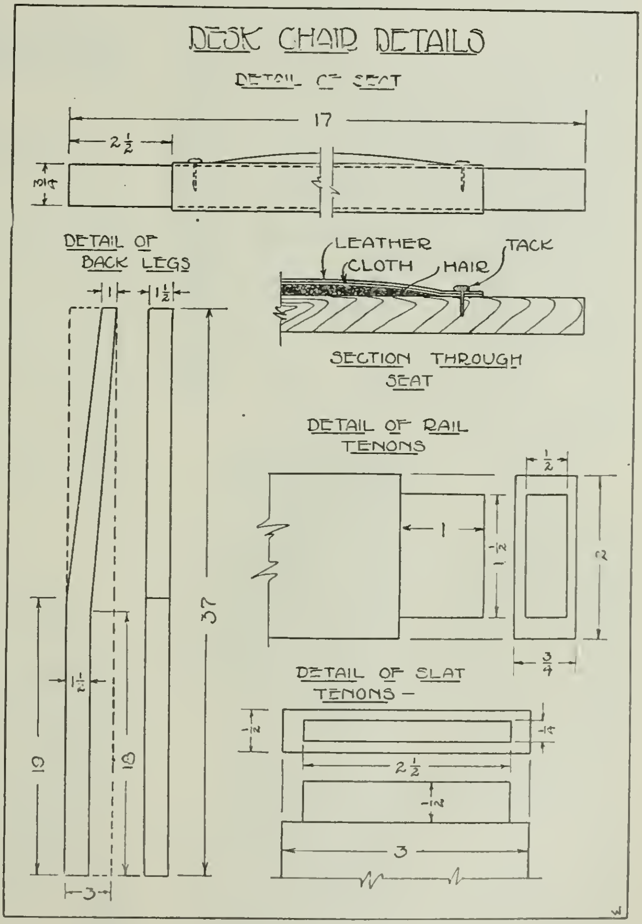
Now comes the splitting—the most interesting operation to laymen. This is accomplished on a delicately adjusted machine having an endless knife traveling between two rolls. The upper, or "gauge" roll, determines the thickness that the leather will be split, while the lower, a "ring" roll made up of a number of small rolls independent of one another, forces the skin up evenly, so that any irregularities in the hide are not transmitted into the split. The leather is split, as has already been told.

After splitting, all hides are re-tanned and thoroughly rinsed and scoured. Then follows a bath in a liquor boiled from the ground leaves of the sumac tree, which serves to brighten them and make them more pliable.

Next the leather is lubricated. This process is known as "stuffing" and consists in filling the fibres with a coating of cod oil and other greases. Both sides are treated in the case of top grains, and the flesh side only of splits. Now the leather is tacked upon frames where it is stretched and allowed to dry. After removal from these frames, it is softened, and made ready for the enameling.

This consists first of a number of coats of linseed oil—varying in consistency—which are allowed to dry before receiving the Japan. This also is applied in successive layers, allowing all to harden. Then the leather is taken to the embossing presses, where the attractive crevices are stamped into the splits. The top grains are usually not embossed in this way, as a special method of retanning accomplishes this. At this stage all leathers receive a coat of color, usually black, which is their finished surface. If the leather is found to be somewhat stiff, it is softened by rubbing with a cork armboard. After cleaning and measuring, each piece is rolled up ready for the market.

It is necessary to emboss all splits, and as this is a mechanical operation, a careful examination of the leather will reveal this repetition of design, while in the best grades, that are not embossed, this repetition of crevices will not be apparent.

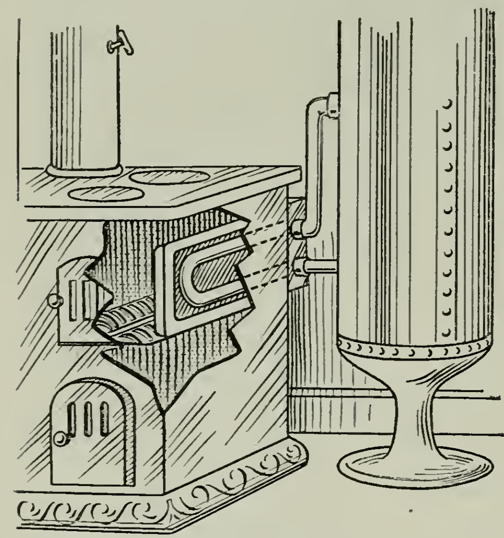


Details of construction of craftsman desk chair

To clean leather, sponge with warm water softened with borax and rub with an old soft cloth; then rub in a few drops of glycerine and polish with chamois. To extract grease spots, rub softly with flannel dipped in ether.

A Serviceable Hot Water Heater Which Can be Made at Home

A SERVICEABLE hot water heater can be made in the home, and it will give as satisfactory results as the more expensive ready-made heaters which are directly attached to the boiler. Pipes should be led from the center and bottom of the boiler, joining in a U-shaped pipe. Brass unions should be used as joints, being installed at the back of the stove. The water front, or heating unit, consists of the U-pipe, bent in a small enough radius so both sides are in range of the burner. It should be packed in place with fire clay.



The home worker can make the connections and install this heater

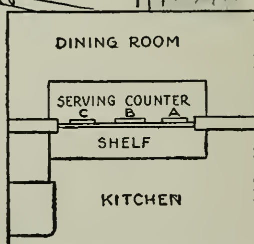
How a Course Dinner Can be Served Without a Maid

A CLEVERLY devised china closet is built into the wall between the dining room and kitchen, a long serving counter and the dish-storage shelves above it opening into both rooms. the linen and silver drawers opening into the dining room only. The sink and drainboard are on the kitchen wall adjoining the cupboard, which makes easy the putting away of dishes after washing. The range is as near as possible on the second adjoining wall, to save steps in dishing up a meal and placing it upon the counter.

The unique feature of the cupboard is that the dining room front of the serving counter is hidden from view, when desired, by three sliding doors. The kitchen face of the counter is uncovered. In serving a meal the housekeeper lays the table with the first, or soup course; places the second, or meat and vegetable course on the counter behind slide *B;* and the third, or dessert course, behind slide *C*.

Without returning to the kitchen she can later remove the first course and place it on the empty counter behind slide *A;* remove the waiting second course, which has been concealed by slide *B;* later, place the soiled dishes of the second course back behind this same slide *B;* and serve the dessert that is ready behind slide *C*. When the meal is finished she can put the remains of the dessert back upon the counter at *C*.

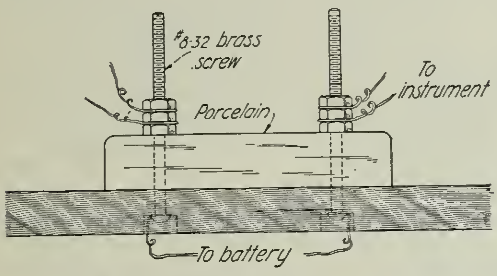
In preparing to wash the dishes she finds, upon reaching the kitchen again, that they are on the counter at her right, as they should be, and she scrapes and piles them upon the drainboard at her left. This makes it possible to route the process of dish cleansing from right to left, which is most efficient.



A china closet which makes it possible to serve course dinners easily without a maid and can also serve as a pantry

Connecting Block for Bell Wires

THIS connecting block is very handy for joining a number of wires from the same set of batteries, such as spark coils, door bells, light lamps, etc.,



As many bells as are wanted can be attached to one set of batteries by this simple connecting block

and as many wires as desired can be added by simply adding more nuts on the bolts. A good idea of it can be obtained from the drawing.

The base can be made of hard wood such as oak or maple. It has four holes drilled in it. The two nearest the end are for No. 10 wood screws, to fasten it on the wall or table. The other two are for the brass bolts. The bottom of the base where the bolt heads rest, is drilled in about ¼″ inch with a ½″ drill.

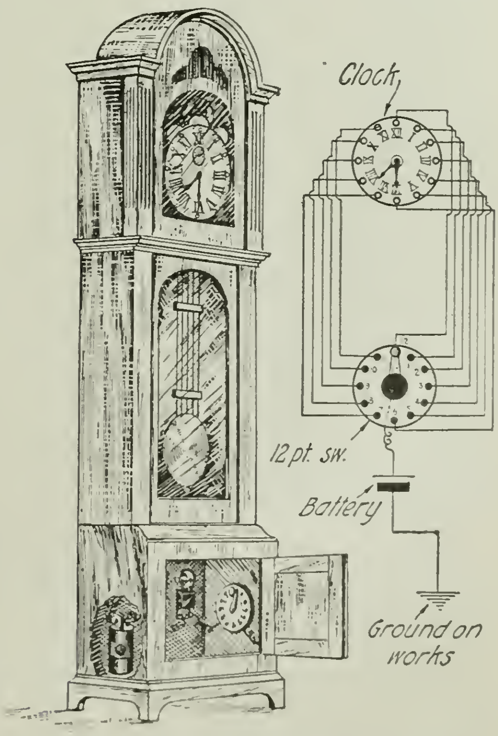
This is so the base to be level on the bottom when the bolts are inserted.

Ink Erasing Blotter

TAKE an ordinary sheet of blotting paper and steep it several times in a solution of oxalic acid or oxlate potassium and dry. While the ink spot is still moist apply the blotter and the ink will be extirely removed. If the ink is dry moisten and apply the blotter.

An Electric Alarm Clock

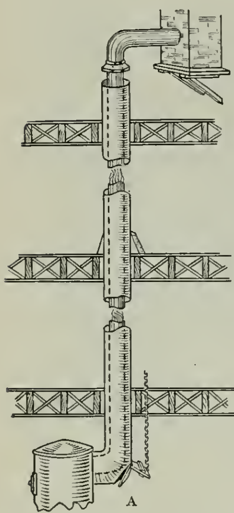
THE tall hall clock that is so frequently found in the halls of old-fashioned houses can be readily converted into a very serviceable and effective electric alarm clock without in any way impairing the dignity of its appearance. The face of the clock, if mounted on metal, should, as the first step, be removed from the metal and remounted on a wooden back, so as to provide proper insulation. Bore ⅛″ holes beside each of the figures as shown in the sketch. Each of these holes should receive a copper rivet long enough to extend 1/16″ above the face of the clock. Soldered to the back of each rivet is a copper wire of the kind used in bell wiring. By means of 12 such wires, the rivets in the face of the clock are connected to the contact points on a 12-point switch, which is numbered to correspond to the figures on the dial. A dry battery, concealed in the base of the clock, is connected with the works at one terminal, and to the bell and switch at the other pole. Now solder to the small hand a very fine spring wire so that it will come in contact with the copper rivets beside the numbers. To set the alarm, for example, at 6 o'clock, turn the switch handle to the number 6. When the hour hand comes in contact with 6 on the dial, the bell will ring until the switch is turned off, or until the hand has moved away from the contact. By using a pleasant bell, harsh sounding effects may be eliminated.



How to make a grandfather clock into an efficient alarm clock without changing its outward aspect

A Fuel Economizer

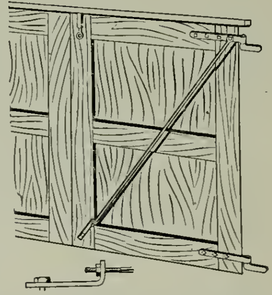
A CONSIDERABLE portion of the heat from the ordinary home furnace escapes, by way of the flue-pipe and chimney, into the open air. Consequently, if this wasted heat could be diverted into the rooms of the house, less coal would be required; and more heat could be produced from the coal used. The device shown in the illustration, which should be installed with the heating system, consists essentially of two pipes of sheet metal, one enclosed within the other. The inner pipe is the flue; and the outer enclosing pipe, which should be 4″ or 5″ larger in diameter than the inner pipe, carries the air from the cellar up along the hot flue pipe. The air enters the outer pipe by way of the opening at A; and as the air rises, it absorbs the heat from the flue. Directly above the floor on each story, a register is installed in this outer pipe; and the hot air, which is ordinarily wasted, is thus used to heat the rooms. The outer pipe should be led into the attic, where it terminates, and a ring should be placed over its open end to prevent the entrance of dust and particles of wood into the device. The inner pipe, of course, enters the chimney in the usual way. To increase the efficiency of the outer pipe, it is advisable to cover it with a layer of asbestos, which insures the escape of the heat only at the registers on each floor.



Helping to Kindle Fire Wood

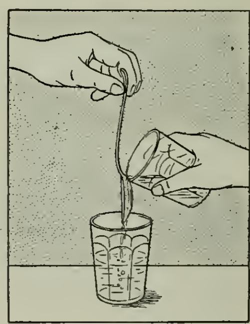
SMALL kindling can be fired quickly if the wood is dipped in a hot solution of two quarts of tar and six pounds of resin. When this is cool, fine sawdust and powdered charcoal should be added until a thick consistency is obtained. This mixture should be spread in a layer one inch thick over the kindling wood.

A Remedy for Sagging Doors



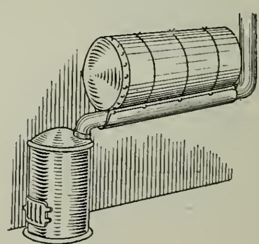
THE tendency of heavy swinging garage or barn doors to sag can be rectified by proper bracing. Two ¼″ iron rods are fitted diagonally inside the doors from the lower outer corner to the hinge in each upper corner. The rods are bent in the shape of an eye at one end and threaded at the other. The eye is bolted to the hinge while the threaded end is passed through the flange of an L-shaped iron cleat held down by a lug. A nut which holds the rod in the cleat serves as a turnbuckle for raising the door to its original position.

Pouring from Lipless Jars



LIQUIDS are likely to be spilled when pouring from a vessel that has no lip. If a glass rod is held against the rim it conducts the liquid where it is required and with care not a drop need be lost.

Waste Heat Warms Water



THE wasted heat from a small gas heater can be put to work, warming water for household use. A small stove pipe should be led from the top of the heater and underneath a hot water tank placed in a horizontal position. A section of eaves trough to cover the pipe in its contact with the tank will save much heat.

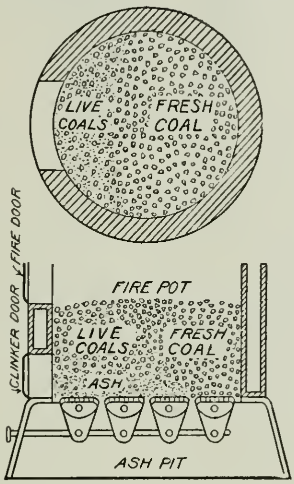
Hints on Running the Home Furnace

TO get the best heat at the lowest cost and with the least expenditure of time and labor, a number of valuable suggestions have been prepared and issued by the United States Department of Bureau of Mines. Here are some:

Attend to the fire regularly, and do not wait until it has burned low and heat is needed throughout the house.

Let the size of the coal fired be as nearly uniform as possible. Using a coal of uneven size prevents an even flow of air through the fuel bed and increases the tendency of the fire to burn through in spots. Try to keep the fuel bed free from air spots.

Avoid excessive shaking of the grates and thus reduce the amount of coal lost by falling into the ash pit. Ordinarily the shaking of the grates should be stopped as soon as bright particles begin to drop through.

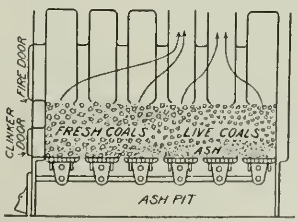


Round fire pot fired by coking method

In mild weather it is well to leave on the grates a layer of ashes under the active fuel bed. This layer will increase the resistance to the flow of air through the fuel bed and will facilitate the maintenance of the low rate of combustion required in such weather. It will also cut off some of the grate surface.

Clinkers should be worked out of the fuel bed, for they obstruct the flow of air, clog the grates, and may break the parts of the shaking grates.

Keep heating surfaces and flues swept clean so they will readily absorb heat. Do not let ashes pile up under the grates in the ash pit, for they will seal off the air from part of the grate surface and may cause the grate bars to become burned and warped.



Square fire pot fired by coking method

Ascertain by experiment what operating conditions produce the best results in your particular heater and adhere to them as rigidly as possible.

Insufficient draft is often responsible for failures of heating systems to meet requirements. The chimney or smoke pipe may be too small, or may be obstructed, or may have leaky joints.

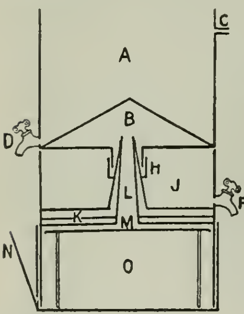
The importance of providing an inlet for the air that must enter the furnace room is frequently overlooked. Roughly 150 to 300 cubic feet of air are required for each pound of coal burned, and to prevent trouble from insufficient draft, some means for admitting this air into the furnace room must be provided. Usually enough air leaks into the furnace room through cracks and poorly fitted windows, but the tighter the construction of the room the greater the need for an outlet.

The person most likely to be interested in proper methods of operation is the one who pays the fuel bills, and as a rule it is to be expected that better results will be obtained if the firing is done by the household rather than some one hired to tend the fires. However, something more than an interest in keeping down the coal bills is necessary; some knowledge of the characteristics of the fuel and the functions of the different parts of the heater is required to save fuel and trouble.

Use the coking method of firing as shown in the illustrations; that is, work the partly burned coal, from which the gas has been driven, to one part of the fire and throw the fresh coal on the remaining portion. The fresh fuel then ignites slowly, the combustible gas is driven off gradually, and the live coals that are exposed on one side of the fire heat this gas, so that it is burned before it leaves the fire pot. If fresh coal is spread uniformly over the fire surface, much of the gas driven off is not ignited and escapes unburned.

Distilling Water for the Household

FOR the housewife who wishes to be sure that her family is drinking perfectly pure water, the new home water still is most important. It is made of copper and lined throughout with tin, as this metal is unchanged by distilled water. The device consists of three drums, one upon the other. The bottom one is the boiler, the middle one is the reservoir for the distilled water, and the upper one is the condensing chamber above which cold water is placed to cause the steam which rises from the boiler to condense.



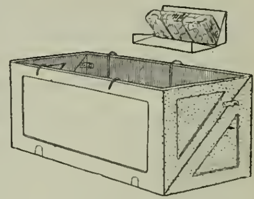
To obtain distilled water, the boiler and cold water chamber are filled and the still placed on the stove. The distilled water falls into the reservoir (middle drum) through a water seal (L). This seal is an important improvement over the ordinary still because it confines the steam from the boiler, thus increasing the pressure in the condensing chamber and giving twenty-five per cent more condensation with the same amount of heat. The distilled water may be drawn off at any time through a faucet, and the water in the cooling chamber allowed to flow from a faucet into the filling aperture of the boiler to replenish it.

Making an Electric Toaster

MANY experimenters wish to make resistances for electric toasters and heaters but are at a loss to know how to wind the resistance coils for it. The following method of winding the coils of wire will be found practicable. The wire used should be about No. 22 (B. & S.) iron wire, such as is used in basket making. Remove the handle from a hand drill and fasten the drill in a vise so that the crank can be revolved freely. Put a 3/16″ rod, 5″ long with a 1/16″ hole through one end in the chuck. Cut the wire into about 10′ lengths and put one end of a piece of the wire through the hole in the rod and as the crank is turned the wire will be wound on the rod in an even layer. Each piece of wire gives a coil, closely wound, 4″ long. Remove the end of the wire from the hole and the coil will slip off the rod. When the coils are stretched over a frame of wood so that they are 6″ long the adjacent turns of the coil will no longer touch. In this way one can wind 120 coils in one afternoon.

A Home-made Paper Baler

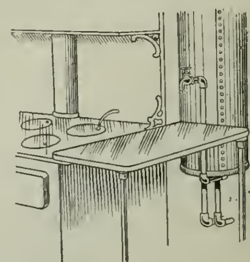
HOW to dispose of waste paper is a problem that is often presented to the city dweller. The accompanying sketch shows how accumulated paper may be baled in a simple apparatus. Use a strong wooden box about 22″x28″x30″, and strengthen the corners with angle irons. Saw the ends apart diagonally, and by means of two step hinges join the two halves together.



Two baling wires should be hung from the inside of the box. Paper placed in this box can be pressed down until a bale weighing from 40 to 50 lbs. is produced. After the bale is wired, it can be easily removed and taken away by the junk man.

Serving Table Attached to Range

A SERVING table that can be attached to the range will save much time for the housewife in the kitchen. Referring to the drawing, the board is attached to the stove by means of braces and rivets.



To the right of the shelf is the hot water boiler. A faucet may be installed in the boiler above the shelf.

Well seasoned wood should be used, and covered entirely with a layer of sheet copper.

For Practical Workers

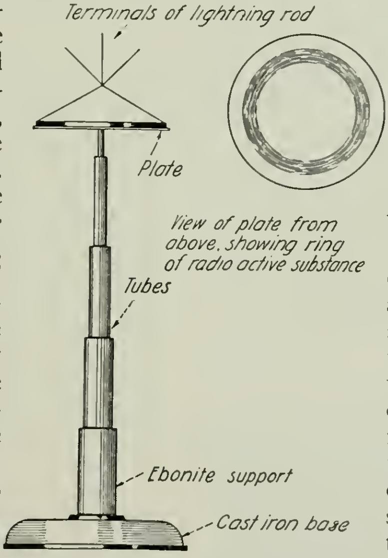
A Radium Lightning Rod

By Lucien Fournier

A LIGHTNING ROD does not prevent the occurrence of lightning. It even provokes it, but suppresses its incendiary effects. Such, indeed, is its chief object.

May we not increase its efficacy in this direction? The problem is an interesting one. We know that if the air were a very good conductor of electricity there would be no electrical storm. All that is necessary for our purpose, therefore, is to give the air this quality artificially.

Nothing is more simple—we need only to *ionize* it. To ionize the air is, so to speak, to "metallize" it by means of infinitesimal particles like those which are given off by radium and which are discharged into the surrounding space from the point of emission. From the recognition of this fact to the construction of a radium lightning rod was only a step. Its construction is not difficult; it is only necessary to put a few milligrams of radium on a plate, installed on a lightning rod near its terminal. The inventor of the process has constructed an experimental rod consisting of three brass tubes fitting into one another and having a total length of about 12 feet. The tubes are mounted on a massive support of ebonite, resting on a cast iron base fixed in the ground. At the summit of the apparatus is a cluster of three points, and below them the plate containing the radio-active substance. This plate, slightly convex upward, is of copper, about one-tenth of an inch thick and ten inches in diameter. The radio-active substance is spread in the form of a ring on its upper surface, the ring being about three-quarters of an inch in breadth and concentric with the edge of the plate. The amount of radium is only 0.2 milligramme (about .003 grain), and it is deposited on the plate by electrolysis.



A radium lightning rod which depends on the ionization of the air for efficacy

What effects are produced by this small amount of radio-active substance upon the surrounding air? The inventor declares that the conductivity of the air is increased several million-fold, and that this conductivity extends to a considerable distance from the point of emission, viz., the terminal of the lightning conductor.

Under these conditions the passage of electricity will take place between earth and air, not by brusque, irregular discharges, limited to a single point, but by a constant, steady current passing through a column of air having a radius of thirty or forty feet. The progressive conductivity of the air toward the terminal concentrates the flow of electricity in that direction. Moreover, the radio-active emissions have the effect of reducing the potential gradient and preventing explosive discharges between the cloud and the lightning rod.

It is easy to see the advantage of this arrangement. The difference of potential between the two electrified bodies being small, the spark will be of moderate intensity and the discharge unimportant; moreover, it will always take place by way of the lightning rod, and not at some distance therefrom, as often happens, on account of the ionization of the air around its point.

A Glue Scraper

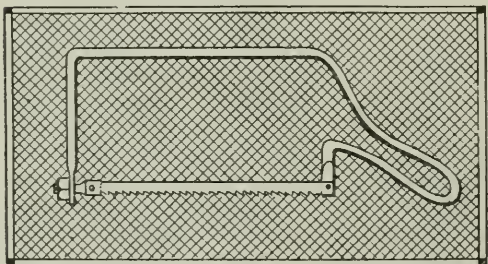
INSTEAD of buying glue scrapers for the shop, convert some of the worn-out files into useful articles.

Heat the end of a file red hot and beat it down to a sharp edge at the anvil. Then heat again and at a point about 1¼ inches from the sharpened end, bend over at right angles. This end of the file should be heated again after bending and plunged into cold water to harden the steel, so that the sharp edge will last.

This instrument will make an excellent glue scraper which will render efficient service in cleaning glue from jointed boards, and also from the top of the bench or work-table.

An Emergency Hack Saw

A SIMPLE yet efficient hack saw to fit an emergency can be made from a piece of iron wire ⅜ in. in

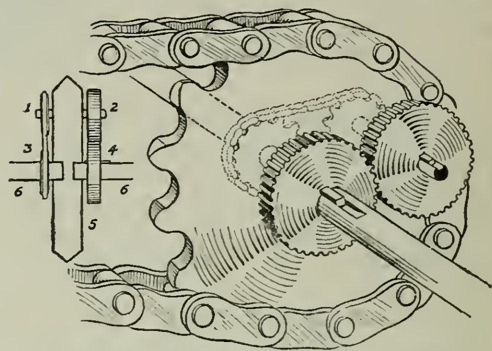


A hack-saw frame can be made from a piece of stout wire

diameter, bent as shown. The length depends on the size of the blades used. The wire is flattened at each end, and the blade is made fast by a rivet.

Differential Gear for Home-Made Tractors and Cycle-Cars

A differential gear that can be made for home-made tractors or cycle cars consists of a main sprocket, or gear, mounted to run loosely on the ends of the two-piece counter-shaft, 6. The sprocket, and spur gear, are keyed on a short shaft which turns in a pillow block. The pillow block is bolted in the



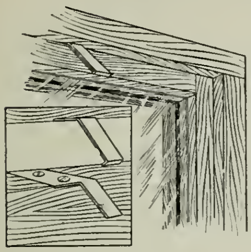
How to make a differential gear for a home-made tractor or cycle-car

main wheel about one-third of the distance from the rim. The sprocket, and the gear, are keyed on the two counter-shafts. The small gears mesh together. An endless chain belt connects sprockets 1 and 3

A Useful Home-Made Glue Brush

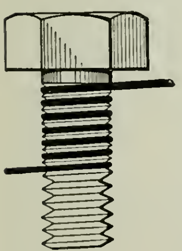
AN excellent glue brush for the cabinet maker or carpenter can be made from a piece of elm tree bark, which may usually be found in the yard of a furniture factory, wagon shop, or any hardwood lumber yard. With a sharp knife, whittle away the brittle outer bark down to the white fibre, or inner side of the bark of which the brush is to be made; cut a piece of this to the length and width required for the brush; soak one end of this piece in hot water for a few minutes; lay the water-soaked end on a hard substance, such as a piece of iron, or hardwood, and beat it out with a hammer, dipping it in the water occasionally to keep it thoroughly wet. The beating will cause the tough fibres of the bark to separate at the end, these forming an excellent and inexpensive brush, which never sheds hairs and lasts longer than the cheap brush commonly sold at the stores.

An Effective Window Lock



AN inexpensive and effective window lock may be made by the average man with a few tools from a piece of sheet steel. Two steel pieces are cut out according to the design illustrated, and bent to a slight angle, care being taken that both are bent to exactly the same degree. One piece is made about one-quarter of an inch longer than the other, and is bent at right angles, so that the other piece will strike against it, and be prevented from passing. When the window is closed, the device is in operation, and because of the projecting end of the longer piece, the window cannot be opened. The device is released by inserting a screw-driver between the metal strips and bending them in order to disengage the catch.

To Make Small Springs

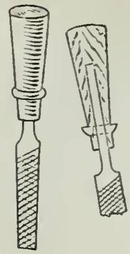


IN making little springs of small-sized wire take a machine screw and wind the wire tightly around it in the threads. This brings the spring out as closely as most home-made springs need be. A slight pull will stretch it to the desired length. A screw somewhat smaller than the size of spring desired should be used to allow for the resiliency of the wire.

How to Case Harden Iron

MAKE up a paste of powdered prussiate of potash and water. Coat the iron with this paste, and set it aside to dry. Let the forge fire be clear and bright. When the paste is dry upon the iron thrust the iron into the fire until it is cherry red. Keep it at this heat for a few minutes and then take it out. Plunge it into cold water, and it will be found converted into steel at the surface.

Files and Tools from Switch Handles



FIRST procure the required number of switch handles. Remove the usual screw. Into the hole left by the screw, force the tang of the file or other tool.

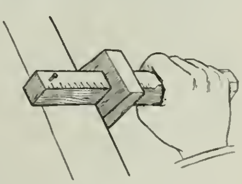
As most of these switch handles are made of wood, there is a metal ferrule on the end which serves to keep the handle from splitting. This ferrule serves the same purpose when a tool is inserted into the handle. Tools vary in size but different sized handles may be used for different sized tools. If a supply of these handles is kept handy a handle may be fitted to a tool at any time.

A Handle for a Small Bit or Drill

A CONVENIENT handle for small bits, drills or screw drivers which are intended for use with a brace can be quickly made from an old spool about 2″ long. If the square end of an old or discarded bit is at hand, drive it slightly into the hole in the spool, so as to make the hole square.

After this is done the spool can be placed on nearly any size of bit, to hold securely.

An Easily Made Marking Gauge

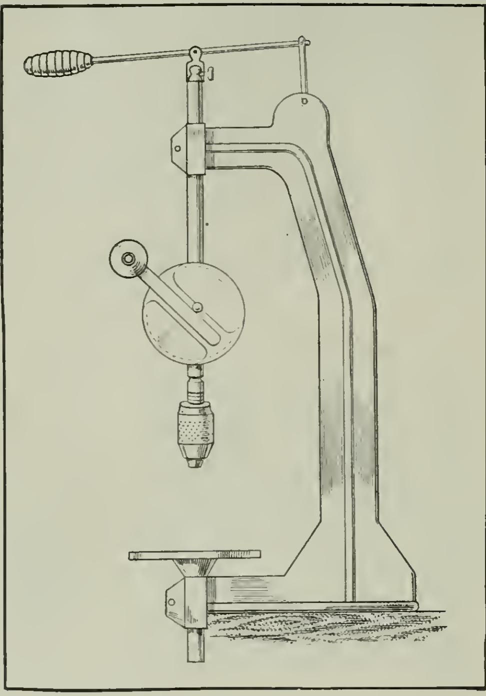


INTO a ¾″ dowel of wood, about 8″ long, drive a 1″ wire brad ¼″ from one end and let the point protrude ⅛″. Take a rule and lay off sixteenths from the nail. Drill a ¾″ hole through a block of wood 2½″ x 2½″ x ⅞″. Then slide the block on the dowel. The friction is enough to hold it for marking. By tapping the dowel with the block held in the hand, the marking distance can be lengthened or shortened, as may be desired.

Home-Made Drill Press

EVERY lathe owner knows what an unsatisfactory job drilling in a lathe is, and a great many cannot afford to indulge their hobby to the extent of purchasing a drill press.

The following is a description of a drill press which employs the ordinary



A drill press made from an ordinary round-shank breast drill

round shank breast drill and two castings, the patterns of which were home-made, as was also the drill table, which was turned in a foot-power lathe.

The attractive feature of this drill press is that the breast drill can be removed in a few minutes' time and used in the regular manner, and in the same length of time it can be reassembled.

To begin with, the breast drill must be one of the round-shanked type, which retail for about $1.50, and with a range of from 0 to ½ inch drills.

In the drawing may be seen the main casting. The casting is very securely fastened by screws to the bench. The pattern should be made of ¼-inch stock, with the sides ribbed ¼ inch so as to give greater strength. The bearings at the top and bottom should be cored a sufficient size to be liberally babbitted. The lugs are slotted with a hack saw and drilled and tapped for adjusting screws at the top and for a clamping bolt at the bottom.

The drill table is self-explanatory; the shank and surface being the only parts that require machining. If the builder has a lathe this can easily be done; but if not, a machinist will do the work at a low cost.

The feed lever is made of 3/16 x ½ inch iron or cold-rolled steel. Two pieces are hinged in an L form. The socket for raising and lowering the drill is made of pipe fitting, such as is used on awnings, lapped for a set screw.

To babbitt the casting a jig must be used in order to align the table with the drill properly. For this purpose procure a piece of steel of the same diameter as the shank of the table. Turn down one end sufficiently to be gripped in the drill chuck, and with this rod it becomes possible.

How to Get the Most From a Football

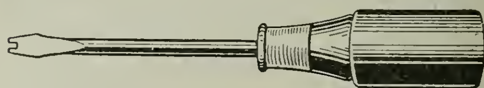
AS a rule the tube of a football bladder will crack off before the bladder is worn out. This is due to the bending of the tube.

A bicycle valve cap will protect the stem and a pump may be used to blow up the football.

To do this coat the outside of the valve with shellac, being careful not to let any get on the stem, and insert it in the tube. Wind a shoe string around the outside of the tube to hold it firmly against the valve. When the shellac has set the shoe string may be removed.

A Help in Wire-Twisting

CUT a notch in the center of a screw driver blade, about 1/16″ deep, as



A notch in a screw driver gives a grip on wires to be twisted around binding posts or sockets

shown in the sketch. This will be found of great aid in bending wires around binding posts or sockets.

Ground Detector for Three Wire Circuit

NEARLY everyone is familiar with the method of connecting a couple of incandescent lamps whereby they will indicate the presence of grounds on a two-wire system. For such service the two lamps are connected in series between two of the wires of opposite polarity of the two-wire system, and a ground wire is tapped between

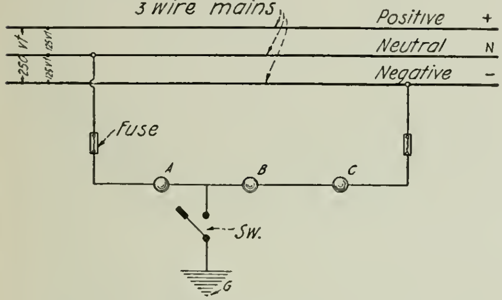


Fig. 1. Wiring diagram of a three-circuit ground detector

the two lamps. Where a ground occurs on the circuit, the lamp connected to the wire on which there is a ground will grow dim or will go out altogether, and the other lamp will burn above normal brilliancy.

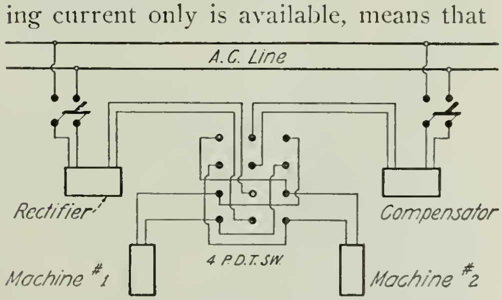
The method of connecting incandescent lamps to indicate grounds on a three-wire system is not, apparently, very well known. It is, however, simple in arrangement and operation, as indicated in Fig. 1, and described in the following paragraph.

The three lamps, *A*, *B* and *C*, are connected between the neutral and the negative wires or between the neutral and the positive wire, as shown. Each of the lamps should be designed for the voltage between either of the outside wires and the neutral. For example, the voltage between any outside wire and the neutral is 125. Consequently *A*, *B* and *C* should each be a 125-volt incandescent lamp.

The three lamps connected in series should be protected with a fuse at each tap as shown in the figure. A lead between lamps *A* and *B* with a switch in series should be connected to the earth. With the three-wire system free from grounds all three lamps, *A*. *B* and *C*, will burn dimly, whether the ground switch *GS* is open or closed. If, however, an accidental ground occurs on the positive wire, all of the lamps will burn with full brilliancy if *GS* is closed. If a ground occurs on the negative wire and *GS* is closed, lamps *B* and *C* will not illuminate, but *A* will burn at full brilliancy. If a ground occurs in the neutral wire, *GS* being closed, *A* will not burn, but *B* and *C* will burn dimly. The switch should always be connected between the lamps (*A* in this case) which connects to the neutral wire and the next adjacent lamp. If it were connected between *B* and *C*, in case of a ground on the positive wire, lamp *C* would have double voltage (250 volts) impressed on it, and hence would quickly burn out.

Ingenious Circuit Saves Money in Photoplay Houses

MOTION picture theatregoers demand that one film shall follow another without interruption. This has given rise to a troubling problem. Dissolving the beginning of one reel into the end of the preceding one, so that a continuous flow of the screen narrative is given, necessitates the use of two projecting machines, one of which is started just before the other stops. This maneuver requires two arcs burning at the same time, and two arcs, where alternating current only is available, means that



This circuit allows one rectifier to serve two motion picture projectors at the same time

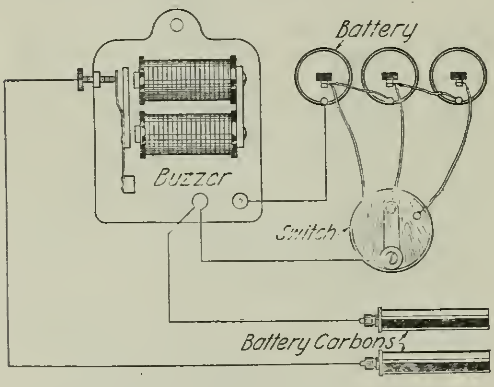
two alternating current rectifiers are necessary.

Motion picture operators in Philadelphia have solved the problem of supplying current to two arcs with one rectifier by the use of a four poled double throw switch connected as the accompanying diagram illustrates.

A Novel Medical Battery

A COMMON buzzer is used in place of the induction coil and connected with the dry cells through a multiple switch. The switch is of very simple construction. A piece of brass, cut in an L, with a battery binding post at one end, which serves as a pivot and terminal, and a knob at the other end to swing it about, compose the arm of the switch. Brass screws are best for contact points. The base may be made of a scrap of wood.

The L on the arm of the switch is a little less than the distance from the center of one screw to the center of the next. Therefore when the arm is moved it contacts with the approaching screw just before it leaves the receding one, and so all the way around. This eliminates the jerk when throwing another battery in the circuit.



A common electric buzzer is the only induction coil needed for this very simple medical battery

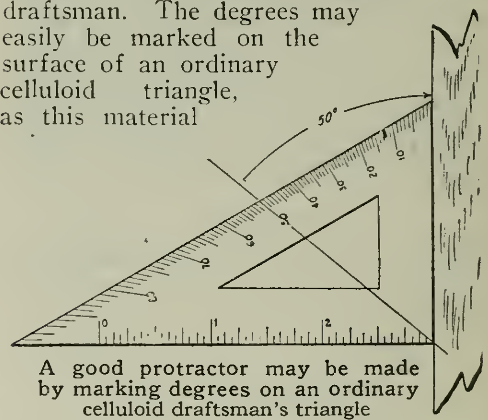
A wire is led from the contact screw and another from one of the binding posts of the buzzer. A round carbon from a battery is fastened to each one of these wires to provide handles through which the shock is given.

The first two batteries should be rather weak, so that persons not used to electricity may stand the shock. Any number of cells may be used, and by connecting each to a screw and to one another as shown in the drawing, the shocks may be varied from a slight vibration to a powerful shock.

All the batteries may be put in a box with a lid and the buzzer and switch mounted on top

A Combined Triangle and Protractor

THE combination of a triangle and protractor will prove a very useful addition to the implements of the draftsman. The degrees may easily be marked on the surface of an ordinary celluloid triangle, as this material is readily scratched with a sharp point. On the perpendicular of the triangle a scale may be marked, this further enhancing the value of the instrument. The degree markings may be placed in their proper positions with the aid of a protractor.

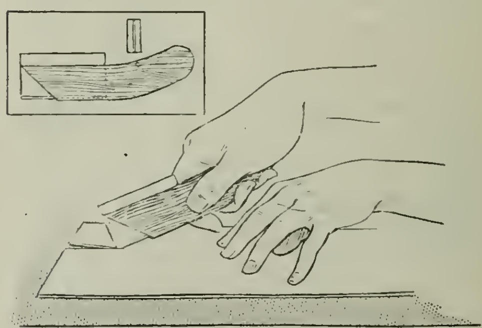


A good protractor may be made by marking degrees on an ordinary celluloid draftsman's triangle

A Drawing Cutter

Make a handle similar to the one shown. Split it with a fine-toothed saw, in the end having the 45° angle sawed off, to a length about ½″ longer than a safety razor blade. Make the opening fine, barely wider than a razor blade.

To use the cutter, place a safety razor blade in the slot, adjust it to the desired length by pushing forward or drawing backward, then hold by a pressure of the fingers on the sides of the handle.



A safety razor blade has many uses. This shows how a drawing cutter can be made out of a blade

Overhauling Your Car for the Winter

By Victor Pagé

(Continued from the December Number)

Valve Removal and Inspection

ONE of the most important parts of the gasoline engine and one that requires frequent inspection and refitting to keep in condition is the mushroom or poppet valve that controls the inlet and exhaust gas flow. In overhauling it is essential that these valves be removed from their seatings and examined carefully for various defects which will be enumerated at proper time. The valves are held against the seating in the cylinder by a coil spring which exerts its pressure on the cylinder casting at the upper end and against a suitable collar held by a key at the lower end of the valve stem. In order to remove the valve it is necessary to first compress the spring by raising the collar and pulling the retaining key out of the valve stem. Many forms of valve spring lifters have been designed to permit ready removal of the valves.

When the cylinder is of the valve in-the-head form, the method of valve removal will depend entirely upon the system of cylinder construction followed.

In the Franklin engine, which is shown in part section at Fig. 9, it is not possible to remove the valves without taking the cylinder off of the crank case, because the valve seats are machined directly in the cylinder head and the valve domes are cast integrally with the cylinder. This means that if the valves need grinding the cylinder must be removed

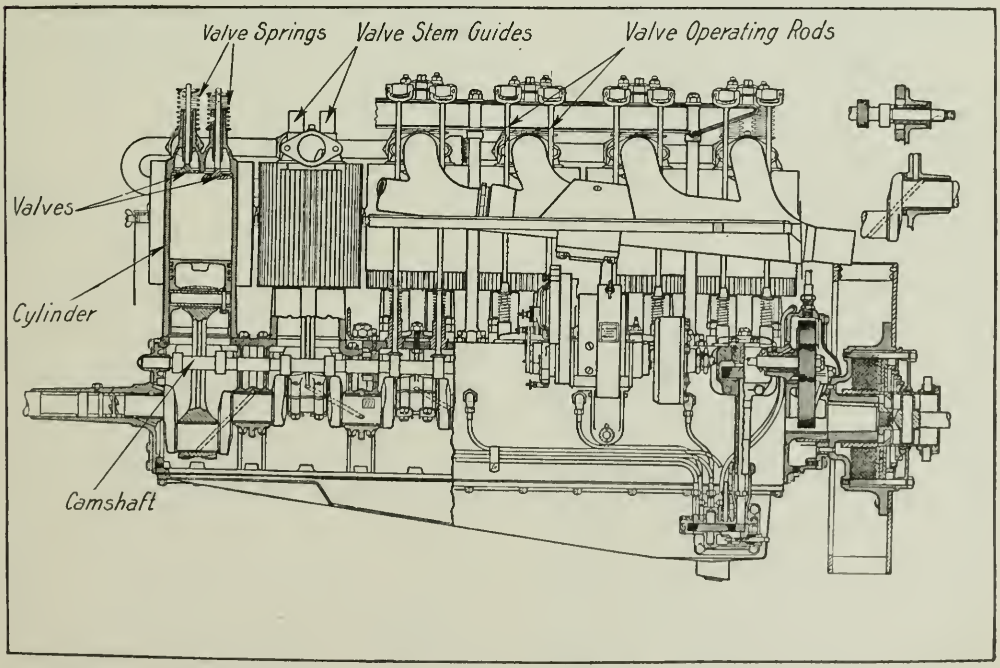


Fig. 9. A sectional view of part of the Franklin motor, showing valve seats machined directly in cylinder head, and valve domes cast integrally with the cylinder

from the engine base to provide access to the valve heads which are inside of that member, and which cannot be reached from the outside, as is true of the L or T-cylinder construction.

The preferred method of carrying the valves when they are placed in the cylinder head in the Buick 6-cylinder motor, is shown in Fig. 10. The valves are carried in cages which are readily removed from the cylinder head by unscrewing the retention nut that keeps the valve cage tightly pressed against the seating at its lower end to obtain a gas-tight joint. The valve cages are easy to handle and it is a relatively simple operation to compress the valve spring and remove the pin which makes for easy removal of the valve. When this construction is followed it is possible to grind in the valve by simply removing the cage assemblies from the cylinder. It is not necessary to disturb the cylinder in any way and does not call for disconnection of intake or exhaust manifolds; the only things that need be removed are the valve operating tappets, which is work of but a few moments.

Valve Grinding Process

Much has been said relative to valve grinding, and despite the mass of information given in the trade prints it is rather amusing to watch the average repairman or the motorist who prides himself on maintaining his own car performing this essential operation. The common mistakes are attempting to seat a badly grooved or pitted valve head on an equally bad seat, which is an almost hopeless job, and of using coarse emery and bearing down with all one's weight on the grinding tool with the hope of quickly wearing away the rough surfaces. The use of improper abrasive material is a fertile cause of failure to obtain a satisfactory seating. Valve grinding is not a difficult operation if certain precautions are taken before undertaking the work. The most important of these is to ascertain if the valve head or seat is badly scored or pitted. If such is found to be the cause no ordinary amount of grinding will serve to restore the surfaces. In this event the best thing to do is to remove the valve from its seating and to smooth down both the valve head and the seat in the cylinder before attempt is made to fit them together by grinding. Another important precaution is to make sure that the valve stem is straight, and that the head is not warped out of shape or loose on the stem when the valve is a two-piece member.

Valve Grinding Processes

Mention has been previously made of the importance of truing both valve head and seat before attempt is made to refit the parts by grinding. The appearance of a valve head when pitted or scored is indicated at Fig. 11, *A*, in order that the motorist or novice repairman can readily identify this defective condition. After smoothing the valve seat the next step is to find some way of turning the valve. Valve heads are usually provided with a screw driver slot passing through the boss at the top of the valve or with two drilled holes to take a forked grinding tool. The method of arranging the valve head for the grinding tool and the types of grinding tools commonly used are also shown at Fig. 11, *A*. A combination grinding tool which may be used when either the two drilled holes or the slotted head form of valve is to be rotated is shown at Fig. 11, *B*. This consists of a special form of screw driver having an enarged boss just above the blade, this boss serving to support a U-shaped piece which can be securely held in operative position by the clamp screw or which can be turned out of the way if the screw driver blade is to be used.

As it is desirable to turn the valve through a portion of a revolution and back again rather than turning it always in the same direction, a number of special tools has been designed to make this oscillating motion possible without trouble. A simple valve grinding tool is shown at Fig. 11, *C*. This consists of a screw driver blade mounted in a handle in such a way that the end may turn freely in the handle. A pinion is securely fastened to the screw driver blade shank, and is adapted to fit a rack provided with a wood handle and guided by a bent bearing member securely fastened to the screw driver handle. As the rack is pushed back and forth the pinion must be turned first in one direction and then in the other.

A valve grinding tool patterned largely after a breast drill is shown at Fig. 11, *D*. This is worked in such a manner that a continuous rotation of the operating crank will result in an oscillating movement of the chuck carrying the screw driver blade. The bevel pinions which are used to turn the chuck are normally free unless clutched to the chuck stem by the sliding sleeve which must turn with the chuck stem and which carries clutching members at each end to engage similar members on the bevel pinions and lock these to the chuck stem, one at a time. The bevel gear carries a cam piece which moves the clutch sleeve back and forth as it revolves. This means that the pinion giving forward motion of the chuck is clutched to the chuck spindle for a portion of a revolution of the gear and clutch sleeve is moved back by the cam and clutched to the pinion giving a reverse motion of the chuck during the remainder of the main drive gear revolution.

A method that can be used for smoothing the surface of a valve head when the usual form of valve head truer is not available is indicated at Fig. 11, *E*. The valve heads are usually provided with a small depression in the center known as a countersink which is designed to act as a support for the valve when it is being machined from the forging. The stem of the valve is caught in the chuck of a bit stock and rested on any sharp point on a wall or bench. This can be easily made by driving a large wire nail in the bench from underneath so that the point projects through the bench. The bit stock is briskly turned by a helper and the rough spots are removed from the seat with a fine file, care being taken not to change the taper of the valve head. The valve stem could be turned much faster and a superior finish obtained if a breast drill were used instead of a bit stock, though with care a very creditable job may be done with the latter.

One of the things to watch for in valve grinding is clearly indicated at Fig. 11, *F*. It sometimes happens that the adjusting screw on the valve lift plunger or the valve lift plunger itself does not

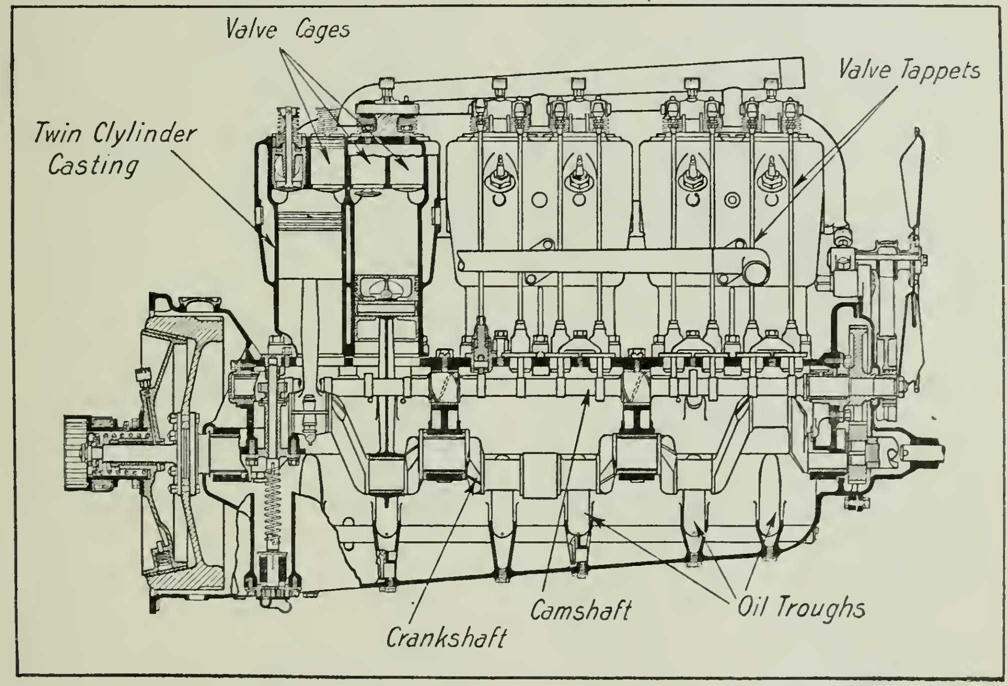


Fig. 10. A part sectional view of Buick Motor, showing method of valve mounting in easily removable valve cages

permit the valve head to rest against the seat. While the condition is exaggerated in the sketch it will be apparent that unless a definite space exists between the end of the valve stem and the valve lift plunger that grinding will be of little avail because the valve head will not bear properly against the abrasive material smeared on the valve seat.

When a bit stock is used, instead of being given a true rotary motion the chuck is merely oscillated through the greater part of the circle and back again. It is necessary to lift the valve from its seat frequently as the grinding operation continues, this is to provide an even distribution of the abrasive material placed between the valve head and its seat. Only sufficient pressure is given to the bit stock to overcome the uplift of the spring and to insure that the valve will be held against the seat.

The abrasive generally used is a paste of medium or fine emery and lard, oil or kerosene. This is used until the surfaces are comparatively smooth, after which the final polish or finish is given with a paste of flour emery, grindstone dust, crocus or ground glass and oil. An erroneous impression prevails in some quarters that the valve head surface and the seating must have a mirror-like polish. While this is not necessary it is essential that the seat in the cylinder and the bevel surface of the head be smooth and free from pits or scratches at the completion of the operation. All traces of the emery and oil should be thoroughly washed out of the valve chamber with gasoline before the valve mechanism is assembled and in fact it is advisable to remove the old grinding compound at regular intervals, wash the seat thoroughly and supply fresh material as the process is in progress. The truth of seatings may be tested by taking some Prussian blue pigment and spreading a thin film of it over the valve seat. The valve is dropped in place and is given about one-eighth turn with a little pressure on the tool. If the seating is good both valve head and seat will be covered uniformly with color. If high spots exist, the heavy deposit of color will show these while the low spots will be made evident because of the lack of pigment. The grinding process should be continued until the test shows an even bearing of the valve head at all points of the cylinder seating.

Piston Troubles

If an engine has been entirely dismantled it is very easy to examine the pistons for deterioration. While it is important that the piston be a good fit in the cylinder it is mainly upon the piston rings that compression depends. The piston should fit the cylinder with but little looseness, the usual practice being to have the piston diameter at the point where the least heat is present or at the bottom of the piston. It is necessary to allow more than this at the top of the piston owing to its expansion due to the direct heat of the explosion. The clearance is usually graduated and a piston that would be .005-inch smaller than the cylinder bore at the bottom would be about .0065-inch at the middle and .0075-inch at the top. If much more play than this is evidenced the piston will "slap" in the cylinder and the piston will be worn at the ends more than in the center. Pistons sometimes warp out of shape and are not truly cylindrical. This results in the high spots rubbing on the cylinder while the low spots will be blackened where a certain amount of gas has leaked by.

Mention has been previously made of the necessity of reboring or regrinding a cylinder that has become scored or scratched and which allows the gas to leak by the piston rings. When the cylinder is ground out, it is necessary to use a larger piston to conform to the enlarged cylinder bore. Most manufacturers are prepared to furnish over-size pistons, there being four standard over-size dimensions adopted by the S. A. E. for rebored cylinders. These are .010-inch, .030-inch, and .040-inch larger than the regular dimensions. Care should be taken in reboring the cylinders to adhere as closely as possible to one or the other of these standards.

Removing Pistons Stuck in Combustion Chamber

The removal and replacement of pistons and rings seldom offer any trouble if the work is properly carried on but if for any reason the piston should be pushed too far up into the cylinder on some types of engines the top ring will expand into the combustion chamber and will lock the pistons tightly in place. This is a difficult condition to overcome with some forms of cylinders though if the cylinder casting is of the *L* or *T* form it may be possible to compress the rings sufficiently to remove the piston by simple means. The best method is shown at Fig. 13, *A*. A very thin strip of metal of approximately the same width as the piston rings is passed through one of the valve chamber openings and passed around the piston and pulled out through the other opening. It requires the services of two people and sometimes three to remove a piston stuck in this manner. The efforts of one are directed to keep the band taut under the ring and to exert an upward pull which forces that portion of the ring embraced by the metal band to fill the groove in the piston. Another person uses a pair of screw drivers, one through each valve chamber opening to compress the ring at the points indicated in the drawing. This means that a three-point compressional effect is obtained and it is a simple matter for the third person to draw the piston back into the cylinder when the ring has been properly compressed in its groove. It is not always possible to compress the ring so the only other alternative is to break it in a number of pieces by hitting the brittle ring with a drift or chisel and then withdrawing the pieces one at a time until the ring has been entirely removed. With the T-head cylinder it is sometimes possible to remove the ring without the use of the metal bands, as that member is compressed at diametrically opposite points by a screw driver inserted through each valve chamber cap.

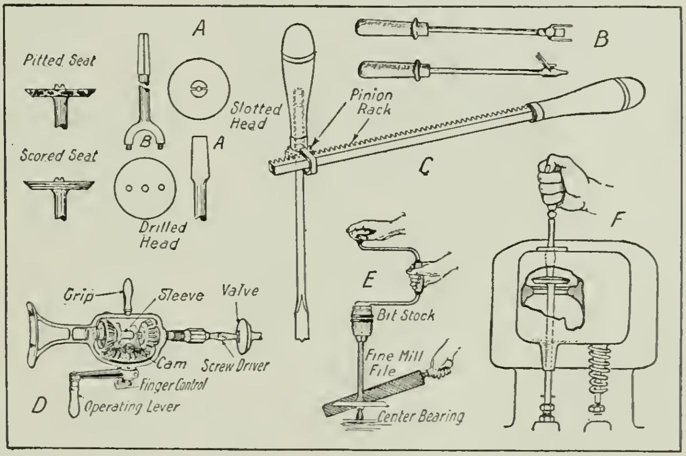


Fig. 11. Forms of valve grinding tools and methods of grinding

Fitting Piston Rings

Before installing new rings, they should be carefully fitted to the grooves to which they are applied. The tools required are a large piece of fine emery cloth, a thin, flat file, a small vise with copper or leaden jaw clips, and a smooth hard surface such as that afforded by the top of a surface plate or a well-planed piece of hard wood. After making sure that all deposits of burnt oil and carbon have been removed from the piston grooves, three rings are selected, one for each groove. The ring is turned all around its circumference into the groove it is to fit, which can be done without springing it over the piston as the outside edge of the ring may be used to test the width of the groove just as well as the inside edge. The ring should be a fair fit and while free to move circumferentially there should be no appreciable up and down motion.

The ring should be pushed into the cylinder at least two inches up from the bottom and endeavor should be made to have the lower edge of the ring parallel with the bottom of the cylinder. If the ring is not of correct diameter, but is slightly larger than the cylinder bore, this condition will be evident by the angular slots of the rings being out of line or by difficulty in inserting the ring if it is a lap joint form. If such is the case the ring is removed from the cylinder and placed in the vise between the soft metal jaw clips, as shown at Fig. 13 *B*. Sufficient metal is removed with a fine file from the edges of the ring at the slot until the edges come into line and a slight space exists between them when the ring is placed into the cylinder. It is important that this space be left between the ends, for if this is not done, when the ring becomes heated the expansion of metal may cause the ends to abut and the ring to jam in the cylinder.

Fig. 12. A nail or piece of wire will grind Buick valves

Another method of fitting a piston ring is indicated at Fig. 13, *C*. A plug is made of soft wood, such as yellow pine that will be an easy fit in the cylinder and one end is turned down enough so that a shoulder will be formed to back the ring. The turned down portion should be a little less than the width of the ring to be tested. The ring is pushed on this turned down end of the wooden plug and held by a small batten secured by a screw in the center. This does not hold the ring tightly enough to keep it from closing up. It is also important to turn the end of the wooden plug small enough so that its diameter will be less than the bore of the ring when that member is tightly closed. The cylinder bore is smeared with a little Prussian blue pigment which is spread evenly over the cylinder wall with a piece of waste and the ring is moved back and forth in the cylinder while it is held square by the shoulder on the plug. The high spot on the ring will be shown by color. Usually the ring will be found to bear hardest at each side of the slot. These high spots are removed carefully with a very fine mill file or piece of emery cloth and the ring is again inserted in the cylinder bore to find other high spots which are removed in a similar manner. When the rings fit fairly well all around, the entire surface will have a uniform coating of blue.

If the old piston rings are bright all around but appear to have lost their elasticity, a new lease of life may be given by a process known as peening, which is shown at Fig. 13, *D*. The ring is stood on a surface plate and is tapped inside with the peen end of a light hammer using the harder blows at the thick section and gradually reducing the force of the blow as the slot is approached. If skillfully done a ring may be stretched to some extent and considerable elasticity imparted. Piston rings are not always of simple form shown. Various duplex constructions have been offered with an idea of reducing the possibility of leakage. A ring of this type which is known as the "Leak Proof" piston packing is shown at Fig. 13, *E*. These duplex rings are harder to install than the simple forms, and it is important that they be carefully fitted to the cylinder and to the piston grooves, as described below.

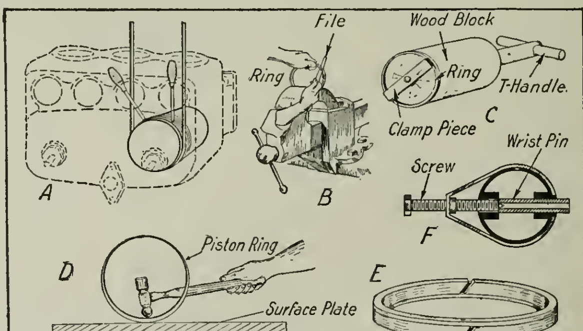


Fig. 13. Processes incidental to piston ring restoration

The bottom ring should be placed in position first; this is easily accomplished by springing the ring open enough to pass on the piston and then sliding it into place in the lower groove which on some types of engines is below the wrist pin, whereas in others all grooves are above that member. It is not always necessary to use guiding strips of metal when replacing rings as it is often possible, by putting the rings on the piston a little askew and manœuvering them to pass the grooves without springing the ring into them. The top ring should be the last one placed in position.

Before replacing pistons in the cylinder one should make sure that the slots in the piston rings are spaced equidistant on the piston and if pins are used to keep the ring from turning one should be careful to make sure that these pins fit into their holes in the ring and that they are

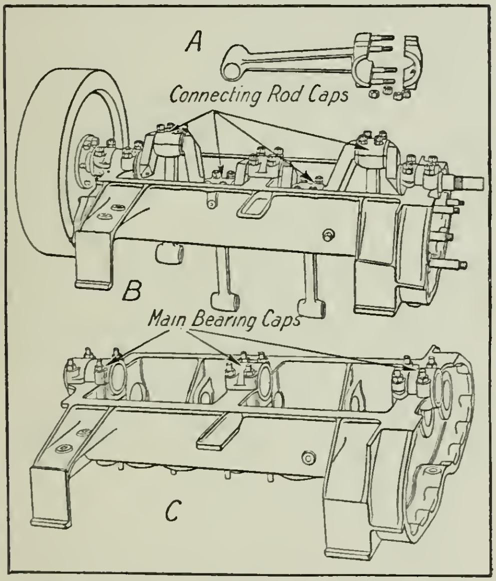


Fig. 14. Showing method of supporting crankcase to provide ready access to connecting rod and crankshaft bearings

not under the ring at any point. The cylinder should be well oiled before attempt is made to install the pistons. The engine should be run with more than the ordinary amount of lubricant for several days after new piston rings have been inserted.

Inspection and Refitting of Engine Bearings

While the engine is dismantled one has an excellent opportunity to examine the various bearing points in the engine crankcase to ascertain if any looseness exists due to depreciation of the bearing surfaces. As will be evident from the views at Figs. 14 and 15, both main crankshaft bearings and the lower end of the connecting rods may be easily examined for deterioration. With the rods in place as shown at Fig. 14, *A*, it is not difficult to feel the amount of lost motion by grasping the connecting rod firmly with the hand and moving it up and down.

The appearance of the engine base after the connecting rods and flywheel have been removed from the crankshaft is shown at Fig. 15, while the appearance of the upper portion of the crankcase, after the crankshaft is removed is clearly shown at Fig. 14, *C*.

After the connecting rods have been removed and the flywheel taken off the crankshaft to permit of ready handling any looseness in the main bearing may be detected by lifting upon either the front or rear end of the crankshaft and observing if there is any lost motion between the shaft journal and the main bearing caps. It is not necessary to take an engine entirely apart to examine the main bearings as in some forms these may be readily reached by removing a large inspection plate either from the bottom or side of the engine crankcase. The symptoms of worn main bearings are not hard to identify. If an engine knocks when a vehicle is traveling over level roads regardless of speed or spark lever position and the trouble is not due to carbon deposits in the combustion chamber one may reasonably surmise that the main bearings have become loose or that lost motion may exist at the connecting rod big ends, and possibly at the wrist pins.

Adjusting Main Bearings

When the bearings are not worn enough to require refitting the lost motion can often be eliminated by removing one or more of the thin shims or liners ordinarily used to separate the bearing caps from the seat. Care must be taken that an even number of shims of the same thickness are removed from each side of the journal. If there is considerable lost motion after one or two shims have been removed, it will be advisable to take out more shims and to scrape the bearing to a fit before the bearing cap is tightened up. It may be necessary to clean up the crankshaft journals as these may be scored due to not having received clean oil or having had bearings seize upon them. It is not difficult to true up the crank pins or main journals if the score marks are not deep. A fine file and emery cloth may be used, or a lapping tool. The latter is preferable because the file and emery cloth will only tend to smooth the surface while the lap will have the effect of restoring the crank to proper contour.

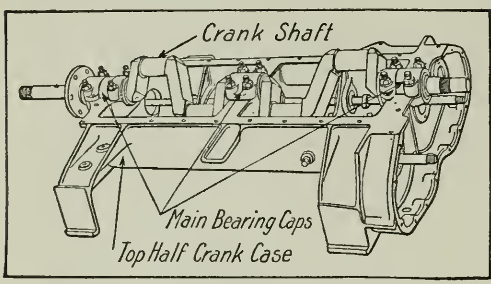


Fig. 15. Top half of crankcase, showing method of crankshaft retention by three main bearing caps

If a crank pin is worn out of true to any extent the only method of restoring it is to have it ground down to proper circular form by a competent mechanic having the necessary machine tools to carry on the work accurately.

After the crankshaft is trued the next operation is to fit it to the main bearings or rather to scrape these members to fit the shaft journal. In order to bring the brasses closer together, it may be necessary to remove a little metal from the edges of the caps to compensate for the lost motion. A piece of medium emery cloth is rested on the surface plate and the box or brass is pushed back and forth over that member by hand, the amount of pressure and rapidity of movement being determined by the amount of metal it is necessary to remove. This is better than filing because the edges will be flat and there will be no tendency for the bearing caps to rock when placed against the bearing seat. It is important to take enough off the edges of the boxes to insure that they will grip the crank tightly. The outer diameter must be checked with a pair of calipers during this operation to make sure that the surfaces remain parallel. Otherwise the bearing brasses will only grip at one end and with such insufficient support they will quickly work loose, both in the bearing seat and bearing cap.

Scraping Brasses to Fit

To insure that the bearing brasses will be a good fit on the trued up crank pins or crankshaft journals they must be scraped to fit the various crankshaft journals. The process of scraping, while a tedious one, is not difficult, requiring only patience and some degree of care to do a good job. The surface of the crank pin is smeared with Prussian blue pigment which is spread evenly over the entire surface. The bearings are then clamped together in the usual manner with the proper bolts and the crankshaft revolved several times to indicate the high spots on the bearing cap. The high spots are indicated by blue, as where the shaft does not bear on the bearing there is no color. The high spots are removed by means of a scraping tool, which is easily made from a worn out file. These are forged to shape and ground hollow and are kept properly sharpened by frequent rubbing on an ordinary oil stone. To scrape properly, the edge of the scraper must be very keen.

When correcting errors on flat or curved surfaces by hand scraping, it is desirable, of course, to obtain an evenly spotted bearing with as little scraping as possible. When the part to be scraped is first applied to the surface-late or to a journal in the case of a bearing three or four "high" spots may be indicated by the marking material. The time required to reduce these high spots and obtain a bearing that is distributed over the entire surface depends largely upon the way the scraping is started. If the first bearing marks indicate a decided rise in the surface, much time can be saved by scraping larger areas than are covered by the bearing marks; this is especially true of large shaft and engine bearings, etc. An experienced workman will not only remove the heavy marks, but also reduce a larger area; then, when the bearing is tested again, the marks will generally be distributed somewhat. If the heavy marks which usually appear at first are simply removed by light scraping, these "point bearings" are generally enlarged, but a much longer time will be required to distribute them.

The number of times the bearing must be applied to the journal for testing is important, especially when the box or bearing is large and not easily handled. The time required to distribute the bearing marks evenly depends largely upon one's judgment in "reading" these marks. In the early stages of the scraping operation, the marks should be used partly as a guide for showing the high areas, and instead of merely scraping the marked spot the surface surrounding it should also be reduced, unless it is evident that the unevenness is local. The idea should be to obtain first a few large but generally distributed marks; then an evenly and finely spotted surface can be produced quite easily.

In fitting brasses when these are of the removable type, two methods may be used. The upper half of the engine base may be inverted on a suitable bench or stand and the boxes fitted by placing the crankshaft in position, clamping down one bearing cap at a time and fitting each bearing in succession until they bed equally. From that time on the bearings should be fitted at the same time so the shaft will be parallel with the bottom of the cylinders. Considerable time and handling of the heavy crankshaft may be saved if a preliminary fitting of the bearing brasses is made by clamping them together with a carpenter's wood clamp and leaving the crankshaft attached to the bench. The brasses are revolved around the crankshaft journal and are scraped to fit wherever high spots are indicated until they assume a finished appearance. The final scraping should be carried on with all bearings in place and revolving the crankshaft to determine the area of the seating. When the brasses are properly fitted they will not only show a full bearing surface but the shaft will not turn unduly hard if revolved with the same amount of leverage as afforded by the flywheel rim or starting crank, bearing caps being bedded down and lubricated.

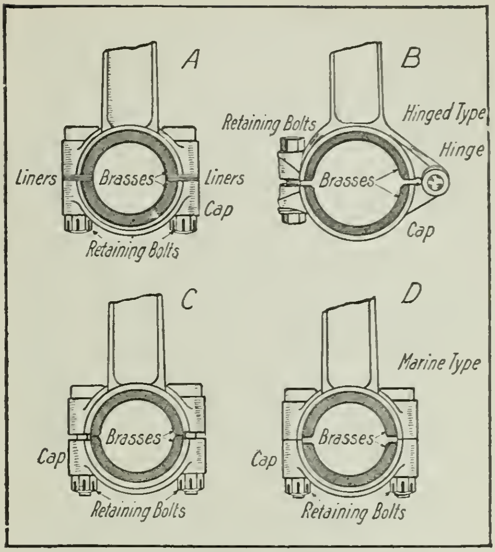


Fig. 16. Outlining common types of connecting rod big ends

Bearings of white metal or babbitt can be fitted tighter than those of bronze and care must be observed in supplying lubricant as considerably more than the usual amount is needed until the bearings are run in by several hundred miles of road work. Before the scraping process is started it is well to chisel an oil groove in the bearing as these grooves are very helpful in insuring uniform distribution of oil over the entire width of bearing and at the same time act as reservoirs to retain a supply of oil. The tool used is a round nosed chisel, the effort being made to cut the grooves of uniform depth and having smooth sides. Care should be taken not to cut the grooves too deeply as this will seriously reduce the strength of the bearing bushing.

Remetalling and Fitting the Connecting Rods

Fitting and adjusting the rod bearings, especially those at the crank pin end, is one of the operations that must be performed several times a season if a car is used to any extent. There are two forms of connecting rods in general use, known respectively as the marine type, shown at Fig. 16, *A*, and the hinged form depicted at Fig. 16, *B*. The hinge type is the simplest, but one clamp bolt being used to keep the parts together as the cap is hinged to the rod end on one side, this permitting the lower portion to swing down the crank pin to pass out from between the halves when the retaining bolt is removed. In the marine type, which is the most common, one or two bolts are employed at each side and the cap must be removed entirely before the bearing can be taken off of the crank pin. The tightness of the brasses around the crank pin can never be determined solely by the adjustment of the bolts, as while it is important that these should be drawn up as tightly as possible the bearing should fit the shaft without undue binding, even if the brasses must be scraped to insure a proper fit. As is true of the main bearings, the marine form of connecting rod has a number of liners or shims interposed between the top and lower portions of the rod end and these may be reduced in number when necessary to bring the brasses closer together.

In fitting new brasses there are two conditions to be avoided, these being outlined at Fig. 16, *C* and *D*. In the case shown at *C* the light edges of the brushings are in contact, but the connecting rod and its cap do not meet. When the retaining nuts are tightened the entire strain is taken on the comparatively small area of the edges of the bushings which are not strong enough to withstand the strains existing and which flatten out quickly, permitting the bearing to run loose. In the example outlined at *D* the edges of the brasses do not touch when the connecting rod cap is drawn in place. This is not good practice, because the brasses soon become loose in their retaining member. In the case outlined it is necessary to file off the faces of the rod and cap until these meet, and to insure contact of the edges of the brasses as well. In event of the brasses coming together before the cap and rod make contact, as shown at *C*, the bearing halves should be reduced at the edges until both the caps and brasses meet against the surfaces of the liners as shown at *A*.

Before assembling on the shaft, it is necessary to fit the bearings by scraping, the same instructions given for restoring the contour of the main bearings applying just as well in this case. It is apparent that if the crank pins are not round no amount of scraping will insure a true bearing. A point to observe is to make sure that the heads of the bolts are imbedded solidly in their proper position and that they are not raised by any burrs or particles of dirt under the head which will flatten out after the engine has been run for a time and allow the bolts to slack off. Similarly, care should be taken that there is no foreign matter under the brasses and the box in which they seat. To guard against this the bolts should be struck with a hammer several times after they are tightened up, and the connecting rod can be hit sharply several times under the cap with a wooden mallet or lead hammer. It is important to pin the brasses in place to prevent movement, as lubrication may be interfered with if the bushing turns round and breaks the correct register between the oil hole in the cap and brasses.

Care should be taken in screwing on the retaining nuts to insure that they will remain in place and not slack off. Spring washers should not be used on either connecting rod ends or main bearing bolts, because these sometimes snap in two pieces and leave the nut slack. The best method of locking is to use well-fitting split pins and castellated nuts. In a number of the cheaper cars, the bearing metal is cast in place in the connecting rod lower end and in main bearings, and is not in the form of removable die cast bushings.

Precautions in Reassembling Parts

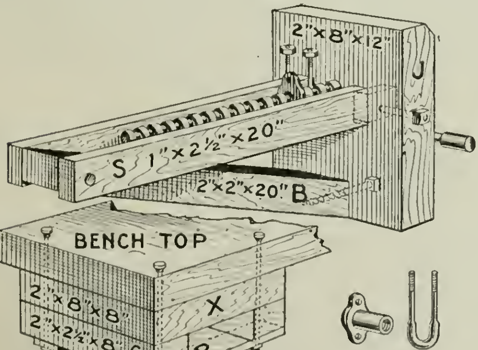
When all of the essential components of a power plant have been carefully looked over and cleaned and all defects eliminated, either by adjustment or replacement of worn portions, the motor should be reassembled, taking care to have the parts occupy just the same relative positions they did before the motor was dismantled.

Before the cylinders are replaced on the engine base, heavy brown paper gaskets should be made to place between the cylinder base flange and top portion of the engine crank case. Gaskets will hold better if coated with shellac, as it fills irregularities in the joint and assists materially in preventing leakage after the coating has a chance to set.

To Make a Work Bench and Vise

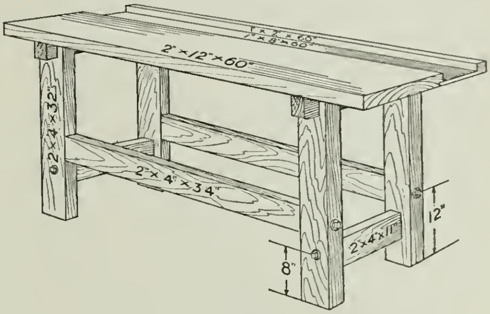
THERE is nothing more essential to good work than a good bench. When room was plentiful and lumber cheap it was the usual practice to construct large, heavy benches. With the spread of the manual training idea a rather new and different type of bench has been developed. They are smaller, and a type of construction is used which will require a minimum amount of lumber to give the required strength and rigidity. In the bench shown the two top rails are notched into the legs, while all of the lower rails are first cut square on each end and drawn and held in position against the legs by means of the bolts. To do this the holes are first located and bored in the legs the size of the bolts or 1/16″ larger. Next, the same sized hole is bored into the end of the rail to a depth of 4″. From the side a 1″ hole is bored in to meet the end of this one. The center of this hole should be located 3½″ from the end of the rails. In assembling, the nut is placed in the rail from the side and the bolt through the leg and into the end of the rail to meet it, when the bolt may be drawn tight by means of a wrench applied to the head. The bench may be kept rigid indefinitely by going over all of the bolts occasionally.

The top of the bench may be one or several pieces glued together. The latter method is the better as well as the most usual one, but is not essential to a good bench. The back pieces are easily worked out to the size suggested. Any good, sound lumber may be used for the bench, though hard lumber, such as oak or maple, is best. The last mentioned is most often used.



Details of the construction of the vise, showing dimensions

The bench described above may be fitted up with a machinist's, cabinet maker's, pattern maker's or any other type of vise the builder may desire. A very satisfactory form for general wood



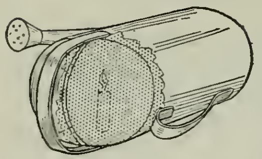
The completed work bench, without the vise, showing dimensions and general construction

work is shown here. The greatest advantage of the parallel jaw vise is the fact that at all times it will take firm hold on the work without injuring it or causing it to pop out as soon as work is begun.

The upper part of the vise, as shown in the sketch, or the front jaw, is first worked up, after which the guides shown under the bench top are worked out and assembled. Care should be used to secure a snug fit, but no binding should be allowed. The edge of the bench top, together with the piece marked X, forms the back jaw. Both back and front jaws should have wood faces supplied them to take the wear. These are easily replaced. They are not shown in the drawing. The part *P* is best an iron plate, although wood will serve; ¼″ x 1″ x 12″ is the size. The iron washer is cut from the same size stock. The ends support the back of the slide marked *S*. They should project ¾″ from *G*. Carriage bolts are used to bolt the guides together and to the bench top.

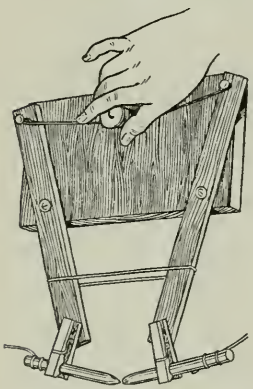
The screw is of the usual form and manner. The nut, however, is not fastened as usually, but instead is bolted to the underside of *X* by means of the clamp shown. The satisfaction this bench and vise will afford will quickly repay the builder for all time and expense required to make them.

A Sprinkling Can as a Dark Room Lamp



An example of how a common utensil can be converted to a purpose other than the one for which it was originally intended is shown in the illustration. A night light or a candle is placed inside a sprinkling can set on its side, and the semi-oval opening which receives the water is covered with a few folds of ruby tissue paper affixed with music tape or glued tags. In this simple way, a very serviceable dark room lamp is obtained. Ventilation is provided for through the nozzle; the bend prevents the escape of light.

An Adjustable Arc Lamp



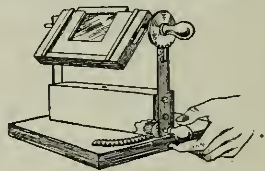
Wooden arms are pivoted to the wood support by a screw and washer. The upper ends of the arms are drawn together by a rubber band passed around them. The carbons are clamped in spring clothes pins, which, being fastened to the arms with one screw only, allows them to be swung up or down. By this means the carbons may be adjusted at any angle to each other.

A spool is fastened at the lower part of the wood support with a long screw and washer. Two pieces of string are tied to opposite ends of the spool, given a few turns around it in the same direction, and fastened to tacks at the ends of the arms. The spool is fastened with just enough tension so that it will stay in place no matter which way it may be turned in adjusting the distance between the carbons.

Two pieces of spring brass wire are made into coils somewhat smaller than the carbons. These are sprung on the ends of the carbons, making good contact with them. The wires carrying the current are connected directly with these brass wires. Pieces of sheet fiber fitted in the jaws of the clothes pin clamps afford additional insulation, although the wood parts, if dry, are quite sufficient insulation for low voltages.

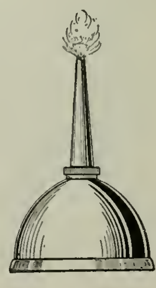
With an 110 volt house-lighting current, the lamp should be run in series with suitable lamp bank or other resistance. If the current is alternating, a choke coil may be used in series with it.

Adjustable Printing-Frame Holder



Photographers are often required to print a negative more deeply at one end than at another; but the ordinary method of holding the frame in the hand is unsteady and unreliable. An adjustable support for a printing-frame, enabling the operator to set one end further from the light than the other, is shown in the sketch. It consists of a wooden base upon which is supported and pivoted a block fitted with two uprights. With the aid of a ratchet and swivel indicated, the block may be moved to various positions. The two uprights are also furnished with a ratchet and screw, which grasp the printing-frame in the two trough-shaped groups provided in the latter. Various sized printing-frames may be inserted in this holder, and with the aid of the ratchets, the distances from the light to different portions of the negative may be easily adjusted.

Alcohol Burner



An excellent alcohol burner can be made from an oil can with the spout cut off about an inch above the body, and a wick inserted. The flame can be raised by picking with a pin or any other sharp pointed instrument.

How to Build an Ice-Boat

THE ice-boat described is fast for its size, and can be built at a small cost. It has a sail area of about 70 sq. ft.—enough to carry two people. Good lumber should be used, such as bass wood or white pine, and the weight should be kept as low as possible.

The sail is of the "balanced" type. The dimensions are: Boom, or bottom, 10′; gaff, or top, 6′; leach, or back, 12′; and luff, or front, 7′. This sail can be drawn tight by means of the rope and pulley on the boom as shown is Fig. 3. The flatter a sail hangs, the closer the boat will sail into the wind, for which reason two bamboo poles are put across the sail as shown in Fig. 1. A set of reef points should be fastened to the lower bamboo pole so the sail area can be decreased in case of a strong wind.

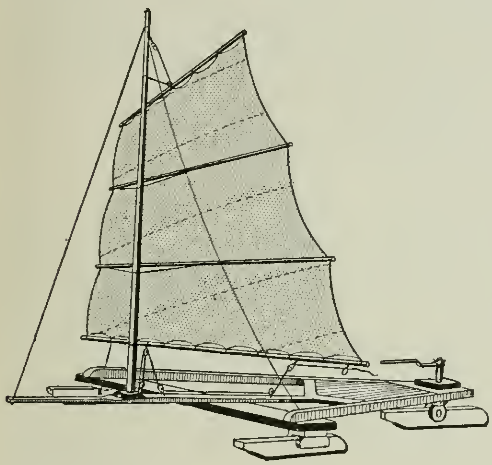


Fig. 1. The completed ice-boat, showing details of the sail

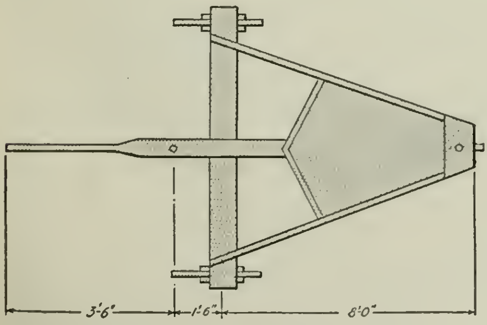


Fig. 2. Showing construction of the runner plank

In making the sail, first chalk its outline on the floor, cut and sew the strips as shown in Fig. 1. The outer edge should be turned over and a cord sewn in. The top of the sail is not straight but is cut with a slight curve. Lace the sail to the poles with a strong cord.

The mast is 14′ high. Care should be taken to select straight-grained wood for the mast. At one-fourth of the distance from the top, the mast should be 3″ in diameter and taper to 2½″ at top and bottom. The bottom should rest on a hardwood block with a 2½″ hole drilled into it. Drill this hole 1½″ deep and fasten the block securely to the bowsprit 1½′ in front of the center of the runner plank.

The mast is held in place by three wire stays. On the two side stays, turnbuckles should be used to tighten the wires. Fasten a 3½″ ring to the boom with rawhide to hold the boom in place on the mast.

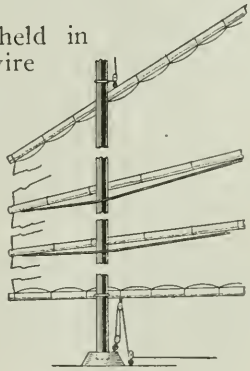


Fig. 3. Mast Rigging

Tie the top ring to the end of the rope, with which the sail is hoisted and thread the rope through the pulley on the center of the gaff, Fig. 3. A strong rope should be fastened as shown in Fig. 3. Do not make the sail poles until the sail is completed, and then make them 6″ or 8″ longer than the sail so stretching can be taken up. For drawing the sail in and out, fasten the rope and pulleys as shown in Fig. 1.

The runners and runner guides are made of oak. Cut runners as shown in Fig. 4, and fit iron shoes to them. For runner shoes use ¾″ square iron rod and flatten both ends so that holes can be drilled for bolts, to fasten to runners.

The runner irons are not perfectly flat on the bearing edge, but have about 1/8" rocker curve. Fig. 5 shows how the runners are pivoted on the riding bolt. The top of the rudder post is square. Drill a small hole at top of the rudder

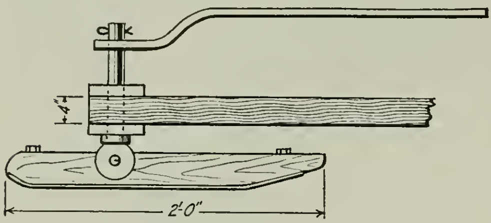


Fig. 4. Construction of the runners

post for a cotter pin so that the tiller will not slip off while sailing. A good rudder post can be made from an old bicycle fork. Put an iron plate and washers under the boat so the rudder will turn easily.

For the runner plank use a 2" x 8" plank 8' long. The side braces are 2" x 4" and the bowsprit is a 2" x 6" reenforced by a 1" board on each side, Fig. 2. The cockpit is 5' long and for the flooring use 1" matched boards. Give all woodwork a few coats of paint.

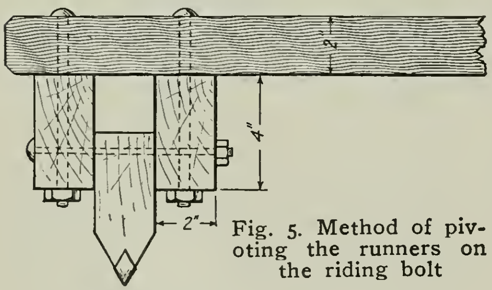


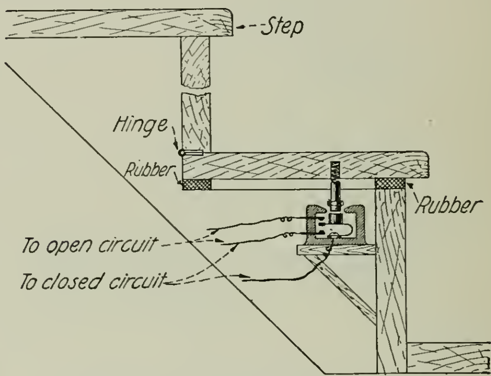
Fig. 5. Method of pivoting the runners on the riding bolt

How to Draw an Ellipse

DRAW the major and minor axes. With a radius equal to one-half of the major axis from the extremity the minor axis describe an arc cutting the major axis. At the two points where the major axis is cut, place tacks or pins. Then place the pencil on the end of either axis and pass a thread around the point of it and the two tacks. Draw the thread tight and tie it. Describe the eclipse. If it is desired to use ink a pen is substituted for the pencil.

A Doorstep Burglar Alarm

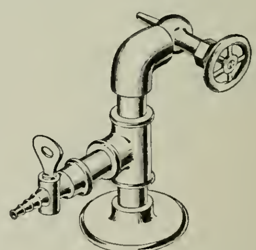
AN alarm ringing arrangement which will announce the intrusion of undesirable visitors can be installed on a door step, and be completely concealed. One of the steps is removed and replaced with a hinge at the back. Beneath the step a spring contact is placed and connected with batteries and a bell. A rubber cushion is tacked along the edge of the board upon which the step rests. The weight of the body on the step will press the contacts together, closing the circuit. The resiliency of the rubber cushion will press the step back in place when the weight is removed.



The contact is made and the alarm bell rung by the pressure of any weight, even that of a child

A Simple Laboratory Burner

A GOOD burner for the laboratory which can be easily constructed is shown in the sketch, which is self-explanatory. The standard was made from 3/8" pipe fittings,



and the valve was obtained from an old kitchen gas range.

Waterproofing Shoes

THE soles of shoes or boots may be made waterproof, and also made to wear much longer, by giving them three coats of varnish, allowing each coat to soak into the leather well before applying another.

RADIO SECTION

Devoted to the Encouragement of Amateurs and Experimenters in the Field of Radio Communication

Impedance of Oscillation Circuits in Wireless Telegraphy

By John Vincent

IN last month's article it was shown that every antenna had a particular natural wave-length, or fundamental wavelength, which it would radiate if it were excited electrically and then left to oscillate. It was pointed out that this natural wavelength depended upon the capacity and inductance of the aerial, and that these in turn depended upon the total length of the antenna-to-ground system. It was also shown that if inductance were added in series with the antenna, so as to "load" the system electically, the resonant wavelength would be increased. A simple rule for computing arithmetically the resonant radiant wavelength in meters, when the capacity in microfarads and the inductance in millihenrys is known, was stated.

It should be noted especially that the wavelength radiated depends upon the size of the capacity and inductance coils in the circuit. The reason for this is that the length of radiated wave depends upon its frequency, or the number of times in one second the electromagnetic field passes through a complete cycle of change in direction. This wave-frequency must be the same as the frequency of the oscillating current in the antenna system, which produces it, and the oscillation frequency is determined by the amount of capacity and inductance in the antenna circuit.

Considering ether-waves of the sort used in radio-telegraphy, which pass over the surface of the earth from the sender to receivers in any direction at a speed of 186,000 miles per second, the usual relation between velocity, wavelength and wave-frequency may be used. In these waves, as in any other traveling waves, the frequency is found by dividing the velocity by the wavelength.

A wavelength of 2,000 meters has, therefore, a wave-frequency of 150,000 per second, since the velocity in meters per second (300,000,000) divided by the length (2,000 meters) gives this figure. Thus, to find the frequency per second of any wavelength in radio, divide three hundred million by the wavelength in meters. Similarly, to find the wavelength in meters for any frequency, divide the frequency per second into 300,000,000, which goes:

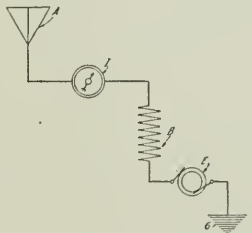


Fig. 1

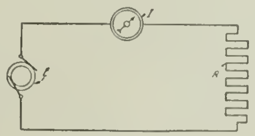


Fig. 2

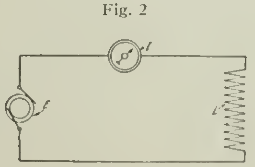


Fig. 3

Wavelength *Meters*	Frequency *Cycles per second*
300	1,000,000
600	500,000
1,000	300,000
2,000	150,000
3,000	100,000

These frequency values are not only the numbers of cycles per second in the radio waves, but also the frequencies of the oscillating currents which will set up such waves. Referring to Figure 1, if E represents a radio frequency alternator which generates current of 100,000 cycles per second in the antenna-to-ground circuit A, I, B, E, G, the system will radiate waves corresponding to that frequency, or 3,000 meters in length. The stronger the 100,000 cycle current in the antenna, the more powerful will be the radiated waves. It is therefore desirable to do anything possible to increase this antenna current. Also, the higher the antenna the more powerful will be the radiation of waves for a given current. It is for this reason that great heights are sought in erecting sending antennas.

When a battery or direct current generator applies a voltage or electrical pressure across the terminals of a circuit having resistance, an electric current flows through that circuit. The strength of the current is fixed by the amounts of voltage and resistance, and, measured in amperes, equals the number of volts pressure divided by the number of ohms resistance. This is simply Ohm's Law in its elementary form, and the fact is one of the first things learned in the study of electricity. But its extension to alternating current circuits is not so well understood, though it is very little more complicated. In fact, the same law in the same form applies to alternating currents, if one uses instead of the simple ohmic resistance its alternating current equivalent, or impedance.

Impedance, or effective alternating-current resistance, is the property of circuits which determines how much current will flow when a certain alternating voltage is applied. The current in amperes is always equal to the applied electro-motive force in volts divided by the *impedance* in ohms. If, in Figure 1, the alternator E generates 100,000 cycles and 100 volts, and if the total impedance of the antenna-to-ground circuit is 5 ohms for this frequency, a radio-frequency current of 20 amperes will flow through the ammeter I, and waves of corresponding intensity will be radiated. If the impedance were 10 ohms, only 10 amperes would flow and the waves would be very much weaker. Evidently for powerful sending the antenna circuit impedance must be kept as small as possible, since then the current is largest.

How can the impedance be made small? Before this question can be answered it is necessary to find out what impedance really is, and whether it is always the same for any particular circuit.

Four quantities enter into the makeup of impedance, and these are the resistance, capacity and inductance of the circuit, and the frequency of the current flowing in it. That portion which depends upon the capacity and inductance of the circuit is called the reactance, and changes as the frequency changes. This reactance is always added by a special rule to the simple resistance to make up the total impedance. The resistance itself remains practically constant for reasonably small changes of frequency, but the reactance may vary greatly if the frequency is changed even slightly. The effort to increase antenna current by making impedance as small as possible must therefore be confined almost entirely to reducing the *reactance* portion, since the simple resistance of coils, wires and earth connection is always reduced to the smallest feasible amount to begin with.

The computation of reactance in alternating current circuits is not complicated, and may be considered in two parts. Referring to Fig. 2, a resistance R is seen in series with an alternator E and ammeter I. Since reactance depends upon the presence of inductance or capacity, and since the circuit of Fig. 1 has no inductance or capacity, there is zero reactance. The impedance is therefore made up of the resistance R only, and the current I is found, in amperes, by dividing the resistance in ohms (which in this case equals the impedance in ohms) into the alternator electromotive force in volts. This is true for any frequency, except for comparatively small changes in the resistance.

If instead of the resistance there is connected a coil having inductance, L in Fig. 3, a very different condition holds. This circuit possesses inductive reactance of an amount in ohms equal to 6.28 times the frequency of the current times the inductance of the coil in henrys. If the alternator frequency is 100,000 per second and the coil has 5 millihenrys (or 5/1000 of a henry) inductance, the inductive reactance is 6.28 times 100,000 times 5/1000, or 3140 ohms. Assuming the resistance to be zero, if the alternator produces 100 volts, only 100/3140 or 0.0318 of an ampere will flow. Thus for this frequency the simple coil of wire presents more effective resistance than would a straight carbon rod of 3,000 ohms. It should be noted that the higher the frequency goes the greater becomes the reactance, and therefore the impedance, of a coil. At zero frequency, which is direct current, the reactance vanishes and the impedance of the coil is merely its resistance.

Still another condition holds if a condenser is connected in the circuit, as in Fig. 4. The circuit now has what is called capacity reactance, and this, in ohms, amounts to the reciprocal of 6.28 times the frequency times the capacity in farads. If the frequency is 100,000 per second and the capacity is 0.0005 microfarad (or 5/10,000,000,000 farad), the capacity reactance figures out 6.28 times 100,000 times 5/10,000,000,000 divided into 1, or 0.000314 divided into 1, or 3,180 ohms. This would permit about one-thirtieth of an ampere to flow if 100 volts at 100,000 cycles were applied. The most important thing to note as to capacity reactance is that it *decreases* as the size of the condenser increases, and as the applied frequency increases. It is in effect an exact opposite of inductive reactance, and each *may be used to neutralize the current limiting characteristic of the other.*

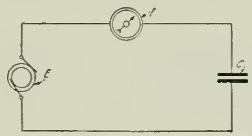


Fig. 4

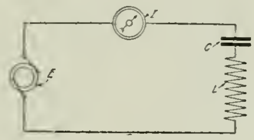


Fig. 5

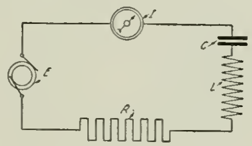


Fig. 6

This opposition of capacity and inductance reactances is one of the most important phenomena made use of in radio telegraphy, and is the basis of resonance. The action may be illustrated by studying Figure 5, where a condenser and an inductance are connected in series with the alternator and ammeter. Assuming resistance still to be zero and remembering that the effective reactance in ohms is equal to the inductive reactance minus the capacity reactance, or vice versa, the remainder taking the name of the larger component. This is found to be 3180 minus 3140 ohms, or only 40 ohms capacity reactance. In the circuit of Fig. 5, therefore, a voltage of 100 at 100,000 cycles would cause 2.5 amperes to flow through the condenser and inductance in series. This is over 750 times as much current as would flow through either the condenser or the coil alone, and is made possible by the neutralizing effect above stated. If the condenser were of slightly more than 0.0005 microfarad capacity, so as to make its capacity reactance exactly equal numerically to the inductive reactance, these two elements would neutralize completely, for the total reactance would be zero. If the resistance were also zero there would be no limit to the current in the circuit; in practice there is always some resistance in circuit, and this determines the number of amperes which will flow through the circuit for a given voltage, if the resonant condition exists.

Fig. 6 shows the practical closed circuit of capacity, inductance and resistance. The current in amperes equals the e. m. f. in volts divided by the impedance in ohms. The impedance equals the square root of the sum of the square of the resistance and the square of the total reactance. The total reactance is found by subtracting the capacity portion from the inductance portion, each computed as above. When the condenser and the inductance are chosen so that they neutralize each other for the operating frequency, the impedance reaches its lowest possible value and equals the simple resistance. This condition of balanced reactances, therefore, gives the largest possible current for any applied voltage of the given frequency. The circuit in this condition is in *resonance,* and the frequency for which the capacity and inductance neutralize is the *resonant frequency.*

The antenna circuit of Fig. 1 is in many ways equivalent to the closed circuit of Fig. 6. The aerial itself possesses capacity, inductance and resistance, and the coil B adds to the system inductance and resistance. If the total inductance of the circuit is adjusted by varying coil B so that it exactly neutralizes the capacity of the antenna for the frequency of the alternator E, the antenna will be *resonant* or *tuned* to this frequency and the greatest aerial current will flow. If the inductance is changed, or if the frequency of E is altered, the reactance will at once commence to grow large and by increasing the impedance will cut down the antenna current and the radiated waves.

In the next article further useful applications of resonance will be described, and additional simple computations explained.

Recent Radio Inventions

By A. F. Jackson

A patent issued during 1915 to C. D. Ainsworth and bearing number 1,145,735 shows an interesting arrangement of three-electrode vacuum-tube detector. Fig. 1 indicates the construction of the device and the circuit connections. Referring to this drawing, within an evacuated glass bulb *1* is sealed a support *8* which carries a tubular anode *2* and two electrodes *4* and *6*, also in the form of tubes and concentric with the central conductor. The two outer cylinders are made of woven wire, *4* (which may correspond to the grid of an audion) being of somewhat finer mesh than *6*. The tube is operated cold, i. e., without a filament heated by auxiliary current, and secures its conductivity through the radio-active material, such as uranium, which is placed near the electrodes at *9*. The usual circuits, combining antenna and ground with inductively coupled secondary coil *10* and tuning condenser *11*, are used. The central electrode, however, corresponds approximately to the plate in the usual audion arrangement, and is connected to the positive terminal of the battery *3* through the telephone *12*. No series condenser in the circuit of electrode *4* is shown.

The patentee explains the operation of the detector by saying that the rarefied gas within the tube is made conductive by the radiation from *9*, which may be a compound of uranium, thorium, radium or actinium, and that consequently a steady small current tends to pass from *2* to *6* and to *4*. The voltage of *13* is adjusted just below that which will "break down the electrical resistance of

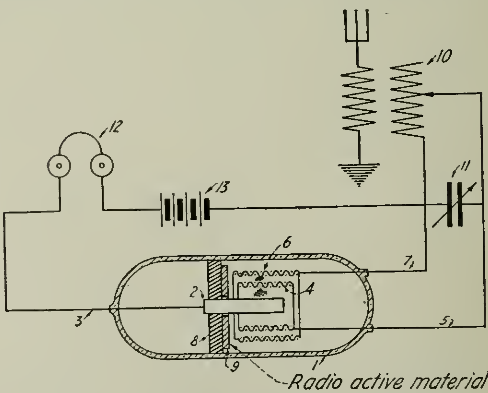


Fig. 1. An interesting arrangement of three-electrode vacuum-tube detector

the ionized gas" when no signals are being received; but when currents are induced in the secondary system from the antenna, a re-distribution of potential takes place and the battery flows, so producing a signal in the telephones. This described operation is therefore closely analogous to that of an autocoherer, in which incoming-wave energy changes the resistance of a conductor and thus alters the amount of current flowing through it from a local battery.

In his early experiments with the audion, Lee deForest is said to have used radio-active compounds in place of the heated filament, but without success be-

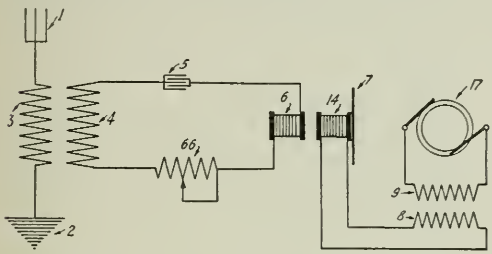


Fig. 2. A heterodyne receiver, operating on the electrical beats principle

cause of the difficulty in securing sufficient conductivity by ionazation. The detector of the Ainsworth patent should prove a useful instrument when developed to a practical operating point, since, as the patentee points out, constancy in operation may be expected and the nuisance and expense of filaments and heating batteries are done away with.

U. S. Patents 1,141,386 and 1,141,453, issued in 1915 to R. A. Fessenden, show not only a simple "heterodyne" receiver operating on the electrical-beats principle now so widely used, in Fig. 2, but also a method for simultaneously sending and receiving with continuous waves, as in Fig. 3. Taking up the first of these, it is seen that the antenna *1* is connected to ground *2* through the primary of the inductive coupler *3*. The secondary *4* has in series with it a variable tuning inductance *66*, a condenser *5* and one winding of an electro-dynamometer-telephone, *6*. The second telephone winding *14* is coupled to a small radio-frequency alternator *17* through a transformer *8*, *9*. The dynamometer *6*, *14*, consists of two coils placed end to end, one of which is stationary and may have a fine iron-wire core and the other of which is mounted upon a diaphragm *7*. In receiving radio signals the antenna and secondary systems are tuned exactly or approximately to the frequency of the incoming waves, so that currents of this frequency will be induced in coil *6*. The alternator, *17*, is then run at a radio frequency slightly different from that being received, and its current output led to coil *17*. The magnetic fields of these two coils interact one upon the other; when the currents are relatively in one direction, the fields add and the diaphragm, *7*, is attracted, and when the currents are relatively reversed, the fields oppose each other and the diaphragm is repelled. This alternate adding and opposing of fields goes on constantly because of the slight difference in frequency of the two currents, and the diaphragm is moved back and forth at a rate determined by the difference in the frequencies. If the incoming wave is of 6,000 meters length, which corresponds to 50,000 cycles per second frequency, and the local generator produces currents of 50,500 cycles frequency, the number of impulses impressed upon the diaphragm will be 500 per second. This last is called the "beat frequency" of the heterodyne receiver, and is the frequency of the signal tone heard by listening to the telephone diaphragm, *7*. No beats or impulses on the diaphragm are produced unless *both* currents are flowing; there-

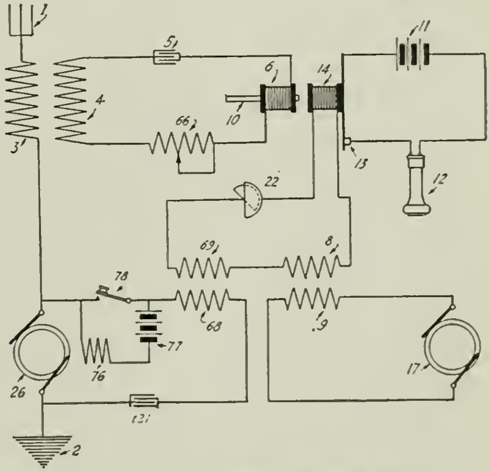


Fig. 3. Sending and receiving simultaneously with continuous waves

fore, although power from alternator *17* is constantly flowing, signals are heard only when waves are received on the antenna from the distant sending station. This dynamometer heterodyne gives a much louder signal than could be obtained from the magnetic effect of the incoming waves applied directly to a suitable air-core or self-excited telephone, since the magnetic force acting on the diaphragm depends upon the product of the two currents in the coils *6* and *14*, and that in *14* from the local generator may be made quite large.

Figure 3 shows the duplex heterodyne system. Here the receiver just described has added to it, in series with the antenna, a radio-frequency alternator powerful enough to generate the strong waves used in sending. This transmitting alternator has its field coils, *76*, supplied with power through the sending key, *78*, and also has connected across its armature terminals a circuit which is

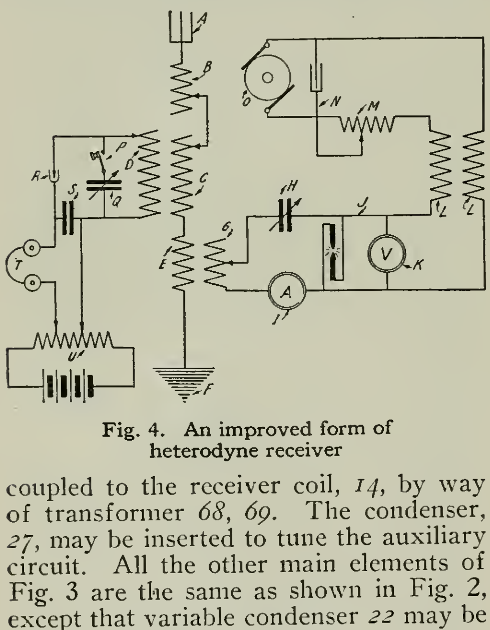


Fig. 4. An improved form of heterodyne receiver

coupled to the receiver coil, *14*, by way of transformer *68*, *69*. The condenser, *27*, may be inserted to tune the auxiliary circuit. All the other main elements of Fig. 3 are the same as shown in Fig. 2, except that variable condenser *22* may be added to make the diaphragm-coil circuit resonant.

When the sending key, *78*, is open the sending generator, *26*, does not generate and the system is entirely equivalent to that shown in Fig. 2, since all the receiving portions are operative. When the key is depressed to make a Morse dot or dash, however, the generator field circuit is closed and intense radio-frequency currents are set up in the aerial system. These induce strong currents in the receiver coil, *6*, which might have so great an effect on the diaphragm as to make receiving from the distant station impossible. Closing the key, however, connects in the circuit *27*, *68*, and through the coupling transformer similar, but opposed strong currents are set up in the receiver coil *14*. The intensity and phase of these is adjusted so that their magnetic field exactly neutralizes that of the transmitter currents in coil *6*, and the diaphragm is therefore left undisturbed and in receiving condition even though the key is pressed down. Thus the aerial is used for sending at the same time it receives.

This duplex system makes possible the transmission of twice the normal amount of traffic between two radio stations, for messages can pass both ways simultaneously. Since the same aerial is used both for sending and receiving, there is no need for erection of separate sending and receiving stations located some distance apart and connected by wire lines, as is done at the Marconi trans-oceanic plants.

The patent specification points out a number of variations of both simple and duplex heterodyne operation; for instance, the telephone receiver may be mechanically tuned to the beat-note frequency, or the action of the dynamometer may control a microphonic-contact relay (*13*, Fig. 3) operating an ordinary telephone *12* by varying the current from a local battery *11*. It is also suggested that, instead of currents, the voltages set up by the received waves may be used to interact with locally generated radio-frequency voltages, upon an electro-static telephone, to produce heterodyne beats and a musical signal.

An improvement upon the dynamometer heterodyne just described is the subject of 1915 U. S. Patent number 1,141,717, issued to J. W. Lee and J. L. Hogan, Jr. In principle this receiver is identical with the older forms of heterodyne, but instead of adding the effects of the incoming and locally generated currents mechanically upon a dynamometer device, the two are combined electrically. As shown in Fig. 4, a normal receiving outfit is first set up. This may consist of the antenna *A*, having in series with it to ground *F* a loading coil *B*, the primary of the receiving coupling *C* and the secondary of another oscillation transformer *E*. The secondary *D* may have the tuning condenser *Q* connected across its terminals leading to the detector *R* and stopping condenser *S*. Across this last named are connected the ordinary telephones *T* and potentiometer with battery, *U*. In addition to these usual receiving instruments, a generator of radio frequency current is coupled to the oscillation circuits. This may be, as shown in Fig. 4, an oscillating arc *J* having the resonant condenser *H* and inductance *G* connected serially across it and fed with direct current from *O* through resistance *M* and choke coils *L, L*.

The heterodyne operation of this receiver may be explained with reference to Fig. 5, which is a series of curves roughly representing the currents in the several circuits. The upper line, *N1*, indicates the incoming-wave currents as they would be set up in the antenna and secondary circuits if signals were arriving but the local oscillator were not in operation. The second curve *N2* shows the current of slightly different frequency which is generated by the local oscillator itself, as it would be induced in the receiving circuits if no signals were being received. The third curve, *N3*, represents the beat-current which is produced in the circuits when signals are being received and the local generator is running; this current is seen to change from zero to maximum strength regularly, according to whether the two interacting currents aid or oppose each other. This varying radio-frequency current has a beat frequency equal to the difference of the two radio frequencies, just as in the simple magnetic heterodyne, and, when rectified by the detector *R*, produces in the telephone circuit a pulsating direct current corresponding to the heavy curve on axis *N4*. These pulses of course act on the telephone diaphragm in the well known manner and produce a musical signal tone of the beat-frequency.

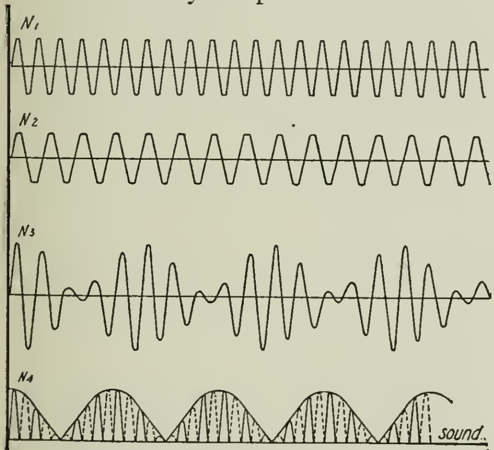


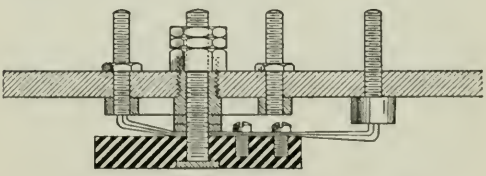
Fig. 5. Curve indicating operation of new rectifier heterodyne

This recent type of heterodyne is the forerunner of many receivers used today for continuous wave signals. In some of these the local oscillator is a suitably arranged audion bulb and the detector a second audion. Occasionally amplifiers are added, and a very sensitive receiving system thereby obtained. In some instances the same audion bulb is used as a local generator, and, simultaneously, as the detector and amplifier. The basic method of operation can be traced back, however, to the heterodyne principles explained in the above three patents and outlined herein.

A Multiple Point Switch

THE drawing shows a positive contact, smooth running multi-point switch, having ½-inch diameter switch points on ¾-inch centers, with the width of contact arm ⅞-inch. It may be seen from the drawing that all movable contacts are of the self-cleaning knife edge type. An attractive and substantial instrument is the result.

This switch may be used on the high voltage audion battery circuit by leaving each alternate contact point dead, and making connection through the central contact ring. This protects the battery against short circuits.


This switch may be used on a high voltage audion battery circuit

Radio Stations in Alaska

By Vincent I. Kraft

RADIO communication plays an important role in Alaska. Many cities and towns which would otherwise be isolated are kept in touch with the rest of the civilized world by this agency alone, and the United States Government employs it to communicate with government vessels in North Pacific waters, and to receive the weather reports from all parts of the northland. Remote as Alaska is from the source of radio inventions and improvements, the Alaskan stations represent strictly up-to-date methods of radio communication.

During the past few months a great deal of construction work has been done in Alaska, both in improving the existing stations, and in the erection of new ones. The past year has witnessed the completion of the Ketchikan unit of the new chain of semi-high-powered stations. Here the Marconi Company has built a 25 kw. plant, which is at present in daylight communication with a similar outfit located at Astoria, Oregon. This first span of the new chain is over a distance of 640 nautical miles, and connects Ketchikan, the southernmost city of importance in Alaska, with the United States. Astoria was chosen as the United States terminus of the chain, after a series of tests in many parts of Washington and Oregon, on account of its natural adaptability to Alaska work.

Another station, of ten kilowatts capacity, will soon be erected at Juneau, the capital of Alaska, and will be within daylight range of the Ketchikan station. The erection of a fourth station, in the vicinity of Seward, the terminus of the new Government railroad, is contemplated. Other stations will probably be erected later.

This chain of stations will be capable of rendering service that the United States Army cable does at present, between the United States and the above-mentioned points. Experiments are still being conducted between Ketchikan and Astoria, the longest of the spans, and although the wave lengths that will be employed in actual commercial communication had not been definitely determined upon up to last August, it had been found comparatively easy to cover the distance satisfactorily, using waves between 3,000 and 5,000 meters in length. Signals ranging in strength from 1,000 to 1,500 times audibility are received at Ketchikan from Astoria in daylight, and this intensity is considerably more than necessary for good commercial operation, employing a typewriter at the receiving station.

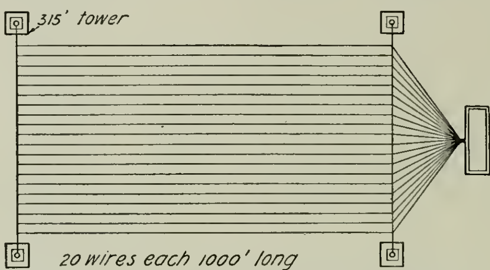


Diagram of the antenna system at Ketchikan, Alaska

The installation at Ketchikan, the largest of the stations of the new chain, includes four steel towers of the self-supporting type, 315 feet in height, between which is supported an antenna of 20 wires 1,000 feet in length. The station is equipped with a 60-cycle transmitter of 25 kw. rated capacity, provided with a synchronous disc discharger. The transmitter is able to operate at 100 per cent. overload. The receiver is of the standard Marconi panel type, adapted to the reception of waves up to ten thousand meters in length. The station at Astoria, Oregon, is a duplicate of the Ketchikan installation.

The United States Navy, which has maintained stations for many years in Alaska, is improving its present installations and building new ones. The station at St. Paul (Pribilof Islands), since its erection some four years ago, has been equipped with a set of five kw. capacity Telefunken apparatus. The

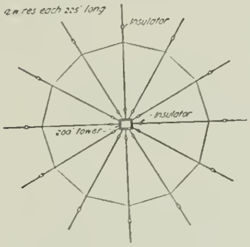
Navy is planning to increase the height of the masts to 500 feet and install a 25 kw. set in addition to the present 5 kw. one. The new set will be of the Poulsen arc type, for the generation of continuous waves. The station at Unalga Island has been dismantled, and that at Dutch Harbor (Unalaska) will be increased in size, to make it capable of handling the traffic heretofor handled by the Unalga station. Unalga and Dutch Harbor are only eighteen miles apart, and it was not deemed necessary to maintain both stations.

These two stations are peculiarly well located for long distance radio work. The station at Unalga Island has several times been in direct communication with the United States Navy station at Key West, Florida, nearly six thousand miles distant, although the power employed at Unalga Island was only ten kw. The operators at Unalga claim to have copied quite regularly, during the winter months, many stations on the Atlantic coast, in spite of the fact that Unalga Island is located more than fifteen hundred miles west of the Pacific coastline of the United States. Stations in Japan, Russia, China and the Philippine Islands are heard regularly and were it not for the fact that the Asiatic stations use languages other than English in their regular work, the operators at Dutch Harbor or Unalga Island could easily communicate with them.

The station at Wood Island (Kodiak) is one of the most efficient the Navy has in Alaska. This is undoubtedly due largely to its favorable geographical location. Kodiak is within daylight range of St. Paul (575 nautical miles distant), Cordova (260 miles), and Sitka (530 miles). Occasionally Kodiak has been in daylight communication with Unalga Island, and it is very probable that, when the improvements at the Dutch Harbor station are affected, that station will be in daylight range of Kodiak. The station at Cape Whiteshed (Cordova) has been rather unsatisfactory for long distance work, although this station is equipped in an up-to-date manner with a ten kw. Telefunken set. This may be due to a poor location.

The station at Sitka is one of the first put up by the Navy in Alaska, and has done very efficient work, although not until recently has it been equipped with the latest type apparatus. At present two sets are installed, one being a five kw. Telefunken set, and the other a 20 kw. 240 cycle synchronous rotary discharger set.

The installation of vacuum tube amplifiers in all the Navy stations of Alaska, recently, has made a marked improvement in the service rendered. Stations that have previously had difficulty in maintaining communication are now working without trouble. The working range with vessels is also materially increased thereby, as the amplifiers enable the Navy stations to receive signals from the 1 and 2 kw. sets on board ships, as far as the ships are able to receive signals from the five and ten kw. equipments of the Navy stations, and oftentimes farther. The Navy has but recently inaugurated a new service, whereby vessels in communication with its Alaska stations may send in reports of their positions daily, which are to be relayed without charge to the Navy station at North Head, Wash., where the position reports are turned over to the telegraph lines for transmission to the daily papers of the Pacific Coast. By this service, the reports of positions of vessels in Alaskan waters each night, are published in the following morning's papers in all the principal cities of the coast.



Umbrella antenna used on Alaska stations

Heretofor the Alaskan station have been able to communicate with North Head at night only, but since the installation of the audion amplifiers, daylight service has been possible to a limited extent between North Head and Sitka, using waves under 2,000 meters in length. This is over a distance of 780 nautical miles. During the summer months there is but an hour or two of darkness each night, and during the latter part of June and the early part of July, it does not get even completely dark. This has made it very difficult to handle traffic during the summer months and as the communication is limited to the period of darkness, it has frequently happened that more business has been offered than could be despatched during one night. For this reason, the Government has been desirous of installing equipment, capable of handling traffic between North Head and Alaska, during all seasons, day and night. With this object in view, the Navy has ordered a thirty kw. arc set to be installed in the present Cordova (Cape Whiteshed) station, to test with North Head. By employing continuous waves of great length, generated by this set, it is very probable that the desired daylight communication will be established. A much larger station will also be erected near Cordova, at Mile 13 on the Copper River and Northwestern Railroad. Here will be installed a one hundred kw. arc set, which will insure continuous communication between Alaska and the United States, and may make direct communication with Arlington (Va.) possible.

The adoption of the arc type transmitter, by the Navy, marks a long-foreseen step in advance, and the results of the tests to be conducted by the Navy will be watched with interest by the engineering profession. If the operation of the continuous wave transmitters proves satisfactory between the United States and Alaska, where the conditions are unusually trying, it is not improbable that they will be installed throughout the Navy service.

The Signal Corps, of the United States Army, operates a chain of stations throughout the interior of Alaska, with stations on the coast at Nome, St. Michael, Kotlik, Petersburg and Wrangell. These stations serve districts where the maintenance if not the construction of a landline would be a very difficult matter. The Signal Corps stations work in conjunction with the United States-Alaska cable system, and the interior land telegraph system, both of which are owned by the Signal Corps. In the interior many points have radio stations as the only means of communication, because the extremely heavy snow fall prohibits the use of telegraph lines. Between Nome and St. Michael, a distance of about 120 miles, it was found, after many futile attempts, impossible to keep a cable intact, during the winter months, on account of the heavy ice floes, which carried the cable away. Accordingly radio stations were erected at these points, and all cable or telegraph traffic for Nome is now sent by radio from St. Michael. A somewhat similar condition exists between Wrangell and Petersburg, in Southeastern Alaska, but in this case it is the tides in Wrangell Narrows, rather than ice floes, which make the maintaining of a cable difficult.

With few exceptions, the Signal Corps stations in Alaska are of one uniform type. The regulation equipment consists of a single 200-foot steel tower, from which is supported a 12-wire umbrella antenna, and a ten kw. Telefunken set. Receiving equipments include both Telefunken and I-P-76 Tuners. Most of the stations have counterpoises.

Another group of radio stations in Alaska, is the group of salmon cannery stations. The majority of salmon canneries are located at points distant from the cable or telegraph lines, and for their own convenience, the owners have installed, or leased, small sets. These stations work with Government or Commercial stations, and afford a means of communication with the outside world. These sets, at small expense, handle business between the canneries and the home offices of the packing companies, in the United States, that would otherwise have to go by the slower mail. These stations are in operation during the canning season only, which lasts from about May to September, and are some ten or fifteen in number.

In times past, when the Seattle-Alaska cable has broken, the radio stations of the Government, in conjunction with the commercial stations of Alaska have satisfactorily handled the heavy traffic although these station then had low-powered sets, and were able to hold communication at night only. With the completion of the improvements and new installations now planned for, however, the radio system of Alaska will be capable of giving uninterrupted service between the United States and most of the important points of Alaska.

New Books on Radio Subjects

TEXT BOOK ON WIRELESS TELEGRAPHY. By Rupert Stanley. Published by Longmans, Green & Co., New York, 1914. 344+XII pp., 200 illus. Price, $2.25.

THIS book, by the professor of physics and electrical engineering at the Municipal Technical Institute, Belfast, Ireland, is intended to furnish a proper introduction to the technical problems of radio signaling. The common fault of assuming on the part of the student either on extended knowledge of electrical theory or an interest in long mathematical discussions has been avoided. The author omits consideration of items which do not lead directly to a clear understanding of radio transmission, but gives full treatment to the physical phenomena which are especially concerned.

Of the twenty chapters the first four may be said to discuss the abstract topics of electrical radiation and energy transfer. The next two take up electrical units as measured and calculated, and the particular effects of capacity and self-induction. After descriptions of induction coil, transformer and alternator operation, and of oscillatory discharges of condensers, a brief history of radio is given in Chapter IX. Later chapters describe the operation of spark and sustained wave transmitters and receivers, the phenomena appearing in coupled circuits, the use and adjustment of telephone amplifiers, etc. A final chapter on radio telegraph measurements leads to appendices of codes and regulations, which, with a short index, complete the book.

In taking up the elements of electricity, the electron theory is used as a basis of explanation. The descriptive portions of the book are excellent, and the discussions of theory seem clear. The Goldschmidt, Poulsen, Marconi and Lepel arrangements for continuous wave operation are shown, and the plate quenched gap and older spark apparatus are described in detail. More attention is given to British Marconi apparatus than that of any other firm; many constructional and wiring diagrams of various Marconi, Telefunken and other instruments are shown.

The book can be recommended for careful study by anyone who desires not only a good technical acquaintance with radio but also a fair degree of familiarity with recent wireless telegraph practice.

WIRELESS TELEGRAPHY. By J. Zenneck. Transl. by A. E. Seelig. Published by McGraw-Hill Book Co., New York, 1915. 443+XX pp., 469 illus. Price, $4.00.

This translation into English of Professor Zenneck's "Lehrbuch," the classic of radio telegraphic technical literature, is sure to be welcomed. Although many of the interrelations of electrical quantities are stated mathematically and in such form as to make a knowledge of the calculus desirable, nearly all these statements are explained so clearly that even the student who possesses only slight acquaintance with electrical matters can find much information in useful form. The book is thorough, and the radio reader will find as he advances in his work he will get out more and more as he rereads it.

Chapter I is on condenser circuits and their oscillations, Chapter II on "open" or radiative circuits. Measurement, calculation and effects of frequency, damping, energy losses, and electromagnetic fields are described. Chapter III discusses the relations of resistance, inductance and capacity, current and voltage in the high frequency alternating current circuit, and explains current measurements. Coupled circuits, with magnetic, conductive and static linking, are taken up in Chapter IV, and the distinctions are brought out contrasting quenching against non-quenching operation, as well as damped oscillations against sustained currents. The next chapter is on resonance and its measurements, while Chapter VI treats grounded antennas. Chapter VII, on transmitters of damped oscillations, describes first the plain antenna sender, second, the coupled tuned-circuit transmitter and, third, the quenching apparatus. This classification as well as the application of the names Marconi, Braun and Wien successively to the three types, is perhaps open to criticism. Radio frequency alternators of Fessenden and Goldschmidt, and the arc senders of Poulsen and Lorenz, form the subjects of the next two chapters. The tenth chapter, on the propagation of waves over the earth's surface, contains much interesting material as to the effects of earth resistance and capacity and of atmospheric changes. Chapters XI and XII describe the operation of detectors and receiving arrangements for both damped and sustained waves. The last two chapters are on directive transmission and radiotelephony, respectively. Some notes on progress up to 1912, a series of useful tables, a bibliography and set of notes on theory and a very full index complete the book.

This American edition is especially well printed and sets a high mark to be reached by other technical publications. As a reference work alone, recording and describing accomplishments in the radio arts, the book should be extremely useful to radio-engineers. As a text for a thorough course in both theory and operation of radio instruments its value can scarcely be overrated. Since the treatment is almost entirely a matter of facts undisputed by real authorities, the tendency to favor German workers on historical points may easily be overlooked in view of the importance of their technical work.

Radio Club News

Schenectady Radio Association

THE Schenectady Radio Association, which was formerly known as the Amateur Wireless Association, held its annual election of officers in September, with results as follows: R. Denham, president; H. Vogel, vice-president; L. Pohlman, secretary; S. Dodd, assistant secretary; E. Kurth, treasurer, and A. LeTarte, librarian.

The association meets every Thursday night in the High School building, where it has a 1 K.W. outfit. The unofficial call letters are S. R. A. The Association welcomes any visitors who wish to attend its meetings, and would like to correspond with other similar clubs and persons interested in the radio field.

The association is also planning to send representatives to New York city, to meet members of other organizations and would like to hear from them.

Cincinnati School Radio Society

The East Night High School Radio Society was organized with a membership of 52 amateurs and students of the school, in October, 1915. Officers elected at the first meeting were Wm. G. Finch, President; C. H. Fender, Secretary; Professor Frantz, Treasurer. It is proposed to install a modern 5 kw. radio set, and thus to train the membership into a thorough knowledge of radio operating conditions. The secretary, who may be addressed in care of the school, Cincinnati, Ohio, will be glad to hear from the members of other nearby organizations.

Bronx Radio Club

At the last meeting of the Bronx Radio Club of New York, election of new officers was held. The results were as follows:

M. Haber, President; H. Berlin, Secretary; J. Smith, Vice-president; A. Richter, Treasurer; A. Schoy, Business Manager.

A lecture was delivered by one of the members on "The Theory of Wireless Transmission." Lectures are given at every meeting, by the more advanced members of the club, dealing with timely topics of wireless or electrical interest. The club will be glad to communicate with other clubs and individuals, desirous of having information or particulars of the proceedings of the club. All communications should be addressed to the Secretary, 705 Home St., Bronx, N. Y.

What Radio Readers Want to Know

Increasing an Umbrella Aerial.

C. A. P., Fresno, Cal., asks:

Q. 1. Would it be advisable to add 2,000′ of wire to my umbrella aerial?

A. 1. If you add the wire so as to make the length of the antenna greater it will be advisable to add the amount of wire you mention. It would be better if you could arrange so as to have this wire extend 300 or 400 feet out from the pole. This would give you a longer fundamental wavelength, which is necessary when receiving from stations using very long wavelights for transmission.

Q. 2. Can I hear Arlington with a silicon detector?

A. 2. It is possible that you could hear NAA. Stations along the Atlantic coast with aerials no larger than yours have heard the high power stations of the Pacific coast. Very recently we had occasion to note the reception of Berlin by an amateur station in Massachusetts. The operator used an oscillating audion in connection with a home-made receiving set. His aerial was about 150 feet long and 50 feet high, although 300 feet above sea level and in sight of the ocean. Very excellent work is being done by well informed amateurs who are using oscillating audions.

Q. 3. What is the best receiver for long distances?

A. 3. We would advise you to equip your station with an oscillating audion. For information regarding audions, oscillating audions, radio telegraphic transmitting and receiving apparatus write to the DeForest Radio Telegraph & Telephone Co., 101 Park Avenue, New York City. Be sure to mention the fact that you desire the instruments for amateur experimental work, as the price is very much lower for this kind of work than when sold for commercial operation. They will supply you with bulletins covering the subject on request.

Q. 4. What station uses call 2GN?

A. 4. We have no record of these letters being assigned as yet.

Radio Receiver Information.

M. H., Wilmette, Ill., asks:

Q. 1. What is the natural wavelength of an inverted L aerial of total length 85 ft., 5 wires on 9 ft. spreader, and 55 feet high?

A. 1. About 200 meters.

Q. 2. What size wire is most efficient for a loose coupler to receive 600 meter wavelengths?

A. 2. It makes very little difference what size wire is used. In general the useful sizes run from about No. 22 to No. 28 B. & S. gauge.

Q. 3. What would be the dimension and size of wire necessary to make a loading coil from 10,000 meter wavelengths?

A. 3. Wind No. 28 S. C. C. magnet wire on a cylinder 5″ in diameter and about 30″ long.

Q. 4. Does the secondary circuit also need loading?

A. 4. Yes, or the two circuits would not be tuned to the same wavelength. The secondary circuit is usually increased in period by shunting the secondary of the tuner with a variable condenser of large capacity. Loading inductance is also used the same as for the primary.

Receiving Set For Amateurs.

J. A. Strossman, Mt. Sterling, asks:

Q. 1. I have a four-wire aerial 90 feet long, 50 feet high at one end and 30 feet high at the other. Is this a fairly good aerial for amateur use?

A. 1. We should consider it quite satisfactory.

Q. 2. What is the natural wavelength of this aerial?

A. 2. About 225 meters.

Q. 3. How many miles should I receive with this aerial, using a double slide tuner, galena detector, and 1,000 ohm receivers?

A. 3. Local conditions so affect the receiving range that it is even worse than guessing to try to give any distance. For this reason we do not publish receiving distances in this column.

Q. 4. What is the best all around detector for amateur use?

A. 4. Galena is usually considered the most sensitive of the single minerals. Silicon will keep its adjustment better but is not as sensitive as galena.

Radio Abbreviations.

A. R. L., Pittsburgh, Pa., asks:

Q. 1. Will you please give me the meaning of the following abbreviations used in sending radio messages? CK, HR, SRNS.

A. 1. CK is the abbreviation for *check* used to state the number of words in the message. HR stands for *here* and is used to indicate that a station has a message there for transmission. It is sometimes used to acknowledge the reception of a message. We can find no reference to your third abbreviation, although the first two letters SR are often used for *senior,* especially in combination with some other abbreviation indicating the title of the person addressed. The abbreviation you mention may be of this type.

Loose Couplers and Stranded Copper.

R. M. L., Indianapolis, Ind., asks:

Q. 1. Will you please inform me as to the sizes of the primary and secondary cylinders, also the sizes of the wire primary, and secondary needed to make a loose coupler with which I can receive signals of a 4,000-meter wavelength?

A. 1. Make the primary 5¼ inches in diameter and 16 inches long; the secondary 4¾ inches in diameter and 16 inches long also. Wind both coils with No. 28 wire. Use bare wire if possible, if not use single cotton covered magnet wire.

Q. 2. Will you please inform me whether it is necessary to use a tikker to receive Arlington, NAA, when using its new continuous wave set?

A. 2. Yes, unless you use some other method such as the oscillating audion, which is capable of receiving undamped waves.

Q. 3. Will you please advise me what kind of wire should be used in the aerial for long distance receiving?

A. 3. Stranded copper is quite satisfactory. There is made a special seven-strand tinned copper wire for antenna purposes which will work very well. This wire costs about a cent per foot and can be obtained from nearly any wireless supply house. Phosphor bronze is also used and has the advantage of being stronger than copper, and it is also more expensive.

Trouble With a Half Kilo-Watt Transformer.

K. T., Scranton, Pa., asks:

Q. 1. I have built a one-half kilo-watt transformer of the Type E design for radio work and find that instead of taking five amperes it takes but two or three. I used stove pipe iron instead of silicon steel called for by the designers. Would it be all right to reduce the number of turns on the primary to cause the transformer to take a larger load?

A. 1. Yes, on the transformer you mention this would be satisfactory. Care should be taken that the safety gap on the secondary is not opened too far, as a higher voltage will be induced in the secondary if the primary winding is shortened. Are you sure that you are using the same size condenser on the secondary that is called for by the designers? Many transformers for radio work were designed before the Federal radio law was passed and were intended to be used with a larger condenser than is now permissible. Accordingly instead of drawing 5 amperes these transformers are only taking 2 or 3 with the lighter load. These transformers are having their primary winding reduced, causing an increase in secondary voltage, and accordingly a larger load on the transformer. We are rather surprised to find that your transformer is taking less current than expected, unless it is the condenser question, for in general transformers constructed by amateurs are noted for their high current consumption.

Some Miscellaneous Information.

H. S., Chicago, Ill., asks:

Q. 1. Would there be any change in the connections of an ordinary receiving set if the set was to be used on wavelength of 10,000 meters?

A. 1. No, the usual connections with loading coils would be used.

Q. 2. In receiving long wavelengths is it necessary to load both the primary and secondary circuits?

A. 2. Yes. The primary is usually loaded by putting a loading coil in series with the primary of the receiving transformer. The secondary is usually brought up to the long wavelength by shunting the secondary of the tuner by a condenser of large capacity.

Q. 3. What would be required to load a 2,200 meter set up to 10,000 meters?

A. 3. For the primary wind about No. 26 wire on a cylinder 5 inches in diameter and 3 feet long. The secondary would be best loaded by adding a small loading coil in series with the secondary of the receiving transformer and shunting the coils with a variable condenser of about 0.008 m. f. capacity.

Q. 4. In the primary circuit is it considered best to put a variable condenser in shunt with only the tuner rather than around both the loading coil and tuner?

A. 4. Yes.

Q. 5. How many condenser plates 12x14 inches do I need for a 1 KW. transformer with secondary voltage of 20,000, using a rotary gap? By 12x14 inch plates I mean the size of the glass, the actual surface of metal being only 9x11 inches. The glass is ⅛ inch thick. Wavelength 200 meters.

A. 5. Your set will probably require about six plates.

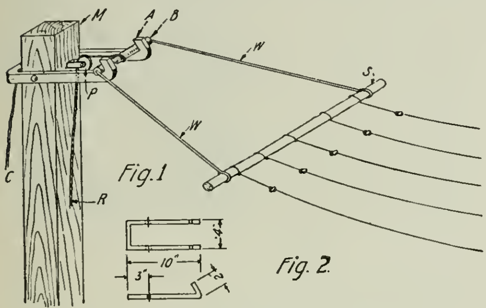
Q. 6. What is the best material to use for connecting up the transmitting instruments?

A. 6. Copper ribbon is about the best thing for general use.

Radio Construction Notes

A New Aerial Supporter

AMATEURS having high masts are often troubled by having their hoisting ropes shrink in wet weather. A remedy which also prevents the spreader from tilting is shown herewith. Re-



Sketch and construction of a steady aerial supporter

ferring to the sketch, piece A is of ⅛-inch strap iron, ½-inch wide and 2 feet 4 inches long. Have a blacksmith bend it as shown and drill two ¼-inch holes, one on either side, 3 inches from the bent end.

In mounting it on the mast it should be on the same level as the pulley. The closed end must clear the mast by about an inch when it is in the horizontal position. Long screws should be used to fasten it to the mast and it should be so loose that the ends with the hooks on will drop down when the light cord C is released. About ⅛-inch diameter is a good size for this cord.

Piece B may be either an iron or wooden rod 6 inches long. It is fastened to the spreader with two No. 14 galvanized wires. The rope R passes through pulley F and is fastened to the middle of piece B.

The aerial is raised by means of hoisting rope R until piece B is against the pulley D, and then the hooks on A are raised by pulling on cord C. Rope R is then slackened until piece A alone supports the aerial. To lower the aerial simply pull on rope R until the hooks disarrange themselves and then lower away.

A Simple Change-Over Switch

A GOOD many cases of poor sending and receiving results may be traced to a poorly insulated change-over switch. One that will cost less than fifty cents and will give as good results as a more expensive one is an ordinary double-pole, single throw switch such as is used in the lighting circuit. This is connected as in the diagram. When the switch is open, the incoming waves will go through the loose coupler; when the switch is in, the receiving set is short circuited, and the power circuit is closed. Thus, when receiving, an accidental touch of the key will do no harm, as the power circuit is broken.

If the station has a rotary gap, a triple pole switch may be used, the extra blade connected in the gap motor circuit as in Fig. 2. Thus, throwing the switch will start the rotary gap.

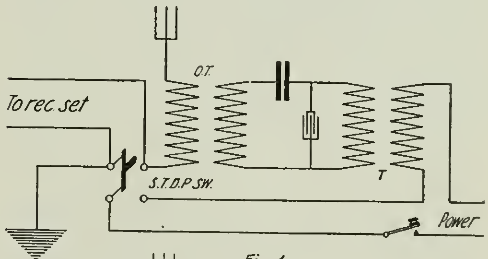


Fig. 1

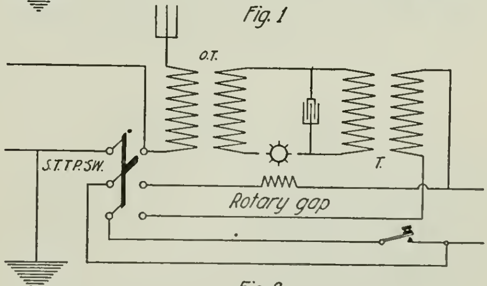


Fig. 2

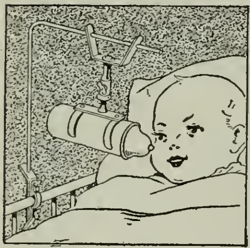
Connection diagrams for ordinary switch used as change-over

A Condenser's Power

AT 60 cycles a condenser will store 1 kw. of power if its value is 0.019 microbarad and it is charged to a voltage of 30,000. This e. m. f. corresponds to a spark gap slightly under one-half inch in length.

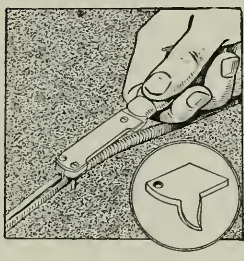
What's New in Patents

Baby's Bottle-Holder



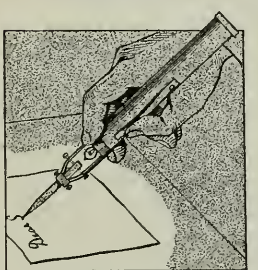
AN adjustable arm is designed to be affixed to an infant's crib or cradle. Attached to the end of this arm is a device for holding a nursing bottle. A bottle is placed in the clamp and its position may be readily fixed and adjusted. This device allows the feeding of an infant without the presence of the mother or nurse.

Tool for Stripping Insulation



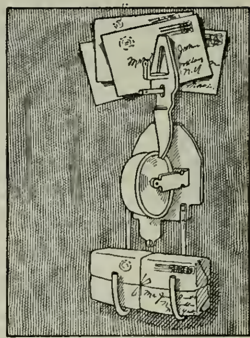
FOR the splitting of the outer wrapping of an insulated electric wire the tool has a laterally projecting blade in the center of two projections which serves as guides while it is being drawn along the wire. On the side of the instrument is a blade which strips the insulation from the wire when the outer covering has been split away.

Electrically Lighted Pencil



TO the end of a slender dry battery terminating in a bulb is threaded a clamp which by means of set screws holds a lead pencil. A leaf spring switch is affixed to the wall of the battery so that the circuit may be easily made. When the switch is pressed the bulb is lighted, and the light is thrown upon the paper directly in front of the moving pencil.

Combined Door Bell and Mail Receiver

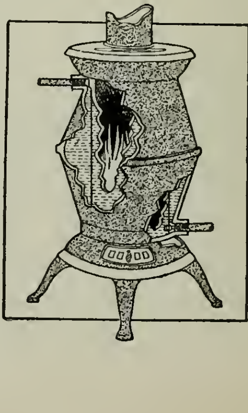


THE fulcrum which actuates the door bell is devised to act as a holder for mail. A spring in the bell holds the lengthened bar against the house at a considerable tension. The mail carrier pulls the fulcrum away from its normal position to insert the mail. This actuates the ringing mechanism of the bell.

An Aid to the Veterinary

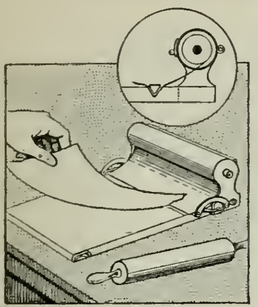
TWO pairs of pivoted jaws are equipped with teeth plates to cover the teeth of a horse. One of the jaws terminates in a set of fixed teeth, which may become engaged with a latch affixed to the other jaw. A strap holds the device in position on the head of the animal. By means of the teeth and latch, the horse's mouth may be held open during a veterinary's examination.

A Room Stove Water Heater



THE water jacket is reversible end for end, having its greatest diameter at its middle point. The walls are thickened where the cold water enters the stove, thus preventing harmful contraction or expansion of the walls.

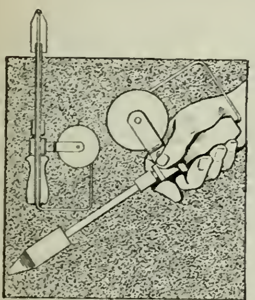
Sanitary Kneading Board



A ROLL of paper or parchment is placed at the head of this sanitary kneading board, and a sheet is drawn over the upper surface of the board when in use. When the work is done, the paper is torn off and a new sheet inserted.

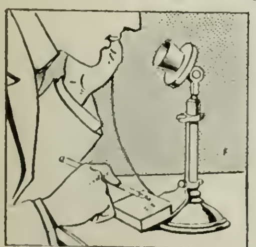
This device saves the work of cleaning the board after kneading bread or cutting meat, and is thoroughly sanitary.

Self-Feeding Soldering Iron



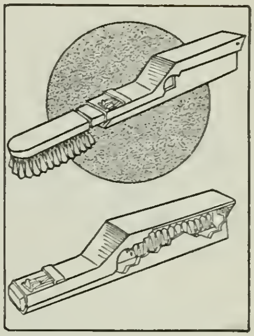
A SELF-FEEDING soldering iron is made with a tube or passage extending from the head through the shaft and handle. A reel, containing a large amount of soldering wire, is mounted above the handle, and the wire passes through the passage in the iron to the head of the tool, where it is melted by the heat and flows to the point to be soldered.

A Pad and Pencil Holder for the Telephone



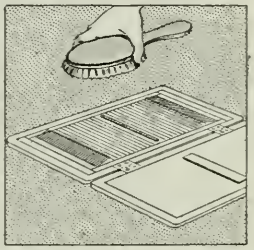
ALTHOUGH the memorandum pad is a necessity for the telephone, the ordinary pad is apt to be lost or mislaid. The accompanying illustration shows an attachment consisting of a single plate of metal curved around the telephone standard. At its upper end it is fitted with a pencil-holding clip, and its lower end is extended forward to contain a pad. The fact that the entire attachment is made in one piece makes it indestructible.

Folding Tooth Brush



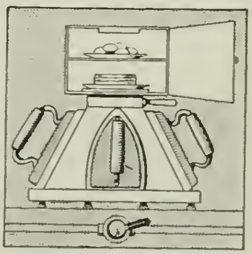
THE handle of a tooth-brush is made to form a casing which will form a cover protecting the tooth-brush when the latter is not in use. When in use the brush is held in its extended position by a spring, which is locked by a jin, and the casing forms a handle.

Apparatus For Cleaning Hair Brushes



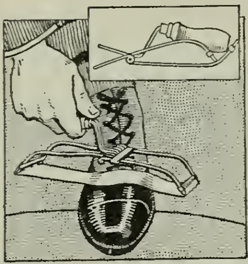
A DEVICE for cleaning hair brushes is made with a comb to remove hair and other foreign substances. A wick is kept moist by means of a moistening tray filled with a disinfecting liquid which cleanses and imparts a pleasing odor to the bristles. A tray at the bottom receives the foreign substances, which have been caught by the comb. As the brush is passed over the device, the bristles come in contact with the moistened wick. Through the friction the liquid is effectually distributed through the bristles in the form of a fine spray.

Combination Sad-Iron Heater and Cooking Utensil



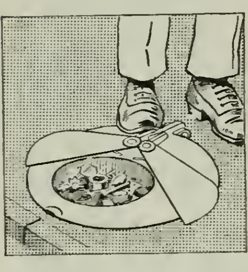
A SHEET metal body, of a pyramid form, is placed upon a metal base plate which rests over the flame. An inclined rack allows the sad-irons to be leaned against the pyramidal body of the heater. Upon the top rests a suitable oven, which may be used for cooking. Heat ascends inside the sheet iron body, thus keeping the sad-irons warm, and also heating the top and the oven.

Shoe Polishing Device



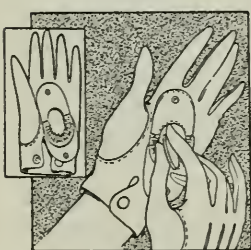
A COLLAPSIBLE shoe polishing device is made of heavy wire, hinged at several places, and held in a rigid open position for use by means of a ferrule. The polishing cloth is extended tightly across the jaws of the device, and when not needed, may be easily removed. A wooden handle is attached by means of a heavy wire.

Opening and Closing Garbage Cans with the Foot



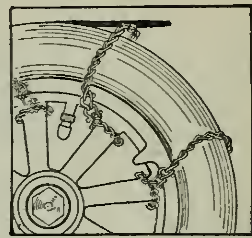
A COVER for a garbage receptacle which may be opened by a pressure from the foot, is made of a metal lid divided in the middle to form two semi-circles. The ends of these semi-circles are pivoted and terminate in metal ears. The pivot has small gears which engage to make both semi-circular covers open away from each other upon the pressure of a foot upon the ears. The covers open away from each other exposing the interior of the receptacle. When the pressure upon the metal ears is removed, a spring forces the semi-circles back into their original position, entirely covering the receptacle.

Purse In Palm of Glove



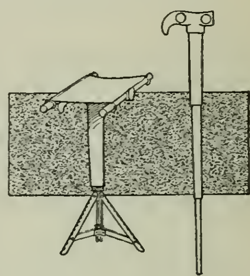
IN the palm of a glove or mitten, an elliptical coin pocket is fastened. This pocket is fitted with draw strings, so that the purse may be easily closed. In addition, a flap is sewed to the glove which closes over the entire device and is secured by a push fastener.

Anti-Skidding Chain



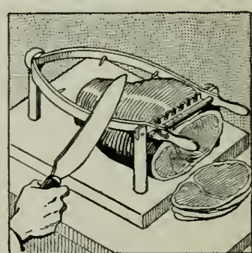
A CHAIN which may be used on any size wheel is made in short lengths, so that it may be placed in position by first passing it about one of the spokes of the wheel, then engaging one end of the chain through a link on the opposite end. This forms a loop encircling the spoke. The chain may then be passed around and around the rim and tire, and fastened with a catch to the loop.

Walking Stick Becomes a Seat



THE stick is composed of several parts and may be readily taken to pieces. At the lower end is a tripod which forms the legs for the seat. Hidden in the stick is the canvas seat, which may be stretched over the head of the cane by means of a removable sleeve designed to be threaded into the handle to form the support for the seat when the affair is set up.

Meat-Holder Which Makes Slicing Easy



UPON a marble or metal base are pivoted two jaws set with clamps for gripping a piece of meat or fowl while it is being cut or carved. If it is desired to turn over the meat, the clamps are quickly loosed and by means of handles affixed to the jaws, the operation is completed without touching the meat with the hands. A strap holds the jaws firmly in a closed, or partially closed, position.

Features of the March Popular Science Monthly

Above the plank floor which now constitutes Broadway, in front of the Metropolitan Opera House, are silks and jewels and glittering lights; below it in half darkness a squad of laborers in khaki overalls, stained with sweated mud, are risking their lives to build another subway.

In the March number the unseen underground activities of New York are revealed in an absorbing article and in a dozen or more interesting pictures—done in the Popular Science Monthly *way—to show exactly how sewer pipes are being rearranged, how rock is being blasted, how a tunnel is being sunk beneath the Harlem River.*

Why did England declare cotton contraband of war? You will find out if you will read in the March number an article which traces cotton from the time that it is in the boll on some southern plantation, to the time when it is placed in the breech of a 42-centimeter gun in the form of smokeless powder of terrific energy.

Of course there are other articles equally worth reading. But how can we enumerate three hundred subjects in two hundred words?

Can This Be Done?

Joseph A. Steinmetz of Philadelphia would mine the air above London against Zeppelins as the Dardanelles are mined against battleships. He would send aloft captive hydrogen balloons carrying explosives, grappling-hooks and torches. It would be hard for the balloons to maintain their level. The wind would toss them about. What is more, a Zeppelin's machine gun could pick them off and drop them into London itself with dreadful results

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Mining the Air Against Zeppelins

By Carl Dienstbach

THE failure of the English high-angle anti-aircraft artillery to destroy Zeppelins attacking London has been repeatedly demonstrated, and it has stimulated many a scientific mind to invent some more efficient means of defense. At night the English aeroplanes are at a serious disadvantage, since the glare of the ground searchlights renders it almost impossible to drop bombs on the enemy with any degree of accuracy. Instead, they fall into London, causing explosion and conflagration. The same danger exists in firing upward against the almost invisible and swiftly moving Zeppelins.

Joseph Steinmetz, an American inventor, proposes to mine the air with bomb-carrying balloons. Small hydrogen balloons, connected in pairs or groups by piano wire (weighing about ten pounds to the mile) are to be set adrift when the Zeppelins are over London. According to the inventor, they would rise rapidly and enmesh the enemy's aircraft. Attached to the balloon units are small hook-trigger bombs of high explosive contact and incendiary torches, which are to be drawn into the Zeppelin's gas bag with destructive results. The method is to be further elaborated by carrying nets of very wide mesh, an idea successfully applied in submarine warfare. In the opinion of Mr. Steinmetz, even though the chance of a Zeppelin's fouling the balloon-connecting wires is only one in a thousand, that one chance is well worth the attempt and expense.

At first blush this scheme of mining the air as a defense against Zeppelins is attractively plausible. Undoubtedly, if the atmosphere above London were full of floating air-mines, it would not be so easy to bombard the town from aloft. When it comes to making this arrangement practical, however, serious difficulties are immediately encountered. Flotation in air is not like flotation in water. A balloon left to itself invariably goes up or comes down. It is generally considered a wonderful accomplishment if a balloonist knows the aerial ocean well enough to keep his craft in regions where sun, winds and vapors do not continually force it from its level, thus causing him to use up gas and ballast and shortening the trip. Over a great city, this procedure would be extremely hazardous. After the air has been thoroughly sown with mine-balloons, it may snow. Imagine the result! With a wind blowing the balloons about during a snow storm, and their bombs striking roofs right and left, the inhabitants of London might prefer the attacks of the Zeppelins. Think of the conflagation these clusters of balloons might cause!

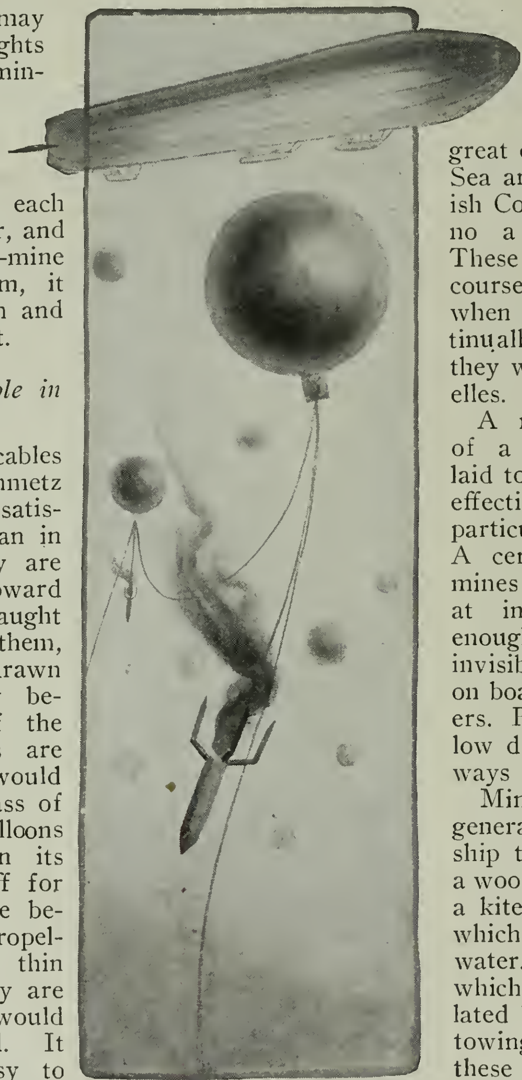
The whole plan harks back to the experiment made in Austrian campaign against Venice in 1849. Nothing was done by halves at that time. No less than two hundred small hydrogen balloons, each carrying a twenty-five or thirty pound bomb, were liberated, but they refused to stay at the right level. They continued to rise until an upper current of opposite direction found them and returned them to the senders.

Even if the mine-balloons remained over London in their allotted places, there are other factors to be considered which could very likely result in a catastrophe. To carry the smallest bombs, balloons must be many times larger than the heaviest floating mines. At short range they would furnish ideal targets to a Zeppelin's machine-guns. A Zeppelin may easily shade its lights and yet clearly illuminate a near object in the air. Let a good marksman with a machine-gun be stationed at each side of the front car, and before any balloon-mine could do any harm, it would be shot down and fall into a city street.

The Plan Is Feasible in Water

Interconnecting cables such as Mr. Steinmetz proposes, are more satisfactory in water than in the air, where they are liable to slip off upward or downward. If caught by airships below them, the bombs will be drawn together harmlessly beneath the level of the hull. The chances are that the Zeppelin would gather a trailing mass of wires, empty balloons and live bombs in its wake, to be cut off for the benefit of those below. The steel propellers would cut the thin wire, and since they are as big and heavy, would hardly be damaged. It would also be easy to shape a Zeppelin so that single wire must slip off wherever it strikes the hull, simply by slanting the outlines of all projections.

It does not look as though the Steinmetz plan would make Zeppelin destruction assured. The three dimensions of the air necessitate the use of mines in large numbers, yet the risk is proportionately increased. Here comes the question of the practical value of the plan.



Hooks and flaming bombs as a terror of the air for Zeppelins and, indeed, for any denizens of the air. But is the terror not as great for the houses below?

Sweeping a Channel for Mines

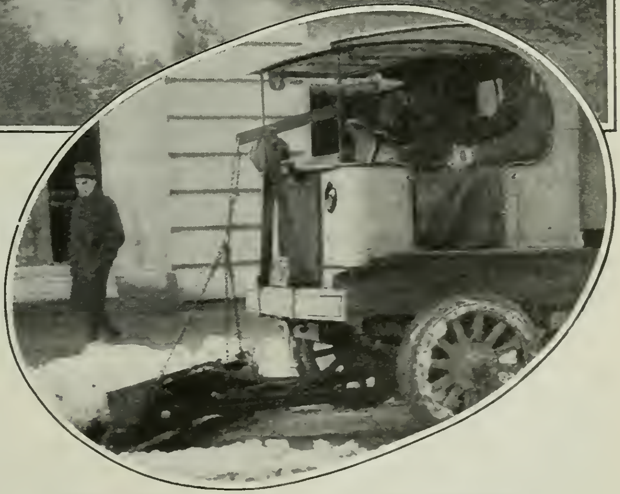
THE operation of mine sweeping is one of the most dangerous and arduous of the many tasks that fall to the lot of a navy. The dangers of mine sweeping are great even in the North Sea and around the British Coasts, where there is no active opposition. These dangers are, of course, greatly increased when the ships are continually under fire, as they were in the Dardanelles.

A mine field consists of a number of mines laid together. It will most effectively block off any particular area of water. A certain number of mines are generally laid at intervals just deep enough to render them invisible to the look-out on board the mine sweepers. For such work shallow draught ships are always employed.

Mine sweepers work generally in pairs. Each ship tows over the stern a wooden apparatus called a kite, fitted with planes which dive beneath the water. The depth to which it dives is regulated by the speed of the towing ship. Each of these kites is fitted with a pulley block. A wire rope is passed from the stern of one ship through the pulley on its own kite across the water through the block on the second kite and so up to the stern of the second ship, where it is fastened. Both ships steam ahead at the same speed, the kites dive to the depth corresponding to the particular speed, and the steel rope is stretched out between them. When the rope strikes a mine, it fires it.

Cleaning New York's Snow-Clogged Streets With Motor-Trucks

Motor-trucks mobilized by city for snow removal dump their loads into Hudson River



One of the new motor-driven snow plows which did much to make the streets passable after the recent New York storm

ON Monday morning, December 13, came New York's first heavy snow storm of the winter. When business men and women started for work, the city's transportation lines were sadly disorganized. Street cars, 'busses and taxicabs floundered through the snow and took workers to their offices, hours late.

At noon, those who were hardy enough to venture out to lunch saw a novel spectacle. Great numbers of privately-owned motor-trucks were crawling through the streets laden with snow. Drawn up beside huge heaps of snow in the busiest streets were other powerful trucks, and gangs of men were speedily throwing the snow into their capacious bodies. The old-fashioned street-cleaners' wagons with their patient horses were in evidence, too, but they were a minor consideration. The great work was being accomplished by the motor trucks.

Through the avenues came heavy-powered trucks with snow-plows fastened to their front axles. Many of these were furnished by a 'buss company, while others were private trucks with a special plow attachment fitted for the emergency. These plows pushed the snow into the middle of the streets, where it was carried away by the workers.

On Tuesday morning, nearly all of the vast quantity of snow had disappeared from the main thoroughfares, and the fleet of motor-trucks vanished as suddenly as they had appeared. Heaps of snow still clogged the middle of many of the side streets, but the work of removing this was done as it had been in previous winters, by gangs of men working twenty-four hours a day, aided by horse-drawn carts.

Where did the motor-trucks come from? Where had they gone when the main streets and avenues had been cleared?

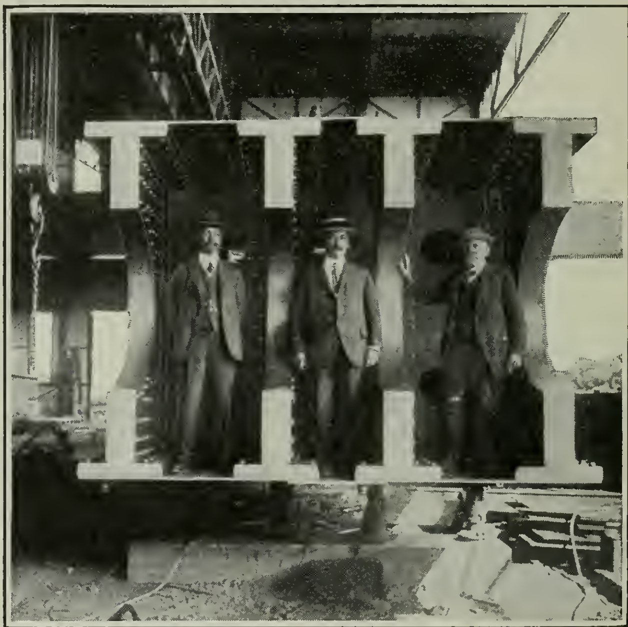
Dissatisfied with the slow methods of snow removal last winter when two or three heavy storms paralyzed the traffic of the city, Street Cleaning Commissioner Fetherstone arranged with a number of large contractors to mobilize a fleet of privately owned motor-trucks, suitable for the removal of snow, whenever a storm threatened to disorganize the transportation of the city.

A census was taken of the owners of trucks who were willing to furnish them when needed for this work. A large number of these powerful vehicles were placed at the disposal of the contractors, and when the call was sent, the trucks were quickly at their appointed stations.

The work done by these trucks was remarkable. The ample bodies held an average load of two and one-half times the amount of snow that could be contained in the largest of the old-style carts and wagons, and the snow was carried to the various disposal points in a small part of the time usually required. As a result, the snow disappeared from the important streets as if by magic.

A Gigantic Steel Bridge-Beam

ONE of the greatest of modern engineering undertakings is the construction of the New Quebec Bridge, which upon completion will span the St. Lawrence near Quebec on the site of the great Quebec Bridge which collapsed several years ago with a great loss of life. Work upon the foundations of the original bridge was begun in the early spring of 1910, but nearly all the work accomplished when the bridge fell had to be practically abandoned and recommenced from the foundations themselves.



One of the largest steel beams ever used in bridge building, designed in place of the faulty members which caused the disastrous collapse of the new bridge at Quebec, before it was completed

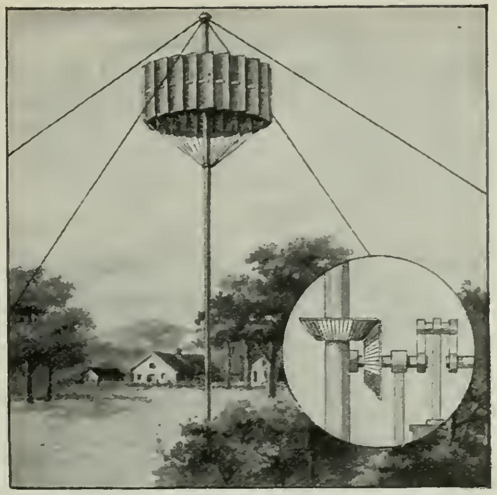
Since the disastrous collapse was caused by weak members, the engineers have fitted to the new bridge some of the largest steel beams ever used in bridge building. An idea of their great size may be gained from the illustration, showing an end section of one of the members. Half of the pin hole shown is to receive a steel pin nearly four feet in diameter. It is expected that trains will be crossing the bridge in another twelve months.

A Windmill Which Always Turns in the Same Direction

WHEN the wind strikes a surface inclined at an angle to the direction of the wind, the surface is displaced in a direction that depends upon the degree of inclination. Upon this well-known principle sailboats, windmills, and aeroplanes are built. When the wind comes in an opposite direction—that is to say, strikes the surface on the other side—it tends to displace it in the opposite direction. It would seem then to be impossible so to place a surface that it shall always move in the same direction no matter whence the wind comes. A French windmill maker, however, has succeeded in solving the problem. He makes a horizontal windmill with perpendicular vanes and axis revolved by the planes without gearing.

The vanes are formed of many sheets of iron arranged in the form of a wheel. The wind on entering the wheel passes between the plates and produces motion, and the wind on issuing, dips along the general slope of the vane and produces motion in the same direction.

The wind is thus utilized going and coming. When the vanes are properly inclined, the power produced by this strange windmill is high, and the wind that reaches nine-tenths of the wheel's diameter is set to work, no matter in what direction it is blowing.



Puzzling windmill which always turns in the same direction, no matter how the wind is blowing

The roll of tape is sixty feet long. On it is written one of the longest letters ever mailed for two cents

An Island Made to Order

HAWAIIAN soil is being used to build up the small coral island in the Pacific Ocean known as the Midway and used as a relay station by a trans-Pacific cable company. A quantity of earth is taken there every three months by the schooner that is sent with food supplies for the operators. The task of building the island has progressed so far that it is now possible to keep a cow on the pasture.

The Longest Letter in the World

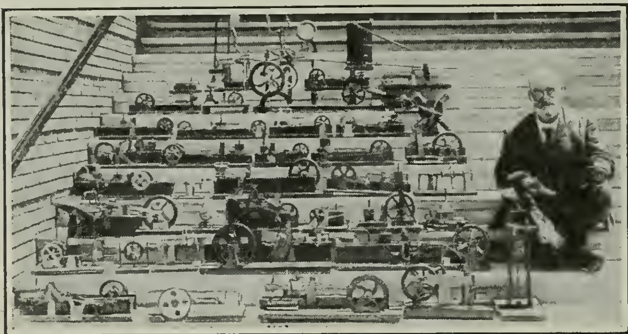
YOUR friends are always asking for long letters. To supply this demand a man in Los Angeles, California, has invented a little novelty that has captured the fancy of visiting tourists.

It consists of a roll of paper tape sixty feet long. The paper is made to write on, and has a place for the name and address of the sender and receiver. It goes as first class mail for two cents, like any other letter, and can be mailed in any mail box.

These little "long letters" cause many a laugh and one can write a regular letter on the tape, by merely unrolling it as it is used up.

Steam-Driven Models Made by a Handless Mechanic

ONE of the chief exhibits at the Home for Aged and Disabled Railroad Employees of America, Highland Falls, Ill., is a collection of model steam engines made by handless Joseph J. Bellaire.



All these miniature engines are driven by steam or air, and were made by the "handless mechanic"

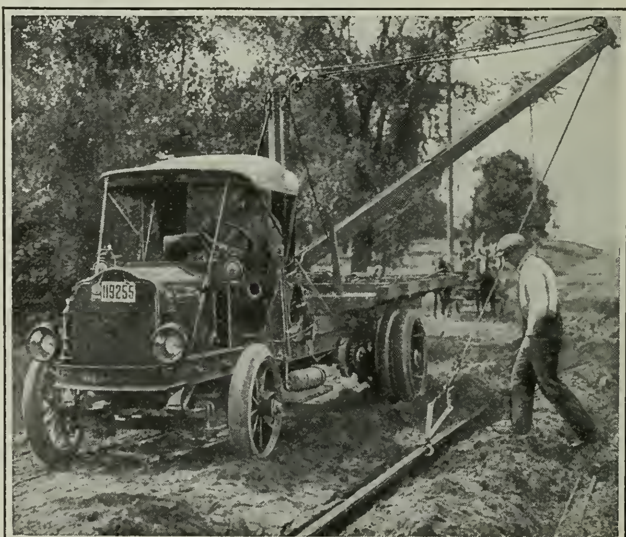
Thirty-four years ago Mr. Bellaire, a young and healthy locomotive fireman, swung down from his cab and crawled under his engine to take the ashes from the firebox. The engineer, forgetting that his mate was beneath the wheels, received the signal from the brakeman and set his engine in motion. The unfortunate fireman, hearing the creak of the wheels, made a wild plunge for safety, and succeeded in freeing himself—all but his hands. When they took him to the hospital they saved one thumb on his right hand.

With infinite patience Mr. Bellaire succeeded in making his artificial hands useful. On his right hand is a thumb and a metal plate. On the left wrist is strapped a wooden attachment, in the center of which is a threaded hole for the insertion of various handy devices, the most useful of which is a steel hook.

Since his accident he has spent much of the time in constructing models of engines, some of which are remarkable bits of machinery. Working models of steam engines predominate in his collections, and most of them run on steam or compressed air. The various tubes and cylinders are soldered together instead of being riveted. All the models work like clockwork. Mr. Bellaire has exhibited his models many times and has received a large number of prizes and medals.

Tearing Up Rails with a Motor Truck

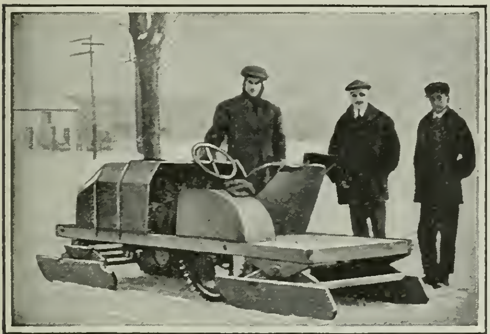
PULLING up the half-buried track of an old railroad much in the same way as a dentist extracts an obstinate tooth, is the novel use to which a heavy motor truck, armed with a derrick, was recently put in a small Ohio town. The boom of the derrick was secured by a heavy braced pillar, which acted as a pivot, to the floor of the truck. Tongs were used to clutch the rail, and the pull exerted through a steel cable and pulleys. This wrecking equipment "extracted" between one hundred and sixty and one hundred and seventy rails per day, which is equivalent to a length of track a half-mile long.



This truck pulls up a half-mile of track during a working day

A Motor-Cycle Converted into a Motor-Sled

HOW to make a power sled, is a problem that has been solved in a rough way at least, by C. H. Carpenter of Waukesha, Wis., whose great plaint in life has been that the motor-cycle he so dearly loves to tour with in summer, with his family, is not available for use in the winter, when the frost is on the pumpkin and the snow upon the ground.



This motor-sled was converted from a motor-cycle at total expense of about one dollar

He has solved the problem, he believes, and that with a total expense of fifty cents for a packing box and about as much for nails and screws. An iron framework, blacksmithed to hold the motor-cycle firmly to the rest of the machine, added the greatest item of cost; for with felt lined clamps to grip, yet not mar the enamel of the motor-cycle, the iron work cost the sum of two dollars.

Mr. Carpenter has made a motor-sled, with a packing box, his motor-cycle, and the stout, hickory runners of an old coasting sled, cut for the purpose. Taking sections of two coasting sleds, the framework of iron was so designed that the motor-cycle power wheel operated between the sleds, much as the walking beam of an old-fashioned steamboat works on the shaft of the paddle-wheels. Built upon the sled, the packing box was cut down, planed and painted. It was given a high back, and the portion cut away in front was converted into a seat. The sled makes about twelve miles an hour, the motor-cycle being equipped on the power wheel with a special gripping tire, made by the simple method of winding wire about the tire and rim.

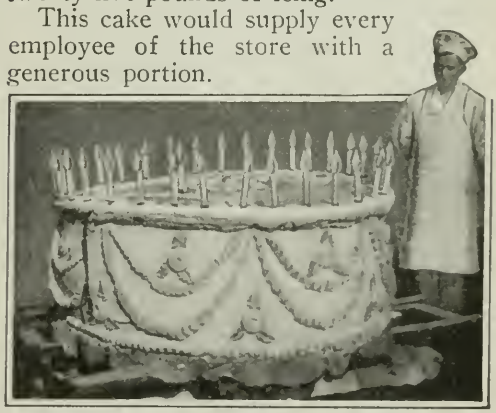
Electric Candles on a Nine-Story Birthday Cake

A BIG birthday cake, with thirty-five electric candles on the top, is a sight which recently astonished Columbus, Ohio. The cake was made in recognition of the thirty-fifth birthday anniversay of a large store devoted to the sale of women's goods. Heretofore it had been the custom to make use of the traditional wax candles but for obvious reasons it was decided this year to make the experiment of using electric candles, which would last longer, give more light and be much more cleanly than those of wax.

The result of the experiment was wholly satisfactory and electric candles will be used in the future. The wiring was buried in the sugar covering of the cake.

Apart from this novel electrical feature the cake itself was very interesting because it was one of the largest ever baked in this country. It was a nine-story layer cake weighing a little short of a ton and it required the services of eight men to carry it from the motor truck which hauled it around the city into the store, where it was the center of attraction. It was four and one-half feet in diameter and into its composition there entered a barrel of flour and one thousand eggs, three tubs of butter, fifty quarts of milk, one quart of lemon flavoring, one quart of vanilla flavoring. It was covered with two hundred and twenty-five pounds of icing.

This cake would supply every employee of the store with a generous portion.



Thirty-five electric candles graced this one-ton birthday cake, which required eight men and a motor-truck to deliver it from the bakery

A Boy's Street Boat

ECHOING the spirit of his forefathers who crossed the bleak prairies of the west in the days of the California gold rush, when sails were occasionally raised on the prairie schooners to help the horses along, a New York boy has added a leg o' mutton sail to the foot power driving equipment of his "scooter" with the result that he has been several times in danger of breaking the speed laws of his city.

With front and rear wheels oiled well,

With the aid of a brisk breeze, this scooter can break the city's speed laws

and a brisk breeze blowing, he can travel at a twenty-mile-an-hour clip without much difficulty, despite the crude construction of his vehicle. The front wheels are those of a discarded baby carriage, while those in the rear are rollers taken from skates. The name of this conveyance is the "windmobile," which is at least as happy as the names of apartment houses and Pullman cars.

Bread Without Grain Flour

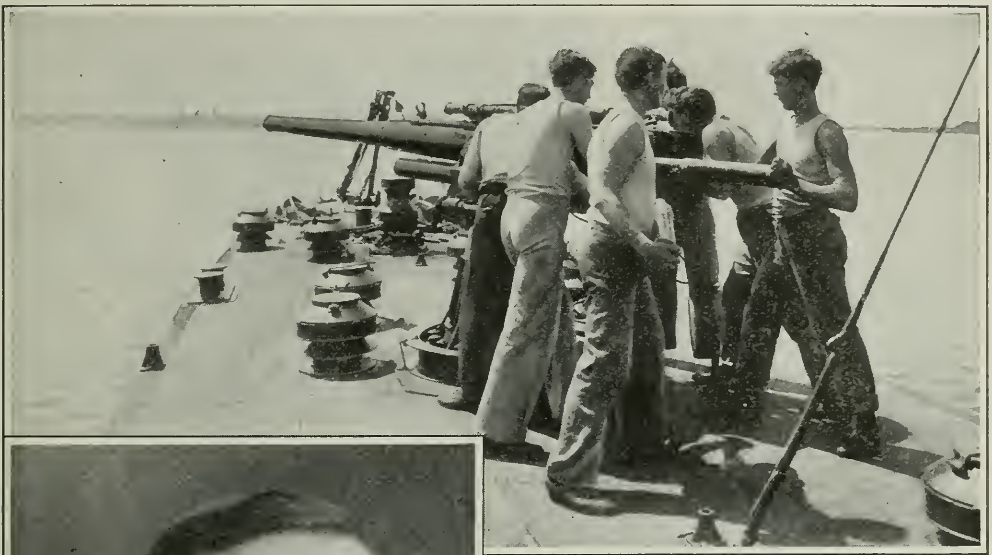
CHEMISTRY in Germany is struggling to produce a substitute for grain flour in making a palatable and nourishing bread. The recent potato harvest being large, most research-workers have sought to use flour from grain in place of potato starch. The difficulty is that when bread contains an unusual proportion of potato starch, or even of rice or tapioca starch, it lacks the sponginess produced in ordinary bread through the carbonic acid developed by the fermentation of yeast or by baking powder.

In an article on the subject in *Umschau* some account is given of the experiments made to overcome the objections to the use of grain flour substituted. It had been proved that the defect in pure starch flour for bread-making is the lack of gluten, for the elasticity and toughness of ordinary dough are caused by the albumen contained in gluten. A chemist named Fornet claims to have found a substance which, when mixed with dough from starch flour, produces the physical characteristics of gluten. The dough is raised with yeast, can be made from all kinds of starch, and looks like ordinary white bread. The bread has been found edible at the army front when several days old. The substance discovered is not yet announced. The famous chemist, Wilhelm Ostwald, has proved that the albumen of gluten is coagulated by heat during baking and has used egg albumen instead with or without a gas-producer, as yeast or baking powder, with good results, but the process is too costly. Walter Ostwald and A. Riedel have substituted thick starch pastes for the various albumens in the dough. These pastes resemble gluten in the qualities of elasticity and impermeability to gas and are also cheap. The leaven is made of potato flour, milk, and pressed hops; baking powder can also be used. The inner friction of the starch paste produces in baking the necessary puffiness and porosity of the dough, and the loaf shows an elastic, porous crumb of fairly normal thickness.

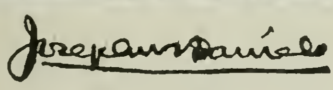
Wilhelm Ostwald also substituted casein dissolved in ammonium carbonate for gluten. In baking, the ammonia and carbonic gases present acted as leaven while the casein replaced the gluten of ordinary white flour.

Enlisted Men: The Foundation of the American Navy

By Josephus Daniels, Secretary of the Navy



Loading a four-inch gun in battle practice on the cleared deck of a torpedo boat



ONE of the curious and unexpected things which I have found since I assumed the duties of Secretary of the Navy has been the effect of a too near point of view in destroying the perspective of some of our ablest Naval Officers as to what the subordination of everything connected with the Navy to its military functions really means, and how far back military preparation must begin.

As each new civilian Secretary of the Navy assumes office, it has of ancient custom been regarded by the service as necessary for the Naval officers with whom he comes in immediate contact in the Department to impress upon him that the Navy is a fighting machine, that its sole purpose and reason for existence is to fight and fight effectively, and that everything that is done must be done with this foundation principle constantly in mind. This is an almost self-evident truth, and it would be indeed a dull mind that could not grasp it and agree, but in the carrying out of this principle there is, I find, a tendency to begin at the top, and, working down towards the foundation of things, to stop suddenly before the bottom is reached. Thus, in all matters of discipline aboard ship.

Thus, in matters of discipline aboard ship, in the training of crews and squadrons, in maneuvers and strategy, in armament and equipment, the idea of military efficiency has been splendidly carried out, and in these matters I hold our Navy ranks second to none.

Have Our Officers Lost Perspective?

When it comes, however, to the utilization of our yards so that they will be of the greatest aid to the Navy as a military weapon, to the subordination of all our so-called civilian activities in the Department to the great military plan, and to the recruiting of men who will prove the most efficient military units, worthy of promotion, when fit, even to flag rank, many of our high navy officers have lost their perspective. This is all the more curious because the German military organization is continually held up by these naval officers as the ideal to be achieved, and if there is any one feature where the German differs from other organizations it is in the thoroughness with which the beginnings of things and things ordinarily thought of as particularly civil are bent and subordinated from the start to their place in the final military organization.

The need of perfectly trained crews so high in character and intelligence that they can grasp the most intricate matters of machinery and drill, that they can save tenths of seconds in the firing of a gun or keep in constant repair the most delicate electrical machinery, is recognized by navy officers as highly important, but there were many, until very recently, who considered that no special effort was required to attract to the service the class of men from whom these results can be obtained. Possibly this was because, in Germany, for instance, military service is compulsory, and the men with the brains and intelligence needed are compelled to enter some military arm of the service in any event, whereas in this country, depending as we do upon voluntary enlistments, high class men cannot be secured unless there are real inducements far more attractive than pretty pictures on recruiting billboards.

It was to remedy this failure to begin at the bottom in one of the most important military matters which led me to inaugurate new ways to attract the right class of men to the service and to keep them in the service when once so attracted by making the term of enlistment a great opportunity to obtain, at Government expense, an education, particularly along technical lines, which would enable the man, upon his discharge, to obtain a higher wage.

Opportunities for such improvement existed before I became Secretary, and, while they have been considerably enlarged since then, the only sweeping change has been to give to those enlisted men who lacked it the rudimentary school education needed before they could comprehend the mechanical and electrical trades.

What I have done, however, is to bring prominently before the country on every occasion the fact that such opportunities existed, and I believe there is hardly a young man anxious to improve himself who does not know that in the Navy he can find his opportunity.

Our Recruits the Cream of Youth

The result of this campaign has been gratifying in the extreme, and the Navy is now recruited to its full strength from so many applicants that we are able to pick the very cream, our latest figures showing that only *seventeen* per cent of those who apply are now accepted. In addition, while the value of a man who has already had the training of one enlistment term in the Navy is recognized as being far greater than that of a landsman just taken on board, and while the military importance of having men of long experience on every ship has been acknowledged, the equal importance of making the service attractive to the enlisted men in order to keep them in the service has not been sufficiently considered until recently. Without abating one jot of the rigid military discipline, without pampering or favoring the enlisted man at the risk of destroying his efficiency as a cog in a great machine, the number of re-enlistments has increased, as the result, from fifty-four per cent to turing establishments as worth time and money in increased efficiency of workmen.

The young man who has mastered the fundamentals of some particular trade can enlist in the Navy and be assigned immediately to work at that trade with sure promotion ahead of him. The experience that he gets in the Navy will be far broader and greater in all probability than he would get working at his trade outside. Take the young man who has gone in for electricity and who lives in a small town. He has few chances of learning the higher branches of his profession; wiring for electric

The daily drill on the ship's deck is an important and interesting feature of the day's routine. Above, sailors in a battleship reading-room

The navy turns out good stenographers and typewriters as well as good mechanics

ninety-two per cent.

I am asking Congress this year for eleven thousand five hundred more men for our Navy. Thanks to the policy outlined, there is not the slightest doubt that we will be able to get eleven thousand five hundred (or more when they are needed) young men of the highest type, keen, intelligent, desirous of improving, and willing to learn their duties. It has simply been a case of willingness to learn from civil life the most efficient way to achieve a military object, for the education of apprentices has been recognized by great manufacbells, occasionally repairing a small motor, putting in electric light fixtures—these are practically the limits of his experience. On every battleship, however, are to be found the most delicate and complicated of electrical apparatus, huge dynamos of enormous horsepower, delicate signaling and recording instruments; every kind of electrical apparatus is there. How to make and how to repair this apparatus is a part of his military education, progressing from the simpler work to that requiring the greatest skill, and with this training will go a thorough education in the fundamental principles of electricity as well.

Every Recruit is Trained to Become a Skilled Artisan

When he leaves the service he will be too proficient as an electrical expert to be in any danger of being compelled to spend the rest of his days as he began —putting up bell wires or installing electric lights in a small town. He will be a welcome addition to any of the great electrical and manufacturing establishments, with good wages, and perhaps a place at the very top.

This is true of all the other vocations, and fifty of them are taught in the Navy. There has just been established, for instance, a new class at Charleston for instruction in gasoline engines, where the enlisted men will be taught not only the theory but the practical handling of the largest gasoline engines now in use. Machinery of all kinds is used in these schools for enlisted men, and, in addition, what is known as the yeoman branch affords an opportunity for those who desire to become expert stenographers, typewriters and accountants. Here is a partial list of the schools for enlisted men at present maintained by the Navy. It is interesting as showing the wide range of subjects covered.

1. Navy aviation school,
   Pensacola, Fla.
2. Electrical schools,
   Navy Yard, New York;
   Navy Yard, Mare Island.
3. Artificers' school
   Navy Yard, Norfolk.
4. Oil burning school,
   Navy Yard, Philadelphia.
5. Machinist's mates' school and school for gas engines,
   Charleston, S. C.
6. Seaman gunner school and school for diving,
   Naval Torpedo Station, Newport, R. I.
7. Yeoman schools,
   Newport, R. I.,
   San Francisco, Cal.
8. Musicians' school,
   San Francisco, Cal.
   Norfolk, Va.
9. Hospital training schools,
   Newport, R. I.,
   San Francisco, Cal.
10. Commissary school (for ship's cooks, bakers and commissary stewards),
    San Francisco, Cal.,
    Newport, R. I.
11. Mess attendants' school,
    Norfolk, Va.
12. Naval Training Stations for apprentice seamen,
    Newport, R. I.
    Norfolk, Va.
    Great Lakes, Ill.
    San Francisco, Cal.

How thorough the instruction is, can best be shown by the course of instruction in the Navy Electrical School at the New York Navy Yard, which follows.

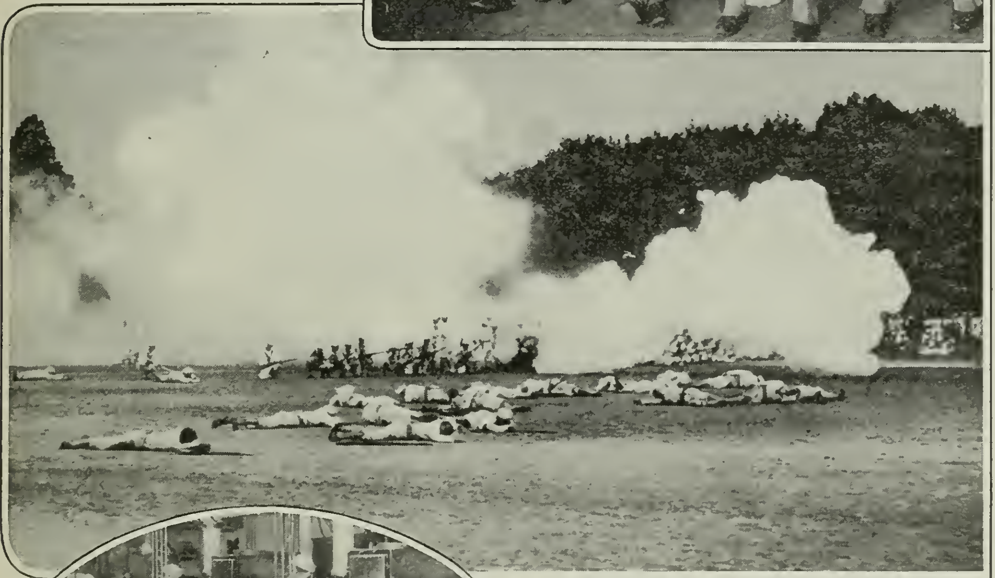
During the first week of instruction, the recruit studies machine shop work, such as forging, welding, tempering, annealing, brazing and soldering, and thread cutting.

In the second week, his machine shop instruction continues, the novice becoming familiar with the hand operated tools such as the lathe and lathe tools, the shaper and shaper tools, the drill press, the milling machine and mill-cutters, and the emery wheel. He also learns the rudiments of machine shop work, such as bench, lathe, drill press, milling machine and emery wheel work.

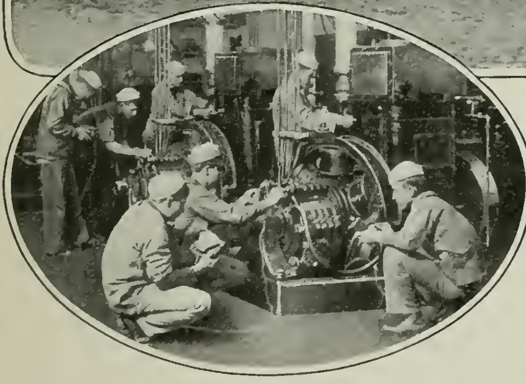
For the third week, he studies reciprocating steam engines, the various courses being in simple and compound reciprocating engines, also in the auxiliaries, viz., separators, traps, pressure regulators, all kinds of valves, condensers, pumps, gages, revolution counters, tachometers and indicators. Practical operation of engines and practical work also occupy much of his time. He learns assembling and dissembling engines, lining up engines, resetting and adjusting valves, reading indicators, overhauling and repairing engine and pumps and the regrinding of valves.

The subject of steam turbines is taught during the fourth week. The practical operation and care and preservation of these complicated engines keeps the recruit busy during the week.

For the fifth week, the subject is that of internal combustion engines. The study of the principles of these engines, and of special types such as the Hornsby-Akroyd, Meitz and Weiss oil engines, is thoroughly pursued, and the practical operation, care and preservation of all oil engines is taught.



Bluejackets in artillery and infantry exercises ashore. Above, a schoolroom on shipboard



The navy offers an opportunity to study electrical engineering

In the sixth week, the theory of magnetism and electricity is studied, and in the seventh week, the instructors teach the students the theory of the dynamo and electro-magnetism.

Practical work on dynamos is accomplished during the next two weeks, and pupils learn the mysteries of turbo-generators, switchboards, operating dynamos in parallel, care of the plant and dynamo room routine.

Theoretical and practical work on motors occupy the recruits' time from the tenth to the twelfth week. Studies are made of the principles of direct current motors, motor generators and dynamos, and practical work is done on service motors and motor starting and controlling devices. Ammunition conveyors and hoists, gun elevating equipments, rammers and turret turning equipments are made the subject of study.

The thirteenth, fourteenth and fifteenth weeks are devoted to the study of the theory and practice of lighting and interior communication. The subjects listed are instruments, circuits and fuses, incandescent and arc lights, telephones, wires and wiring, wiring appliances and fixtures, search lights, signaling apparatus, interior communication cables, switchboards, telephone circuits, telephones and fire controls.

During the sixteenth and seventeenth weeks the theory and practice of primary and secondary batteries are studied.

The last two weeks, the eighteenth and nineteenth, are spent in a general review of the entire course, and any points that have been missed by the pupils are made clear in their minds.

Radio Telegraphy

For the first six weeks of the course in radio or wireless telegraphy, the study closely parallels the study of magnetism and electricity, dynamos and motors, alternating currents, batteries, and internal combustions which is pursued in the course just outlined.

From the seventh to the nineteenth weeks, the pupil is constantly practicing at the instrument, becoming efficient at sending and receiving. He also devotes one week each to the following subjects: Condensers, inductances, oscillating currents, primary circuits (transmitting), secondary circuits and closed oscillating circuits, radiating circuits, transmitting sets, receiving apparatus, receiving circuits, Fessenden sets, wireless specialty companies' sets, and Telefunken sets. The nineteenth week is spent in review, as in the other course.

Immediate entrance to these schools is, of course, obtained only by those who already have some knowledge of the trade, but every enlisted man who wants to take up a trade of which he may be utterly ignorant at the time of his enlistment has only himself to blame if he does not eventually acquire a chance to obtain this special shore instruction. He has only to state to his superiors on the ship what line he would like to follow and provided there are not too many already having the same desire at the time on the ship, he will be assigned duties on shipboard which will give him a certain familiarity with the subject. After a year's service, he can make application for a special course of training at the school, and, if he has shown sufficient intelligence and progress in his work on board ship, he is certain to have his request granted.

With such inducements and with a daily school on shipboard where the subjects to be found in every public school on shore are taught him as well, it is not surprising that, instead of a lack of men of the type desired, the Navy now finds it a difficult matter to choose from the host of applicants those best suited for the service. Judges no longer sentence ne'er-do-wells to the Navy as a punishment, nor are such men received, and desertions in the last three years have decreased thirty-two per cent.

In this way has the doctrine of subordination of everything to military efficiency been carried to the very beginning, and we are certain of efficient crews on board our ships because we have efficient recruits to begin with.

Iron Industry Gains in Germany.

DESPITE the smothering effects that the war has upon industry of all kinds, the production and manufacture of iron implements increased considerably in Germany since the opening of hostilities. During the last year of peace, 1913, the German iron industry mined approximately 35,941,000 tons of domestic iron ore, from which, after exporting 2,613,-000 tons and importing 14,019,000 tons, a total of 19,300,000 tons of crude iron was smelted. During the month of August, 1914, when the war started, the output of iron products sank to 18,310 tons daily. During 1915 this daily average has increased to 33,000 tons. A large percentage of the iron being produced in Germany is finding its way into war implements of various sorts.

THE commission form of government is in effect in eighty-one of the two hundred and four cities in this country of over thirty thousand inhabitants.

Fish That Travel on Land

When the tide goes out and strands these fish in a shallow pool, they leave the water, and actually flop over land to the sea. They never get lost and travel in the wrong direction, but always take the straightest road back to deep water

SCIENTISTS rarely go a-fishing in troubled waters; Professor S. O. Mast, however, of the zoological department of Johns Hopkins, is an exception. The Johns Hopkins professor discovered that such fish as minnows are often found in the little temporary pools left in the sand by the tide, but rarely, if ever, after the water in such a tide is so low that the outlet is closed.

When the tide is falling, these fish—*fundulus majolisis,* the scientific name for them—swim out, somehow knowing when the tide is about to get so low that they might be trapped in the little pools in the sand. As the tide falls, they swim in and out of such tide-pools at short intervals. Thus, these fish avoid being trapped in the pools and killed when the little collections of water dry during low tide.

Professor Mast has observed that the outlets of such tiny pools may be closed while the tide rises, but if they should close while the tide is falling, the fish swim about rapidly in various directions to discover water. If they find none, they leave the water and actually flop over land to the sea. Professor Mast has seen scores and scores of these fish leave large pools and travel across sandbars more than twelve feet wide and half a foot high. The fish nearly always leave the pools on the side towards the sea. They evidently remember the direction of the outlet and the direction from which they entered.

Curiously enough, they never make any mistakes in "walking" on dry land, either. Professor Mast never found one to take a wrong direction for any great distance. Although he admits that it is not yet definitely known how fish are guided in the right direction, it is certain that light reflected from the water is not a factor in this sense of direction.

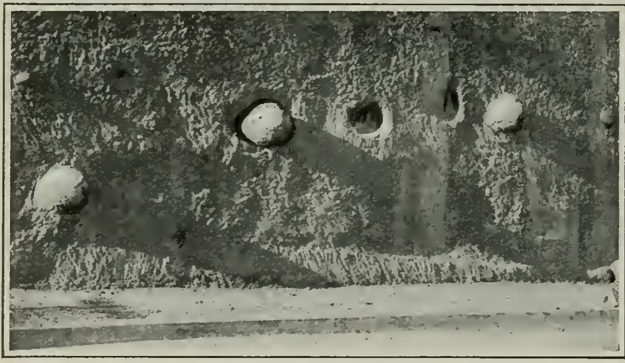
Perhaps one of the most interesting discoveries made by the Johns Hopkins zoologist shows how fish can make their way on dry land.

Of course, locomotion on land by fish can be brought about only by successive leaps and jumps produced by rapid bending and wriggling of the body or sideswiping by the tail.

When trapped in a pool which rapidly dries up or evaporates, they swim about for a few minutes, then come closely to the edge of the water and swim up and down the side of the pool nearest to the sea. Finally a dense aggregation of fish forms in the outlet near the dam, and three minutes by the watch after they are shut in, they manage to climb out on the sand. They leave in groups of twelve and "march" like General Sherman to the sea. These fish are superior to some men in finding their way home.

Natural Cannonballs

THE cannon balls illustrated are simply big, nearly spherical rocks which are found at intervals in the soft sandstone of Southern California, the same sand formation in which the great deposits of petroleum are found. Of course there is no oil left in these cliffs; it has all leached out and evaporated, but where the strata dip down from two thousand to three thousand feet below the surface, there it is saturated with oil and natural gas, to constitute one of the greatest oil deposits in the world.



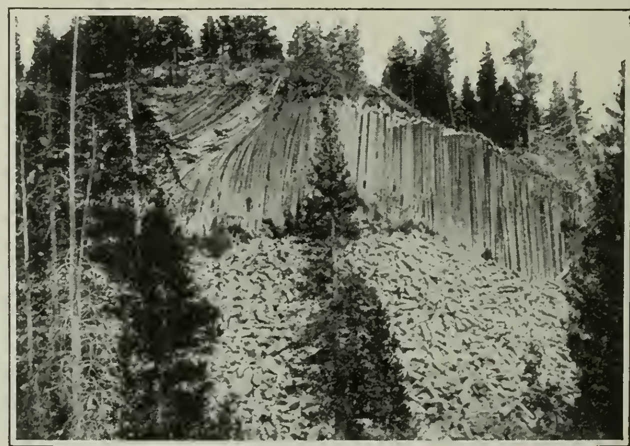
Natural cannon balls found in the soft sandstone of Southern California

The Devil's Post Pile

THE Devil's Post Pile is one of the greatest wonders of America. It is such a remarkable formation of volcanic rocks that it has been constituted by Presidential Proclamation into a National Monument.

The huge pile is composed of large basaltic columns about the dimensions of telegraph or telephone poles, though most of them are either hexagonal or five-sided. Some, however, are four-sided and closely resemble hewn timbers about two feet in diameter. The "posts" stand in the pile at all angles from vertical to almost horizontal.

The visible height of the tallest post is over fifty feet, although it is not known how far down they extend—a considerable distance it is believed by geologists. Each year's freezes and thaws throw down portions of the outer columns. From the vastness of the rock pile at the base of the standing columns it is evident that this process of disintegration has been going on for many centuries. The posts are composed of basalt of great hardness and density, the product of volcanic eruption. Exposed portions of the top of the pile show the scratching of glaciers, yet the pile itself and the surrounding country is covered with a layer of pumice dust, an evidence that the "post-pile" is the product of a volcanic eruption which occurred after the glaciers had long since retreated.

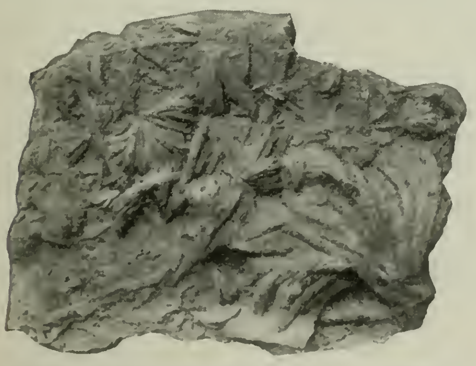


A huge pile of basaltic columns which brings to mind Ireland's "Giant's Causeway"

Fossil Plants Twenty Million Years Old

GEOLOGISTS describe what is known as the Denver Basis as a great, low, swampy region (Denver is approximately its center) which existed during an early period of the earth's history when the Rocky Mountains were just pushing their way up out of the primal ocean. This great "basin" was made up of shallow lagoons and low-lying, sandy shores on which grew a rank, tropical vegetation somewhat similar to that of the valley of the Amazon today. Huge palms, fig trees and giant ferns were laced together with a tangle of vines, through which man, had he been on the earth at that time, would surely have found it difficult to pursue or escape from his enemies. And of the latter there would have been many. The country must have fairly swarmed with strange animal life, according to the bones of scores of species of the enormous, half-animal, half-reptile of the Mesozoic Era.

The photograph shows the perfectly preserved leaves and stalks of this swamp growth, which was submerged in the sandy shores of some lagoon. The air having been excluded, the growth was silicified and fossilized. At a glance it resembles the intricate carving in coarse sandstone such as might have been used in some ancient decoration. This formation is placed by geologists as belonging to the Cretaceous Period which is variously estimated to have been from fifteen to twenty millions years ago.



Perfectly formed leaves and twigs fossilized in the course of twenty million years

A Piece of Salt that Weighs Two Hundred Tons

AT the famous salt mines of Wieliczka, eight miles southeast of Cracow, Galacia, which was the scene of bloody fighting between the Russians and the Austrians, there recently fell a huge mass of salt weighing some two hundred tons. The great block evidently became detached from the roof of one of the chambers and came crashing to the ground. In its fall it demolished a portion of a passage and broke down heavy timbered barriers. No one was hurt, however.

A two hundred ton rock of salt which recently fell into the working chamber of the greatest salt mine in Austria

These salt mines are famous not so much on account of their size and large output as for the many wonders they contain. Indeed, they are regarded as one of the show places of Europe. They comprise a sort of underground world, with all kinds of chambers, such as ballrooms, restaurants, theatres, churches, chapels and monuments hewn out of the solid rock salt. In these chambers may be seen wonderful chandeliers carved out of the rock salt. There are sixteen subterranean lakes in the mines, on one of which is a boat. It lies some seven hundred feet below the surface of the earth. The aggregate length of the galleries at present accessible is upwards of sixty-five miles and that of mining railways twenty-two miles. The mines have an annual output of no less than sixty-five thousand tons. They are the property of the Austrian government and have now been worked for upwards of a thousand years.

Niagara on Tap

By Professor Thomas H. Norton

To what extent should Niagara Falls be sacrificed in the production of electric power? Each year witnesses a growing bitterness between two factions: The one insists that no scenic treasure shall be permanently marred by servitude to the demands of commercialism; the other claims with almost relentless logic, that in the case of Niagara, the right of the nation to utilize the enormous power available, shall not be subordinated to a mere sentiment. Professor Thomas H. Norton, in a paper which he read before the American Electrochemical Society, outlined a scheme whereby it would be possible to satisfy those who see only the beauty of Niagara, and those who see only power going to waste. The following article by Professor Norton is an abstract from the paper in question, especially revised for this issue of the Popular Science Monthly *by its author.*—Editor.

THERE must be some practicable, workable thesis, according to the terms of which, on our own continent for example, the rights of its inhabitants shall suffer no material diminution in the opportunity to fully enjoy the splendor of Niagara, while conditions are created which permit the utilization, on a satisfactory scale, of the tremendous source of power,—one of the nation's grandest assets.

The principle of an *intermittent waterfall* would appear to offer a simple, but thoroughly practicable solution. It may be briefly formulated as follows:

During somewhat more than half of the twenty-four hours, especially during the night time, a waterfall is completely harnessed. Every kilowatt which it is capable of creating is devoted to the service of industry. During a shorter period—from ten A. M. to eight P. M.—the cataract resumes its normal activity, contributing to the esthetic enjoyment of all who behold it.

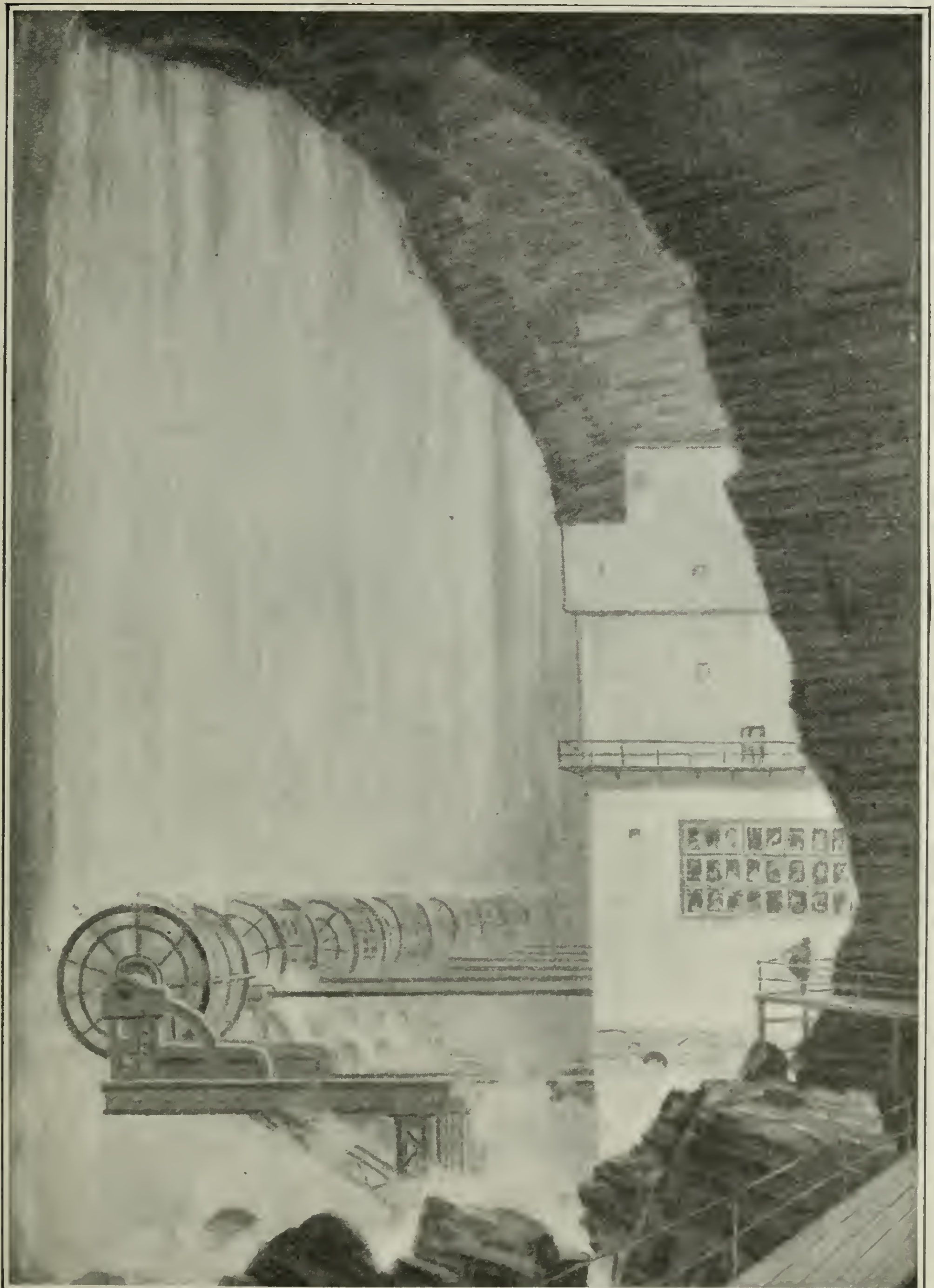
In the case of Niagara, naturally the most familiar of the world's great cataracts to the readers of the Popular Science Monthly, the application of the intermittent principle would offer no difficulties of an engineering nature. The topographic factors are simple.

To harness completely the great mass of descending water is a matter of comparative ease. The expense would be far less than that required for the monumental Assouan Dam of the river Nile,—five hundred millions. It would probably not exceed two hundred millions at the outside.

One-quarter of a mile above the western extremity of Goat Island, where ripples betray the beginning of the upper rapids, a dam would be constructed at right angles to the axis of the river. The length would be about four-fifths of a mile. Niagara River at this point is exceedingly shallow. Equidistant soundings from the American shore to the Canadian shore show an average depth of 3¾ feet. It is evident that the construction, based upon the rocky bed of the river, would be relatively easy and inexpensive.

The dam would possess the necessary architectural features to harmonize with the environment. The water impounded by the closing of the gates could be led by huge canals, on both sides of the gorge, to the edge of the bluff overlooking Lake Ontario. From this point a multitude of penstocks and rock tunnels would conduct the entire volume of water to the level of the river near Queenston on the Canadian side and Lewiston on the American side, where battalions of power-houses can easily be located.

The total section of the system of canals and penstocks required for the complete utilization of the average flow of Niagara River would be approximately sixteen thousand square feet. The mean flow of water, with a hydrostatic head of nearly three hundred and fifteen feet,



"In the deep recesses behind the falling sheet of water at Niagara," says Prof. Norton in his article, "a gigantic system of scaffolds would be erected. These would serve as the supports of a series of over-shot wheels or endless-chain bucket wheels. By careful disposition a considerable fraction of the available power—possibly thirty to forty per cent.—could be utilized without revealing any portion of the mechanism to the eye of the beholder" would produce about seven million, four hundred thousand horse-power.

Once provided with the mechanical means to control the vast volume of water, ordinarily sweeping over the crest of Niagara, the daily program would be as follows:

At 8 P. M. the entire series of gates on the dam would simultaneously close. A few minutes later and the American Falls would falter. The volume of water would swiftly diminish. Soon the grand curtain would be rent and gashed as if by invisible knives. A minute or two more, and rivulets here and there pour over the brink. The gloomy, cavernous recesses beneath the overhanging edge are revealed to the eye. Another minute, and the rivulets have changed to drops.

From Goat Island to the apex of the great Horseshoe the same sequence of transformations begins. It creeps steadily along the crest until it reaches the Canadian shore. The deafening roar of the cataract sinks to an agonizing groan, a reproachful sigh, a dying murmur. Niagara is silent!

A few minutes later and the rage and fury of the long stretch of rapids in the picturesque gorge falter and slowly subside. The vast volume of water between the foot of the falls and Queenston gradually drains away. A quiet lake remains between the railroad bridges and the base of the falls. Its surface is about eighty-six feet below the normal level, and the enclosing cliffs gain that much in height. It would be somewhat narrower than the present river, and frequent rocky islands would appear near the temporary banks.

For three-quarters of a mile the relatively narrow and shallow bed of the whirlpool rapids would be laid bare. The whirlpool itself would remain a somewhat restricted and motionless sheet of water, forty feet below its normal level, at the head of a quiet fjord, extending inland from Lake Ontario.

Such would be the topographic changes attending the harnessing of the cataract.

Synchronously with the vanishing of the falling tons of water, in thousands of workshops scattered over the fruitful territory of Ontario and New York, a million, perhaps many million, workmen begin their daily task. For fourteen hours the world's greatest beehive of industry is filled with the busy hum of activity, keyed to the highest pitch, banqueting, as it were, on the corpse of a murdered Niagara! One shift of seven hours is succeeded by another of the same length. All the energy of the seven million, four hundred thousand horse-power is devoted to the welfare of the nation.

It is 10 A. M. As the signal is flashed from the National Observatory the gates of the great dam shoot upward. The hum of spindle and loom, the clang of the triphammer, all the many-toned gamut of sound which forms the orchestral accompaniment of a busy, happy people shaping, fashioning, creating the objects of convenience or luxury destined for each other's comfort or enjoyment,—all sink to a whisper,—vanish!

A minute later and the crest of a vast billow sweeps over the brink of the American Fall. In an instant, almost, with a deafening roar of exultant joy, the cataract has sprung into full activity. Swiftly the falling curtain spreads from Goat Island along the crest of the semicircle, until Niagara, in full panoply of power and might, hurls her defiance at the assembled thousands gathered to witness the most wondrous sight on the face of the globe—the rebirth of a cataract. The spectacle would combine all the swiftness of movement and stupendous grandeur offered by the sweep of the Johnstown flood, or the tidal wave of Galveston, free from the tragic terrors and horrors of those cataclysms. The gloomy, beetling cliffs disappear behind the sheet of foam and spray; rainbows hover in the clouds of mist; the gray walls of the gorge echo back the roar of the proud cataract!

In a less dramatic and spectacular manner the level of water in the gorge would steadily rise; the foam and spray of the rapids become evident; the whirlpool resume its circling activity; and Niagara's normal life reappear.

For ten hours the thousands of machines, of furnaces, of electrolytic vats rest or are available for repairs, until the sun sets, and in the twilight the hour approaches for an eager multitude to witness again the death agony of a cataract unequaled in size.

A view of Niagara Falls when, a few years ago, ice dammed the river above and shut off all but a small proportion of the water. One of Prof. Norton's plans would denude the falls each night still more than is shown here. When the water diverted by his dam to the running of his power plant, the "grand curtain would be rent and gashed as by invisible knives, a minute or two more, and rivulets here and there would pour over the brink . . . Another minute, and the rivulets have changed to drops . . . Niagara is silent!"

Such would be the daily sequence of events. On holidays, on the Sabbath, the lovers of nature could view the falling sheet of water at all hours of day and night, in the twilight, at dawn, in the solemn quiet of midnight.

When used for motive power on railways, street-car lines, etc., in many branches of electrochemical industry, continuity of current is imperatively necessary. Storage batteries may be employed, but at an increased cost for each electrical unit.

It is, however, perfectly feasible to rescue a very large proportion of the power, ordinarily going to waste during the shorter period of the day, when the cataract resumes its normal activity, without affecting, to any noticeable degree, any elements of its scenic beauty.

In the deep recesses behind the falling sheet of water at Niagara, the Cave of the Winds, etc., a gigantic system of scaffolds could be erected. These would serve as the supports of a series of overshot wheels or endless chain-bucket wheels. By careful disposition a considerable fraction of the available power—possibly thirty to forty per cent—could be utilized and directed to electrochemical or transportation centers without revealing any portion of the mechanism to the eye of the beholder gazing at the cataract. There would be a noticeable increase in the volume of spray, which could tend only to heighten the scenic beauty of the waterfall.

The simplest means to accomplish the purpose would be a series of buckets, operating on endless belts, working on axes located immediately beneath the brink of the cataract and at the base of the falling sheet of water. Essentially an enormous overshot water wheel, with its modern effective devices on the periphery, distorted and elongated into the form of a belt, as used for the transmission of power from one shaft to another. A complete series of such elongated wheels, closely adjusted side by side, would occupy the entire space behind the curtain of falling water, as far as their presence could be concealed from the view of those on the adjacent banks.

It is scarcely necessary to state that during the fourteen hours of enforced quiet and rest, while the waters of the Great Lakes are diverted through a maze of penstocks, to dash upon thousands of turbines, the sight of a serried array of mechanical devices, lining the cliffs of Niagara, would be sadly out of harmony with the otherwise gloomy grandeur of the gorge.

Although this period covers the time ordinarily devoted to slumber, still in the evening and during the early forenoon, tourists and others would constantly gaze upon Niagara at rest.

To remedy this feature, one per cent or less of the river's volume would be allowed to pass the dam, and flow over the brink. It would generate a thin curtain of water, just enough to hide the massive scaffolding and the maze of wheels. By simple hydraulic devices, this small amount of water could be largely transformed into spray. A delicate lace-like "bridal veil" would screen cliffs and every trace of commercialism.

The initial outlay would scarcely exceed two hundred million dollars. This is equivalent to a capital outlay of twenty-seven dollars per annual horsepower, based upon continuous use. The annual interest charge would be less than a dollar seventy-five. This approximates the rates of two dollars per annum in Iceland and of three dollars on the west coast of Norway. At present the electric power of Niagara costs twenty dollars per annum.

It would mean the creation of an industrial metropolis, surpassing any now existing on the face of the globe. No cinders or soot would pollute its atmosphere; no towering chimneys would rise against the sky-line. Industries of the most varied nature, carbides, carborundum, aluminum, cynamid, chlorin, alkalies, steel, copper, and many minor branches—all dependent upon the electric current—would gravitate to this point. It would become in very truth—perhaps in name—the *electropolis of America!*

A Mile-a-Minute with an Air-Driven Sled

It was doughty old Count von Zeppelin who first pointed the way toward locomotion with an air propeller. More than fifteen years ago, when he first planned the giant, rigid airships which are now known by his name, he had to conduct a series of experiments in order to obtain propellers of sufficient thrust for his huge untried craft. Accordingly he mounted them upon a boat and made experiments on Lake Constance. The speeds which he attained were not more than twelve miles an hour, but they were sufficient to prove that he could urge his first giant vessel through the air at forty miles an hour.

The idea reappeared in France at a later date. Ordinary launches as well as specially constructed hydroplanes were driven on the Seine by propellers revolving in air. Tissandier and Santos-Dumont made speeds as high as fifty miles an hour on water. As in Count von Zeppelin's case, their experiments were prompted by the thought of obtaining a system of propulsion for air boats. So successful were they that a few motorcycles and automobiles appeared thus propelled.

Now comes an American manufacturer who reduces the idea to commercial practice. He has constructed an air-propelled sled with which it is possible to obtain a speed of sixty miles an hour over ice or packed snow. An engineering experiment, to test out the possibilities of an aircraft, has been developed commercially. The air-propelled ice-craft is now a vehicle of sport.

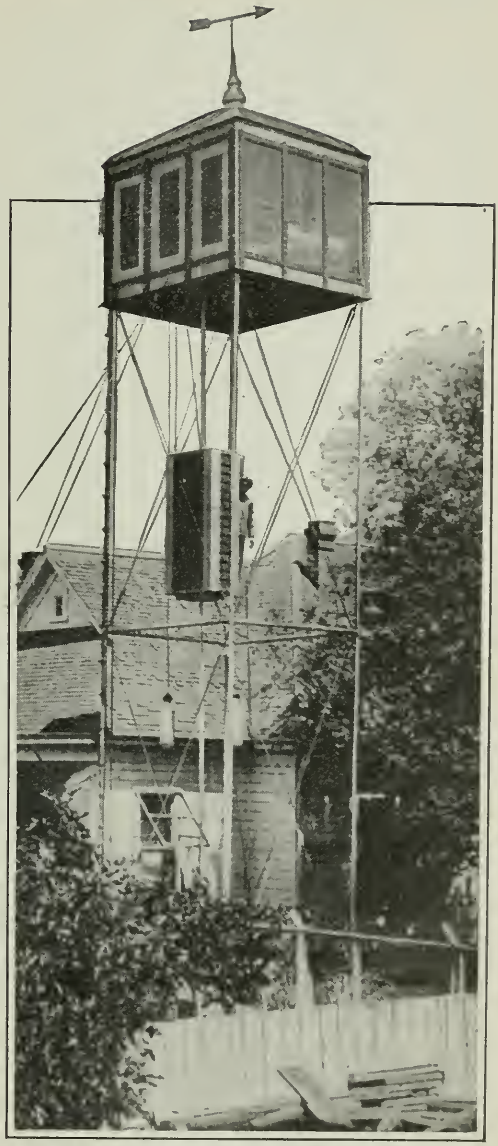
Notice the construction of the sled as it is depicted on our front cover. Upon a frame supported by the two rear runners a gasoline engine is carried, by which the air propeller is driven. A string-piece connects the motor-carrying frame with the single forward runner. There is room for two men. The rear man does the guiding with an automobile steering-wheel connected with the forward runner, which is pivoted so that it acts as a kind of rudder. Stop the motor and the whole sled can be checked and brought to a standstill very quickly by a powerful emergency brake.

A Sleeping Nest With an Electric Elevator

A CALIFORNIA electrical engineer has constructed a sleeping porch thirty-eight feet above the ground. He thinks that the night air close to the ground interferes with his repose, and that the temperature forty feet from the ground is at least ten degrees cooler. His sleeping porch is a veritable nest in a steel tree.

He took pains to build his cage to withstand the high winds that occasionally prevail in that section of California. The steel poles which support the elevated bedroom are stoutly braced, and he has estimated it will be comfortably safe in winds blowing as briskly as two hundred miles an hour, thus allowing him an ample margin of protection.

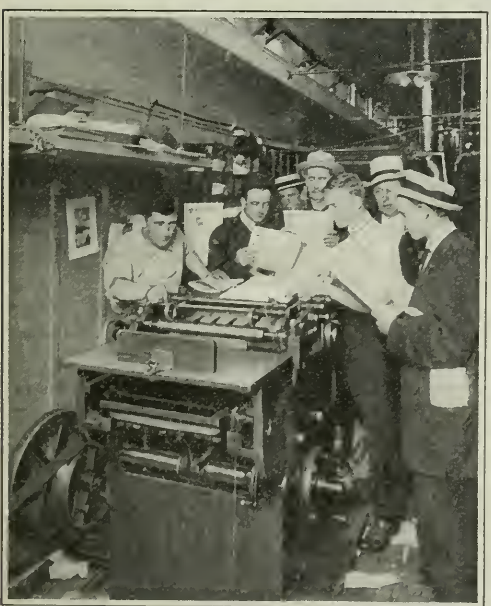
A miniature elevator lifted by a diminutive electric motor of one-sixth horsepower is employed in making the flight between the ground and the lofty bed chamber.



The owner of this sleeping nest cannot fly to his bed, like a bird, and so he installed an electric elevator

Publishing a Paper Aboard a Train

PERHAPS one of the oddest publications of recent years was that issued aboard a special train traveling between St. Paul, Minn., and Spokane, Wash. An entire printing equipment, including a linotype machine, a large cabinet of hand type and a printing press, was installed in the baggage car. The editors were selected from managers of the touring party and did their work in the parlor cars, and the paper was printed every day in the baggage coach. The press used was the first working model of a new type of machine.



While the editors wrote copy in the parlcr cars, the newspaper was printed every day in the baggage coach

America's First Thirty-Five Knot Battle-Cruiser

COMMON sense teaches everyone that speed, range, striking power and adequate armor protection, are essential in a fighting vessel and the ship in which these are combined to a pre-eminent degree most fully meets the ideal. But it is no easy matter to unite all these attributes in a single craft of a given tonnage. If a battleship is excessively armored, weight must be saved elsewhere—in guns, engines, etc. And so it happens that every fighting ship is more or less a compromise effected by the advocate of speed with the advocate of heavy guns and thick armor.

Although the developments in battleship construction have been exceedingly rapid, the greatest impetus was given about ten years ago when Great Britain came to the fore with the Dreadnought, a ship which mounted only big guns, namely ten twelve-inch rifles. She was fast too, for her speed was twenty-one and one-half knots, something unprecedented in battleships.

Soon the superdreadnought appeared, a vessel still faster, mounting still bigger guns, and still more heavily armored. Then came the battle cruiser, a formidable craft with a speed of twenty-eight knots—a type also first introduced by Great Britain.

These battle cruisers—vessels which mount somewhat fewer heavy guns than the superdreadnought, but of the same caliber, and which have somewhat lighter armor and the greatest speed that can be given to a warship are at last to be introduced in our own navy. If we were to engage now in a naval war with a foreign power, we would be hopelessly at a disadvantage, not only because of the fewness of our superdreadnoughts, but because we utterly lack battle cruisers.

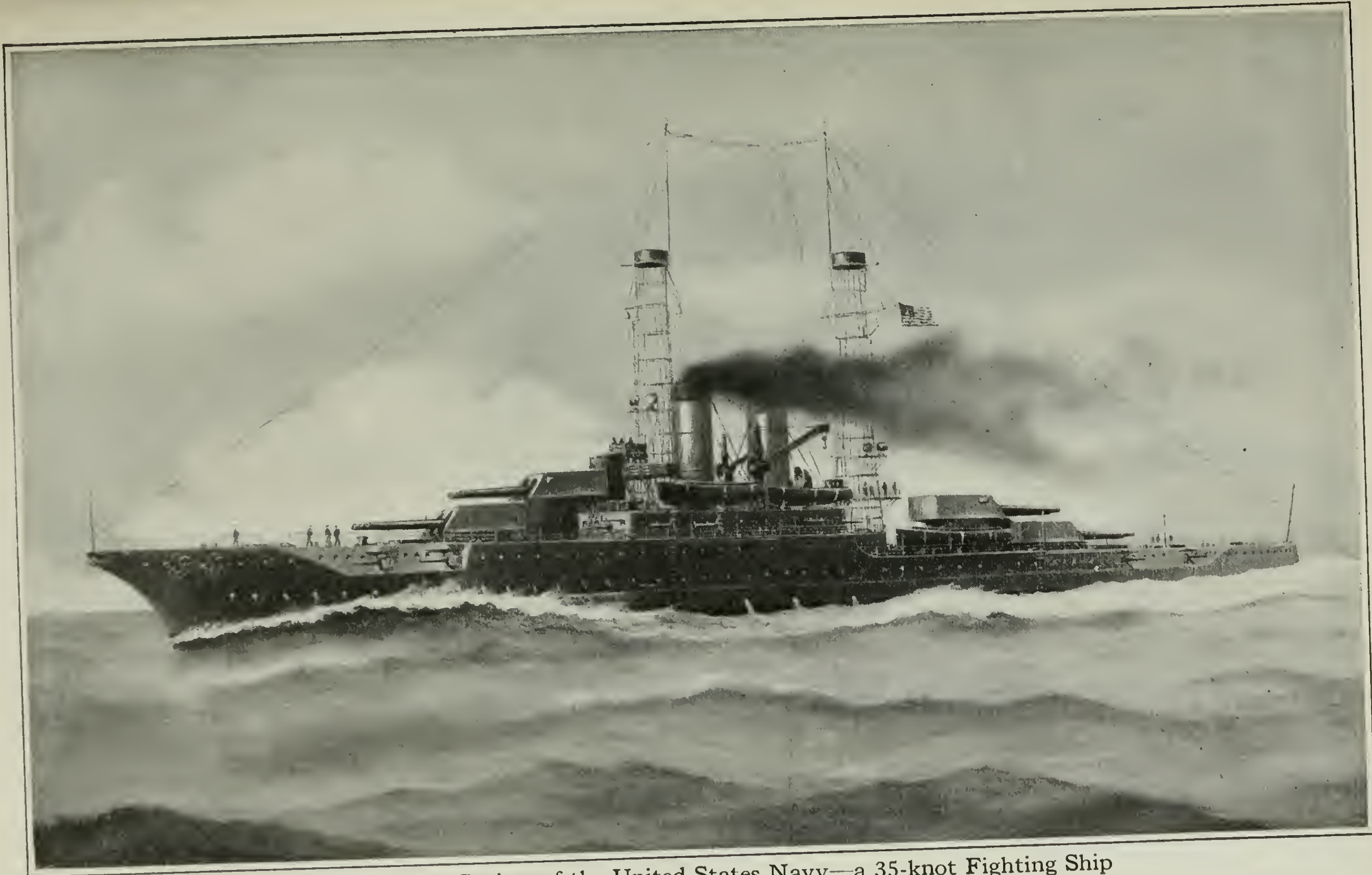
While no official announcement has been made of the principal features of these new ships, the Popular Science Monthly is in a position to present details which may be accepted as accurate.

Profiting by the lessons taught by the engagements fought off the Falkland Islands and in the North Sea, this new battle cruiser of ours is to have a speed somewhere between thirty-two and thirty-five knots. Obviously engines of enormous power are required to attain that speed, and so we may expect that one hundred thousand horsepower must be generated. Every additional knot means an inordinate increase in engine capacity.

Our unbuilt and unnamed battle cruiser will have eight fourteen-inch guns and twenty five-inch guns. At first blush it would seem as if the *Queen Elizabeth's* fifteen-inch guns must carry the day if these two ships were ever opposed. But our ordnance officers have made the statement that the new fourteen-inch guns which they have developed are the superior of the fifteen-inch guns at present used in the British navy—or statements to that effect.

The armor protection of the new United States battle cruiser is to be twelve inches amidships and four inches at the ends. The *Queen Elizabeth* has thirteen and one-half inches of steel on the waterline, ten inches above that and a top layer of eight and one-quarter inches. It is here probably that we had to make our sacrifice in order to gain the engine power and, therefore, speed. But if speed will enable our ship to pick out her own position and our guns have the greater range, the loss in armor protection is more than compensated for.

The *Lion* and *Tiger* are battle cruisers in the true sense of the word. Our ship will easily outdistance them. In tonnage there is not much to choose, for they displace thirty thousand tons as against the thirty-one thousand tons of our vessel. In armament we will be far superior. The *Lion* and the *Tiger* each mount eight fourteen-inch guns which are probably inferior in range to the guns of equivalent caliber on the proposed American ship. The *Tiger* has twelve six-inch guns and the *Lion* sixteen four-inch guns; but weapons of such small character play no part in a long range engagement and are serviceable chiefly for the repulsion of torpedo boats.



The First Battle Cruiser of the United States Navy—a 35-knot Fighting Ship

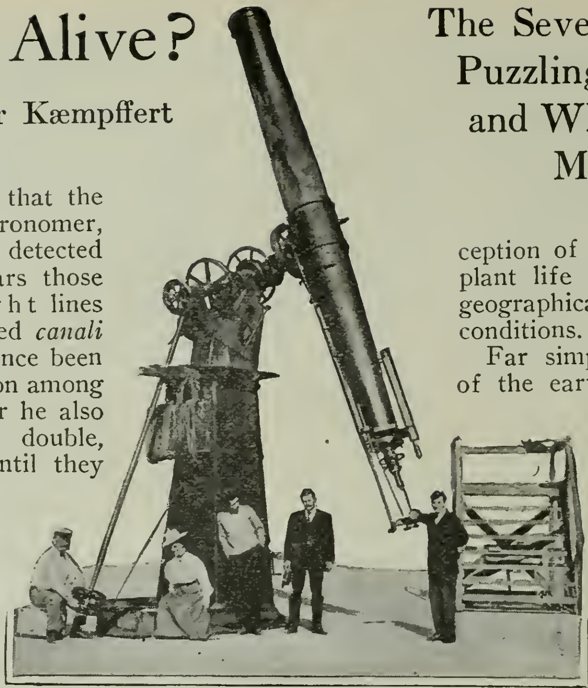
Length, overall, 730 feet; beam, 88 feet; maximum draft, 30 feet; displacement, about 31,000 tons; horsepower, 100,000; speed, 32-35 knots; armor, amidships 12 inches, ends 4 inches; main battery eight 14-inch rifles, secondary battery twenty 5-inch rifles; drive, turbine-electric

Is Mars Alive?

The Seven Hundred Puzzling Canals and What They Mean

By Waldemar Kæmpffert

IT was in 1877 that the Italian astronomer, Schiaperelli, detected on the planet Mars those curiously straight lines which he christened *canali* and which have since been a bone of contention among astronomers. Later he also saw his "canals" double, very curiously, until they looked like parallel railway tracks—something which has not been satisfactorily explained to this day. Now that Mars is about to approach the earth again, a number of observers, headed by Professor W. H. Pickering of Harvard, are to add their opinions to the dozens which have been delivered in past years, all without materially affecting the validity of Schiaperelli's work.



E. C. Slipher, of Doctor Lowell's staff, took this instrument with him to South America. The drawings of the "canals" made by Mr. Slipher with this instrument agreed in detail with those made at Flagstaff, Arizona

Although Mars can never approach us nearer than thirty-five million miles (which is much nearer than it will approach in February), we know more about its surface markings, in some respects, than we know about our own Earth. If the Earth were viewed as we view Mars, the only evidence of human handiwork that we could see would be the extensive grain fields of Canada and the United States. Of natural phenomena we would note the melting of the Himalayan and Rocky Mountain snows and the consequent flourishing of vegetation; the great caps of snow that cover the poles; the continents and oceans; and the clouds that girdle the Earth. If a Martian were asked to fathom the mystery of a planet of which he knew only these things, we would hardly expect him to form a very accurate conception of our animal and plant life or even of our geographical and physical conditions.

Far simpler is the task of the earthly astronomer who studies Mars. The planet is never obscured. No clouds, no veils of mist can dim the view; for the Martian atmosphere is ever dry, rare and severe, except around the melting caps. A weather prophet would have nothing to do on Mars. There is no weather—only the changes of the seasons.

Watching the Snows of Mars

Soon after the telescope was invented and used for astronomical observation it was discovered that there is snow on Mars. During each Martian winter great white caps settle down on the poles; during each spring and summer they dwindle and disappear. In the dead of winter these white expanses may measure thirty-three hundred miles in extent.

Besides the snow, astronomers long ago discovered that there are curious blue-green and russet areas on the planet. At a time when astronomy was not as advanced as it is now, the blue-green areas were supposed to be seas and the russet expanses continents, with the result that both were christened with picturesque but inapt names drawn from classical mythology.

Some years after Schiaperelli discovered the famous canals of Mars, Professor Percival Lowell established at Flagstaff, Arizona, an observatory, equipped with the best instruments obtainable for the special study of Mars. He has gathered about him a corps of observers, who have become wonderfully skilled in refined Martian observation; he has the advantage of viewing the planet in an atmosphere unsurpassed for clearness; he has made his observatory the fountain-head of all important Martian discoveries. To him we owe our remarkably detailed knowledge of the planet's surface markings.

The Seven Hundred Canals—What Are They?

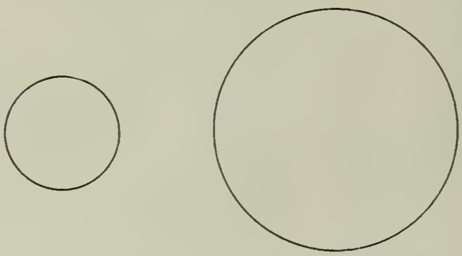
It was Professor Lowell who not only confirmed Schiaperelli's discoveries of the canals, but who plotted them accurately year after year and added to them until now their number is seven hundred and eighty-eight. It is he who originated and for more than twenty years has developed the theory that the canals are all that their name implies—artificial waterways constructed by intelligent beings. Perhaps it is because he has so persistently heaped one piece of evidence upon another to prove his theories that there is any Mars controversy at all. His opponents would probably be more inclined to accept the existence of the canals if he had not interpreted the markings of Mars in the way that seemed most natural and simple to him. It is certain that they accept without question the markings of other planets, plotted under the same conditions.

The distinguishing surface features of Mars are the snow caps at the poles, vast russet areas and blue-green regions between the poles, and the fine, straight lines which are known as "canals." Dr. Lowell holds that the straight lines are indeed "canals," and serve to conduct the water from the melting snows at the poles to the russet-brown areas, which are deserts, and cause them to flourish. Dr. Lowell's theory finds confirmation in the fact that portions of the russet-brown areas assume the characteristic blue-green hue of vegetation with the advent of Spring

The significance of the canals is apparent when it is considered that nowhere on Mars is there any water except at the poles. Ages older than the earth, Mars has arrived at a pitiful condition which may best be described as deadly aridity. Long ago much of the fertile area of the planet shriveled to an immense desert. Oceans, seas, and lakes leaked into the interior by way of caverns and crevices, leaving only parched basins. The atmospheric gases have in part floated away, so that the air has become as rare and as thin as we should expect to find it miles above the Rocky Mountains. Whatever water still remains, gathers in the form of snow or hoar frost at the poles.

Clearly, if Mars is inhabited, Professor Lowell argues, the one supreme task that engages the attention of every thinking being on the planet is the utilization of that pathetically scant supply of water. If it were possible to conduct the water of the melting snows in spring to those portions of the torrid and temperate zones that would still bring forth, if properly nourished, a race might save itself.

In the canals Professor Lowell sees the life-lines of the planet. They are to him great irrigating trenches which con-



The relative sizes of the moon and of direct Mars photographs are shown by these two circles. The size of the moon to the naked eye is indicated by the circle to the left; the circle to the right indicates the size of a direct Mars photograph before enlargement. This disposes of the usual contention that the Mars photographs made at Flagstaff are no larger than pinheads

duct the water of the melting snows to fertile fields thousands of miles away.

The Canals Are Irrigating Ditches

No more forcible argument in favor of this view can be advanced than their appearance and arrangement. Nature never works with mathematical precision. Yet the canals have been planned with mathematical foresight. No whim governed the choice of their direction. Invariably they terminate in large well-defined spots, from which they radiate like spokes from the hub of a wheel. If there were one spot, or even two spots, to which a pair of lines converge, we might look on the phenomenon as one of the natural features of the planet. But when more than a dozen lines run with geometrical directness to a single spot, and, when, moreover, the spots themselves are connected by lines and are in no sense isolated, we must assume that an intelligence has been at work.

Aptly enough the spots and lines are distributed in the very regions where we should expect a Martian engineer to place them; in other words just where water is needed. Were it not for their staggering length (fifteen hundred to four thousand miles), we should never see the canals at all. Viewed from a distance of more than thirty-five million miles even so large a city as Chicago or London would be no larger than the head of a pin. What we see is not really a waterway, but, as Dr. Pickering and Dr. Lowell has pointed out, the vegetation that fringes its banks.

Curiously enough, the canals disappear at intervals, only to reappear with their old clearness. On the face of it this would seem in itself an unanswerable refutation to any theory which assumes that the canals are irrigating ditches. It would be absurd for a hypothetical race of Martians to dig canals periodically, only to fill them again. But Dr. Lowell explains the disappearance very simply. What we see is but the seasonal growth of the vegetation along the banks. Time is required for the water of the polar seas to make

Size of Moon to naked eye

The relative visible sizes of the moon and Mars. In the small circle is a photograph of the moon (the size which it appears to the naked eye). In the large circle, is a drawing of Mars exactly the size which it appears through the telescope with a power of 392 diameters—the lowest used itself felt; weeks must elapse before sufficiently luxuriant vegetation has sprung into being so that the courses of the canals can be traced each spring and summer. And the peculiar manner in which the canals seem to creep down from the poles at the rate of two and a half miles an hour lends color to the explanation.

Dr. Percival Lowell, who erected at Flagstaff, Arizona, the finest private observatory in the world for the special study of the planets. Here for many years he has made those observations of Mars which have made him the foremost authority on that planet in the world

The Growth and Death of Vegetation on Mars

This elaborate network of sluices divides the planets into plains of more or less geometrical shape. Blue, green and orange are the colors of these plains—colors that proclaim the character of the areas in question. The blue-green areas are fertile regions fed by the canals; the orange sections are deserts, hopelessly arid. This distinction Professor Lowell draws by reason of the peculiar fluctuations in hue which the blue-green patches undergo with the advent of spring and winter. As autumn approaches they assume a russet tint, which renders it almost impossible to distinguish them from the orange deserts. When the polar snows begin to melt they gradually deepen in shade until they assume the characteristic color of vegetation. Inasmuch as these changes are closely linked with the waxing and waning of the canals, it is evident that the one phenomenon is dependent upon the other.

That the spots toward which the canals converge are the objective points of Martian irrigation, is demonstrated by the scientific precision with which the canals have been drawn to meet them. Not a solitary spot is anywhere to be found. Three, four, six, even seventeen canals concentrate their floods on a single spot. In diameter the spots range from seventy-five to one hundred and fifty miles. Like the canals they have been designed with geometrical economy. If there are cities on Mars, it is not unlikely that they are situated in these spots.

Like the canals the spots disappear with the approach of winter; but before they are extinguished the canals have faded away. This is as it should be. Before our time the spots were thought to be lakes and were named accordingly. Professor Lowell regards them as oases studding the Martian deserts. Lakes would never deepen in color; only vegetation can cause the characteristic fluctuations to which the spots are subject.

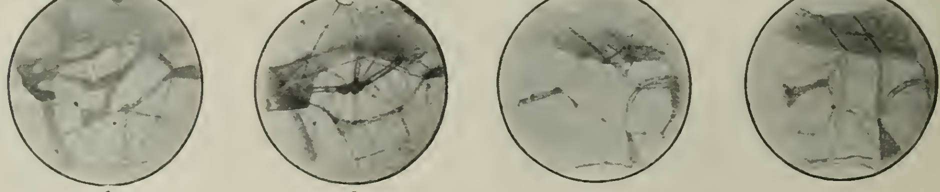
Are the Canals Real or Merely Illusions?

The amount of ink that has been spilled over the canals and their meaning would fill a hogshead. Many astronomers deny that the canals exist at all and regard them as optical illusions produced by eye-strain. But none of these skeptics has had the opportunity of studying Mars night after night in a clear atmosphere, far from the smoke of cities. Doubting astronomers who have troubled themselves to journey to Flagstaff or other well-situated observatories are speedily convinced that the canals are objective realities and not illusions. Until 1907 the Flagstaff observatory was the only one devoted to the study of planets and especially equipped and maintained for that purpose. In that year M. Jarry Deloges, at the suggestion of Flammarion, started an investigation of Mars in France and Algeria. The result was an astonishing confirmation of the Flagstaff observations. So similar are the drawings of the Martian disk made nearly seven thousand miles apart that one set might well be taken for a copy of the other. If any evidence were needed to prove that the canals of Mars are real, it is surely found in the *actual photographs* which were first made ten years ago at Flagstaff by Mr. Lampland of Doctor Lowell's staff, and which have been duplicated over again by others since then. Unfortunately the detail in these pictures is so very fine that they cannot be satisfactorily reproduced in the pages of a magazine such as the Popular Science Monthly.

It must be admitted that it is not everyone who can see the canals. The man who is a successful observer of faint stars may be quite unable to detect fine planetary detail for structural reasons. Moreover, big instruments, especially in high latitudes, are rather a hindrance than a help in observing Mars.

Granting that Doctor Lowell and his followers are right and that Mars is a living world, what manner of beings are these who have dug canals to water their planet? Unfortunately, no adequate conception of a Martian's physical appearance can be formed, although Edmond Perrier, a French academician, some years ago boldly declared that they must be very tall and very blonde. Romantic guessing is not scientific deduction. Doctor Lowell in one of his earlier works shows that, while we can never hope to draw a picture of a Martian, we can at least deduce something about him because Mars is a small planet.

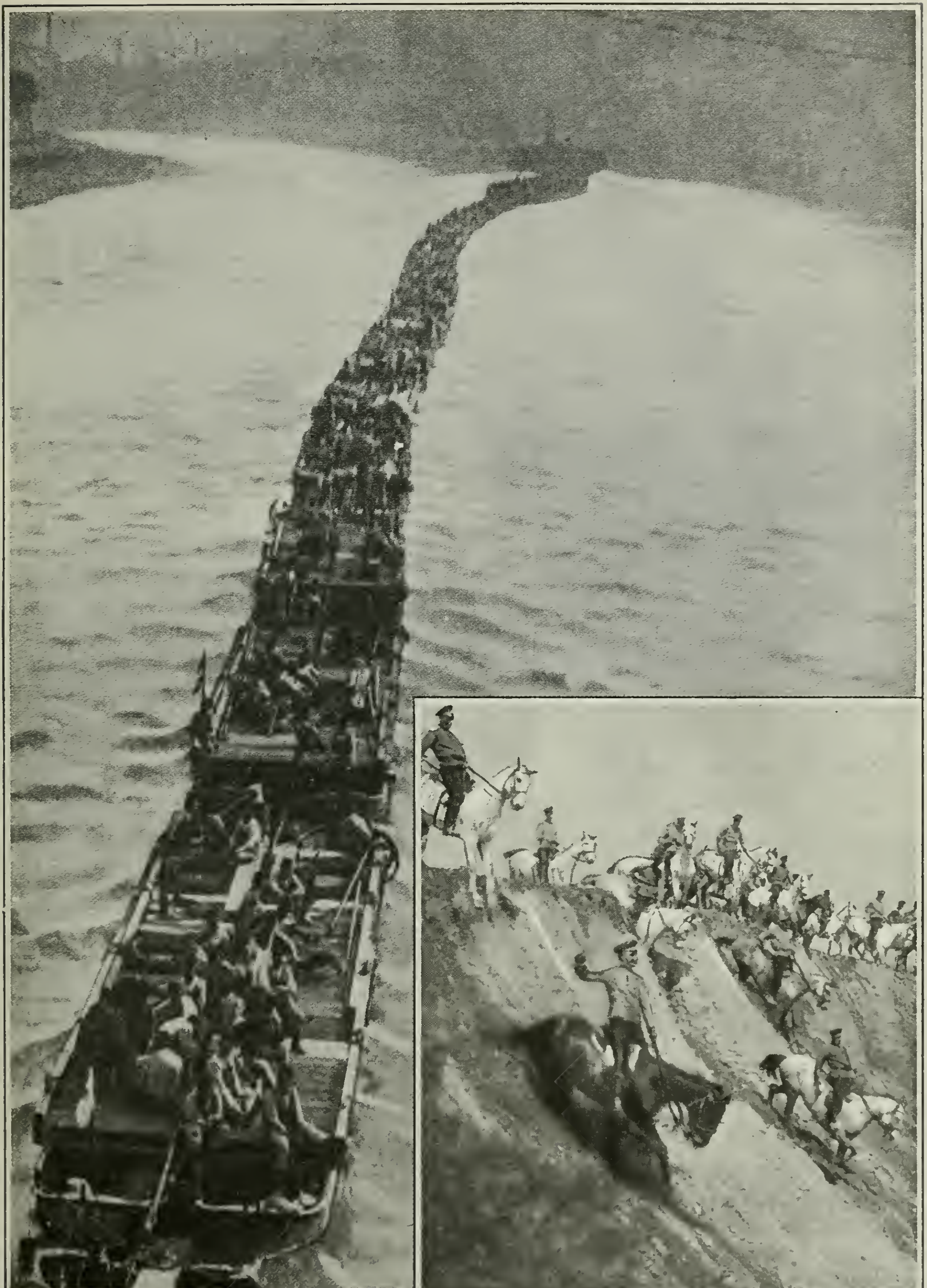
The bigger the planet on which you live, the harder it is for you to move about. A steam crane would be a welcome assistance in moving your body about on Jupiter. This is due entirely to the enormous gravitational attraction of Jupiter. The bigger the planet the harder are you pulled down to its surface. Mars is only one-ninth as massive as the earth. Hence you would weigh much less on Mars than you do on the earth. A Martian porter could easily carry as much as a terrestrial elephant. A Martian baseball player could bat a ball a mile. Because his planet is not able to pull him down with the attractive force that the earth exerts upon us, the typical Martian has conceivably attained a stature that we would regard as gigantic. Three times as large as a human being, this creature has muscles twenty-seven times as effective. His trunk must be fashioned to enclose lungs capable of breathing the excessively attenuated Martian air in sufficiently large quantities to sustain life. As a canal digger—assuming that he had no machinery—he would be a great success, because he could excavate a canal with the speed and efficiency of a small Panama steam shovel.



1 2 3 4

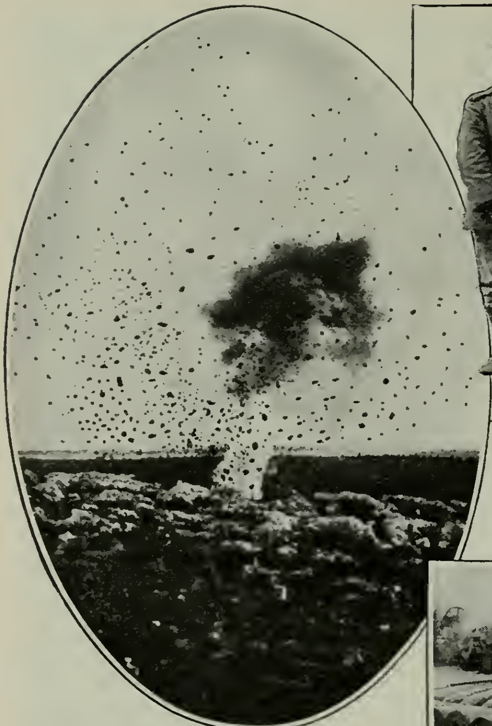
These drawings of Mars were made under different conditions by observers who knew nothing of each other's activities. And yet the pictures agree in their essential features. Drawing No. 1 was made October 21, 1909, by E. C. Slipher, of Doctor Lowell's staff, at Flagstaff, Arizona; drawing No. 2 was made by Jarry Desloges four thousand miles from Flagstaff on November 13, 1909; drawing No. 3 was made on January 21, 1914, with the Lowell 46-inch reflecting telescope, a magnifying power of 365 being used; drawing No. 4 made by Mr. Slipher about one hour later on the same night with the same instrument and the same magnifying power, shows the same important features

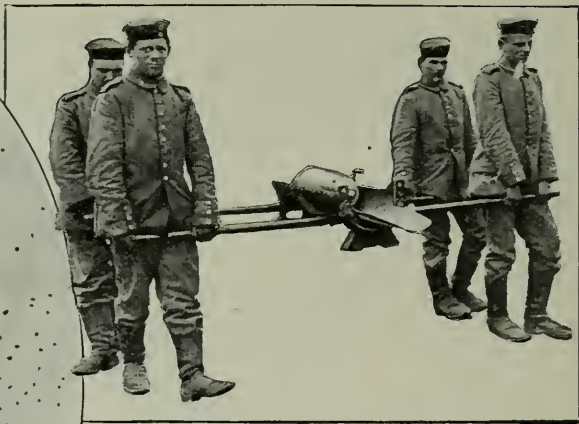
A Bridge of Boats



Towing a French pontoon to its proper position—work often done under fire. The bridge is practically completed before it reaches its destination. On arrival, it is anchored and the remaining flooring is laid to connect the different sections. (In the insert.) Cavalry shrinks from nothing—not even steep embankments. The horsemen in the picture are Russian Cossacks who are noted for their daring exploits

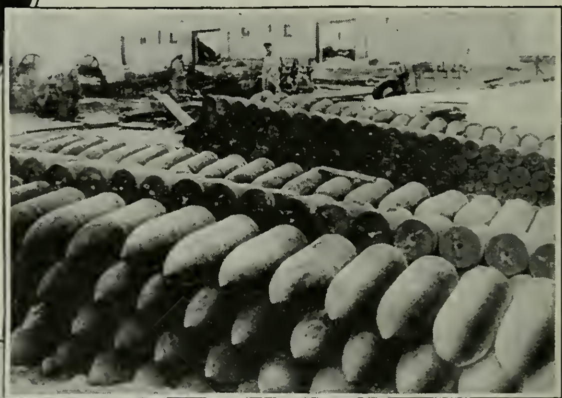
In this War of Big Guns

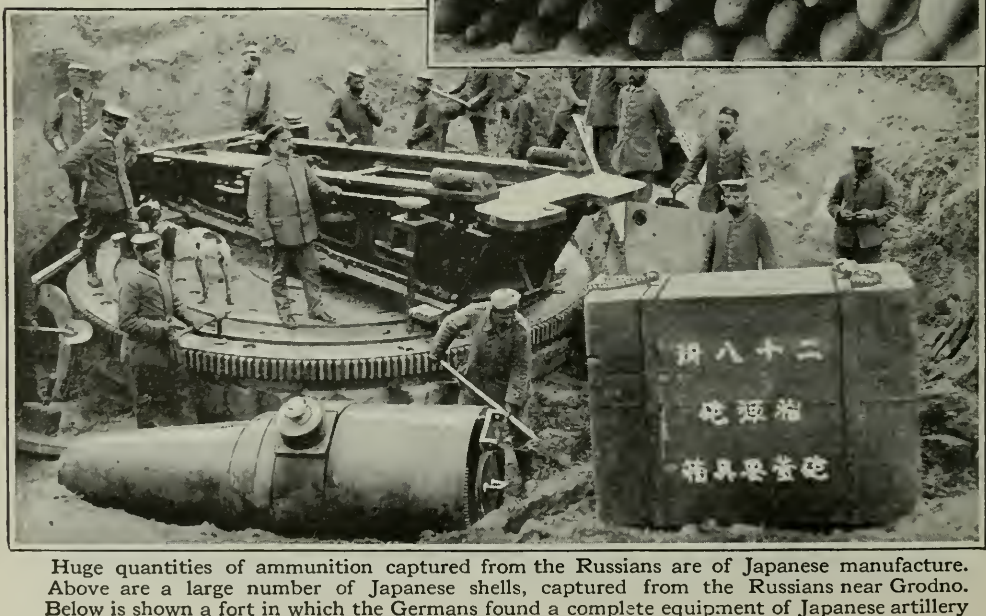




German artillerymen carrying a heavy 21-centimeter (8.4 inch) shell to the big gun emplacements which line the Russian front

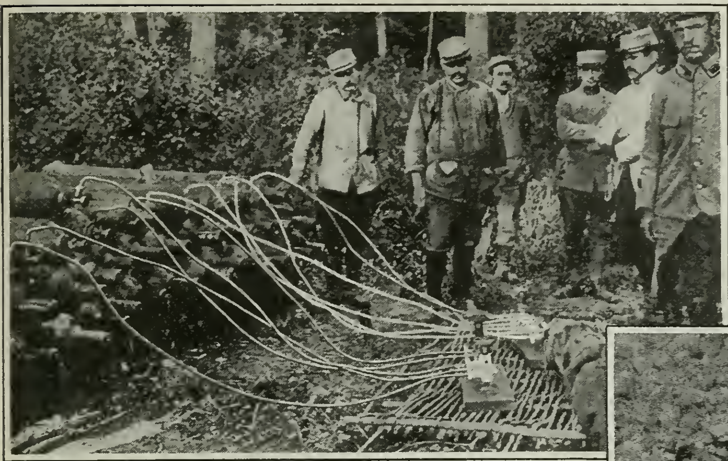
An Austrian shell bursting close to the Italian trenches. The photographer who snapped this picture was buried under the earth thrown up by the explosion, and two men standing beside him were killed



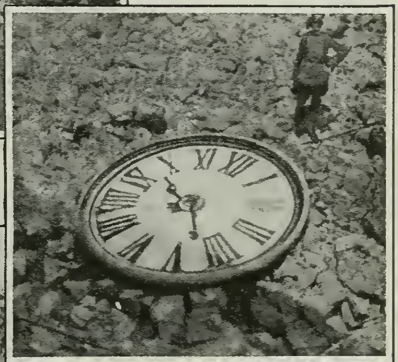


Huge quantities of ammunition captured from the Russians are of Japanese manufacture. Above are a large number of Japanese shells, captured from the Russians near Grodno. Below is shown a fort in which the Germans found a complete equipment of Japanese artillery

Curious Phases of the War



Filling a French captive balloon from cylinders of hydrogen gas. The invention of this form of gas container permits of much more rapid filling of balloons, and dispenses with the old cumbersome generating plant which was formerly used



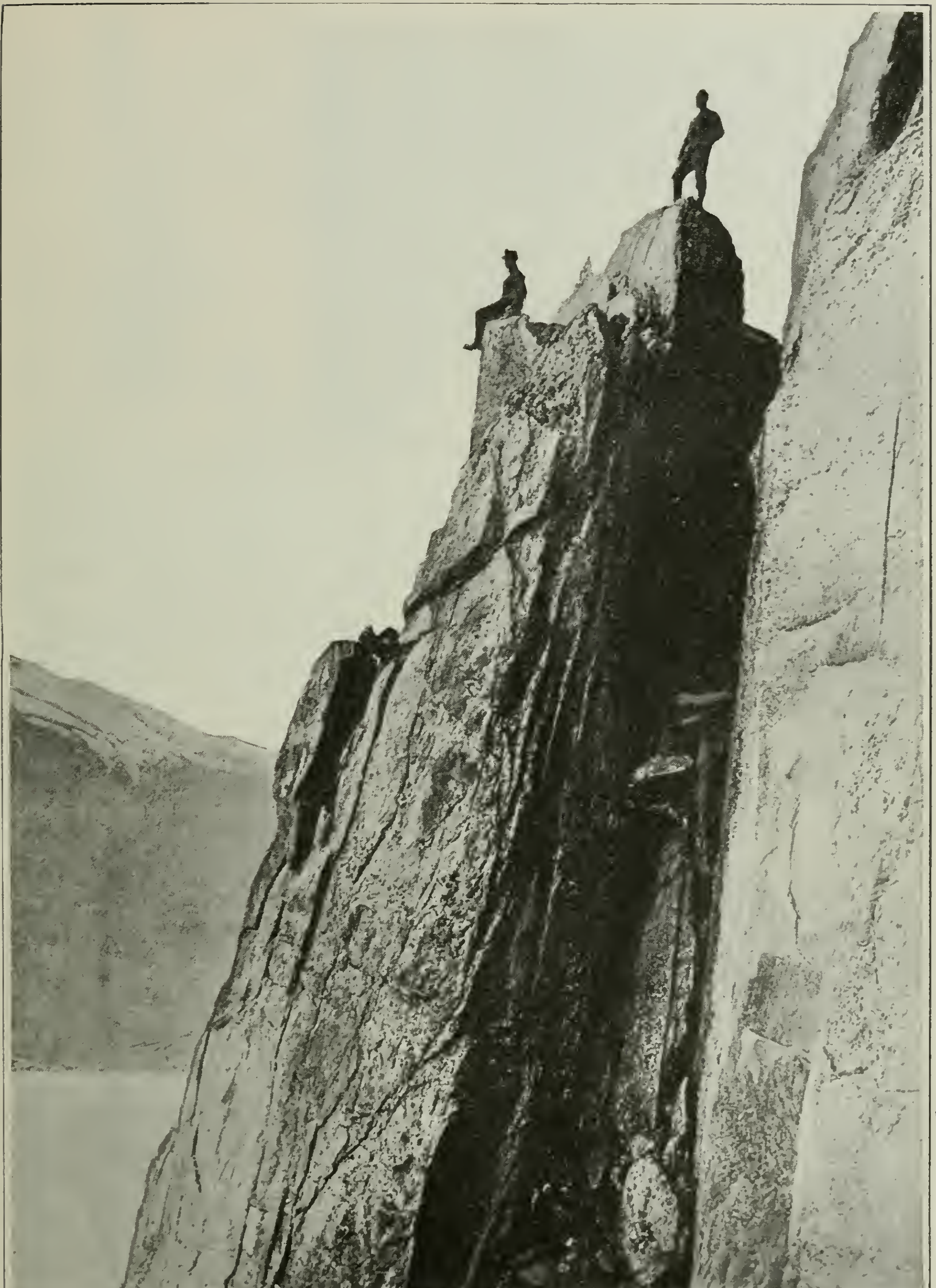
The clock of a destroyed belfry at Monfalcone, which continued to go for three hours after it fell

These field kitchens in the Aisne country have been concealed in caves by their French cooks, who are preparing meals as calmly as though they were at the Cafe de Paris

(At Left.) An incendiary bomb which fell on a London house during a recent Zeppelin raid

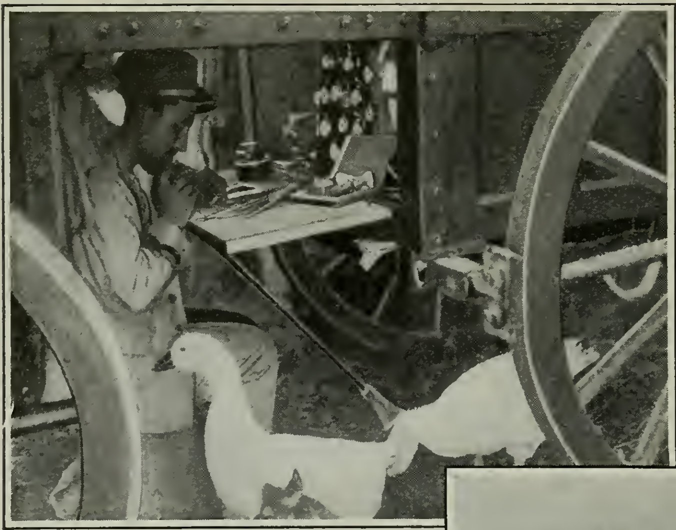
Where the Austrians and Italians are Fighting

The Italian army, with enormous effort, and overcoming difficulties the like of which are unknown on any other front, is endeavoring to drive the Austrians from their mountain strongholds. At present the action around Goriz, or Gorizia, holds the center of the stage, for unless they capture this fort, the Italians cannot hope to take Trieste. In the illustration, the Austro-Italian border is indicated by the broad white line. The heights of the mountains are indicated in feet



Austrian outposts watching the movements of Italian troops. Imagine the difficulty of storming this spot! Yet the Italians are every day attacking a seemingly impregnable mountain top. The suffering on both sides in the Alpine campaign is terrible, for the cold in the high altitudes is most penetrating, and snow-storms sweeping through the mountains cause the loss of many lives in both the contending armies

War Trades Practiced at the Front

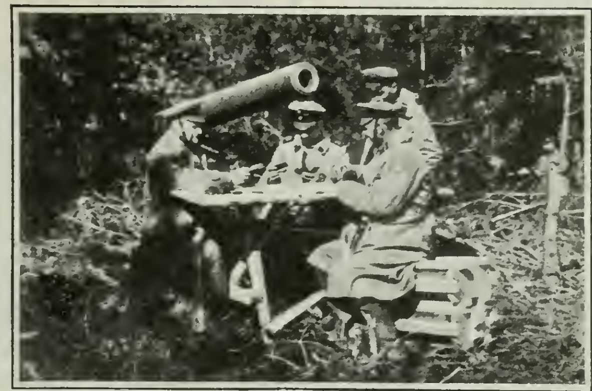


An odd watchmaker's shop. An Italian watchmaker who had been called to the colors took up his trade again when he arrived at the front. Underneath an army wagon he set up his shop

Many visitors to the trenches have brought away cigar lighters made of two cartridges. In one is placed the gasoline and wick, while the bullet of the other contains flint and a steel friction wheel

An outdoor blacksmith shop among the sand dunes near Ostend (below). Most of the German troops occupying the stretch of land along the coast of Flanders are sailors from the idle fleet. Their presence at the front has released a great number of soldiers for use along other sections of the line

Guns and Games at the Front



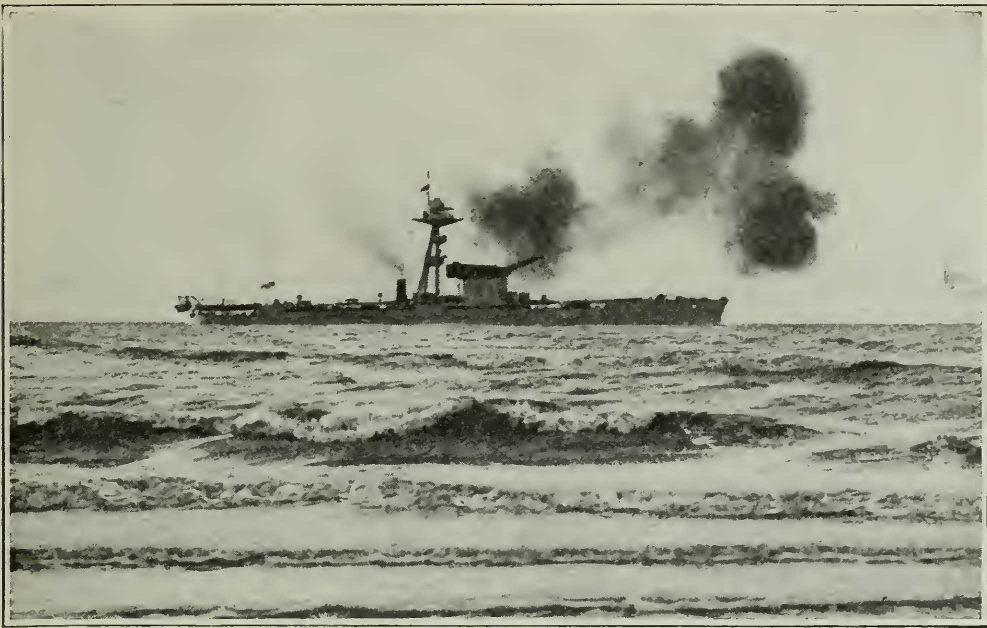
A card game at the cannon's mouth. These German officers are enjoying themselves while awaiting an attack upon their concealed gun emplacement

Bulgarian artillery being set up in the field. The Bulgarians were equipped with French Creusot guns during the Balkan wars. It is quite probable that they are still using these powerful guns

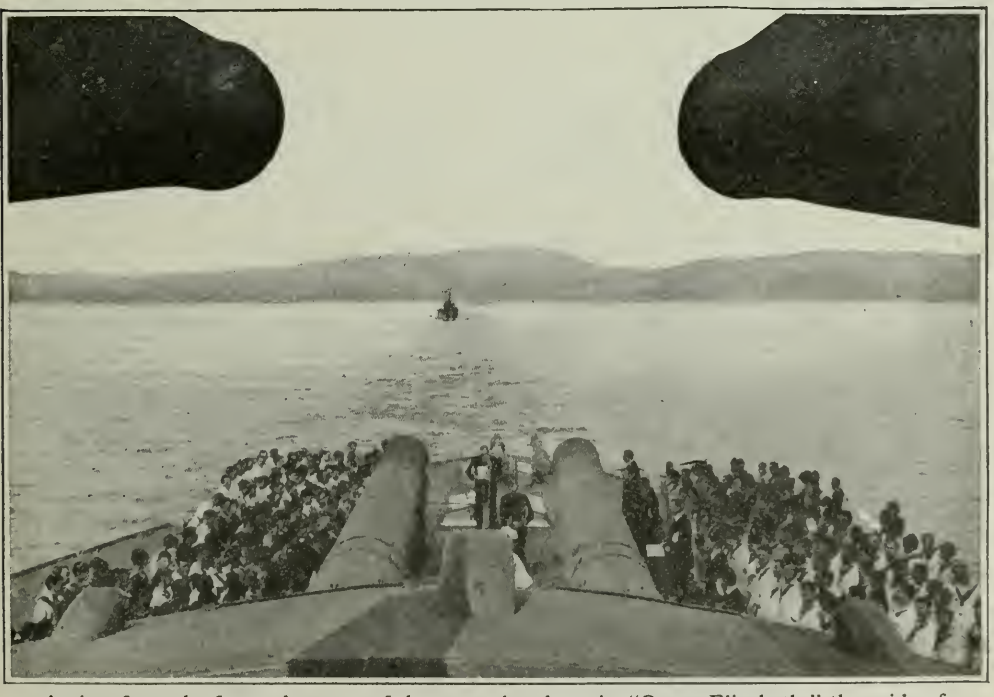
Cartridge belts for machine guns captured from the Russians. In spite of the tremendous losses in equipment, the Russians seem always able to secure enough to recoup their losses. The Japanese are now supplying the Czar's forces with war material to renew the equipment lost in last summer's retreat

Building a mountain. This is not a ruined temple in Central America, but fodder stacked by Russian Prisoners for the use of German horses during the winter campaign. The Russians have gladly accepted the opportunity to work outside the war prisons

Caves are now used along the whole western front for the storage of explosives. With the aid of aeroplane scouts, gunners have been remarkably successful in dropping shells upon the ammunition stores of the enemy. Hence the need for caves



The first photograph ever made of one of the new British monitors in action. These craft are equipped with one fourteen or fifteen inch gun, and are very effective for coast bombardment. Six first-class monitors may be built at the cost of one super-dreadnaught, and are useful for coast attack as in the Dardanelles



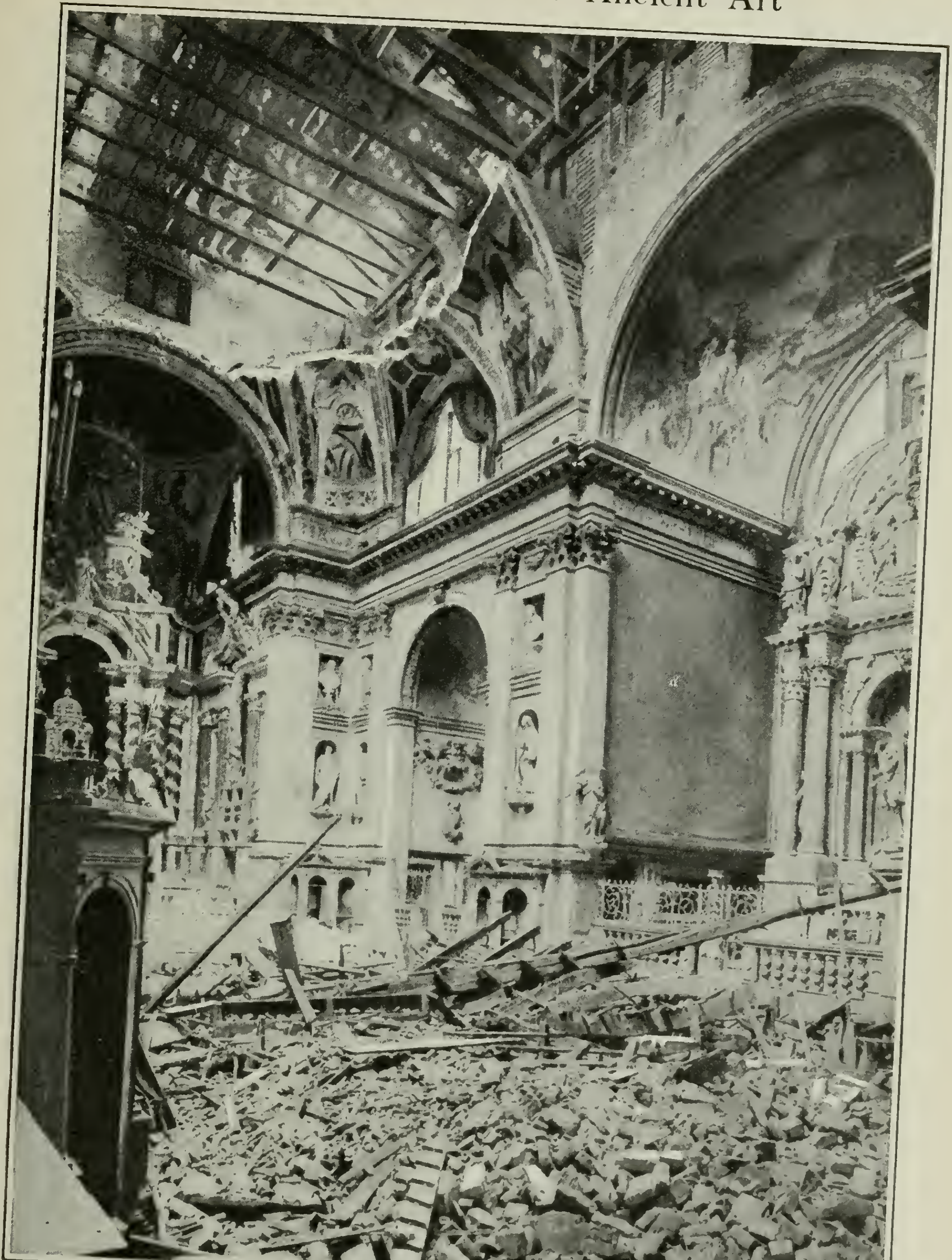
A view from the forward turrets of the super-dreadnaught "Queen Elizabeth," the pride of Great Britain's navy. The huge fifteen-inch guns shown throw a heavier shell than has ever been shot from a battleship before. During a bombardment in the Dardanelles, these great guns hurled their one-ton projectiles over a distance of nearly fifteen miles

Searching for the Best Respirator and Mask

Styles in poison gas masks change more rapidly than Parisian styles in bonnets. Officers and men are constantly searching for a more efficient mask which will enable the soldiers to resist the thickest clouds of asphyxiating gas. The favorite method of testing the efficiency of a new mask is to call for volunteers, who descend into a tunnel which is filled with the deadly fumes. Many volunteer to perform this hazardous experiment, though the outcome is uncertain at best. They know that it may mean the saving of many lives, even if it is at the actual sacrifice of their own. More and more the war resolves itself, in its minor phases, into battles of science, and science demands a laboratory. Here is the laboratory of the respirators

If these men come out of the gas-filled tunnel unaffected, the mask will perhaps be adopted. At least, it will be given a further trial. We have not heard how many of these devices have been tested in this manner and found faulty, but it is certain that many soldiers would rather be in the trenches than in a gas-filled tunnel with an untried respirator

What War Means to Ancient Art



During a recent aerial attack upon Venice by the Austrians, a high explosive bomb fell upon the Church of the Scalzi and completely ruined the wonderful ceiling decoration which was renowned throughout the entire world. According to an art critic who examined the church, "Nothing but fragments of dust remain, and the loss is irreparable"

Women Shouldering the Burdens of War

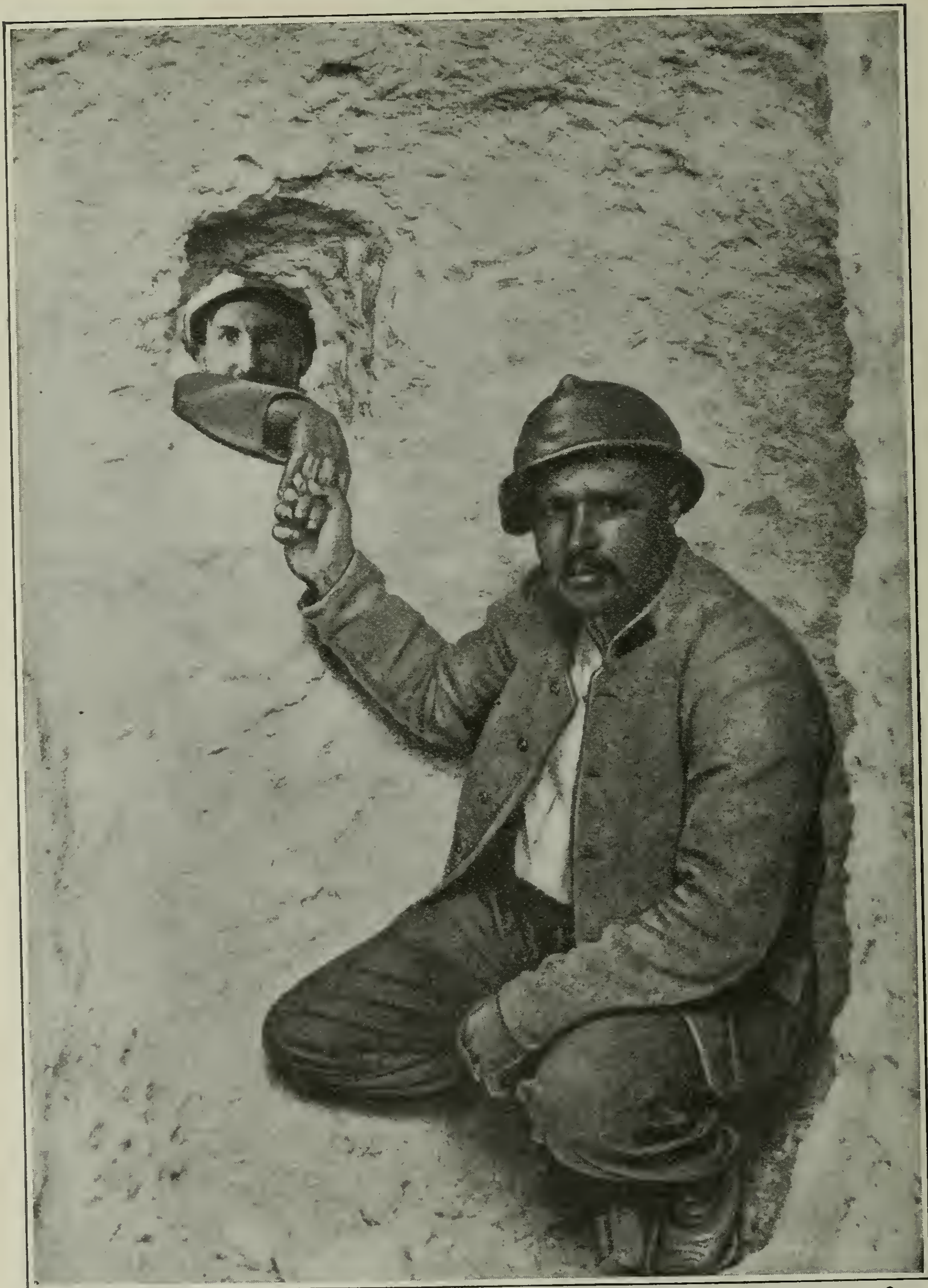
A Serbian girl who is a pumpkin dealer. Serbia is now destitute of men in civilian occupations to a greater extent than any other of the warring nations

A modern Delilah. Yet they say that the war is touching London lightly!

Loading bags of coal for several hours a day can be considered a good day's work for the strongest man. Very few women would envy these Scotch women who are so valiantly taking the places of their fighting husbands

An Artillery Shell Used as a Bomb

Preparing a huge 220-millimeter (8.8 inch) shell for use as an aeroplane bomb. The French have adapted some of their artillery shells so that they may be dropped from aeroplanes during their frequent raids over German territory. A percussion cap takes the place of the time fuse, and wings are placed at the large end of the projectile to keep it true to its course

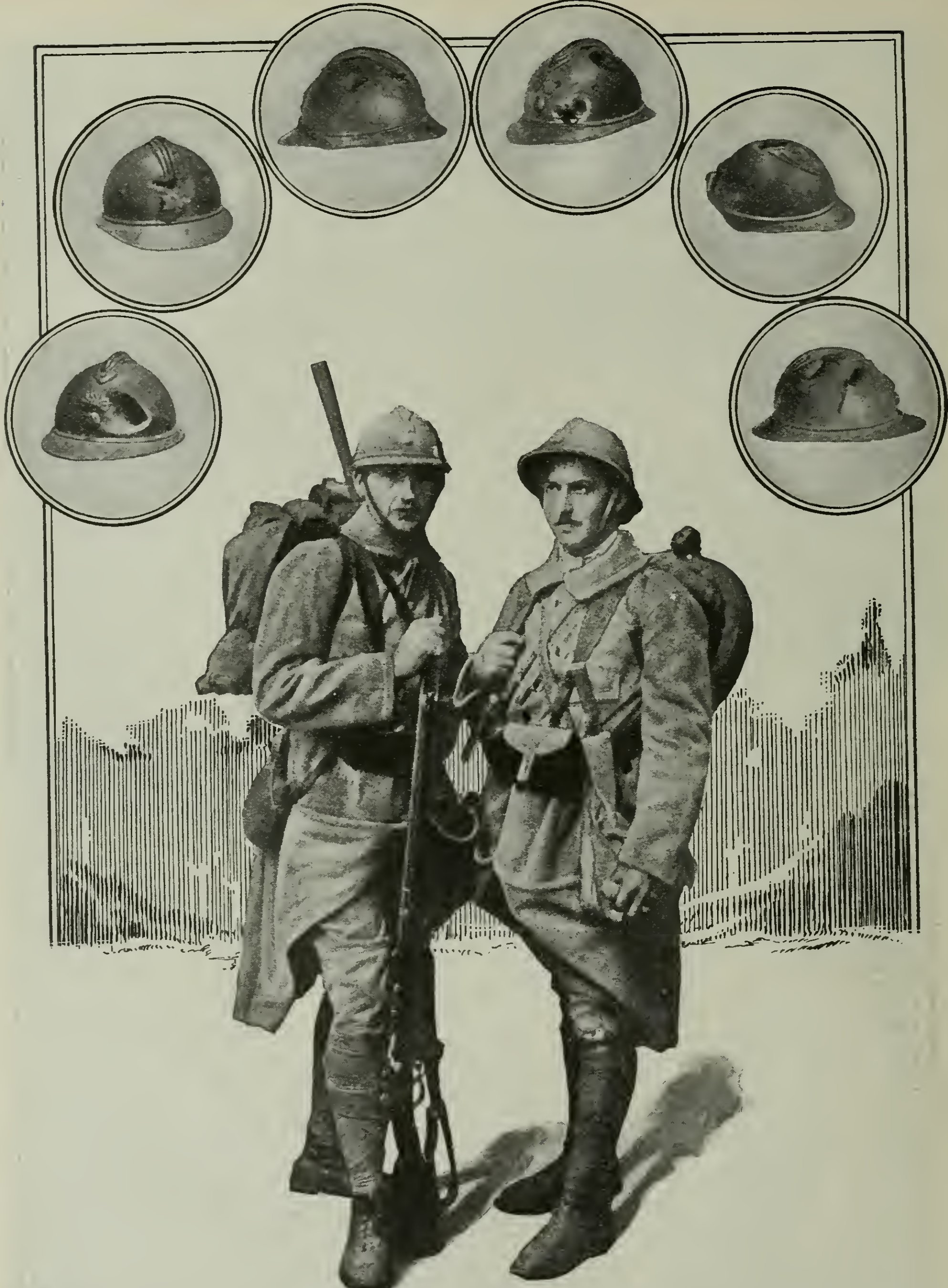


A subterranean passage connecting two distant French trenches. Such is the danger of being shot by enemy sharpshooters while passing from one trench to another, that long communicating tunnels are dug. Sappers start from both ends, and meet in the middle. The illustration shows the first connection between tunnels which have been begun a considerable distance apart, and which are about to be united

The battery of pumps above is used to draw the water out of a flooded trench. One motor pump would draw more water and in less time, and the German army is equipped with thousands of power driven pumps. Many of these hand pumps bear American trade-marks, and much of the piping was made in this country also

On the right is an improvised open-air bath. A whole book could be written on the inventions of all armies for keeping clean under difficulties which vary with every new station, and with the ingenuity of the soldiers

The French Helmet's Practical Success



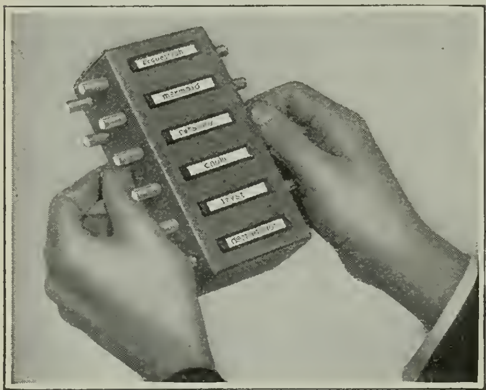
The new field equipment of the French infantryman. The French have gone far in their efforts to substitute for their comic-opera uniforms of blue and red a practical fighting costume, and they may now be considered as well clothed as any soldiers in the field. The steel helmet is the latest addition, and met with instant favor among the fighting men. The helmet is admirably designed, and tends to prevent the multitude of head injuries which have swelled the mortality rate. The illustrations of damaged helmets show the remarkable strength of this head-gear, for in all cases shown, the soldier was only slightly wounded by missiles which would otherwise have killed him

Collecting copper and brass is still in vogue in Germany. The little boys of the large cities enjoy the work; they look upon it as a new sort of game. All copper and brass utensils are bought by the German government and market prices paid for the metal

The Christmas spirit, strange as it may seem, was prevalent in the very trenches that are the scenes of the greatest slaughter. In many parts of the battle line foes became friends for a few hours, and after exchanging greetings and cigarettes, went back to the deadly game of killing each other. Here we have a picture of Father Christmas, a soldier, on his way to present the children of a half-ruined village with a few simple toys made by his comrades

A Machine That Thinks Up Movie Plots

NEARLY every one of us believes that in the back of his brain he has a perfectly good moving picture scenario that awaits only the chance to be flashed upon the screen. He is now given an opportunity to produce, by the demand for scenarios in a field where hundreds of new stories are filmed every week. And now comes an opportunity,



Turn the handle and new words appear on the face of this machine—words that suggest plots for motion picture plays

in the form of a plot manufacturer, for those without ideas, a compact little cardboard box that contains more plots than the moving picture people could use in a hundred years.

The "movie writer" as it is called, is exceedingly simple. Arthur F. Blanchard, of Cambridge, Mass., who is a Harvard graduate, is the inventor, and he believes his machine will revolutionize literary art. The device consists of a modest cardboard box six inches long, three inches wide and two inches deep. Half a dozen slots are cut in the top surface, beneath which revolve spools of paper upon which are printed several thousand scientifically selected words. Handles project from either side which are turned at will.

The word in the top slot is an adjective, that in the second a noun, the third a verb. Next comes another noun (the subsidiary character) and then follows a word expressing a *denouement*. Each knob is given a few twists, either selectively or at random, and a complete plot, perhaps extravagantly impossible, perhaps hackneyed, or perhaps new and useful, turns up. But at all events there will be a plot. Here are a few samples; imagination must supply the details.

Beautiful, stenographer, bribes, customs officer, adventure, recall.

Benevolent, steward, captures, empress, affair, reflection.

Chivalrous, stranger, dares, governess, alliance, repentance.

Cowardly, author, deceives, editor, anguish, rejection.

Bold, beggar, blackmails, broker, brawl, banishment.

As a toy, the mechanical plot creator also has its uses. With each person at a dinner provided with one of the machines, a story can be started by the first person, the others following in turn, each based upon the preceding one and carrying the story. It remains to be seen how many successful picture plays result from the use of this invention.

A French Motor-Tricycle Sweeper

JACQUELIN, the French champion cyclist, has conceived the idea of attaching a rotary brush to the back of the motor-tricycle. His novel combination attracts much attention, in operation upon the streets of Paris.

To a light frame, made over steel tubes, the motor-tricycle is attached, and this frame holds the brush and is driven by a chain from the rear axle of the cycle. A basket of the proper shape lies next to the brush so as to receive the sweepings, as the work proceeds.

That a professional cyclist should have invented this street-sweeper is natural. But why use muscle when gasoline motors are cheap?

The Latest Style in Handcuffs.

LAWBREAKERS may be nipped in the bud most effectively by the police nippers invented by John J. Murphy of Norwich, Conn. The police nippers or "leaders," as they are sometimes called, are clasped about the wrist or even the ankles of the arrested man.

The advantage of the new nippers is not alone in their effectiveness but also in the fact that they may be quickly and easily operated with one hand. The closing of the hand about the handle portions of the nippers causes the jaws to close. These are pivotally connected by opposed extending arms with a sliding tubular member attached to the T-shaped inner handle. This tubular member slides on a basic rod to which the outer T-shaped handle is mounted. It takes but an instant to clasp the nippers on the wrist of an offender.

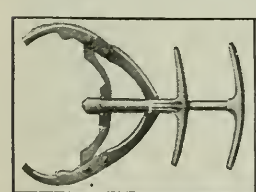
Have You Eaten Your Cow?

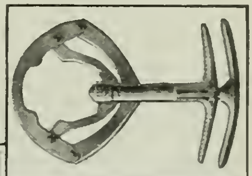
EVERY man, woman and child in the United States eats, each year, a whole steer, sheep or hog, according to United States government figures, which show that one hundred million meat animals are slaughtered in this country each year.

Of one's beef, mutton or pork, however, one has to give up one and one-half per cent, on account of condemnation by government and city officials, for this proportion of the meat slaughtered is thrown out as unfit for use. The federal inspection covered, last year, fifty-eight million meat animals slaughtered, and condemned 299,958 whole carcasses, and 644,688 in part. This represents considerably more than that number of cases of ptomaine poisoning which government inspection saved Americans, but it also represents a considerable saving in other diseases.

Tuberculosis was the chief disease condemned, 33,000 beeves and 66,000 pork carcasses being entirely condemned and parts of 48,000 other beeves and 440,000 other swine being removed. Hog cholera was responsible for the next largest loss, nearly 102,000 swine being condemned entirely on this account.

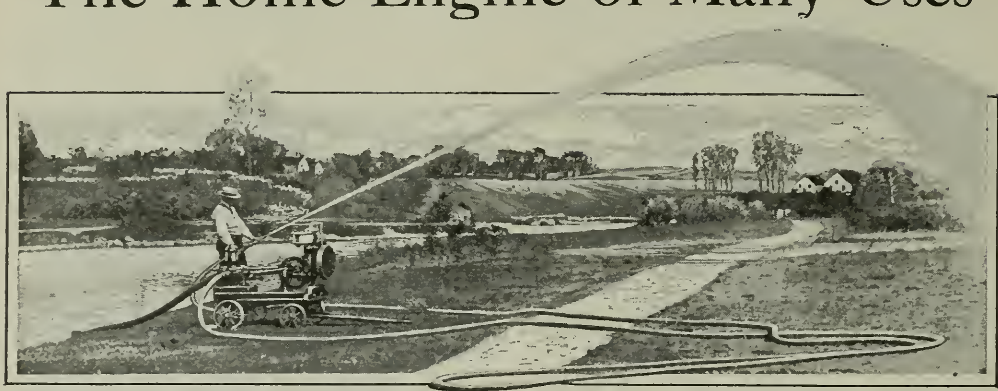
It cost the taxpayers $3,375,000 for this protection, or four cents a head for the population of the country, which was paid for when they bought their beef, sheep or hog for the year. In selecting one's diet for the year one should bear in mind the additional fact that over half the number of food animals inspected by the federal government last year were hogs.





It will be difficult for a thief to escape the clutch of the law if these new "nippers" are adopted, for they can be quickly and effectively operated with one hand

The Home Engine of Many Uses



The portable gasoline engine makes possible the watering of lawns and parks where the source of water supply is a nearby lake or stream

THE farmer is probably buying more gas engine horse power to-day than any other half dozen general classes. Besides being the most generous purchaser of motor cars and practically the sole buyer of tractors, he purchases the greater part of the half million stationary and portable engines turned out annually by several hundred American manufacturers.

Few farms are now without a gasoline or kerosene engine—many have two, and some of only fair size have five or six, all busy. The average size of engine is increasing rapidly (now probably about six horse power) and as farmers become more familiar with them, these handy power plants are daily put to a more varied and more nearly constant use.

The great majority consume gasoline. The danger of a gasoline famine, so imminent a few years ago, has been averted for the present, at least, and the heavy-oil engine has not made much headway in the small units adapted to the farm.

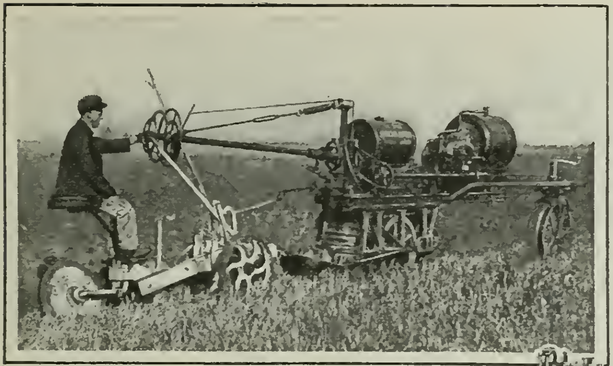
Farm engines, other than tractors, are almost wholly of the single-cylinder type, both vertical and horizontal being widely used. Some manufacturers make both, not only to give the farmer his choice, but to provide more than one dealer in a town with an "exclusive" agency.

Most of these engines are stationary or semi-portable, i. e., mounted on skids. Many are portable (on wheels), and this is especially true of the larger sizes. The usual range is from one to thirty horse power. Roughly speaking, skid-mounted engines range from one to eight horse power, and the portable from ten to thirty-five horse power or larger. The tractor has taken the place of many of the larger portable units, and is rapidly encroaching on the smaller portable field. However, there is a growing demand for the light-weight, high grade throttle governed type, so easily adaptable to many uses.

The versatility of the gasoline engine in the farmer's hands is really remarkable. A one horse power model may play the part of a chore boy about the house, while a larger size may be at work around the barn and a still larger one be doing heavy work somewhere in the open.

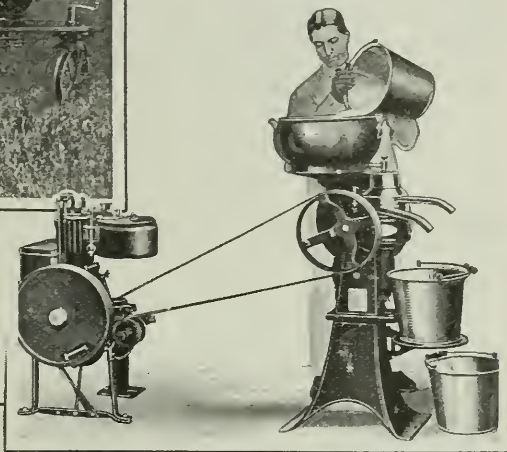
The washing machine, cream separator, sewing machine, churn, grindstone and some of the lighter machines in the workshop call for the smallest engines. A two or three horse power engine may be the mainstay of the farm water system and run the milking machine. The electric lighting plant, plus the work just mentioned, may call for four or five horse power, whereupon the corn sheller and feed grinder are brought in to keep the power plant busy.

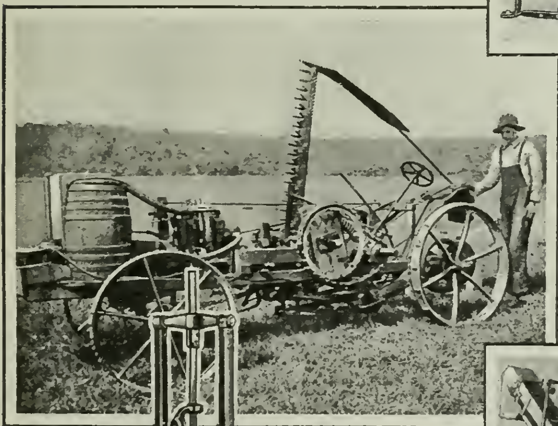
From this point upward the character of work changes less than the size of machine for doing it. Saws, feed mills, grain elevators, hay balers, etc., may use only a few horse power or the full



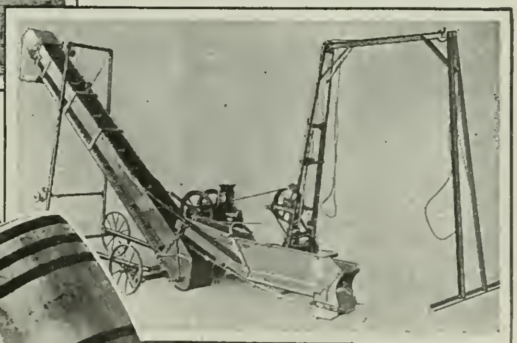
A traction engine of novel form at work. This machine is one of the many attempts which have been made to supply a small traction engine which can be profitably used upon farms of moderate size. The problem of supplying such a tractor is more difficult than that of a cheap automobile

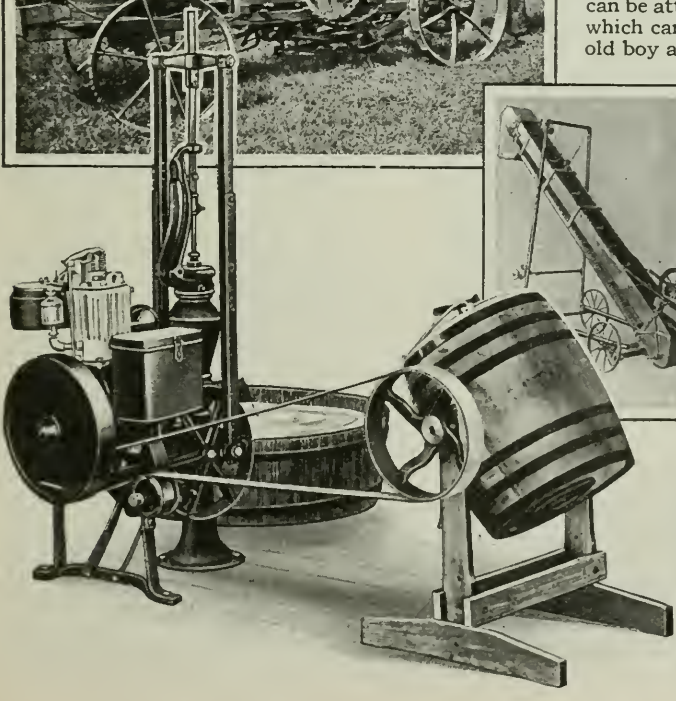
Running a cream separator with a small engine. The same engine can be employed for other dairy work and for dozens of other uses on the farm



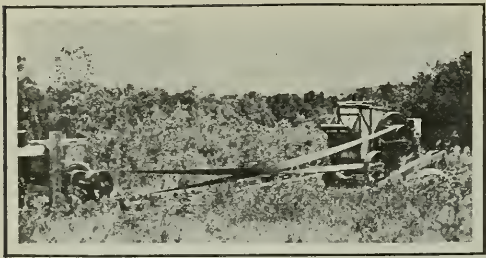


So varied is the work to be done upon a farm that the engine must be readily movable from one place to another. The photograph shows a small engine which has been mounted upon a truck so that it can be readily shifted about. It has been geared with wheels so that it can be attached to the mower shown, which can be run by a thirteen year old boy and faster than with horses





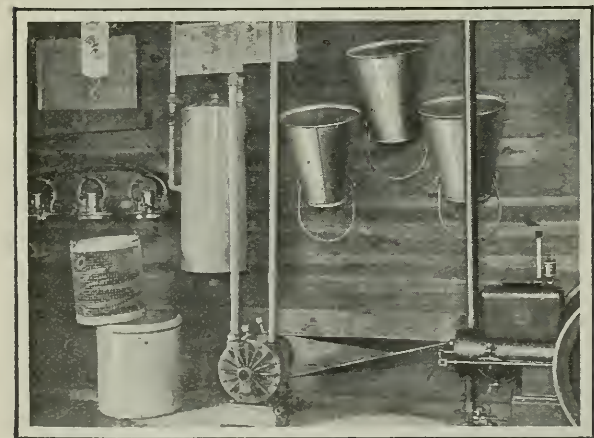
Above is an installation which shows how a gas engine can be used to drive a conveyor by means of which a wagon can be loaded, or hay or grain stacked and stored. At the left is an engine used to churn butter and pump water at the same time



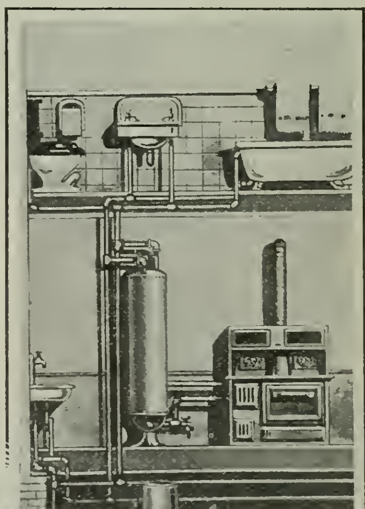
Gasoline engine used for irrigating one hundred and fifty acres

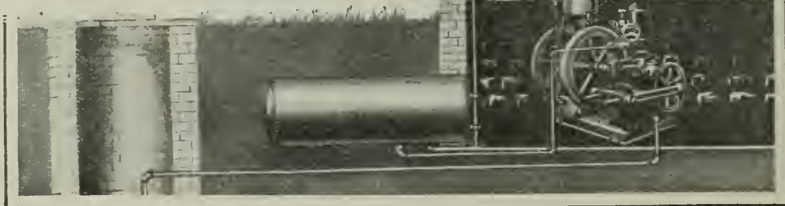
Circular bales madeby the gasoline baler shown on the opposite page

Unloading alfalfa and hoisting it into a barn with the aid of a portable engine



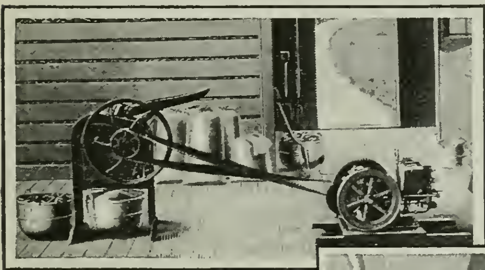
Engine power is the most economical for running the separator, milk-testing machine, churn, mechanical milker and other devices of the dairy





An engine-driven water power plant for the small home is one of the luxuries brought by the gasoline engine

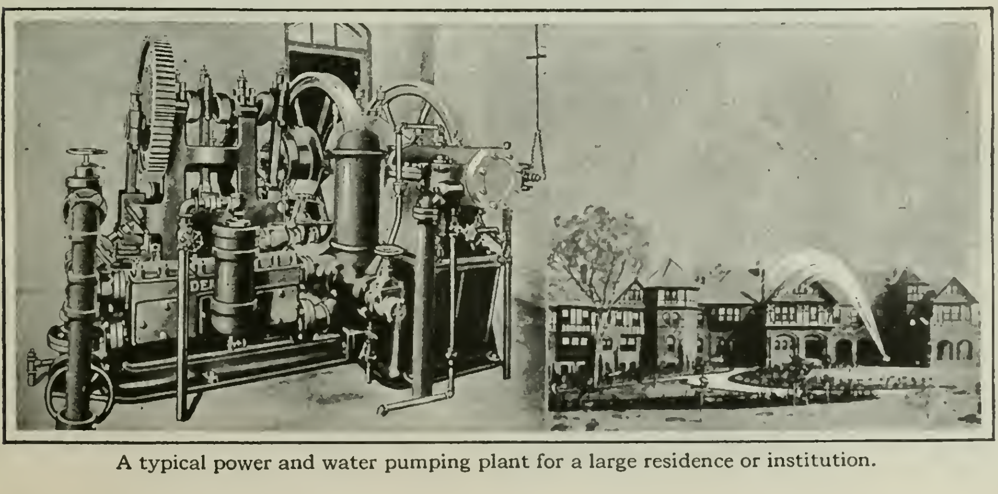
The engine-driven hay baler at work. It makes the bales shown on the opposite page



Shelling corn by gasolene engine power

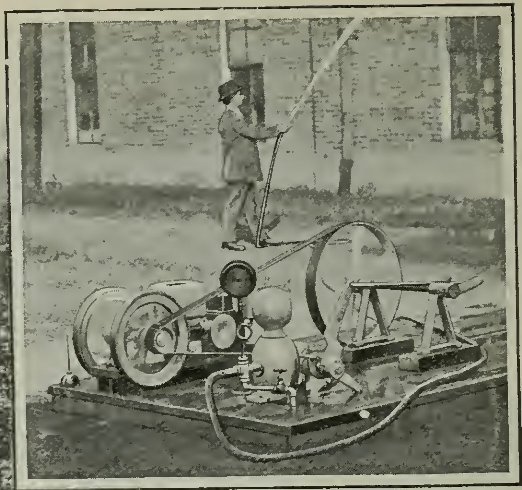
Engine-driven cement mixer

A portable engine driving an air compressor operating a pneumatic timber stripper

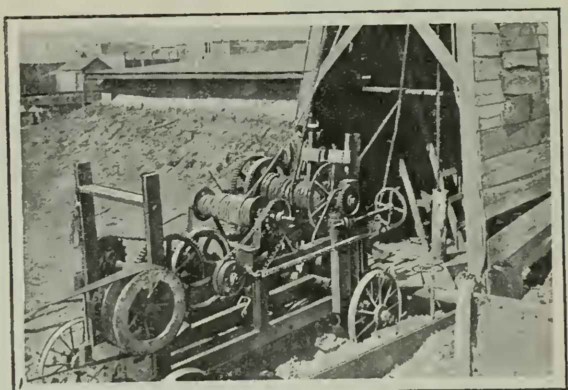


A typical power and water pumping plant for a large residence or institution.

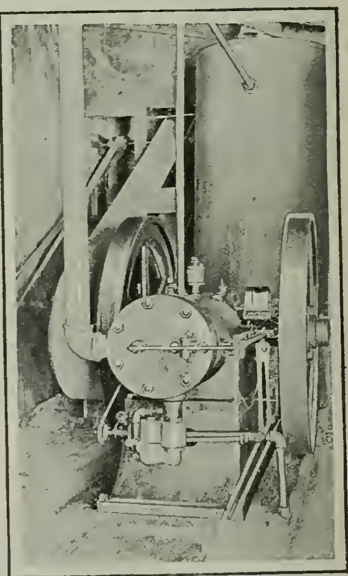
Spraying trees in a park with the aid of an engine mounted on a horse-drawn truck



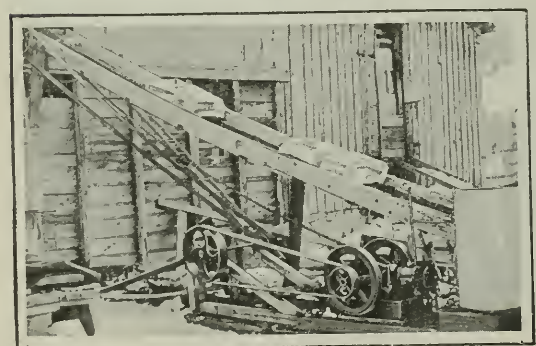
A gearless two-horsepower engine which pumps from a deep well



A drilling well at work at Amarillo, Texas. Power from a traction engine was used



A twenty-two horsepower gasoline engine driving an attrition mill



The picture to the left shows how a small engine can be employed to drive a conveyor and transport ice to an ice house. An engine is a very convenient thing to have whenever there is any sort of heavy hoisting to be done. Its power and ease of control make it splendidly adaptable for such work. The same engine has many other uses on the farm

Threshing with the aid of a portable engine. Below are two pictures which show how hay can be hauled with a motor under difficult conditions

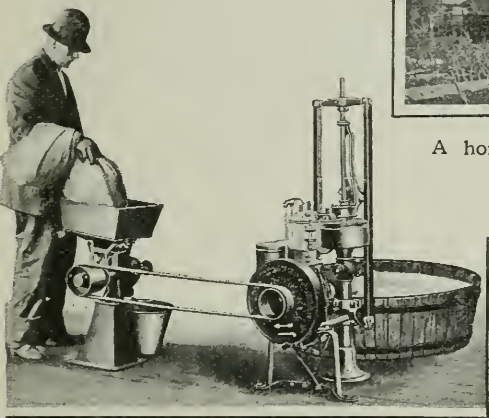
A real gasoline horse guided by reins. It can go anywhere and never gets tired

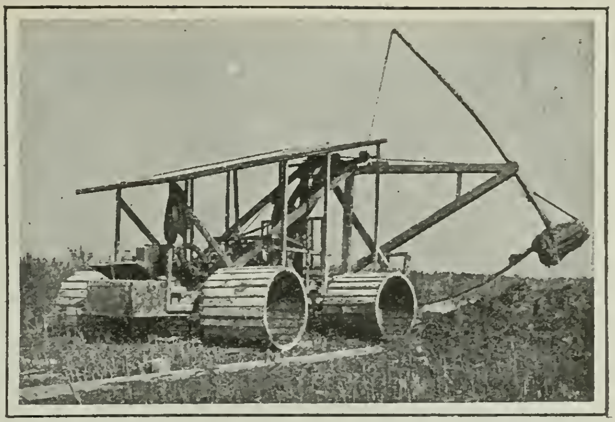
Baling hay in the field. Below, is an arrangement for threshing and bagging peas by engine power. Contrast the horse with the engine. A horse tires out before the day is over; an engine is as fresh at night-fall as at dawn

In the circle is shown a large power sprayer at work in a celery field. If the same work had to be done with hand-operated sprayers, dozens of men would be required to take the place of this single machine

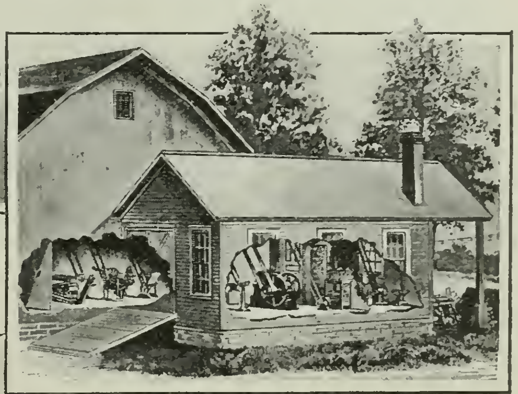
To the left is a silage cutter showing a connection with gasoline engine power for cutting corn silage inside the barn during any sort of weather

One engine running a grinder and pumping water at the same time. This particular outfit has many uses and has been especially designed to meet the requirements of the small farmer who cannot afford an expensive installation. It is illustrated on other pages at some of its tasks. Water pumping and wood sawing were the first uses to which gasoline engines were put on the farm

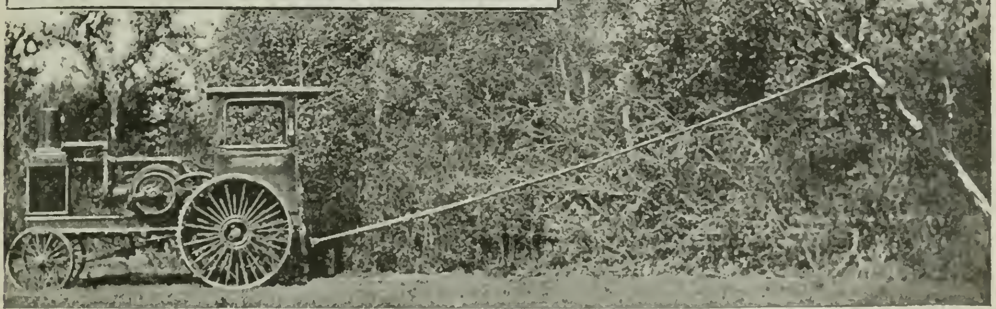




A home-made gasoline bucket dredger at work digging drains on a farm



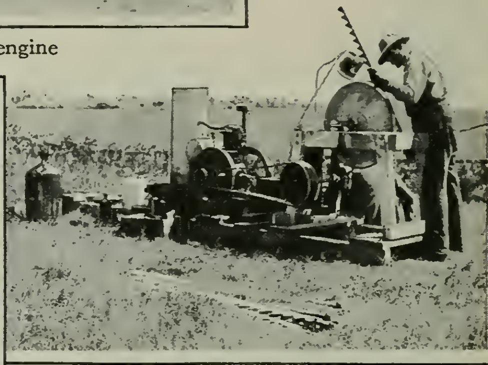
Below, an engine-driven wood sawing outfit at work



Using a traction engine to uproot trees

House moving *a la mode* with a traction engine

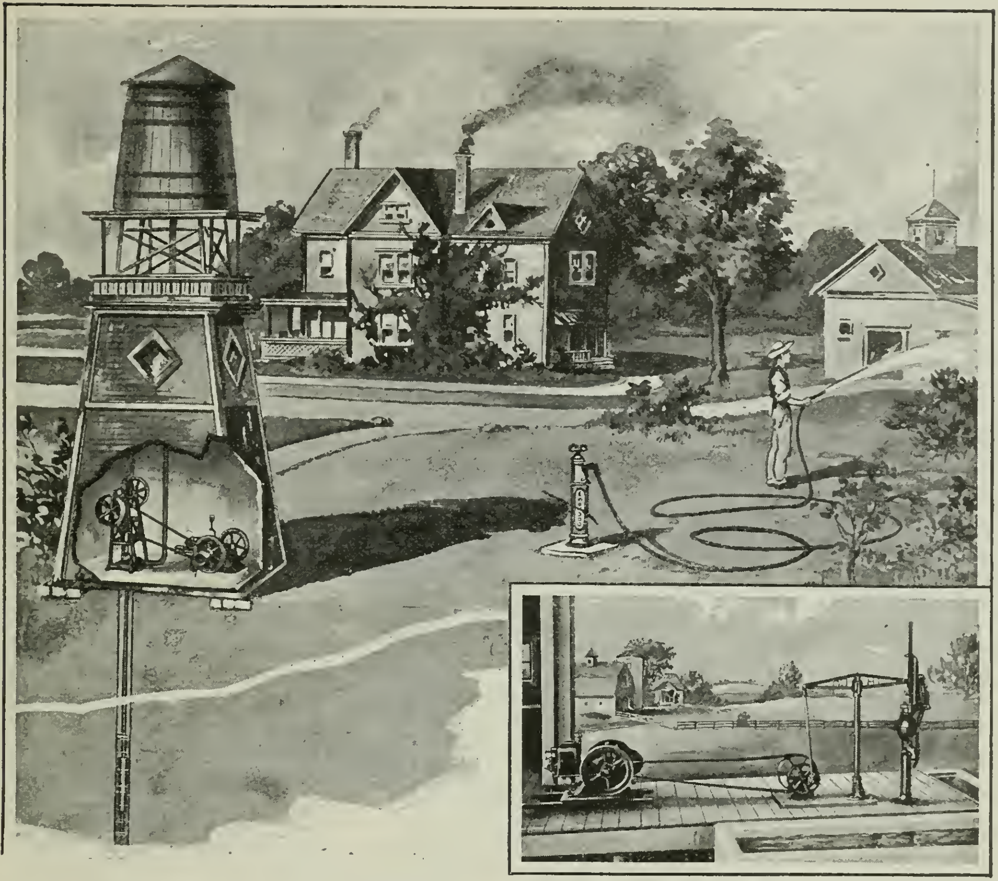
The man below is grinding mower blades with the aid of a gasoline engine. The youth who was formerly obliged to turn the handle of a grinder will welcome this machine with joy



To the left, a five-horsepower gasoline engine mounted on an ordinary farm tractor and used for almost every form of farm work

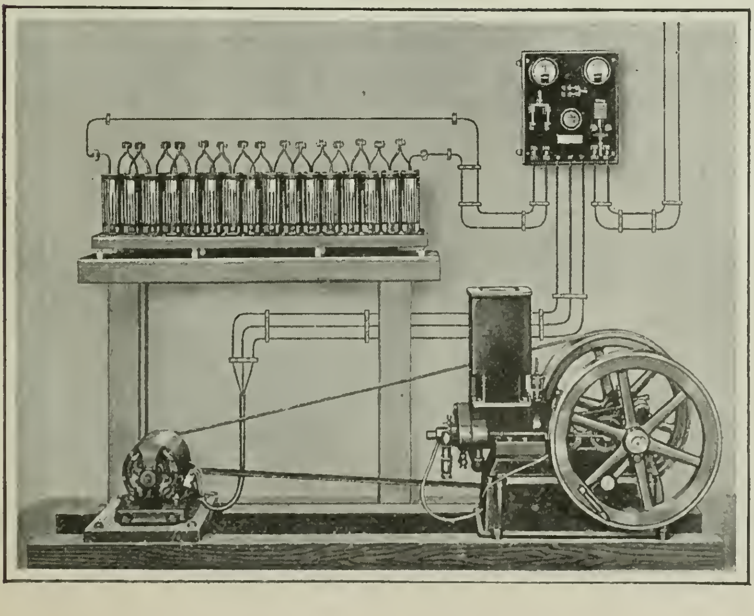
A battery of sprayers is at work in the picture in the circle, spraying hops in British Columbia. The gasoline engine has become invaluable wherever spraying must be done over large areas

Driving a husker in Indiana with a portable engine is a great aid to the big western corn growers. The "hired hand" problem is brought a step nearer solution by it

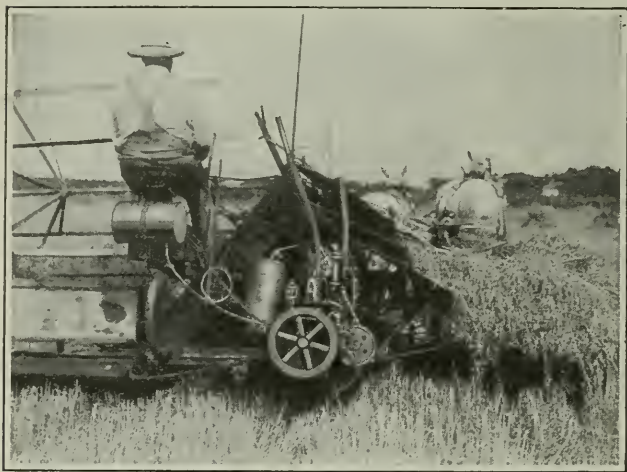


A gasoline engine displaces the windmill

Operating a well pump with a little engine



To the left, an electric light installation for the small home. The improvements in engines and electrical generators have placed electricity within the farmer's easy reach. Good, safe illumination in the farm and stable more than pays for itself in the saving of time required for various duties, to say nothing of the elimination of risk from fire, always the terror of the dweller in the country capacity of an engine of twelve to eighteen horse power. The corn husker and shredder, the silo filler (especially if fitted with a "blower," or pneumatic elevator), the big baling-press, etc., may easily utilize the power of the largest portables which are now obtainable.



This little engine, attached to mowers and binders, made possible the saving of thousands of bushels of grain in the West last summer. Heavy rains had made the ground soft, so that the power-driven mechanism was practically inoperative for lack of wheel-purchase. The binder was mounted on skids so that it could run over soggy ground almost as easily as over snow. A small gasoline engine drove the binding mechanism

Irrigation is almost a separate field, requiring a special installation, yet some of the smaller engines are pressed into service. In combination with hoists, spray pumps, balers and what-not, the utility of the gas engine becomes almost unlimited.

One great drawback to the universal popularity of the gas engine is the excessive competition and almost total lack of standardization — whether of price, rating, equipment, method of selling, or service to the customer after the sale.

An engine advertised at a low price may turn out to be of good value, but minus cooling tank, magneto, skid base, battery box, and other desirable accessories, while a higher apparent price may actually prove lower because equipment of good quality has been provided in full.

The tendency is toward better accessories, better workmanship, and better facilities for the furnishing of necessary repairs. Moreover, at least two influential organizations of technical men are working toward the standardization of power ratings and the use of stock sizes of bolts, nuts, pins and other easily obtainable parts.

A farm engine is not only far more easily maintained than is commonly realized, but it is extraordinarily inexpensive. The horse is an expensive luxury compared with a small motor. He must be fed regularly every day, whether he works or not; he is not as fresh in the afternoon as he was in the morning; he requires constant attention in order to keep him clean, to bed him properly and to minister to his physical wants. He may die at any moment. In fact, his working life is brief. Besides there is something almost pitiful in watching a horse doing heavy work.

Not one of these considerations applies to the inanimate, tireless, cheap engine. Its initial cost is less than that of a horse; it is never fatigued. It costs nothing when it is not in operation; it requires but little attention. The "hired man" problem is not so difficult to solve when a cheap source of power is at hand. A farmer wrote to an engine manufacturer and made the following interesting comparison:

"A man works at the rate of about one-tenth of a horse power. That is to say, the ordinary man in one hour does one-tenth horse power of work. In a day of ten hours, he does one horse power of work. If we consider a man's time to be worth at least $1.00 a day, it costs $1.00 to do one horse power of work by man power. A gasoline engine uses one pint of gasoline per horse power per hour. If we take gasoline at twenty cents a gallon, a pint costs two and one-half cents. The cost of one horse-power hour of work done by gasoline engines, therefore, is two and one-half cents. The cost for man power is one dollar."

A Machine to Pull up old Telegraph Poles

ONE of the most difficult tasks falling to the lot of the telephone or telegraph lineman is that of removing a pole which has been firmly embedded in the ground for a number of years. It is often necessary to dig the post out of its bed.

A Chicago concern has recently placed on the market a jack which is said to be able to accomplish this task in a few minutes. The device is very similar to an ordinary automobile jack, but is larger and many times as powerful. In the illustration is shown a pole which was fixed five feet in the ground, and which had been embedded for eight years. It took the jack nineteen minutes to pull the pole from the ground.

A chain, with a grab hook attached, is fixed to the lift of the jack, and is passed once about the pole. The lift extends two feet; then it may be lowered and the chain given a new grip. The capacity of the jack is fifteen tons, large enough, it is claimed, to uproot the most stubborn pole. The amount of time and labor saved by this machine are worth considering.

A pole was embedded five feet in the ground. It was removed by a powerful jack in four and one-half minutes exactly

A Racing Car Built of Tires

A CLEVERLY constructed racing car, built of tires, tubes and cartons containing parts is shown in this photograph of a Houston, Texas, tire dealer's show-window. The vehicle is composed mainly of outer cases, which range in size from twenty-eight by three up to thirty-seven by four and one-half inches and are set upon a frame of light timbers. The seat is formed of cartons containing inner tubes; the dash is made of cardboard, on which are fastened patches and repair material tins to imitate speedometer and lighting systems; the exhaust is composed of a tube, stiffened within by cardboard to keep it rounded. In the seat is a driver who gives the final racing touch by gripping the famous Barney Oldfield cigar in the corner of his mouth. As yet, no one has tried to buy this car, though it will undoubtedly be sold piece by piece.

A show-window racer built of tires, tire boxes, and tire repair accessories

When these trees were young, fence boards were nailed to their trunks. The boards are now completely buried in the tree

A Tree Captures a Fence

MANY years ago a row of Irish poplar trees was used for the posts of a fence, and boards were nailed to the trees. The trunks of the trees, in the process of growing, gradually overlapped the boards, until now the boards are near the center of the trunks. Not needing the fence any longer, the owner sawed off the boards, the remnants of which still protrude from the trunks of the trees.

To Keep Automobiles off Railroad Tracks

THE new long distance railroad signal has been brought about by the new conditions arising from the general use of the automobile. Chauffeurs are so frequently found driving through country which is new to them that they often find themselves on the tracks of a railroad line before they know it. The long distance signal was designed to give them sufficient warning of the proximity of the railroad tracks to enable them to be on the alert and to avoid accidents on the tracks. The new signal was designed by the officials of the Southern Pacific Railroad, and the first one was placed at the crossing of the main street in Tropico, Cal., but such excellent results attended the experimental installation that others are now being installed. The use of the new signal will be further extended.

The lines of the signal are such a departure from the typical railroad signal that it cannot help being observed by the wayfarer, either mounted or afoot. It consists of a tube of metal eight inches in diameter and two and a half feet long, mounted on a support, which, in this case is a piece of three-inch pipe. The pipe also offers accommodation for the electric wires which supply the current. The tube is painted black and is mounted in the direction of the road, so that the red light inside may be seen at a great distance before reaching the signal.

A red light inside the tube of this railway signal is visible for a great distance, and the disk attracts attention in the daytime

It Looks Like a Telescope, but It's Really a Camera

A CAMERA that can be used for taking photographs without the subject's knowledge, resembling in appearance a short telescope, has been brought out in Europe, in spite of the war's absorbing interest. A lens almost invisible is located in the side of the telescope so that the photographer, pointing what appears to be a telescope at some distant object, can get snapshots of objects that interest him, directly at right angles to his apparent line of vision.

This camera looks like a small telescope, but takes snapshots directly at right angles to the apparent line of vision of the photographer

The lens is equipped with an adjustable shutter, so that snapshots or time exposures can be made. For tourists traveling in foreign lands, such an equipment would be of considerable value, as natives often spoil photographs by unnatural posing and vacant staring, and this little camera would throw them off their guard. In Europe they call these contrivances "detective" cameras, probably because no detective ever carried them. The accompanying illustrations show snapshots obtained without the knowledge of those in the picture.

The new camera is especially valuable for securing natural pictures of persons who would pose and stare, or else run away, if a camera were pointed at them

What Is the Best Shade Tree in the United States?

THE prize for the largest shade tree in the United States was won by a sycamore tree in Worthington, Indiana, which the judges of the American Genetic Association found to have a circumference of forty-three feet, and a height of one hundred and fifty feet. This interesting incident calls attention to the fact that foresters are recommending the sycamore very strongly for city planting. They tell us that long experience with sycamores planted in city streets and on lawns has shown that the species is very well adapted to withstand the smoke, dust and gases so common in cities. Besides, the sycamore is very resistant to the attacks of insects and fungi, and grows rapidly. At ten years of age, a healthy sycamore is large enough for shade as well as for decorative purposes. Indeed, in the latter respect, it is not exceeded by any other Eastern species. Its mottled bark, its full, rounded crown, and its dense foliage, impart a very handsome and striking appearance to any lawns or boulevards which are fortunate enough to display these magnificent trees.

The sycamore ranks with the oak and hard maple as a decorative tree.

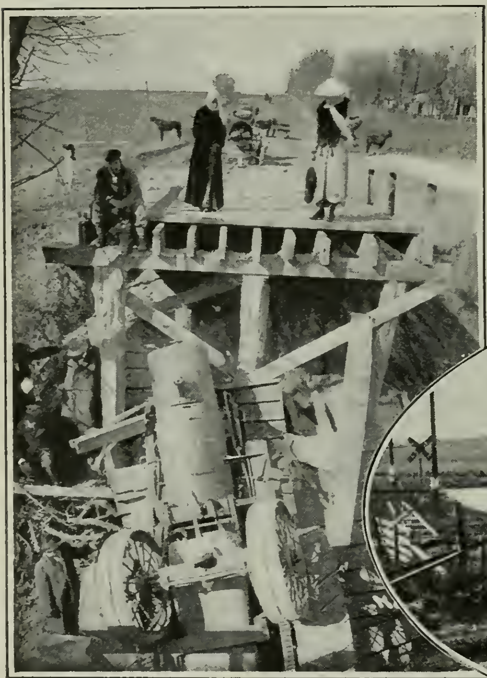
Perils of the Bad Road

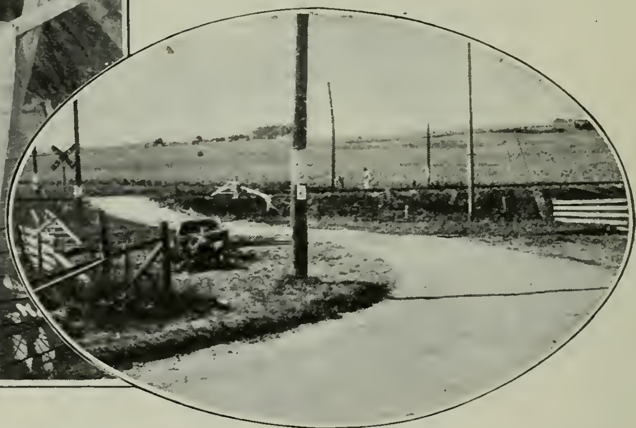
By O. R. Geyer

WITHIN the last few years Iowa has been brought face to face with the new problems of preventing the tremenduous loss of life on the state's highways. Every state in the Union is confronted with the same problem. Failure to exercise even the most important safety first principles is costing the lives of more than one thousand Americans each year, according to statistics compiled by road experts. This number is as large as the casualities in many a day's fighting in the world wide war. After much study, the State Highway Commission of Iowa is pushing vigorously a campaign for the building of permanent roads and bridges as a means of saving many lives.

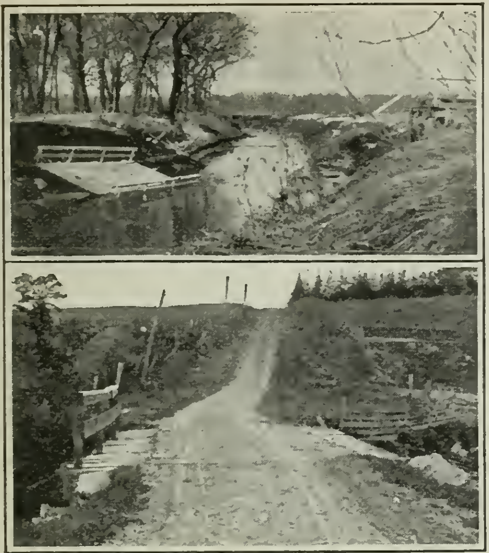
The majority of these accidents could have been prevented with the exercise of a little more care, but since the average American is in too much of a hurry to protect his own life and the lives of others, the state must help him. Iowa lost seventy-five of her citizens through accidents which occurred on the highways of the state in the year ending November 1, 1915. The number of persons seriously injured was many times this, totaling about five hundred, according to the best information obtainable by the Highway Commission. Conservative estimates based on these returns from Iowa indicate that each year sees an average of from one thousand two hundred and fifty to two thousand persons killed and more than five thousand seriously injured in accidents on the highways. This means that in each state of the Union more than twenty-five persons meet death on the highways in a year's time.

This loss of life and limb and the resultant destruction of property is





Grade crossings and unsafe bridges constitute two of the gravest perils of the road, although the danger of unsafe bridges is more important in those districts where heavy farm machinery is moved than it is in the Eastern States. The illustration on the left shows a fatal accident caused by a farm tractor and trailer falling through a wooden trestle, resulting in two deaths. On the right is a typical grade crossing, with a dangerous sharp curve, in approaching which the driver's back is toward many approaching trains



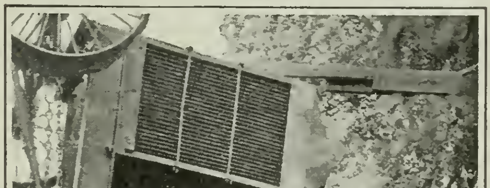
Such bridges as these are responsible for many fatalities. When the spring rains cause the rivers to rise, these light bridges are carried away, or so undermined that they cannot support the weight of an ordinary automobile

costing the country about twenty-five million dollars a year, a sum sufficient to build many miles of paved roads—an estimate based on an allowance of ten thousand dollars as the value of a human life. The loss in Iowa, economic and real, is more than one million dollars.

The greatest contributing factors to this huge death list are bad roads and bridges, speeding and reckless driving. The Iowa Highway Commission, realizing that it cannot put a stop to reckless driving and speeding, is working on a plan to make the highways as safe as possible, and has succeeded in bringing about a material reduction in the number of accidents. Still, the commission realizes that even the safest roads will not make speeding entirely safe. It has begun a campaign against reckless driving.

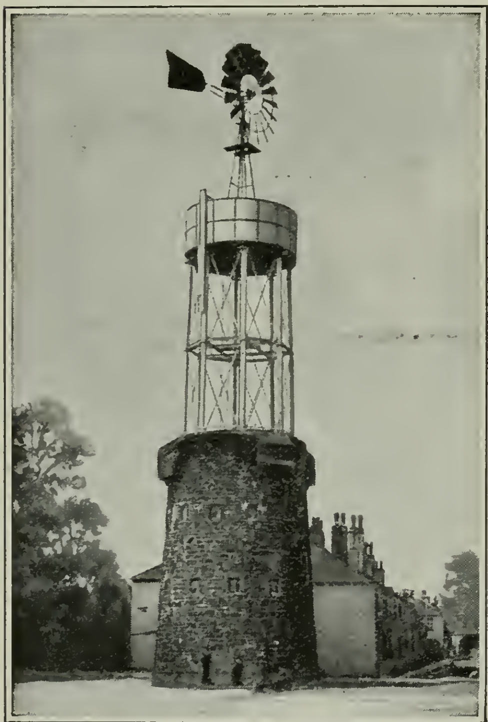
Second in the list comes the grade railroad crossing, which takes an unusually heavy toll of lives and mangled limbs in a year's time. There are eight thousand six hundred and seventy-six railroad crossings in Iowa, and of this number nine hundred have been classed as a constant menace to life by the commission. The work of removing these dangerous crossings was taken up in a serious manner more than a year ago, and at the present time nearly one hundred of the nine hundred crossings are scheduled for improvement in 1916. Improvements were completed on eighteen crossings during 1915.

The task of removing and relocating these bad crossings is a stupenduous one, the average cost of each change ordered so far being four thousand four hundred and forty-seven dollars. At this rate it would cost Iowa nearly twenty million dollars as her share of the improvement. The railroads must pay a sum equally as large, too, before these nine hundred crossings are made safe for ordinary travel. The question as to whether these costly improvements are worth while is best answer-



Another view of the tractor and trailer which fell through a wooden trestle. The driver of the machine and his assistant died on the way to the hospital ed by the reports for the year 1914, which show that fifty Iowans were killed on railroad crossings of this sort. The death toll from this source for 1915 has been almost as large.

Immediately following a fatal accident, when public opinion demands action on the part of the local authorities, plan and estimates of cost are worked out, and a tentative adjustment of the cost between the county and railroad is made. In the majority of cases the railroads have been willing to co-operate with the state in removing these sources of danger from the country highways. One railroad in particular relocated eleven dangerous crossings in one county.



This old fort has been converted into a water tower, and is saving much expense to the town

Dangerous turns in overhead crossings, bridges undermined during flood seasons, sharp turns in roads, "chuck" holes, ditches alongside roads, weeds and other obstructions on roads, unguarded bridges, speeding on slippery roads, reckless driving at night, "short" culverts, steep embankments, neglect in placing warning signs or barricading dangerous places are some of the sources of danger the traveler in the country must encounter almost every day.

The loss of more than 125 Iowans in the last two years has not been without some beneficial results, as a demand for the building of permanent roads has been crystalized as the result of these sacrifices. It has been rather a costly manner in which to awaken the public to the need of these changes, however.

Sprinkling Streets with the Aid of an old Fort

ONE of the many Martello towers or forts found around the coast in the Channel Islands has been put to a novel use. These buildings lie idle for the most part, having been built over a hundred years ago, and are now useless from a military point of view.

In Jersey Island, however, a use has been found for one of these towers. It now forms the base of a water tank used for street-sprinkling.

A windmill pumps water into the tank, thus saving considerable expense formerly incurred when water was taken from the water company's mains.

Signal Lights for Traveling Cranes

WORKMEN employed in shops where a traveling crane is used are constantly on guard to see whether the crane is approaching them. This consumes a considerable amount of time, which, when multiplied by all the workmen so occupied in looking up at the crane, totals up to a formidable loss. An Ohio firm has placed on the market a device which is designed to warn the workmen, by means of red and green lights on the crane, whether the latter is coming toward, or moving away, from them. When the crane approaches the observer, the red light automatically lights, and when it departs from the observer, a green light gives the safety signal. The device has the advantage over warning gongs, which merely attract without telling the direction in which the crane is moving.

This pneumatic chisel is installed in the sculptor's studio, and greatly simplifies his work

The Sculptor's Use of a Pneumatic Chisel for Artistic Carving

SINCE the very beginning of sculpture, the greatest difficulty encountered by the creator has been in the matter of outlining the marble. The only method known, until quite recently, was the tedious process of carving with mallet and chisel and this was not only laborious, but awkward as well, for only one hand was left free to guide the chisel, the other being required to hold the statuary in place. Naturally the result was often crude and imperfect because of the limited strength of the one hand.

Hans Schuler, the well-known Baltimore sculptor, was among the pioneers of those who broke away from this confining and hampering method. He installed in his studio what is known as a "pneumatic chisel"—literally a chisel operated by air. This is nothing more than the old chisel employed by the stone-cutter and carver. The device greatly simplifies the work and gives infinitely wider scope to the artist. It leaves both hands free.

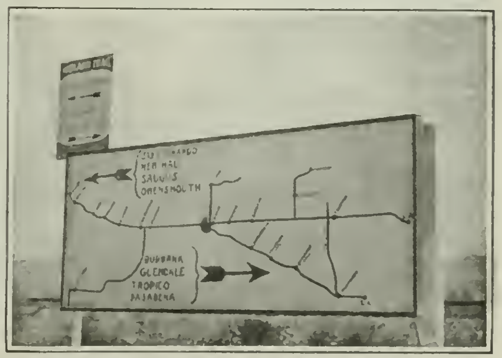
The chisel, in shape and size exactly like that of any ordinary stone-cutter's, is driven by compressed air at a pressure of seventy-seven pounds a square inch, operating through a long flexible tube, the air being compressed in a large tank by means of an electric motor. The chisel is pounded against the stone as if hit by a mallet, due to the air passing through the tube.

It is amazing that the application of this long-known invention did not occur to sculptors several decades ago, but the efficacy of its use is well illustrated when it is realized that such eminent sculptors as Lorado Taft, Hans Schuler, and Edward Berge make use of it exclusively. Of course it can be employed only in the rough modeling and in large figures, all of the finer and finishing work having to be done by hand as before. The amount of labor saved, however, is inestimable.

An Automobile Road Sign and a Map Combined

THE Automobile Club of Southern California has installed guide signs at different points, which give a complete diagram of the good roads as well as the distances to the various towns and highways from that immediate district. The sign itself is complete and thus saves the motorist the trouble of consulting his own map, if he should have one with him. The point at which the sign is placed is designated on the diagram by a three-quarter red disk.

Guides of this type are a great aid to the motoring public and save any amount of annoyances and inconveniences due to inaccurate directions so often picked up on the roadside.



A sign post that is a boon to the motorist

Forest Rangers Must Fight Snakes as Well as Fires

THE Forest Service is on the war path against rattlesnakes in the national forests. Many forest rangers have been bitten by these venomous snakes from time to time, but the attention of the forest service was sharply called to the necessity for the extinction of rattlesnakes by an episode which occurred during a recent forest fire.

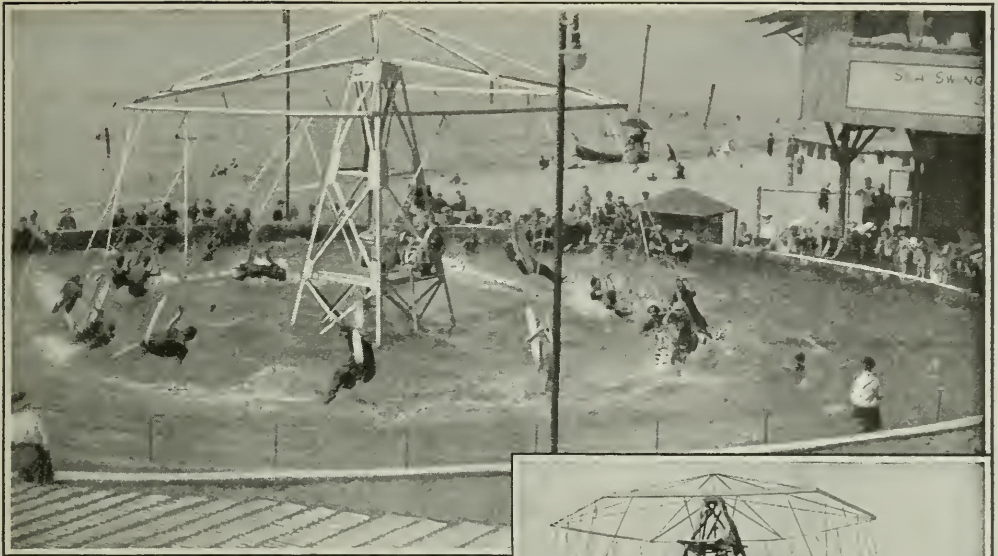
Several fires broke out in the Shasta National Forest, and a force of men was called to subdue it. After the fire was thought to be extinguished and the men were withdrawn it was discovered that one blaze had broken out again. A squad of men who returned to the scene ran into a section of brush that seemed literally alive with rattlesnakes. Six hours were spent in fighting the snakes before it was possible to enter the forest, and in the affray several men were bitten.

Arrangements are now being completed for the arming of forest guards and fire fighters against snake bites. The weapon to be given out consists of a small combination tool containing a sharp lancet and a receptacle to hold permanganate of potash, which is declared to be the best antidote for snake bite.

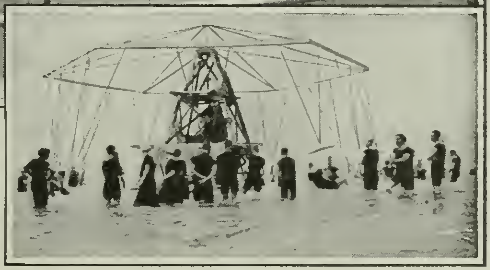
Making Butter by the Barrel.

DAIRY work is receiving much attention in England during the war. The thousands of wounded and convalescent soldiers in the hospitals throughout the British Isles consume tons of eggs, milk and butter every day, and it is extremely important that all of this material be of the very best. The accompanying illustration shows a monster churn which can make and wash six hundred pounds of butter at a single operation.

This monster churn makes and washes six hundred pounds of butter at a single operation, and is exceeding valuable at this time in English hospitals, where wounded soldiers consume large quantities of dairy products by the orders of their doctors



This merry-go-round furnishes great enjoyment for bathers who must have water sports of a more or less reckless variety It is operated by an electric motor, and splashes the bathers in the water as it whirls them about



A Merry-Go-Round in the Water.

FOR the entertainment of its patrons, who enjoy water sports of a more or less reckless variety, a recreation park on Lake Erie near Cleveland, Ohio, installed last summer a revolving mechanism for bathers which, in the form of pleasure it offers closely resembles the familiar merry-go-round, or carousal, of the state fair.

An iron framework similar in design to an oil well derrick supports revolving arms to the outer ends of which cables are attached· The bathers swing and splash in the water as the arms revolve. An electric motor on a platform a few feet above water level is connected by gears to an upright rod through which power to revolve the arms is applied.

Motion Pictures on the Firing Line

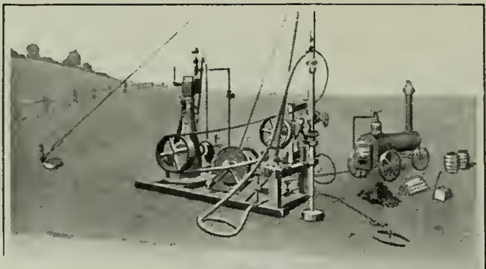
A LETTER from the War Front in Europe gives an interesting description for a motion picture theater near the firing line in Flanders. This theater is operated by several British army officers to provide relaxation and amusement for the troops when off active duty.

There are usually two performances each evening, with a four reel program. The soldiers pay twelve cents admission, while the officers are charged a double amount. The expenses are very low, since most of the work is voluntary, and all profits are devoted to charity. The operator and pianist were both formerly employed in the same capacity at motion picture theaters in London. The power for the lights and the machine is obtained by fastening a dynamo to an automobile.

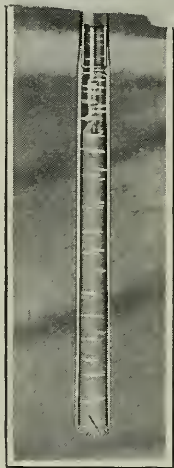
At first all the films were obtained from Paris, but the cost was so high that the theater was being operated at a loss. The lieutenant in charge of the theater then went to London to attempt to rent the films at a more reasonable price. When he had explained his desires to the officials of a prominent motion picture concern he was offered sixteen thousand feet of film monthly until their supply was exhausted.

It is said that it is by no means unusual to hear the reports of shells while the performance is progressing, as the firing line is but a short distance away.

Inspecting the Inside of the Earth



IN mining for coal or metals, operators must know a number of things about their claims in advance unless they are out-and-out gamblers. Before starting operations at a mine the thickness, extent and richness of the vein must be estimated in order to determine whether the mine can be worked profitably. The depth of the vein from the surface, the dip or angle at which it lies and the nature of the materials that will be encountered before reaching paying values, are also factors of the greatest importance. In a word, the mine operator must have a good idea of the "lay of the land" in advance, or he may be doomed to failure from the start.



How the drill samples the earth through which the boring is made

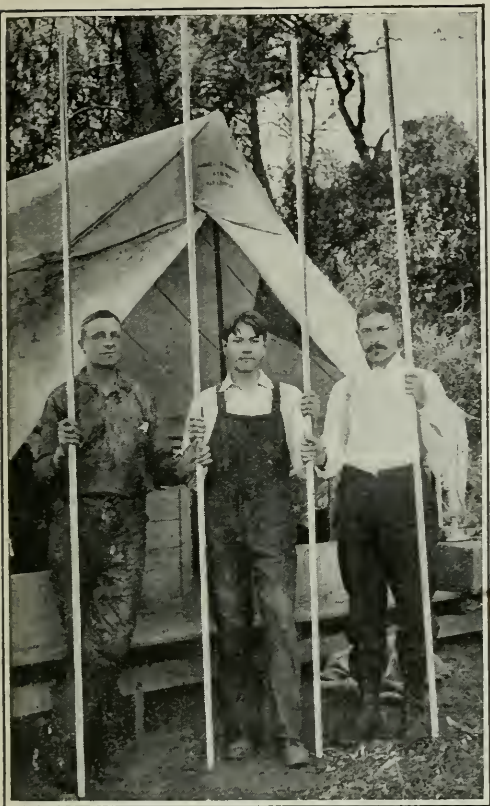
All of these questions are easily answered in advance by means of core drills. Think of the way a corer takes out the heart of an apple and you have the main idea of the core drill. These drills have been used for taking samples out of the earth at varying depths from a few yards to several thousand feet. The speed of drilling, of course, depends upon the size of the core and the hardness of the rock, but the average is probably between two and four feet per hour. Several typical cores are illustrated.

Piles of cores from the drill. Here is a record of the contents of the earth for hundreds of feet below the surface

Figure 1 illustrates, in section, a core drill penetrating loose material composed of soft rock and earth. Here the cutting bit is shown with several sharp cutting edges, and the core barrel is about three-quarters filled with the different kinds of rock that have been penetrated.

Figure 2 shows a core drill employing a steel shot bit, which type is used for cutting hard, solid rock. The rod *F* extending to the surface of the ground imparts a rotary motion to the cutting tool. As the drill sinks deeper and deeper, this rod is extended correspondingly by screwing pieces into it at the top. The rod is hollow and through it are fed water and very hard small steel shot. The shot settles, entering the diagonal slot near the bottom of the bit which feeds it beneath the rotating bit, as shown at *L*. Here the weight of the drill, combined with the abrasive qualities of the shot, rapidly wears away the rock and permits the cutter to settle around the core.

While the core is being made, the cuttings are washed upwards by the stream of water and settle in the receptacle *B*, which is known as a calyx. This gives an additional record, in inverse order, of the rock and earth penetrated, the materials being in pulverized form, suitable for assay purposes. Figure 3 illustrates this point and also shows how the core is broken preparatory to extracting a piece. For this purpose, pebbles are fed into the drill in place of the shot. They jam around the core near the bottom and break it off as the drill is rotated. This wedged material also holds the core in place while the drill is being raised to the surface.



These drills, while sinking deep into the ground, constantly send up samples of the earth for examination. They are in the form of solid rods, large or small (as here)

With several soundings thus made in different parts of a property and accurate records kept of the material encountered at different depths, it is a simple matter to map the various underlying strata and eliminate absolutely all guesswork from subsequent operations.

The Size of a Railway Station

LOVERS of statistics will be interested to know that in the concourse of the express level of the Grand Central Station, New York, the old City Hall of that city could be placed with twenty-eight feet to spare at either end and with one foot clear on each side. The top of the statue on the City Hall would be nearly fifteen feet under the ceiling. The number of passengers handled annually at this great station increased from fifteen million, seven hundred and fifty thousand in 1903 to twenty million, eight hundred thousand in 1914. In 1905, nine hundred and eighty-two thousand cars entered the station, and in 1914 there were one million, one hundred and twenty-six thousand. Fewer trains, however, are entering the station, for in 1905 there were two hundred and seven thousand eight hundred trains, while in 1914 there were but one hundred and eighty-two thousand five hundred. This decrease is due to the fact that more cars are hauled by the electric locomotives in one train than were hauled by the steam locomotives, and therefore fewer trains are required than heretofore.

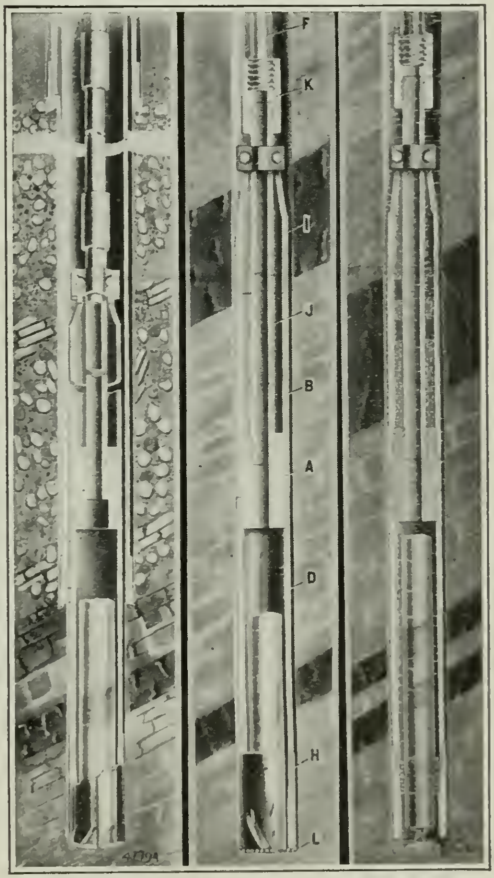


Fig. 1 Fig. 2 Fig. 3

Typical cores and how they are procured. Fig. 1 is working through loose material, with a sharp-pointed drill. Fig. 2 is using steel shot to cut through hard rock. Fig. 3 shows the use of water in cutting, also how pebbles are used to break and hold the core preparatory to stopping the work

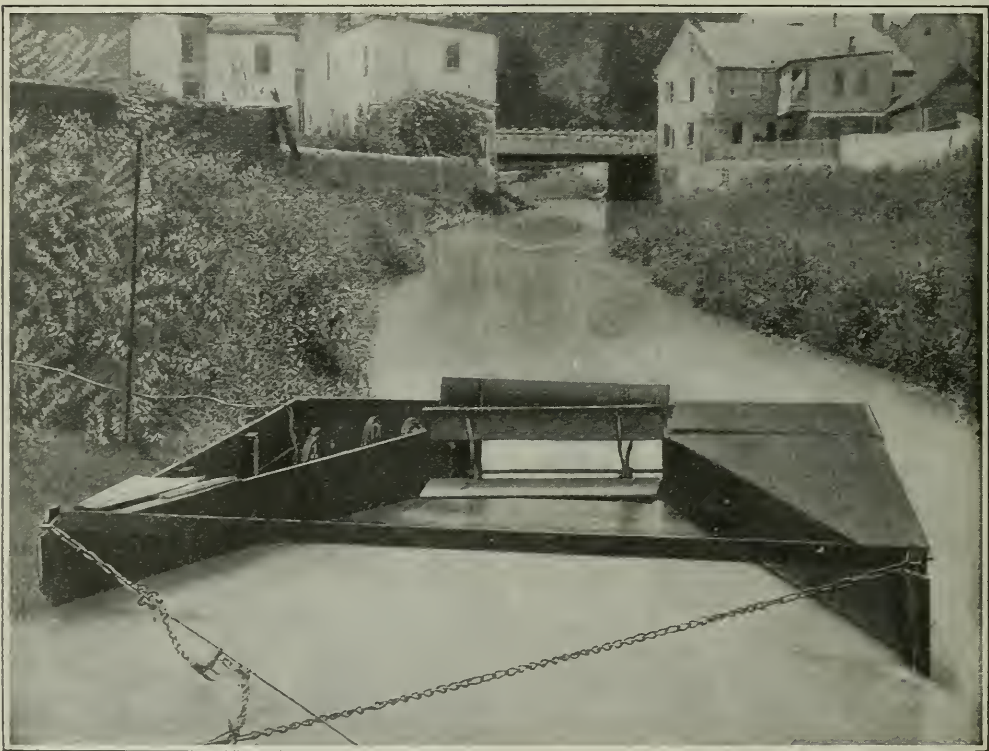
Power from a Floating Water Power Plant

FARMERS who have small streams running through their places are showing much interest in the portable and self-contained power plant which has been designed and patented by A. G. Watkins of Philadelphia. The apparatus can be used wherever water moves at the rate of two miles an hour, which is less than that of the average stream. The plant consists of two triangular floats fastened together by iron rods to form a channel of decreasing width. A water wheel is mounted in the narrow part. Between the floats and beneath the water there is an adjustable platform, set at a slight angle, so that, together with the floats, a wide-mouthed opening is formed, decreasing in its dimensions in three directions toward the wheel. This has the effect of increasing the volume of water passing through the narrow opening and acting on the blades of the wheel.

The float on one side houses a motor with a series of gear-wheels which multiply the power to such a degree that a one-half horse power dynamo is effectively driven. The other side of the float contains a pump, and thus water or power may be secured as desired. The float is anchored to a tree or any other convenient object. Where more power is wanted several of these devices can be tied up one behind the other.

The plant shown is the first which has been demonstrated by the inventor. It is shown on the surface of Carrol Creek at Frederick, Md. A line was run to the bridge appearing in the distance, where twenty incandescent lamps of sixteen candlepower each were operated.

One of these plants will soon be in operation at St. Petersburg, Fla. It is said that the operation of the power plant in cold weather is not interfered with by ice for the reason that the motion of the water in the passage between the two floats prevents freezing.



Two triangular floats support the water wheel, which derives power from any stream flowing at a rate even as low as two miles an hour

How to Make Knots, Ties, Hitches and Bends

The Timber Hitch, a safe and simple knot usually employed in holding poles and booms. The turns in the loose end must be carefully made

The Double Bowline is used when the end cannot be used, and when a loop is desired in the bight

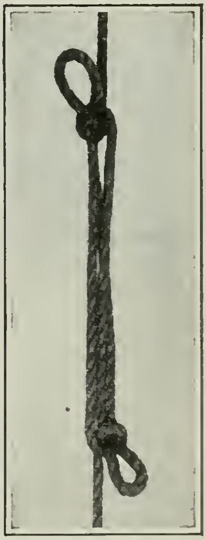
The Single Bowline is one of the most important of all the hitches. It is very safe and will not slip or jam

The Timber and Half Hitch. Much the same as the Timber Hitch with the addition of a half hitch to avoid any danger of the rope's rolling

The Square or Reef Knot is one of the safest ties, but care should be taken to avoid a "granny"

The Blackwell Hitch, while safe for light loads, is likely to part under heavy strains

A "safety-first" tie, the Cat's Paw. This hitch will sustain heavy loads, and is most used for that reason



When the rope is too long, it may be shortened by the use of this knot, the Sheepshank

The first operation in preventing the dead end of a rope from ravelling

The Clove Hitch is a very safe knot, and may be handled very quickly

The Stopper Hitch is used to hold the strain in the fall line of blocks

The second operation in preventing the dead end of a rope from ravelling

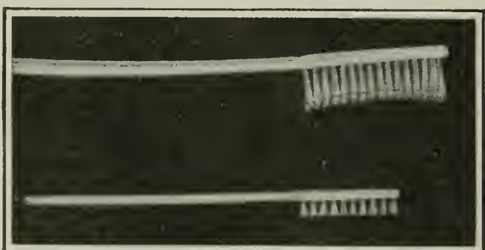
Brushing Your Teeth; There Is a Right and a Wrong Way

IF people as a whole were aware of the importance that a toothbrush plays in the healthful happiness of their entire body more attention would be paid to this perfunctory daily exercise. The soberness of this fact is perhaps a trifle more evident when it is mentioned that mouth infection is now known to be the source of numerous diseases that cause chronic sickness and eventually death. Looking upon the situation from the opposite side, it is equally true that mouth and teeth cleansing is the chief means of preventing these diseases, and in many instances, curing them.

The teeth and gums should be scrubbed with a circular motion five or six times in succession

A Philadelphia physician, who has gone more deeply than usual into this question, points out that mouth washes are of no value in the presence of bacterial masses, unless these are removed once a day at least. In other words, the mouth should be thoroughly scrubbed daily.

This physician lays even more stress upon the correct use of the toothbrush. He has calculated the antiseptic and curative results brought about by the the use of the toothbrush on a mathematical basis.

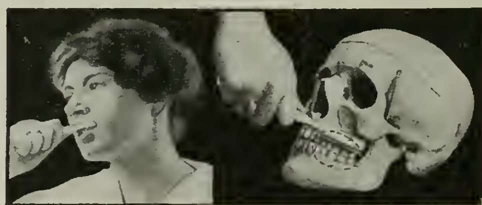


The tooth brush should be small and the bristles short. The upper brush is similar to those usually bought. The lower brush is correct

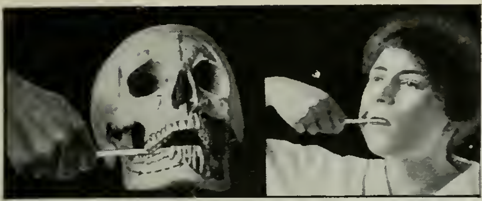
The spaces between the teeth should first be carefully cleaned with dental floss

For example, the tooth brush being usually two inches long, generally reduces the movement of the bristles to a half inch, which is almost all taken up by springing and pivoting, so that the actual friction amounts to very little, if anything.

Therefore, considering that friction is a highly desirable factor, the ideal tooth brush is one not over one inch and a quarter long with bristles not over a quarter of an inch in length. Bristles of this length will necessarily be stiff, but if the gums are soft and inflamed, a brisk rubbing is the best thing in the world for them, and will, in the course of a week or two, bring them back to a state of health again. The fact that the inflamed gums become sorer than usual during the first few days is an indication of self-poisoning, or autoinoculation, a condition and a result that should not exist in an otherwise healthy person.



It is most important that the circular brushing should extend as far back in the mouth as possible



Care should be taken to follow the curve of the gum with the entire face of the tooth-brush

Floss silk, so this physician has noted, is another great corrective for ailing teeth. The silk should be passed between teeth, across gums and drawn rapidly, even roughly. The discomfort may be slight, but it is sufficient to cause most people to avoid the practice, although they would perhaps be somewhat more enthusiastic towards this particular tooth cleanser if they knew that it would help greatly towards avoiding gout, rheumatism, valvular heart disease and ulcer of the stomach.

Concerning the general mechanics of tooth brushing, there are three important actions to be borne in mind. The first is the rotary motion, whereby all the gums and the teeth in front of the second molars are cleansed by a vigorous whirling motion. Second, the drawing motion wherin the middle of the brush is placed behind the wisdom teeth and drawn vigorously across the gums. Third, the drawing motion wherein the brush is placed back of the last molar and drawn sharply forward along the gum margins and the teeth.

It may be mentioned that healthy gums can stand the same vigorous friction as can be borne with impunity by the finger nails.

The middle bristles of the brush should be placed at the back of the third upper molar and drawn briskly forward along the gum margin

Hard-Pressed Germany Invents New Foods

POTATO sausages are being made in Germany which are said to taste a great deal like blood sausages, and are not a great deal lower in food value. The price of the potato sausages (called also K-sausages) is much less than the blood sausages.

It was found possible in Germany to purify bacteria-carrying oysters by allowing a stream of pure, fresh, filtered sea-water to run over them, in tanks, for four or five days. No sickness resulted from eating these oysters.

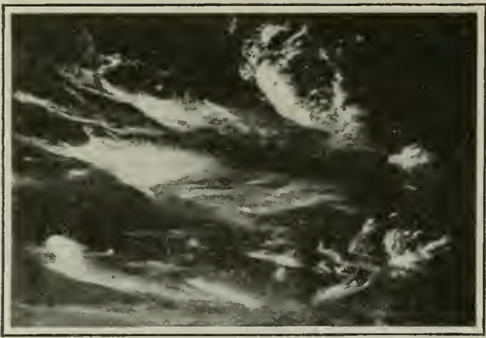
Study of the milk marketed in Zittau, Germany, up to the present time of the war shows that scarcity of good fodder for the cattle does not decrease the fat content of the milk, but only the quantity of the milk.

This movement will clean the backs of the teeth which are too often neglected

In Germany the comparative quality of the milk can be decided by the use of certain bacteria. Five are used, called respectively and alarmingly the "Danish streptococci," "Jaroslawer diplococci," "Guntherschen diplococci," "Russian lactic acid streptococci" and "Bacillus bulgaricus." The Danish streptococci can live only in fairly good milk, the Jaroslawer diplococci in worse, and so on down the list until we reach the Bacillus bulgaricus, which is tough enough to live in very bad milk. However, there is milk so bad that not even the accommodating Bacillus bulgaricus can live in it.

An elderberry wine is being made in Germany which is so like grape wine that it can easily be used as an adulterant of grape wine. It can be detected by chemical analysis, however.

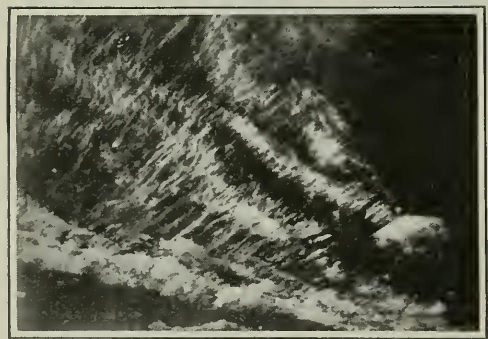
New methods for determining husk residue in meals and flours have to be used, since the German war orders to grind more of the husk into the flours.

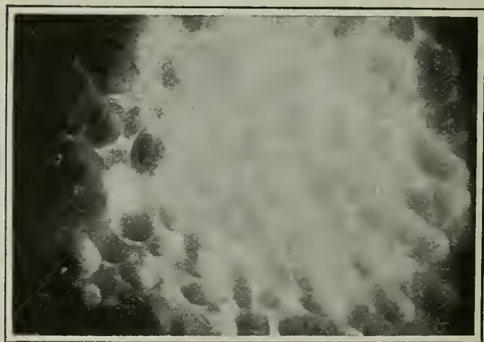

Cirrus clouds

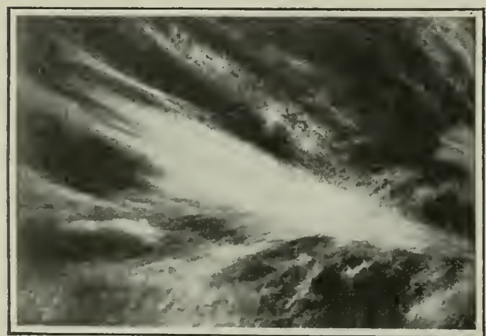

Cirrus passing into Cirro stratus


Cirrus clouds


Alto-cumulus clouds


Cirrus clouds


Mammato-cumulus or "pocky" cloud


"Mare's tail" Cirrus clouds


A small form of Alto-cumulus

A Journey to Cloudland

A majestic cumulus, passing into cumulus-nimbus. A very beautiful and common type

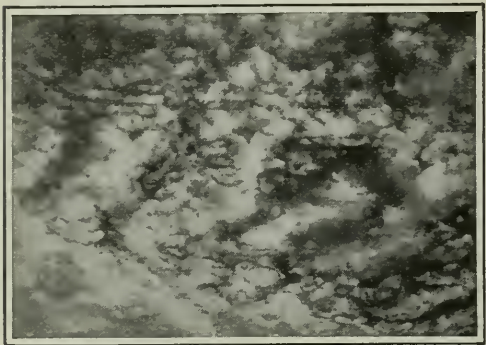
THE clouds, like the stars, are among those common objects of Nature upon which men look, for the most part, with unseeing eyes. Some aspects of the clouds do, indeed, force themselves upon our attention—chiefly those that denote the imminence of a storm—but few of us realize to the full the beauty and scientific interest of the vapory pageant that is continually sweeping across our skies. Strange to say, many artists, skilled in painting landscapes, are unable to paint plausible sky scenes. About half a century ago an English painter, Elijah Walton, published a book (now almost forgotten) in which he pointed out that the great majority of out-door pictures, including those of the old masters, are very inaccurate in their skies. If the painter, whose business it is to observe Nature, has acquired so imperfect a knowledge of clouds, no wonder the average citizen needs instruction concerning them.

At first sight, clouds seem infinitely various, yet with a little study one can assign them all to a few broad classes. The scientific classification of clouds dates from the year 1803, when an English chemist, Luke Howard, published a description of seven cloud-types, to each of which he gave a Latin name. With a few additions and modifications, Howard's classification is now generally used by meteorologists. This system is based upon three fundamental forms: viz, fibrous or feathery clouds (cirrus), clouds with rounded tops (cumulus), and clouds arranged in horizontal sheets or layers (stratus). Intermediate forms are described by compounding the names of the primary types; e. g., cirro-cumulus, cirro-stratus, etc.

There is really no good reason why the intelligent schoolboy, who knows an oak from an elm and a crow from a turkey buzzard, should not be able to call the clouds by their names. The International Cloud Classification, now adopted for scientific purposes all over

Mammato-cumulus clouds

Cumuli with cirri-form appendages

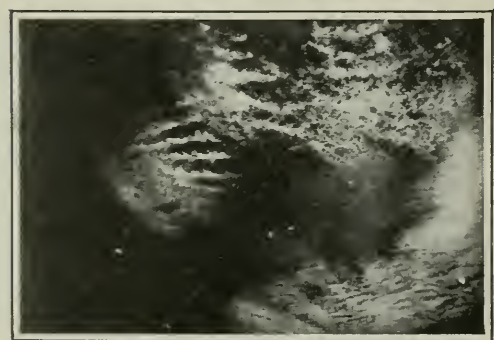


Cumulus mammatus clouds

Alto-stratus clouds

Lenticular clouds

Cumulus, passing into strato-cumulus



A nondescript form of alto-cumulus

Nimbus (rain-cloud)

Anvil-shaped cumulo nimbus

Strato-cumulus clouds

the world, is brief and simple, and must serve as the point of departure in our excursion to Cloudland:

I. Upper Clouds

1. *Cirrus* ("Mares' Tails"). Detached clouds, delicate and fibrous, taking the form of feathers.
2. *Cirro-stratus.* A thin, whitish, often web-like sheet of cloud.

II. Intermediate Clouds

3. *Cirro-cumulus* ("Mackerel sky"). Small globular masses or white flakes.
4. *Alto-cumulus.* Rather large globular masses, white or grayish, partly shaded.
5. *Alto-stratus.* A thick sheet of gray or bluish cloud.

III. Lower Clouds

6. *Strato-cumulus.* Large globular masses or rolls of dark cloud, often covering the whole sky; especially common in winter.
7. *Nimbus.* Dark, shapeless clouds attended by rain or snow.

IV. Clouds Formed by Day in Ascending Air Currents

8. *Cumulus.* Thick clouds with more or less rounded summits and flat bases.
9. *Cumulo-nimbus* ("Thundercloud"). The common cloud of summer thunderstorms; a mountainous mass, often turret-shaped or anvil-shaped, generally with a fibrous sheet spreading out above.

V. High Fog

10. *Stratum.* A uniform layer of cloud resembling fog, but not resting on the ground.

The international Classification also recognizes a few minor types: especially *fracto-nimbus,* or "scud," (shreds of nimbus seen drifting under the rain-cloud); *fracto-cumulus* (small detached fragments of cumulus, undergoing rapid change in form), and *fracto-stratus* (formed when a uniform layer of stratus is broken into irregular patches by wind or by mountains). *Mammato-cumulus* ("sack cloud," or "pocky cloud") is a rare and striking cloud form, seen especially in thundery weather, consisting of rounded sack-like clouds, convex downwards.

The photographs accompanying this article will help the reader to interpret the foregoing descriptions. There are several collections of such pictures, known as "cloud atlases," of which the most important is the International Cloud Atlas, published in Paris, with descriptions in French, English and German. Equally useful, however, to the American student is the booklet entitled "Classification of Clouds," with beautiful illustrations in color, issued by the Weather Bureau and sold at twenty-five cents a copy by the Superintendent of Documents, in Washington.

The layman who has learned the cloud names given above will sometimes, perhaps, be puzzled to find a variety of other names applied to cloud forms by technical writers. The explanation is that many specialists have sought to introduce more elaborate cloud classifications; in which, however, the International nomenclature usually forms the substructure. None of these systems has ever come into general use.

Clouds are Composed of Tiny Needles of Ice

Turning, now, from the obvious to

the recondite, let us consider briefly the anatomy of a cloud. The highest clouds, cirrus, cirrostratus, and probably also true cirro-cumulus, with an average altitude of six or seven miles above the earth, consist of tiny needles of ice. All other clouds are composed of drops of water, and do not differ at all in structure from an ordinary fog, which is simply a cloud resting on the earth.

These cloud particles are formed by the condensation of the invisible water-vapor (water in a gaseous state) which is at all times present in the air. Just as water-vapor condenses and becomes visible on the cold surface of an ice-pitcher, so, it is supposed, condensation occurs in the free air on the surface of extremely minute (mostly ultra-microscopic) grains of so-called "dust," when cooled to the critical temperature with respect to the amount of water-vapor present (the "dew-point"). The exact nature of this "dust" is not fully understood.

You will perhaps wonder how clouds composed of water can exist in cold weather, when our ponds and streams are all frozen to ice; especially as it is a matter of common knowledge that the temperature of the air diminishes with altitude, so that wintry weather on earth implies wintrier weather in Cloudland. To find the clue to this enigma we consult the books on physics, and learn that, with proper precautions, it is possible to cool a liquid far below its ordinary freezing point (32 degrees Fahr. in the case of water). Clouds of "supercooled" water-drops are seen even in the polar regions. A sudden jar turns a supercooled liquid instantly to a solid; and thus it happens that, in cold weather, raindrops or fog particles turn to ice on coming in contact with terrestrial objects, such as trees, telegraph wires, and the like, giving us the interesting spectacle of the "ice storm."

Clouds are Always Falling

Another paradox is the fact that the bits of ice and drops of water composing the clouds should appear to "float" in the air, though of much greater density than the latter. As a matter of fact they do not. Cloud particles are all the time falling relatively to the air around them; though since this air itself may constitute an ascending current, they are not always falling in an absolute sense. The speed at which a cloud particle falls through the air depends upon its size; the smaller the particle, the more slowly it falls. The smallest have diameters of the order of .0004 inch and fall in still air at the rate of about a tenth of an inch per second. The largest range up to more than a fifth of an inch in diameter, and fall at the rate of about twenty-six feet per second. Raindrops and snowflakes are cloud particles which, in virtue of their size and other favorable conditions, succeed in falling all the way to the earth. Many a shower of rain or snow never reaches the earth, but evaporates in midair.

Reverting to the aspects of clouds as we see them from the earth, there are a few interesting phenomena that require notice. Cirrus and cirro-stratus clouds sometimes occur in long, narrow strips, extending across the sky, and, while really parallel, seem to converge toward two opposite points on the horizon on account of perspective. These strips are called "polar bands," or, popularly, "Noah's Ark." Parallel bands of cloud, whether in continuous strips or in separate cloudlets, reveal the presence of waves in the atmosphere. Where a wave carries a body of water vapor upward the latter cools by expansion and condenses to visible moisture. Thus the clouds mark the crests of the waves.

The "White Flag of the Chinook"

A kindred phenomenon is that of the "cloud cap" often seen over a mountain. Here the ascent of the air, with its charge of water vapor, is due to the upward deflection of the wind by the slope of the mountain. Sometimes the cloud cap, once formed, spreads far away to leeward of the mountain peak, constituting a "cloud banner." Such is the "white flag of the chinook," seen stretching from the crest of a mountain ridge in our Western states when the chinook wind is blowing over it. The same phenomenon constitutes the "foehn wall" attending the foehn wind in the Alps. One of the most famous and striking of cloud caps is the "table cloth" that spreads itself over Table Mountain, near Cape Town, when a moist wind blows in from the sea.

Sometimes the local topography causes the wind that has swept up over the crest of the mountain to form a second "standing" atmospheric wave to leeward of the mountain, and this may also be marked by a cloud, which, like the cloud cap itself, presents a delusive appearance of permanence, while it is really in constant process of formation on the windward side and dissipation on the leeward. The pair of clouds thus formed—one over the mountain and the other at some distance from it—is exemplified in the well-known "helm and bar" of Crossfell, in the English Lake District.


Alto-cumulus clouds


Cumulus and alto-cumulus (above)

Of all clouds the most majestic are the mountainous masses of cumulo-nimbus that attend our summer thunderstorms. The formation of these clouds can often be watched from its early stages. On a hot, still day the warm air near the earth's surface streams upward by virtue of the same "convective" process that accounts for the draft of a chimney. The diminished pressure prevailing at higher levels permits the air to expand, and expansion causes it to cool. When the ascending column reaches a sufficiently low temperature, its water vapor condenses into cloud. The first visible stage is the appearance of a small cumulus, rounded above and flattened on the under surface, constituting the capital of an invisible column of rising air. This occurs at an average altitude of from four thousand to five thousand feet above the earth. In the course of the afternoon one sees these clouds grow and coalesce, until they have towered up to enormous heights; often ten thousand feet or more. Very often the summits become fringed with feathery ice clouds, called "false cirrus," but really identical in structure with true cirrus or cirro-stratus. Sooner or later the violent atmospheric circulation that produces these clouds culminates in disruptive electrical discharges, rain, and hail.

Similar clouds are not infrequently formed over great fires, and almost always over a volcano in powerful eruption. In the latter case an actual thunderstorm is commonly generated.

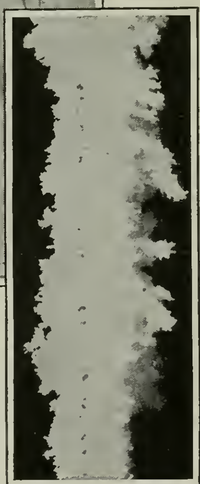
Apart from their shapes, clouds present interesting phenomena of color and give rise to a great variety of luminous appearances, including rainbow, halos, coronas, and the like. These yield much information concerning the structure of the clouds in which any occur. Thus halos occur only in ice clouds, rainbows only in water clouds. The corona (notwithstanding statements found in many books on meteorology) probably never occurs in ice clouds, though it is sometimes due to fine dust in the air. The colors of the rainbow, often described as invariable, really differ considerably from one bow to another, according to the average size of the water drops in which they are generated.

Beautiful iridescent colors may sometimes be detected in clouds, especially along their borders, and not pertaining to a true halo, corona, or rainbow.

What Is Hoarfrost?

IN every-day English the word "rime" is synonymous with "hoarfrost" and is applied to the fine white deposit which replaces dew in cold weather. Hoarfrost is sometimes defined as "frozen dew," but it is more often a direct deposit of small ice crystals from the atmosphere, the invisible water vapor turning to ice without passing through the liquid form.

In recent technical literature the term



Hoarfrost is a powerful but mischievous magician. Above, a beautiful effect created on a tree; on the right, a wire rope

"rime" has a different meaning. It is limited in its application to those striking deposits of rough ice or of feathery crystals which sometimes form on exposed objects surrounded by fog, when the temperature is below freezing. This formation is, in its turn, distinguished from the smooth coating of ice which results from rain in cold weather, and to which the name "glazed frost" is now applied. Heavy deposits of glazed frost often load branches, wires, etc., to the breaking point, and give us the familiar phenomenon of an "ice storm."

Of all these various frost deposits, true rime perhaps presents the most curious forms, and these reach their fullest development on mountain summits and in the polar regions. Beautiful tufts and fringes of ice form on objects of small diameter, such as twigs and wires, and along the angles of square posts and the like, but not on broad surfaces. The deposit is almost or quite confined to the windward side, and grows against the wind.

At the former meteorological observatory on Ben Nevis these ice feathers were sometimes seen to grow at the rate of two inches an hour. In the winter of 1884-5, according to Mr. R. T. Omond, "during a long continuance of strong southwesterly winds and cold weather a post four inches square grew into a slab of snow some five feet broad and one foot thick in less than a week; the crystalline mass then fell off by its own weight and a new set began to form."

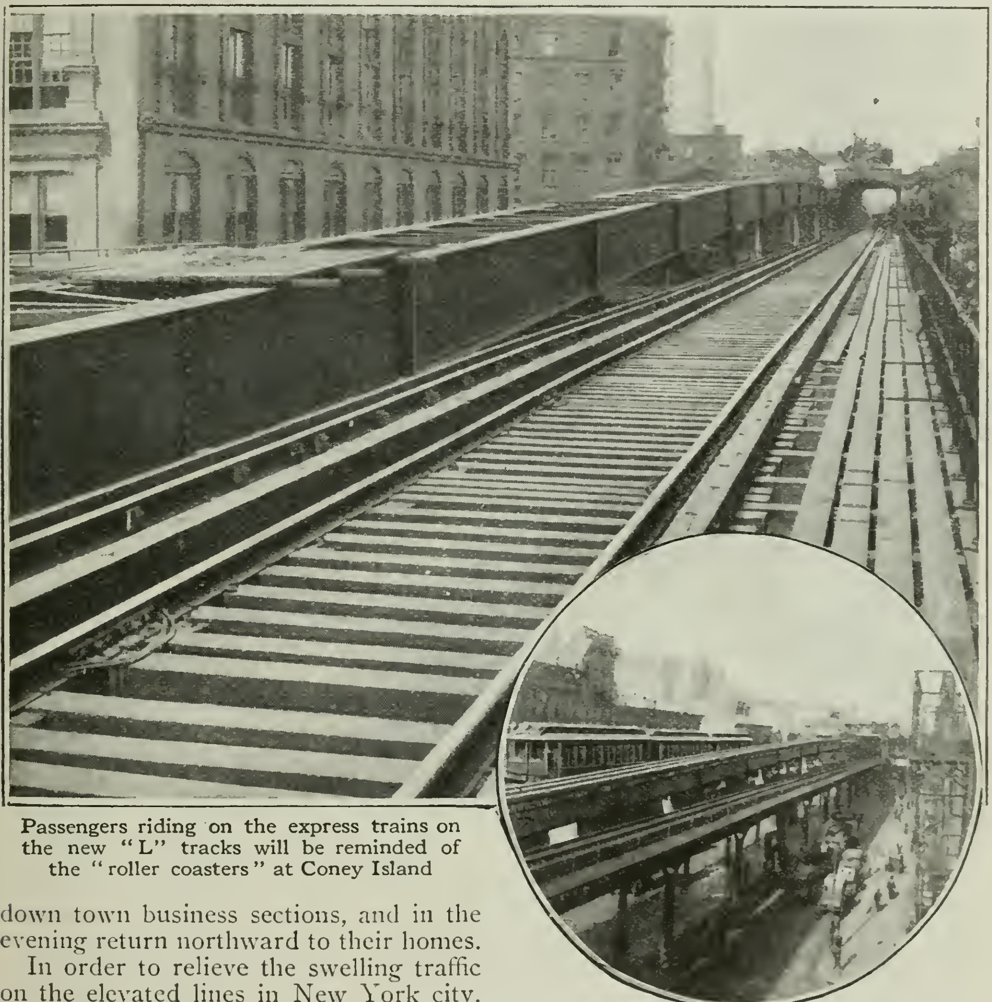
The anemometers and other out-of-door instruments at the observatory were generally so coated with rime in winter as to be useless.

A Curious Tobacco Pipe-Borer

TRAVELERS among the Sioux Indians are very much impressed with the perfect smoothness of the bore in their pipe-stems. Without the use of a tool of any kind, they make a perfect bore in the twigs of ash trees, which they use for musical instruments and for pipes. To accomplish this end, they employ the larva of a butterfly which inhabits the ash tree. The Indians remove the pith for about three inches from the stick they wish bored. Into this cavity, they place one of the larvæ of a brown butterfly, which gradually eats its way down through the pith until the bore is completed. A little heat applied to the wood expedites the work of the larvæ. The Indians consider both the tube made in this way and the larva as sacred as their idols.

New York Trains That Play Leap Frog

A VERY interesting traffic situation occurs on the long and attenuated Manhattan Island, which makes only one express track necessary. In the morning, New Yorkers travel southward to the



Passengers riding on the express trains on the new "L" tracks will be reminded of the "roller coasters" at Coney Island

down town business sections, and in the evening return northward to their homes.

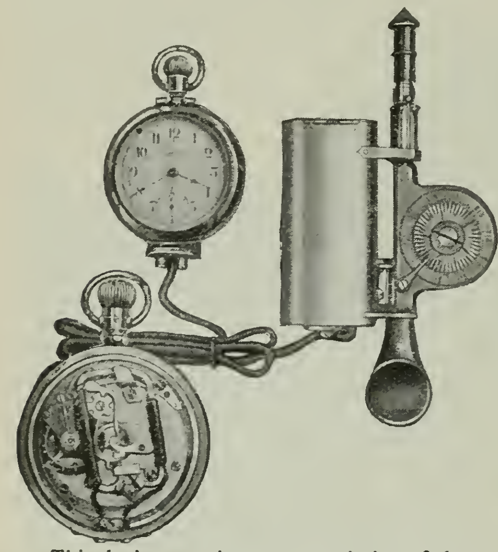
In order to relieve the swelling traffic on the elevated lines in New York city, an ingenious method of track-laying has been resorted to. A horizontal view of the completed structure would bear a strange resemblance to the roller coaster railroads so much in evidence in nearly all of America's amusement parks. Nearing a station, the express trains for which the new track is being designed, rise swiftly on an incline, so that they play at a modified, mechanical game of leapfrog. Under the raised tracks, or "humps," as they are known technically, the local stations are situated.

The reason for the leapfrogging is obvious. There are three tracks in service already on the elevated line, but the third track could not be used for express service unless the trains crossed over and on

At each express station, the new tracks rise above the level used by the local trains

the local tracks to take on and discharge passengers. This would involve delay and a serious possibility of accident, due to the failure of engineers to obey signals.

The stations selected for the express stops are either reinforced or renewed, and the middle track is raised about twelve feet. The loading platforms for the "extra elevated" express tracks are built over the existing local tracks, which are left unchanged. The length of the "hump" is determined by the grade of the present local tracks at that particular section, as the grade of the express



This device permits accurate timing of the revolutions of a machine

tracks never exceeds three per cent. The new platforms are to be three hundred and fifty feet long.

It is expected that the cost of operation of the express trains will be somewhat decreased as the headway which they get on the incline will carry them some distance before power need be applied. Trains will also be able to stop quickly and smoothly because of the upward incline as they enter the station.

Great credit is due the engineers engaged in the construction of the new tracks, for, with a few brief exceptions, traffic on the local tracks has not been interrupted.

A Revolution Timer and Stop Watch Ingeniously Combined

IT takes skill to time the number of revolutions a machine is making per minute, especially if it is running rapidly. One's attention is so divided between the watch and the revolution counter that it is difficult to start or stop the reading exactly on the second. In order to eliminate the human element and make the reading positive, a Chicago man has connected the revolution counter electrically with the watch.

Within the case of a stop watch is a tiny electro-magnet, which, when energized, allows the second's hand on the watch to run; but the instant the electric current is broken and the magnet is no longer energized, the watch stops.

The electric current is furnished by a flash-light dry battery attached to the revolution counter, and the counter itself is so constructed that the electrical circuit is completed the instant the counter starts to revolve and is broken the instant it stops.

The electrical mechanism does not interfere with the use of the watch, as a time piece or as a hand-operated stop-watch. The revolution counter may be used in the ordinary way if desired.

The Danger of Safety-Tin Boiler Plugs.

THE attention of the Bureau of Standards of the Department of Commerce has been called to a very serious condition in the safety-tin boiler plugs used to warn engineers of dangerous boiler conditions. The plugs, which are made of fusible tin and which are supposed to melt easily when the temperature rises too high, were found on inspection to have become oxidized. Since the melting point of oxidized tin is about three thousand degrees Fahrenheit, one can readily see that the oxidized plugs, far from being a safety device, actually increased the possibilities of danger from explosion. Lead and zinc impurities are found to be the principal causes of this oxidation in the tin; and their elimination by strict inspection is urgently advised by the federal authorities.

Our Women Police

POLICEWOMEN are now employed in twenty-six cities. Chicago has twenty-one; Baltimore, Los Angeles and Seattle, five each; Pittsburgh, four; San Francisco, Portland, Oregon, and St. Paul, three each; and Dayton, Topeka and Minneapolis, two each. Fifteen other cities have one each. Their pay ranges from $625 a year in Dayton to $1,200 in San Francisco.

Charles M. Schwab Lifts a House over Trees: Sentiment vs. Cost

THERE is real sentiment in trees to Charles M. Schwab, especially those trees which have sheltered his fine old homestead called "Immergrun" near Loretto, Pa.

Recently Mr. Schwab decided to build a new palatial summer residence on the site of the old home, but he did not want to destroy the beautiful frame house which has been more home to him than even his mansion on Riverside Drive, New York. The house is entirely surrounded by trees. To move it and not destroy the trees was no unsurmountable obstacle to the man who is furnishing guns and fighting ships for the Allies of Europe.

In order to move his old homestead without destroying it and without killing the beautiful trees which surround it, Charles M. Schwab, President of the Bethlehem Steel Co., told the engineers to spare no expense. Accordingly they proceeded to jack the frame house up to a height of thirty-four feet. It will be necessary to lift the residence over twenty-three trees before it can be lowered

When Schwab first spoke to his engineers about moving the Loretto homestead, they mapped out for him a plan which sacrificed only three trees. But that was too much for Schwab.

So the engineers attacked the problem again. The photographs herewith show them in the act of moving the fine old Schwab residence over the trees. By the route that is being taken, the house goes over 23 trees before it will reach the road where it will have clear sailing. The maximum height the house will be jacked over is thirty-four feet. It then starts on its journey across a deep valley on the Schwab farm where it will find a new resting place. It will travel a thousand feet from its present location and will crown a little hill.

The steel king intends to build a million dollar summer home in the heart of the cluster of trees that this jacking operation has saved.

A Queer Adventure in War

MANY aeroplanes are captured during the fighting in Europe; seldom does an aeroplane land on an enemy's aviation field without a fight. At an important British aviation station in northern France a great German biplane was seen recently to emerge from the fog. As the anti-aircraft guns were about to fire upon it, the machine circled several times around the field and finally alighted.

Surprise changed to amazement when the English aviators, mechanics and officers saw the German warplane drive quietly across the field and enter an empty hangar. The German aviators calmly said they had lost their way in the fog, and that on becoming short of fuel they decided to alight. Jokingly, one of the Germans remarked, "If you will kindly give us a little petrol we should be able to return home."

Nature has built the largest stadium in the world for the sport-loving population of Cleveland, Ohio. Over one hundred thousand persons watched this baseball game, and thirty thousand more could have been accommodated

A Natural Stadium Which Holds One Hundred and Thirty Thousand

THE largest stadium in this country is not a product of engineering skill but the work of nature. More than one hundred thousand persons, the largest crowd that ever witnessed a baseball game, was assembled in this great bowl recently without taxing its capacity. It is estimated that it could accommodate one hundred and thirty thousand persons.

The natural stadium is part of a city park in Cleveland, Ohio, and all athletic events which take place there are free to the public. It is almost a perfect amphitheatre. The large field, suitable for all kinds of athletic games, is almost completely surrounded by hills inclined at just the right degree to accommodate spectators. At one end there is a break in the hills that affords a convenient entrance and parking space for automobiles.

Fifty Thousand Aviators

TO the average American, the aeroplane is still a wonder, a miracle, a creation of magic. In Europe men have become so accustomed to it, that children now talk of becoming "aviators" as they would of becoming "policemen." Counting both pilots and observers, there are more than fifty thousand men now in Europe, in daily flights above ground. The number increases from day to day, and before the war is ended it is possible that the number will reach one hundred thousand. A hundred thousand human beings taken to the air every day—and only six years ago Glenn H. Curtiss made his first long flight down the Hudson River—a wonderful feat chronicled in the press of the world!

Paper from Grass

TERMINATING a series of experiments, the Department of Agriculture has recently announced that it is possible to manufacture a first-grade machine finished printing paper from zacaton grass, which grows in great profusion from California and Texas southward to the Argentine Andes.

This grass is harvested for the sake of its roots. These are made into brushes of various sorts, and are frequently known as broom root grass. At the present time the tops of the grass are allowed to go to waste. There is reason to believe that from these a satisfactory paper-making material may be developed.

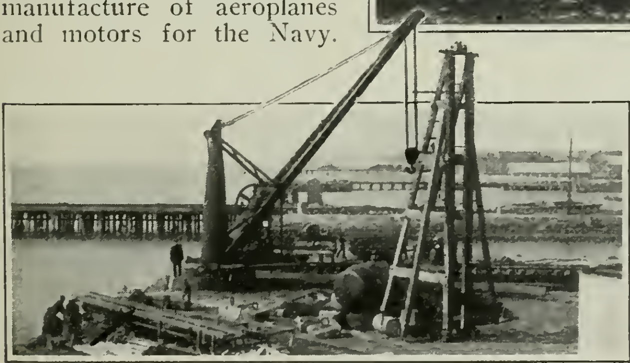
Government Manufacture of Aeroplanes—A National Menace!

By Eustace L. Adams

A GOVERNMENT factory for the manufacture of aeroplanes and motors. The specter which haunts those who hope to see the United States take her place among the nations with a fleet of aircraft which will demand, and receive, respect! The experiment which cost Great Britain nearly five millions of dollars, and produced, altogether, fourteen flying officers and seventeen aeroplanes at the end of a wasted three years!

There is a strong Southern movement, of which Senator Duncan U. Fletcher is a leading spirit, to establish at the new aeronautic base at Pensacola, Florida, a government factory for the manufacture of aeroplanes and motors for the Navy.

It is on these grounds that Florida hopes to see factories established to manufacture aeroplanes



A general view of the wharves at the new Aero Base at Pensacola, Florida

Senator Fletcher, in defending his attitude, says:

"I am strongly of the opinion that the aeronautic base (at Pensacola) should be equipped to manufacture aeroplanes and motors. Not to manufacture all that we may require, but a considerable number. This will act as a stimulus to private manufacturers, as a nucleus for a considerably increased output in war times, as a check on any tendency toward slackness on one hand, or too high prices on the other, by private manufacturers. Experiments may be conducted there which will evolve a highly valuable type of military aeroplane. There a highly trained force may be created, and a training and industrial plant built up, capable of infinite expansion on the government's 1,400 acres, which would be of service that cannot be estimated to the country in time of war. The government has an opportunity to build up a modern manufacturing plant, school and experiment station at Pensacola that will attract the best of the official and enlisted personnel of the Navy as well as the most skilled workmen."

A year ago the Secretary of the Navy requested the Bureau of Construction and Repair and the Bureau of Steam Engineering to investigate and make a report upon the advisability of having the Navy enter upon the manufacture of aeroplanes. This report, which the Secretary transmitted to Congress, advised strongly against such an attempt. Some of the reasons given were:

"It would be a tremendous loss to the

advancement of aeronautical work to lose the ideas and results of private investigation and experiment. The establishing of a government plant for the general manufacture of aircraft would require a complement of officers that could be ill-spared at the present time, not only because the Navy has a very limited number of specially trained designers in this class of work, but because such a plant would call for the diversion from actual flying work of many of the most competent operators. Any government plant which could be established in the near future would be entirely inadequate in war time, as aircraft would be required in large quantities for such an emergency."

The navy has a half dozen of these flying boats which can really fly. It should have five hundred as a basis for a real aero corps

In spite of this report, the project is still being agitated, and numerous officials appear to be in favor of establishing such a factory. Southern newspapers, particularly those conducted in Florida, are jubilant, but it is to be hoped that they are "counting their chickens before they are hatched."

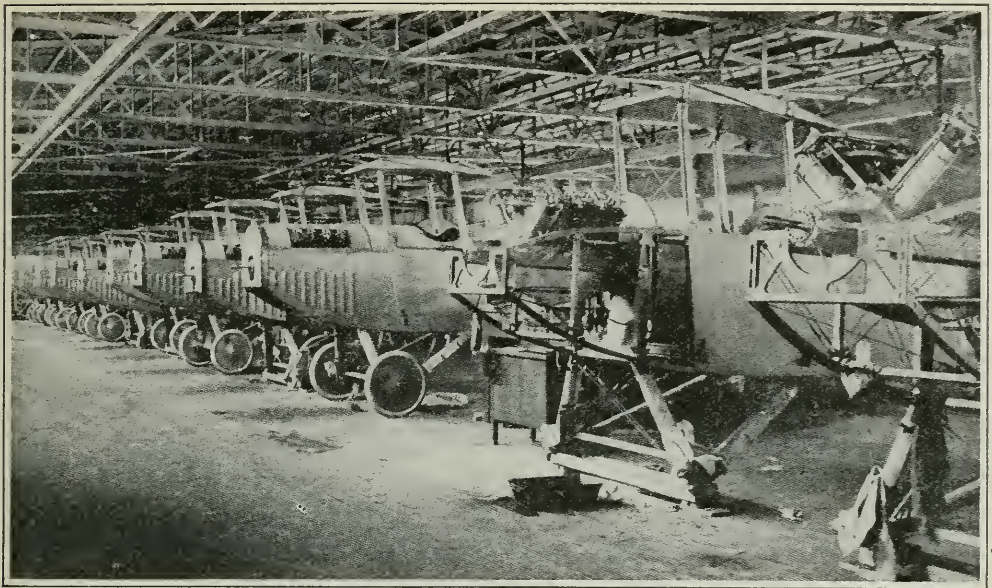
Senator Fletcher says that government manufacture would act as a stimulus to private manufacturers. When did government competition ever act as a stimulus to private manufacturers? Certainly not in Great Britain when the government was conducting its costly experiments along those lines. Great Britain found that by means of government manufacture it could not keep up with the foreign powers in times of peace. How did it hope to produce the thousands of aeroplanes necessary in time of war, especially if the private manufacturers had been driven out of business by government competition? At present, after a year and a half of warfare, and although private manufacture of aeroplanes took a tremendous boom after the failure of the government's experiment, Great Britain is forced to buy almost the entire output of the many American aeroplane factories.

Should war be declared upon this country after the private manufacturers had ceased their efforts, because of government competition, the government factory would not be able to supply the needs of our Army and Navy. It is conceivable that we might not be able to cross the ocean in search of privately manufactured aeroplanes. In that case we would have to build up the industry from the start, while thousands of enemy aeroplanes hummed over our heads, and dropped bombs upon our ships and troops.

Mr. Henry Woodhouse, a Governor of the Aero Club of America, in expressing his opinion of this project to the writer, said:

"Manufacturing of aeroplanes and motors, which Senator Fletcher proposes, is inadvisable, first, because it would retard the development of naval aeronautics, and second, because it would discourage the youthful aeronautic industry. Needless to add, there is, therefore, no argument in favor of the proposition."

There are many persons, interested in the problems of national defense, who see in such a project a real start toward a greater air fleet, and overlook the fact that it is a start in the wrong direction. It is probable that they cannot see the far-reaching evil results of such a step. On the other hand, a large number of far-seeing advocates for real preparedness are displaying great concern that so obvious a "pork barrel" proposition should receive even the most casual attention of Senators and Congressmen at a time when the nation seems at least



An efficient private aeroplane factory. All these Curtiss machines are going to Europe. The aeroplanes in sight in this picture are almost double the number that either our Army or Navy Aero Corps has in commission, if only the serviceable machines in both services are counted

awakening to the shocking condition of army and naval affairs, particularly in the branch of aeronautics.

Mr. Alan Hawley, President of the Aero Club, the public-spirited organization that is leading the vast movement to supply the national guard and naval militia of the various states with aeroplanes, said to the writer:

"So long as the appropriations for aeronautics for the Army and Navy are not sufficient to meet the actual need for aeroplanes and for the training of aviators, there is no justification for spending the small amount available for factories and experiments. The dozen or so aeroplane manufacturers and aero motor makers have shown that they are able to supply, in any quantity needed, the type of aeroplanes and motors required, and they have assured us that they will be at all times ready to do their utmost in every way to supply the aeronautical needs of the Army and Navy."

Mr. Augustus Post, one of the fathers of the Aero Club, an experienced balloonist and a pioneer aviator, gives us his views on the matter. He says in part:

"It would seem just at this time that it would be well to purchase what has already been perfected by the manufacturers in this country and so well proven abroad, and that the Army and Navy might well devote their energies, at present at least, to training men to fly and in perfecting an aerial organization which could be moved where needed. The developments are bound to be so rapid in the near future that immediate steps must be taken to keep up with even the present rate of progress, and it would seem that rather than extensive laboratories, schools of flying should be established and the manufacture and inventive side of aeronautics left in the hands of those who are doing so well and who have accomplished so much."

As was pointed out in the last issue of the POPULAR SCIENCE MONTHLY, the aviation corps of our Army and Navy are at the present time, rather ghastly jokes. Congress has continually overlooked aeronautical needs, and the little money appropriated has been sadly misspent. A recent court martial of one of the officers of our Army Aero Corps afforded the public a glimpse into the rottenness of affairs when politics are applied to our infant aeronautical efforts. If government manufacture is introduced at Pensacola, perhaps it will be the death blow to the hopes of those of us who wish to see the United States, the birthplace of self-sustained flight, provide for its Army and Navy a fleet of aircraft which in time of war would safeguard our Navy, our fortifications, and eventually our homes.

Making a Dancing Floor Into a Skating Rink

NEW YORK, the city of many fads and fashions, is now forsaking the dance floor for the ice skating rink. Dancing, which has held sway for three winters, was doomed to a slow death, even before a substitute was found.

The ice-skating rink which took the place of the popular dance floor in one of New York's prominent hotels

It needed only the advent of a successful play in which an ice skating scene was the chief attraction to turn the tide in favor of the rink. Quick to see the coming change, the manager of one of the largest hotels in the city converted his famous dance floor into a skating rink, and at present has the largest in the city, with the exception of the permanent arenas which have catered to ice skaters for a number of years past.

The rink is circular in shape, and consists of a shallow tank which holds five inches of ice. The water was frozen at the beginning of the season by the refrigerating plant of the hotel, and is to remain in that condition until the skating season is over. Every night, when the last skater has left the rink, the ice is scraped, and a slight film of water is sprinkled over the surface. When this water is frozen, it makes an entirely new surface for the next day's sport. It is said that the rink was made at a cost of about twenty thousand dollars.

Our Big Birdseed Bill

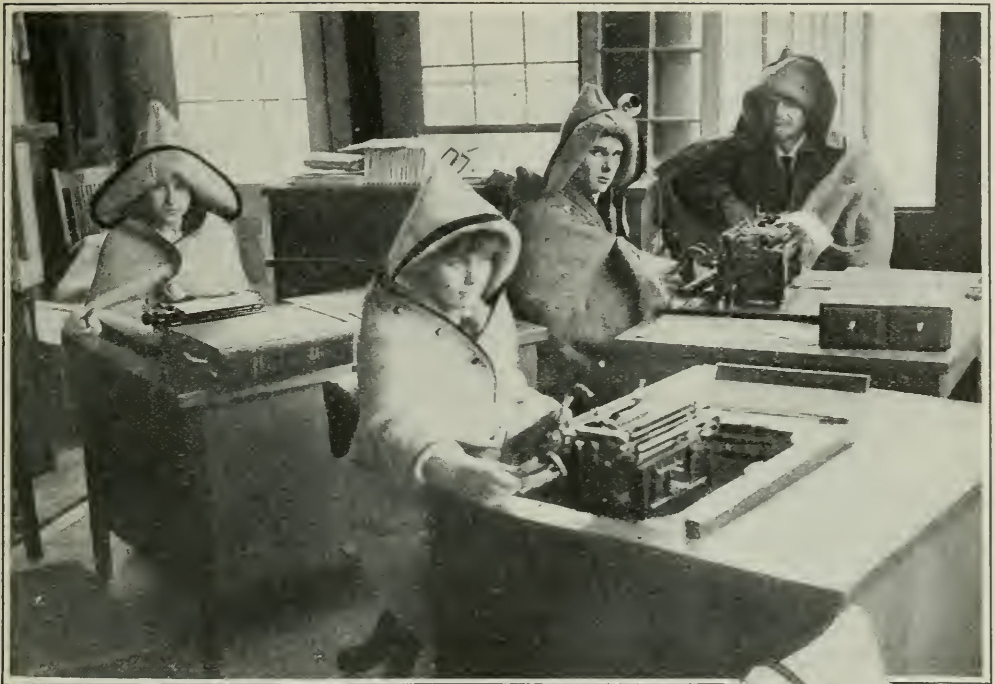
WHEN one watches a canary daintily picking at its little box of birdseed, one is not likely to reflect upon the large quantity of that food which is eaten every year. Nevertheless, during the past year the canaries of this country consumed a total of four million seven hundred and four thousand six hundred and twenty-five pounds, or two thousand three hundred and fifty tons of birdseed. At the advanced price of five and one-half cents a pound which has been in force since the war made it difficult to import this material, the tiny birds have cost their owners two hundred and fifty-eight thousand seven hundred and fifty-four dollars and eighty-eight cents.

THE average annual fire loss in the United States is about two dollars per inhabitant.

Hazards of Aeroplane Making

AEROPLANE manufacturing must now be rated among the hazardous employments. At a foreign aeroplane factory a number of workmen employed in the varnishing department were taken seriously ill, and two deaths resulted.

Upon careful investigation the cause was found to be poisoning by tetrachlorethane, an ingredient of the varnish used. These accidents led to an order forbidding the use of varnish containing a high percentage of this deadly chemical.



Roger Babson and his staff work in the open air. As the thermometer often drops below the zero mark, the office force must be heavily clothed. The heavy woolen mittens make it impossible to operate the machines with speed, so two curved sticks are provided with which the keys are depressed. Good speed is thus attained

A Business Office in the Open Air

ONE of the most remarkable testimonials ever given for the fresh air cure is that of Roger Babson, the famous statistician, at his Wellesley Hills, Mass., office. The confinement of Mr. Babson's work broke his health to such an extent that his physician ordered him to live in the open, even during his working hours.

A large office, built in the rear of his building, was so arranged that it could be enclosed in stormy weather. As may be supposed and as our illustrations show, his office force is heavily clothed; the altitude is high, and the thermometer often drops below the zero mark.

The main difficulty was found in operating their typewriters. It was necessary that the hands of the typists be protected with heavy woolen mittens; but even with this covering, it was almost impossible to operate the machines with speed. The difficulty was solved when Mr. Babson suggested the use of two curved sticks. These are held one in each hand, to depress the keys, in much the manner that a Xylophone performer plays upon his instrument. After some practice, the stenographers become expert in the use of these novel tools.

Saving Men from Scalding Steam in Steamship Engine Rooms

THE engine and boiler room forces of a steamship need no longer die like rats in a trap when a steam pipe explodes and fills the compartment with scalding vapor, if the invention of Mr. Ernest H. Peabody and Walter B. Tardy, of New York, is adopted by any of the steamship companies.

At present the life of coal-passers and engineers is one of extreme hazard, for in modern steamships the engines are driven by forced feed. This means that the boiler rooms are filled with air at a high pressure, driven into the compartments by means of a blower, and passing into the fire boxes to give the flames greater heat. To keep the compartments under this pressure it is necessary for the men to enter or leave by means of air locks, where one door has to be shut before another is opened. This method of entrance and exit is, therefore, very slow, and should the compartment become suddenly filled with steam or noxious gases, all the men at work could not gain the outer air in time to save their lives.

In order to obviate this difficulty, the inventors provide a tank extending from the engine or boiler room under the bulkhead to the adjacent compartment. In case of accident the men jump into the tank, and the force of their jump carries them under the bulkhead, which extends several inches under the surface of the water, thus shutting off the gas or steam from the adjacent compartment. When the men rise to the surface, they appear in the safe compartment on the other side, which compartment is fitted with an exit leading to the deck.

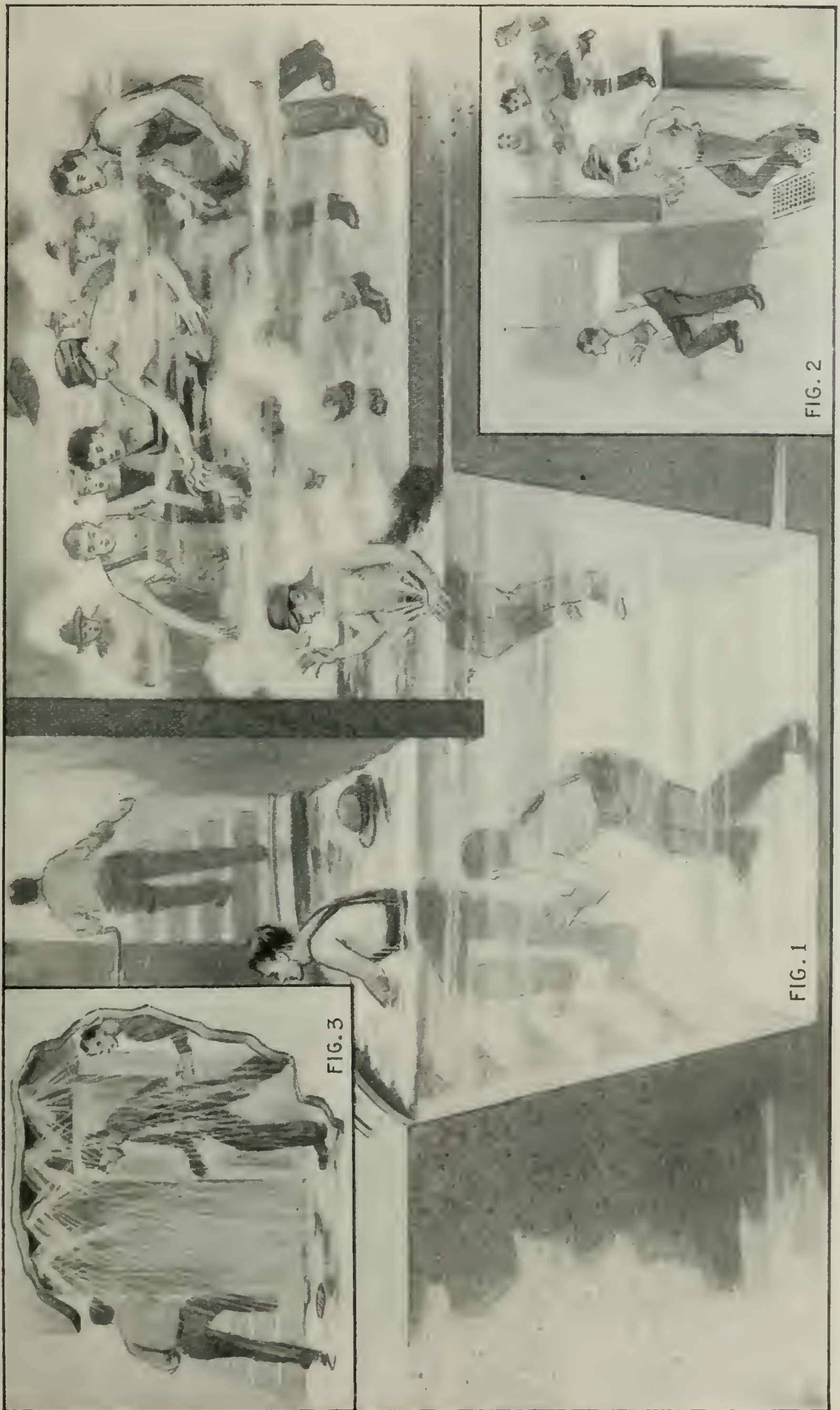
The tank, which is constantly filled with water, is about eight feet deep, thus allowing those escaping to become completely submerged and to pass safely under the bulkhead. The water acts as an effective barrier to the escape of the steam or gases into the adjacent compartment, and at the same time offers a ready means of hasty escape for men who may be caught in the room when an accident occurs.

A modification of the invention is shown in Fig. 2 of the illustration. Instead of having the tank filled with water, a series of valves are arranged to blow a draught of air from the bottom of the empty tank. This blast will be forced upwards in that side of the tank located in the gas-filled compartment, and will blow back the steam or noxious gases, so that they can not pass under the bulkhead separating the two compartments. A trap is set in the floor a few inches from the tank, so that the first man to reach the tank will step on the trap and open the air valves.

Another modification specified by the inventors is the use of a large room between the two compartments, which is operated in the manner of an ordinary air lock, but is so arranged that when the door is opened, a great quantity of water shall be sprayed from sprinklers in the ceiling, as shown in Fig. 3. This water will drive out or condense the steam or gases so that the men may pass through the room in safety.

Testing Shrapnel Shells in Electric Ovens

AN electric oven for testing shrapnel shells has been introduced by a Chicago firm. This oven is for use in one of the government arsenals for the purpose of ascertaining the amount of heat which the shells can withstand. For twenty-four hours, each shrapnel shell must be exposed to a temperature of one hundred and twenty degrees Fahrenheit; and by the use of an automatic thermostat the temperature is maintained at this point for the desired length of time. A pilot lamp outside the oven indicates whether the current is on or off. On a continuous test of more than twenty-four hours, the temperature in the oven did not vary more than one degree.



When a steam pipe explodes and fills the boiler room with scalding vapor, the firemen may jump into a tank of water, and when they rise to the surface, they are in another compartment, with means of safe egress to the open air

As the photograph shows this huge ant-hill has been deserted by its original occupants to make room for two-legged inhabitants

An Ant-Heap as a Look-out Station

ONE of the most destructive of African insects is the white ant. This strange little creature, well under an inch in length, erects huge heaps in which to dwell. In some places, particularly in the Congo, these heaps convert an otherwise flat country into a hilly one. They rise from twenty to fifty feet and more in height. Invariably they are crowned with several bamboo trees, which often attain a height of another thirty to forty feet. Then the heaps are often covered with beautiful ferns and the choicest of wild tropical flowers.

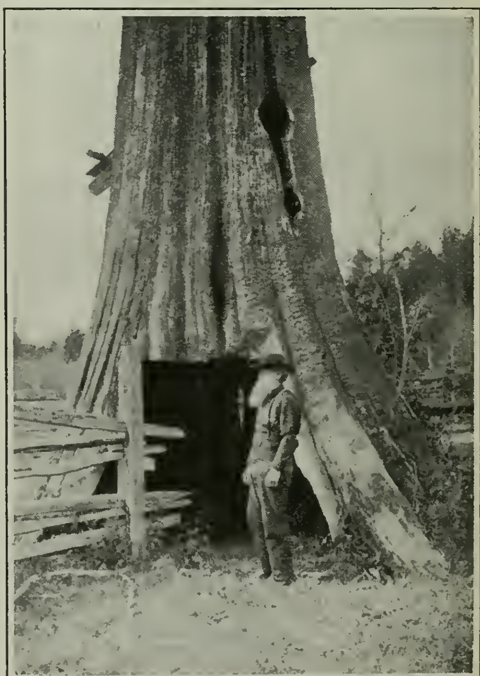
The ants themselves are most destructive, demolishing everything except iron and steel. They go about in vast armies, and in a single night the damage they will do is almost incredible. They will enter huts or tents and attack everything that is not made of iron. Curiously enough, they only destroy that portion of the object that is not exposed to the air. For instance, they eat away the soles of boots, leaving the uppers standing in their place. It is only when you come to pick up the object that you find it has been destroyed. The photograph depicts a deserted ant heap in the Congo which the surveyors converted into a look-out station.

Living In a Tree Stump

IN the big timber section of the Pacific Northwest many huge fir and cedar stumps are to be found, reduced to mere shells through the action of fire or rot. Some of these stumps measure twelve feet in diameter.

The pioneers of this region often utilized these hollow stumps for cattle shelters, storage rooms or even as dwellings for short periods. If open to the sky, a roof of "shakes" was put on, which kept the interior dry. Open fires could be used, as the huge stumps acted as chimneys, creating an excellent draught.

The accompanying photograph shows a big Washington cedar, in which four men lived for over two months some forty years ago. They were engaged in building a home for one of the party, who is pictured standing beside the stump, which he has carefully preserved.



Four men lived for two months in this tree stump while building a permanent home

Detecting Fires in the Holds of Transatlantic Liners

BY means of an apparatus which is now found on many of the large trans-Atlantic steamships, the officer on duty on the bridge can instantly detect any fire which breaks out in any of the holds or compartments.

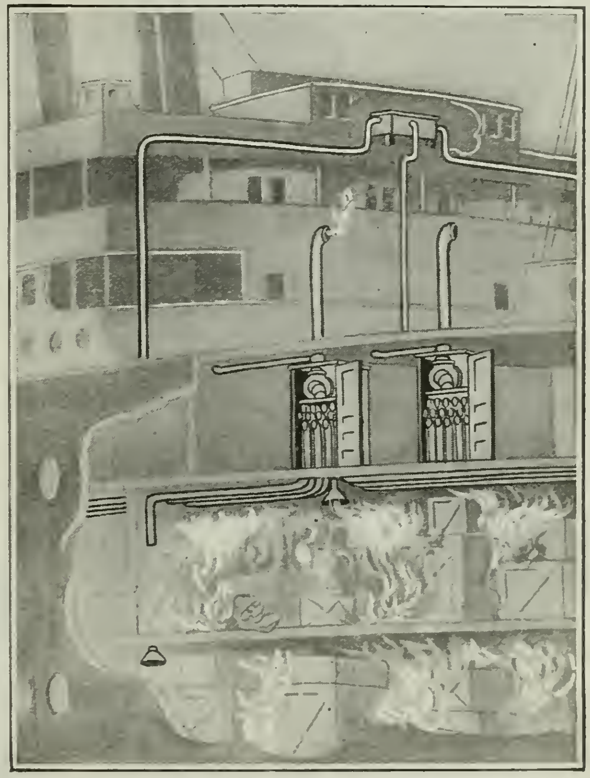
This efficient indicator consists of a set of pipes extending from each of the holds directly to the wheelhouse. At the terminals in the wheelhouse is a set of electric fans which draw air from the holds into a glass case to which the pipes lead. Should a fire start in a hold, some of the smoke would be drawn through the tubes into the glass case, and would be noticed by the officer.

As soon as the fire is discovered, the officer opens the case and fastens to the open end of the tube a steam pipe, which sends live steam through the tube into the compartment and smothers the blaze.

This device has met with considerable objection among ships' officers, because it was claimed that the noise of the electric fans was found very disturbing to the officer on duty, and also that the apparatus took up a large amount of space, particularly on large steamers with numerous compartments to be protected.

In order to overcome these objections, the inventor, William Rich, an American, living in Liverpool, England, has taken out patents for improvements over his original device. A set of small glass cases, one serving for several compartments, is located on the bridge, or wheelhouse, while the remainder of the apparatus is located in a more convenient part of the ship. In the terminal compartment for the tubes is a set of fans which draw the air from the holds, and another fan which serves to send a smaller amount of air from each of these tubes through pipes into the device in the wheelhouse. Each of these smaller tubes leads into a bottle or container which is filled with lime water.

If a fire should break out in a hold, the smoke is drawn into the terminal box for the tubes as before, but is immediately drawn on until it reaches the glass jars containing lime water on the bridge or in the wheelhouse. The carbon dioxide carried up with the smoke turns the fluid to a milky color. The officer can then order live steam turned into the tubes to smother the fire.



The moment a fire breaks out in the hold, it is detected by the officer in the pilot house and by the watchman on deck, by means of the system of tubes and fans indicated, which carry the smoke to the bridge or the deck

With this new device, all the fans and the cumbersome apparatus are located in a distant part of the ship, while only the small set of glass cases is found in the wheelhouse, where saving of space is of more importance.

The chief advatages in the system obviously lie in the fact that a fire can be discovered immediately, and can be extinguished quickly by means of the same apparatus.

How to Sit Straight and Still be Comfortable

THE ordinary straight-back chair encourages incorrect posture. It does not conform to the natural mould of the back. The sitter must assume a slouching attitude to be comfortable.

The cushion fits into the small of the sitter's back and encourages him to sit upright with the chest properly raised

All this is remedied by a simple device invented by Dr. J. H. Kellogg of Battle Creek, Michigan. The device is a small leather or cloth bound cushion which may be attached to any chair. This cushion is so placed that it fits into the small of the sitter's back and enables him to sit upright, with chest properly raised and at the same time to be comfortable.

Concrete to Replace Willow Mats

EXPERIMENTS have been made by the United States Bureau of Standards to develop a method for accelerating the hardening of concrete in order that concrete may be substituted for the willow mats that have been used in the past along the Mississippi River. As a result of the experiment, it was found that four per cent of calcium chloride added to the mixing water increases the strength of the one-day-old concrete one hundred per cent.

Testing a Hack-Saw's Strength

IN order to prove that a hack saw is an instrument of remarkable tensile strength, an experiment was recently conducted at Springfield, Mass. It was found that the thin steel would sustain without injury two hundred and eighty-two pounds, the weight of two men.

Much damage is done to hack saws by too speedy operation, the operator often forgetting that it is the action, not the speed, that does the work. A hack saw should not be run faster than forty to sixty strokes a minute, and no blade will stand a higher speed without injury.

The thin hack-saw, although bending badly, is supporting two hundred and eighty-two pounds without damage to itself

A Lens That Remains in Focus

WHEN dissecting small objects under a magnifying glass, and in many similar operations, inconvenience is caused by the object's continually getting out of focus as the work progresses. An English inventor has hit upon an ingenious method of overcoming this difficulty by fixing the lens to the tool so that when once focused it will always follow the point of the instrument. The illustration shows a lens fitted to a teazing needle in a wooden holder for dissecting purposes. The arrangement consists of a sliding sheath, A, capable of being slid to-and-fro along the holder, but gripping with sufficient force to maintain its position after adjustment. To this is pivoted an arm, B, to the other end of which a shorter arm, C, is similarly attached. The latter carries the lens, which may be anything from two inches to three inches focal length, and from one inch to one and a quarter inch in diameter.

A lens mounted in the manner described above, will be found a great convience for the purposes of microscopical and botanical dissection, fine engraving on metals and the more delicate photographic retouching. Provided the holders are round and of a size suited to the sliding sleeve the attachment may be fitted equally well to a dissecting knife, scalpel, teazing needle, steel scriber, or a photographic retouching pencil.

When the microscope is properly adjusted, it remains in focus without further attention

The wire-drainer clasps over the edge of the kettle and holds a row of doughnuts suspended so that they may drain

Wisconsin Cook's Doughnut-Drainer

A LONG-FELT want of the American home has been a doughnut drainer, a device that would save the housewife from getting her fingers burned with spatterings of hot lard. Mrs. Lyda M. Schultz, of Dorchester, Wis., has devised one of wire that clasps over the edge of the doughnut kettle and holds a row of doughnuts suspended over the kettle where they drain off on being taken from the kettle.

The doughnuts cook in less than half the time it requires without the drainer, according to Mrs. Schultz, thus saving fuel, time, energy and lard, and the doughnuts are better. The drainer is easily cleaned. A shake in hot water and it is ready to hang up to dry. The drainer can be used with equally good results in making shoe string potatoes, potato chips, fried oysters, dumplings, greens, vegetables, and even fried bacon.

SWITZERLAND is best supplied with postoffices. There is one for every nine hundred and sixteen inhabitants.

And Now Comes the Front-Wheel Drive Motor-Cycle

AMONG the many new forms of locomotion which are continually startling the public appears the front-wheel drive motor bicycle. This novel machine is equipped with a device very similar to the motor wheel to be seen on the street.

This front-wheel drive motor-cycle will run one hundred miles on one gallon of gasoline

The motor wheel in this case is actually the front wheel of the bicycle, and it is claimed by the makers that it embodies the correct principle of pulling the load instead of pushing it. This method of construction permits of a direct transmission of power, the usual chain, belt or shaft drives being eliminated. The front wheel bears the weight of the motor, while the weight of the rider is borne by the rear wheel.

The motor is a single cylinder, four-cycle, and air cooled. It is said that it will drive the machine at a speed of twenty-five miles an hour for a distance of one hundred miles on one gallon of gasoline.

Three-Wheeled 'Rickishas for Asia

A CONSIGNMENT of five hundred jinrickishas has been shipped to Calcutta, India, for distribution throughout the Orient, with the intention of eventually displacing the two-wheeled 'rickishas now in use in Asiatic countries. The two-wheeled 'rickishas have a great disadvantage in the unpleasant way they often tip out the passenger when the coolie drops the handles to the ground. The new 'rickisha eliminates this disagreeable feature, and it possesses an added advantage, because of having pedals, in keeping the feet of the coolie from the ground. Wet pavements and muddy roads have been the cause of many deaths among the jinrickisha coolie population of Asia ever since that vehicle was first introduced by an enterprising American missionary in the lands where the 'rickisha reigns.

Some of the new jinrickishas are provided with storage batteries and an electric motor, but the majority of them are driven by foot pedals. The gearing is comparatively low, to adapt the new 'rickisha for hill climbing.

Another consignment of five hundred of the vehicles will be shipped as soon as the American factory, where they are made, can turn them out. They are destined for India, China, Philippine Islands, Java, and the Straits Settlements.

A Makeshift Polarity Indicator

TWO lengths of soldering wire attached to the two wires of a direct current circuit and suspended in a weak solution of sulphuric acid will serve as an emergency polarity indicator. After the wires have been in the solution for several seconds, one of them will become covered with a brown layer, indicating that the wire is connected to the positive side of the circuit. The brown layer is lead peroxide.

Tricycle jinrickishas are now used in the Orient, thanks to American salesmen

A Giant Metal Shoe

A PERFECT shoe more than fifteen times as large as the ordinary man's shoe, and weighing five hundred pounds has just been made by a manufacturer of Peoria, Ill., to be used as a part of an advertising sign.

This giant shoe, fifteen times as large as an ordinary shoe, is complete in every detail, even to the eyelets and heel strap

The shoe is made entirely of sheet metal and is seven feet six inches in height, fourteen feet long and four feet eight inches across the sole. It is complete in every detail, even to the eyelets and the strap for pulling it on, and is a perfect, magnified counterpart of the small shoe after which it was patterned.

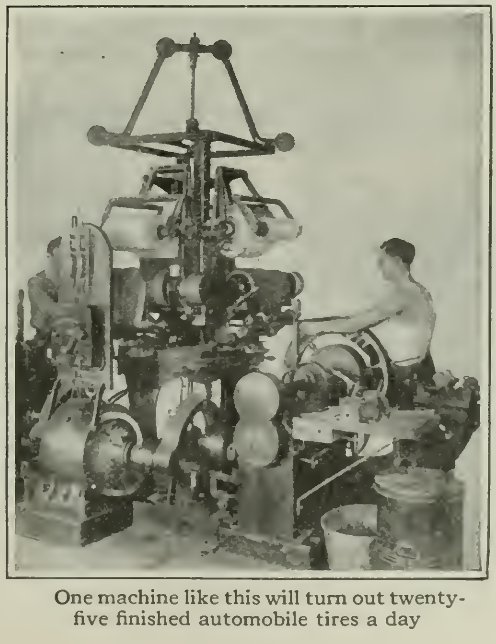
Painting Cars Rapidly

A PROCESS has been patented by which a railway car can be thoroughly painted, inside and out, in a fraction of the time usually required. The car is first given a priming coat and put in a drying oven which has a temperature of 250° F. After drying for three hours, it is removed and painted. Another three-hour period of baking follows, after which the car is ready for a second coat. This process is repeated until the car has not only been painted, but the necessary letters are also placed on the sides and it is varnished within. The length of time required depends upon the number of coats that are given and the quickness with which they are applied.

Making An Automobile Tire Casing

ONE of the most interesting sights in almost any one of the great tire factories are the great machines which are used in tire making. The one illustrated is used for making casings. Two men work together at each machine and their combined output is twenty-five finished casings per day of ten working hours.

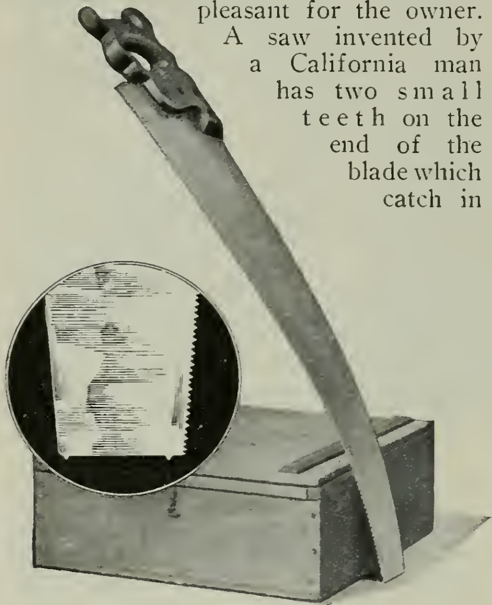
Patterns conforming to the shape and size of the tire are mounted on a revolving wheel. The operator builds up a tread on this foundation. From spools of prepared fabric, cut to the proper width, lengths unwind automatically over the tire structure, the casing being built up in successive layers. The number of fabric strips is governed by the sectional diameter of the tire. For example, a four inch tire requires five strips, a four and one-half inch tire, six strips, and the large five inch tire requires seven strips. These processes, of course, prepare the tire only for the ovens where it remains for varying periods according to the rubber stock, size of tire, and construction.



One machine like this will turn out twenty-five finished automobile tires a day

A Saw That Stands Up

ONE of the inconveniences of the ordinary handsaw is that it will not stand readily against a wall or a sawhorse. The least jar causes it to fall. This is neither good for the saw nor pleasant for the owner. A saw invented by a California man has two small teeth on the end of the blade which catch in



The two small teeth prevent the saw from slipping when leaned against a box

the floor just enough to keep it from slipping. With these points against the floor only a very slight support at the side is sufficient to keep the saw upright.

Josef Hoffman Invents a Shock Absorber

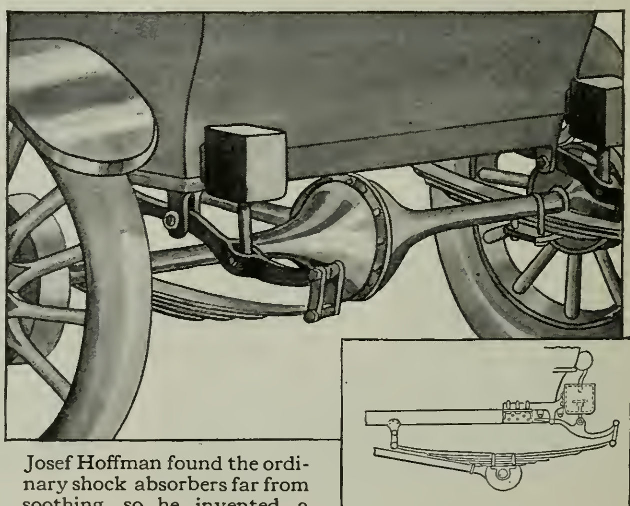
THE avocations of genius are always interesting, and sometimes really valuable. The hobby of Josef Hoffman is science and mechanics, and above all automobiles. He has patented several automobile improvements. The latest of these is a pneumatic spring and shock absorber for automobiles, on which he was recently granted a United States patent.

Mr. Hoffman has found that the ordinary automobile spring or shock absorber tends to bind when there is a side displacement between the body and the spring, as for example, on a curve. His pneumatic spring is an improved type which is designed to eliminate all the sliding contact both from between the parts of the pneumatic spring and from the parts of the steel springs.

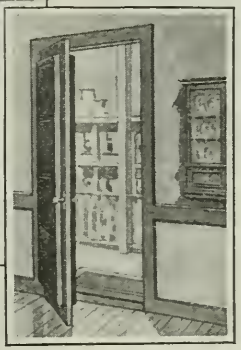
The device consists of a cylinder, a plunger, a diaphragm, and a connection between the ends of the steel springs and the plunger of the pneumatic spring. The plunger is guided solely by the air held with the cylinder, which contains the diaphragm. Thus, when once the plunger is set centrally within the cylinder, the air will not permit the plunger head to get out of center; but if, by some unusual force, its center is disturbed, the plunger will immediately spring back to its normal position. A perfectly safe guiding of the plunger is thus provided, and all sliding contact eliminated.

The diaphragm is made of a grooved fabric, so as to enable the compressed air in the cylinder to reduce the diameter of the plunger. This reduction in size permits the diaphragm to enter the cylinder, whose walls it has shortly before been touching. The entire device may be connected to the body and the semielliptic springs of the ordinary car.

This apparatus is inexpensive and so simple in its construction that it cannot readily get out of order.



Josef Hoffman found the ordinary shock absorbers far from soothing so he invented a pneumatic one of his own



When the tradesman shuts the door of this receptacle, it can be opened only from the inside of the house

Door Parcels-Receivers

EVERY housekeeper has times when no member of the family is at home when the day's supply of milk or meat or groceries are delivered. Some dealers will not leave parcels when there is no one to receive them. The milk and the meat tempt roving cats and dogs. In city homes, at least, the chance of human thievery has also to be considered. It is now possible to have a special kitchen door fitted with four box-like compartments, one above the other. Each compartment is independent and is for a definite kind of supplies. Each has a door opening outside and another inside the house. The tradesman finds the outer door unlocked and closes it upon his delivery, after which the receptacle can be opened only from within the kitchen. Even if the housekeeper be at home it is convenient to have such an arrangement to save her coming from upstairs or from the basement laundry.

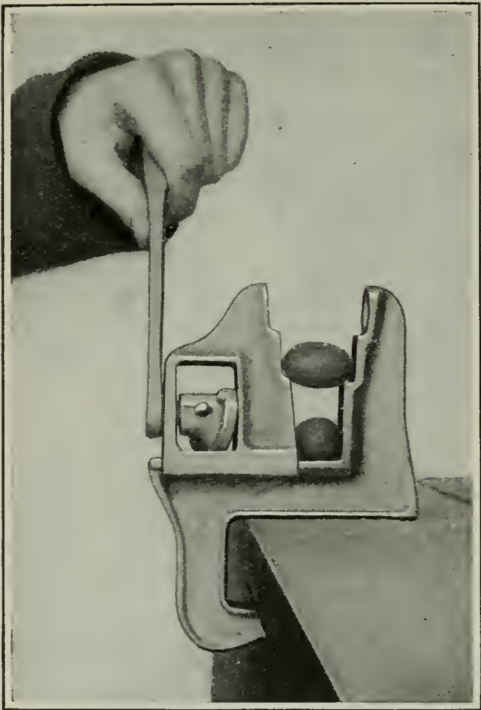
A Handy Darkroom Lamp

A LAMP that can be used for printing and lighting the developer tray while the print is being developed can be made by covering one side of a wooden or metal box with orange or ruby paper or glass and leaving the other side open. The covered side should cast its light on the developer tray, while the open side can be used for exposing the print.

A Rolling Clock

AN oddity in the way of a clock has lately been invented by a young jeweler in Los Angeles who claims that it is more accurate than the ordinary timepiece. The clock is placed upon the high end of a small table which is eighteen inches long and of polished mahogany. Gravity draws it to the other end of the incline, but the speed is controlled by a wonderful system of weights in the clock. There are no springs and therefore no winding. Every thirty days the clock runs the eighteen inches and is then taken up and started all over again. The case revolves as it runs down, but the dial remains in the usual position.

It takes this clock thirty days to roll the length of the stand



The leverage is so great that three nuts may be easily cracked at the same time

Cracking Nuts Three at a Time

A NEW vise-like utensil to crack nuts easily and quickly is designed for use in the kitchen in preparing a large bowl of nuts for table consumption or cracking nuts for use in cakes or other confections.

The new cracker consists of a small vise equipped with a large handle to give adequate leverage. A simple worm moves one of the vise jaws. The jaws are notched so that nuts of different sizes can be broken and so that more than one nut can be cracked at a time. The leverage obtained by this construction is so great that it is very little effort to operate the handle, a point that is of great importance in preparing brazil nuts or hickory nuts for the table.

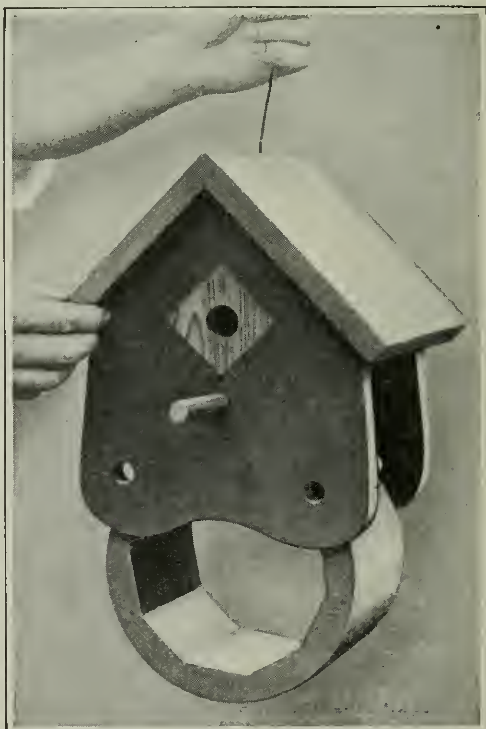
"Growing Pains" are Rheumatism

ACCORDING to Dr. Mary H. Williams, an English specialist in diseases of childhood, "growing pains" are nothing but rheumatism in the vast majority of cases.

A Bird-House That Can be Cleaned

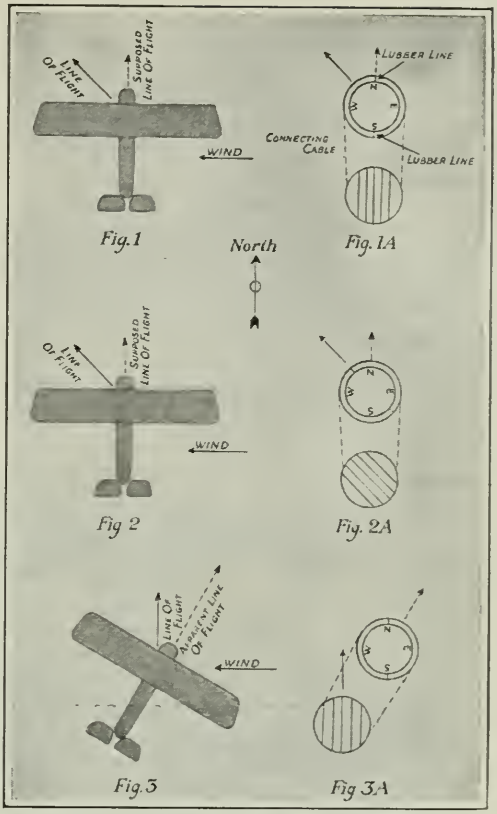
A BIRD-HOUSE that can be "house-cleaned" each year before the feathered tenants return from their southern pilgrimage has just been perfected by J. C. Hubbard, a Battle Creek, Michigan, lover of birds. The new house obviates the loss that sometimes ensues because particular varieties of birds will not raise a second brood of youngsters in an old nest—they want new quarters for each nesting.

The washable bird-house is made of a frame and a roof into which a hollow cylinder fits, held firmly in place by pegs. After the nesting season is over and the birds have gone south, the house can be cleaned by simply removing the pegs and allowing the cylinder to drop down. A garden hose is all that is needed to make the renovation complete. When the vernal migration is over the former occupant finds the old home clean and fresh and as inviting as a new house.



By removing a few pegs, this bird-house may be opened and cleaned for the next coming of the birds

Aeroplane Drift and What It Means



Showing different wind conditions met by aviators during a flight, and on the right the corresponding readings on the drift indicator in each case

WHEN making a flight between two distant points separated by water, or over strange ground on which there are no familiar landmarks, an aviator uses a compass like any sailor. He may find his bearings at any time during the trip by plotting a line on his chart in the direction in which he has been travelling. Then by estimating his rate of speed and the length of time he has been flying he obtains a point on this line which represents his position at the moment. Such was the plan which Lieutenant Porte originally intended using in navigating the *America* on his proposed transatlantic flight.

Serious errors are possible in steering by compass, because no correction is made for drift with the wind. Of course, there would be no drift in a perfectly calm atmosphere; but the air is unfortunately a very unstable medium, filled with currents of varying velocity and direction, which insidiously divert air craft from their supposed line of flight.

This is illustrated in Fig. 1, where the aeroplane is shown heading due north and the aviator naturally supposes that he is flying in that direction. A strong east wind is blowing and carrying him northwest. He cannot feel this wind because he is moving with it and the longer he flies the farther he drifts from his objective. This matter had never received very serious consideration until the transatlantic flight of the *America* was planned, and then it loomed up as a serious problem. A gyroscopic stabilizer had been installed and automatic control ensured, thereby relieving the aviators of much responsibility, save that of "setting the course." Yet with the *America* well on her way there would have been no certainty as to where she would have landed, although the pilot might have kept her absolutely upon the compass course.

The air compass, like the mariner's compass, is provided with a mark known as the "lubber-line," a line usually engraved on the compass case and representing the bow of the ship. Generally there is a corresponding line 180° distant representing the ship's stern. While the "compass needle," is frequently referred to, nautical compasses are provided with a card to which several "needles" are affixed on the under side. This card, bearing the cardinal points, is held toward the north through the influence of the earth's magnetism. It will be seen, therefore, that when a northerly course is to be sailed the ship must be so maneuvred as to bring the "N" on the card directly opposite the "lubber-line," as shown in Fig. 1A.

Now let us again consider drift. Suppose we set our course as described and the conditions are those disclosed in Fig. 1. If we are flying at a reasonable height we see below us so much of the earth's surface that we appear to be standing perfectly still in space; we know we are progressing because we would fall if we were not. We can rely only upon the compass for our sense of direction. If we look at the earth through a telescope, however, we limit our field of vision to a comparatively small area, which rushes past so rapidly that we are unable to distinguish a single object. The earth seems to "flow" under us.

If you have carefully followed the foregoing explanations you will be quite able to appreciate fully a drift indicator which has recently been developed and which is regarded as one of the most important contributions to the science of aviation.

The lubber-line is engraved on a movable ring mounted inside the compass and encircling the compass card. A telescope, provided with five fine cross-hairs, is mounted at any convenient location and so connected with the lubber-line ring that any movement of the telescope results in a corresponding movement of the ring.

When the aeroplane is flying as indicated in Fig. 1, the positions of the lubber-line, the compass card and the cross-hairs of the telescope are as shown in Fig. 1A. Looking through the telescope the earth appears to flow in the direction of the wavy lines. We know the aeroplane is drifting, and at once we set the cross-hairs to parallel the lines of drift; the lubber-line is automatically and simultaneously moved in the same direction and to the exact number of degrees. Fig. 2 shows the aeroplane following the course unchanged, but the compass card Fig. 2A indicates our course to be actually northwest and not north. Fig. 3 and 3A show that the pilot has swung his craft around to meet the changed conditions. While the aeroplane is heading northeast, the actual line of flight is now due north.

Dust from the mop falls through the sieve and is caught in the dustpan

Battery Wax Recipes.

THERE is nothing better for the upper edges of glass cells or open-circuit batteries than hot paraffin. Brushed about the upper edge it prevents the sal ammoniac or other fluids from creeping up over the top.

The paraffin can be colored, if necessary, with red lead, green dust, or powders of various kinds. Generally the paraffin is used without color, so that it has a frosted appearance when cool.

A black wax for stopping the tops of dry cells and coating the tops of carbons is composed of tar and pitch in equal parts. These are made into a pasty mass with turpentine heated over a stove, but not over an open flame because the ingredients are inflammable. The compound should be like very thick molasses, so that it can be worked with an old knife.

Another good black wax is composed of paraffin, eight parts; pitch, one part; lamp black, one part. Heat the mixture and stir it until thoroughly mixed. Apply with a brush or dip the parts into the warm liquid.

Oil Mop Cleaner and Dustpan

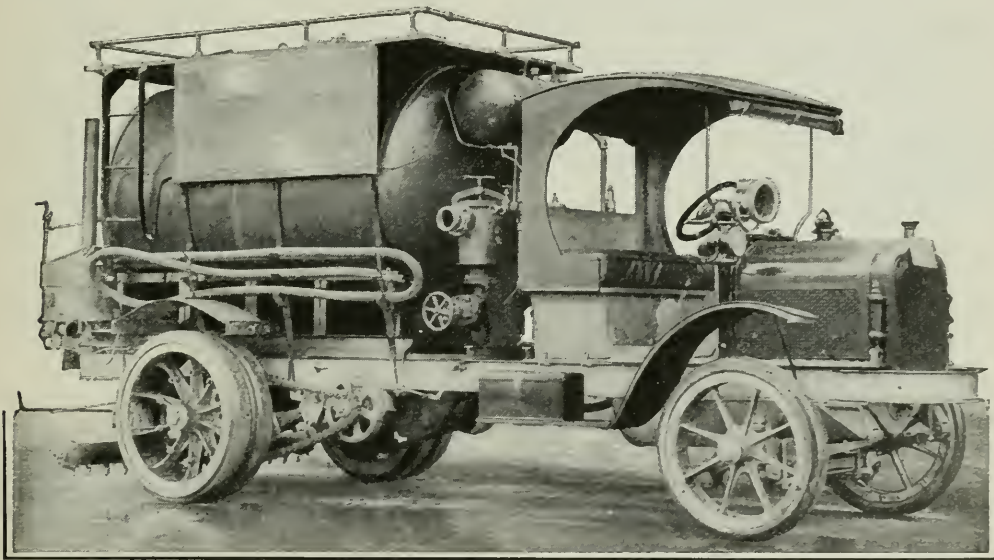
THE oil or polish mop is coming into very general use in homes with finished floors. The dust is quickly picked up in the soft yarn mesh of the mop but the problem of removing the dust from the mop then arises.

A special cleaner has been devised which is also a dustpan. One holds it in place with a foot upon the short handle, and combs the mop back and forth over a perforated platform, the dust falling into the dustpan beneath. This can be used in the house as well as out of doors.

Applying Hot Road Material

TO be impervious to water and to resist wear to the greatest possible degree, roadways must be impregnated with hot tar or some similar material. This condition demands vehicles which combine the necessary distributing apparatus with a plant for heating the road material.

The truck illustrated herewith is of five tons capacity and is one of three recently installed in Baltimore, Md. The truck has a four cylinder gasoline motor, and this also operates a powerful air compressor with which the hot liquid is forced out on the roadway.



To obtain the best results, the tar to be used in making roads must be sprayed while hot. A great tank truck has been built, which has a small boiler on the rear of the chassis to keep the material at the desired temperature

The material within the tank is maintained in a liquid state with the aid of a small flash-steam boiler, which is mounted at the back of the chassis and which may be fired with either kerosene or gasoline. From this generator, superheated steam is led through the material in a continuous flow by means of pipe-coils.

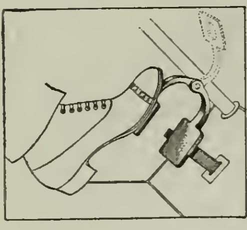
THE most remarkable gold and silver beetles are to be found in Central America. Some have the appearance of burnished gold while the others are like silver. They are worth $35 apiece.

With the Forty-Niners

THE historically important discovery of gold in California was made in January, 1848, at John Sutter's mill on South Fork of American River near Coloma, a point only ten or fifteen miles southeast of the town of Auburn. From 1850 to 1853 the greatest yield was derived from the gravels, and the largest annual output for this period was more than sixty-five million dollars in 1852. There was some reaction in 1854, due to previous wild speculation, but a production of about fifty million dollars a year, chiefly from placer mines, was maintained up to the year 1861.

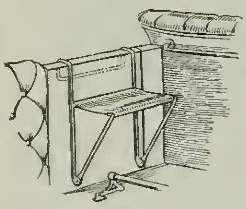
At first the gold was won chiefly from the gravels along the present streams. Those who first got possession of the rich bars on American, Yuba, Feather, and Stanislaus rivers and some of the smaller streams in the heart of the gold region, made at times from one thousand to five thousand dollars a day. In 1848 five hundred to seven hundred and fifty dollars a day was not unusual luck; but, on the other hand, the income of the great majority of miners was far less than that of men who seriously devoted themselves to trade or even to common labor.

An Adjustable Auto Foot-Pedal for Short-Legged Drivers



SHORT persons usually have difficulty in driving an automobile because of the distance of control pedals from the seat. Especially is this the case in cars made in large quantity, where no allowances are made for the varying leg lengths of prospective owners and drivers. For the convenience of these short-legged persons there has been brought out the two-step extension pedal, which can be attached and adjusted in a few minutes. The pedal consists of two sections with a serrated joint, similar to that of the adjustable handlebars on bicycles. The pedal can be adjusted to suit any driver and is nickel plated.

An Extra Seat for Ford Cars Which Hangs on the Door

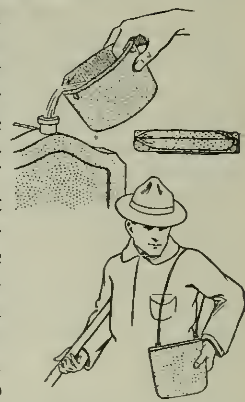


CROWDING one or two extra persons into a Ford car appears to be rather more of a habit than before. Time has shown that a little Ford touring car can be relied on to "ramble right along" with as many as seven people in it, and inventive geniuses are busy supplying additional seats. The accompanying illustration shows a neat, simple and very light seat, to be hung over the doors of the car. The hinges at the bottom of the hanging rods show that the seat can be folded flat. The device is finished in japan, with padded leather or pantasote seat. The hooks are also padded with leather to avoid marring the finish of the doors.

Beeswax for Cracks and Holes

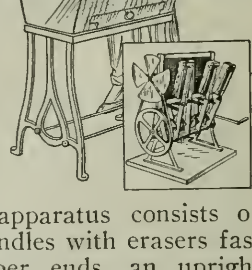
WHEN filling cracks and holes use beeswax instead of putty. Heat it until it is plastic and push it into the crack. Then sandpaper the wood around the crack and let the dust mix with the beeswax. When the wood is stained, the crack will be hardly noticeable.

This Folding Motor Bucket Is Also a Game Bag



A WATER bucket which folds up and may be put in the door pocket or under the cushions of an automobile is one of the most convenient of recent motor accessories. It is made of heavy brown waterproof canvas and holds over a gallon. The only metal in the bucket is the top rim, which folds compactly, and when unfolded stays in position. To unfold, the rims are pushed out to the regular size and the bucket is immediately ready for use. It may also be used as a fish or game bag, by leaving it flat and fastening a strap or small rope in the loops on the side of the bucket. This latter fact makes it especially handy for a long tour.

A Machine for Cleaning Blackboard Erasers



A MECHANICAL cleaner for blackboard erasers has been brought out which will entirely obviate the highly unpopular schoolroom task of beating the erasers on the window sills, with the unpleasant clouding of the room which accompanies this operation. The apparatus consists of several pivoted handles with erasers fastened at the upper ends, an upright screen and a rotating shaft fitted with cams. Rotated by a handle at the end of the machine, the cams force the handles outward so that they descend briskly upon the screen, thus driving out the chalk dust retained in the erasers. A fan whirling rapidly at one end of the screen blows the dust away from the operator.

If You Only Have a Rope

SUPPOSE you are caught like a rat in a trap in a house on fire. Your only means of escape may be a dead wire, a loose rope, or sheets and blankets tied together to make a rope.

Would you know how to slide down the rope or wire like a fireman or sailor? You will very likely say, as sixty odd university students replied when asked that question: "Ah, that is easy. Anybody can slide down a rope."

But can they? Boys are usually as agile as monkeys, and more likely in an emergency to be able to rescue themselves than others, yet a recent test of boy scouts with a rope lowered from the first story of a supposedly burning building, proved that only two or three knew how to use a pole, a wire, twisted sheets or a rope in order to reach the ground safely.


The correct way to slide down a rope

Sliding down a rope, like many other things, is simple enough—if you know how!

If you lower yourself by letting the rope or wire slide and slip through your hands or touch any part of the uncovered flesh, the motion and friction will sting and tear your skin beyond endurance. This will cause you to let go and may produce serious results.

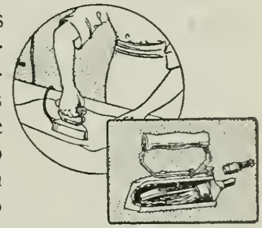
By holding on with your hands and letting your weight go down, one hand over the other, you will not go far before you are too tired to support your own body. Disaster will be the price, because you will drop like a shot. Nor can you slide with the rope between your legs, because the swaying will make the rope slip or will jerk it from its clutch.

There is a right way, which secures to you almost the safety of walking on solid ground. You stand upright and put out your leg, say the right, and give it a turn around the rope. Next put the rope into the crook of your elbow and there hold it firmly.

Your hands and skin do not now touch the rough rope at any spot. You may slip down slowly or rapidly, but under complete control by bending or stiffening the body, to the security below. Your garments act as a shield to your flesh, and you have a fire-escape and rope-ladder fit for safety, stratagems or adventures.

A Bunsen Burner Flat Iron

AN Illinois manufacturer has placed on the market a novel gas flat-iron which employs the principle of the Bunsen burner to keep it at an even temperature and to eliminate any outside heating. Essentially, it consists of a hollow flat-iron, in the back of which is inserted a modified form of the simple and inexpensive burner. By its means the gas flame is directed down towards the point of the iron; and the intensity of the heat may be very easily regulated by the amount of air admitted to the tube attached to the back of the iron.



A Hair-Drying Comb

A COMB with a hollow back for receiving a hot iron is the essential idea contained in the illustration. The comb is the exception that the back is hollow. A handle with a heating iron is provided as a part of the device. When it is desired to use the comb for drying the hair, the iron is heated in a gas flame and inserted into the back of the comb. Gradually the heat is conducted to the teeth, which are made of steel. Stroking the hair with the warm comb readily dries it, and, the inventor claims, leaves it in a lustrous, soft condition.

That Mathematical Short Cut

Short Cuts in Arithmetic

THE principle described by Mr. Shourn in the November issue of the Popular Science Monthly as a "Short Cut in Multiplication," can be used equally as well in addition, subtraction and division, with slight variations. To use his figures in

Addition.

$$\begin{array}{rcl} 974265 = 33 = 6 \\ 84337 = 25 = 7 \\ \hline 13 = 4 \\ 1058602 = 22 \quad = 4 \end{array}$$

Subtraction.

$$\begin{array}{rcl} 974265 = 33 \\ 84337 = 25 \\ \hline 8 = 8 \\ 889928 = 44 = 8 \end{array}$$

If the 33 and 25 were further reduced it would be 7 from 6, in that case 10 would have to be added to the six, and 1 subtracted from result, as below:

$$\begin{array}{r} 33 = 6 = 16 \\ 25 = 7 = 7 \\ \hline 9 \\ 1 \\ \hline 8 \end{array}$$

Multiplication.

$$\begin{array}{r} 974265 = 33 = 6 \\ 84337 = 25 = 7 \\ \hline 42 = 6 \\ 82166587305 = 51 = \quad 6 \end{array}$$

Division.

In division the division digits are multiplied by those of the quotient and to the result the remainder is added, these must equal the sum of the digits of the dividend:

Dividend = 974265 = 33 = 6
Division = 84337 = 25 = 7
Quotient =1146558 = 27 = 2 1/7
(7 × 2) + 1 = 15 =6
Dividend = 6

—L. E. F.

Be Sure You're Right

THOSE who read in the November number of the Popular Science Monthly the article entitled "Short-Cut Multiplication Proof" may be interested to know that the principle of the method there discussed may also be applied to the other three fundamental arithmetical processes.

As a simple example suppose we divide 25 into 375. Our answer or quotient would be 15. Now let us reduce each one of these figures to its lowest terms, which, according to this process, means adding the 2 and 5 in the divisor, making 7. Then 3 plus 7 plus 5 in the dividend equals 15, and 1 plus 5 in the 15 makes 6, the lowest term of our dividend; and 1 plus 5 equals 6, the lowest term of our quotient. To prove the problem all that is necessary is to multiply the lowest term of our quotient by the lowest term of our divisor. If our division was correct our answer will be the lowest term of the dividend. That is, in this case (quotient) 6 x (divisor) 7 equals 42; and as 4 plus 2 is 6, the same as the lowest term of our dividend, we know that our division was correct.

The following is an illustration of proving substraction:

5721 equals when the digits are added together 15
3545 equals when added 17, and 7 plus 1 equals 8
——
2176 equals when added 16, and 6 plus 1 equals 7

The same problem in addition would be:

5721 equals 15 equals..... 6
3545 equals 17 equals..... 8
——
14 equals 5
9266 equals 23 equals....... equals 5

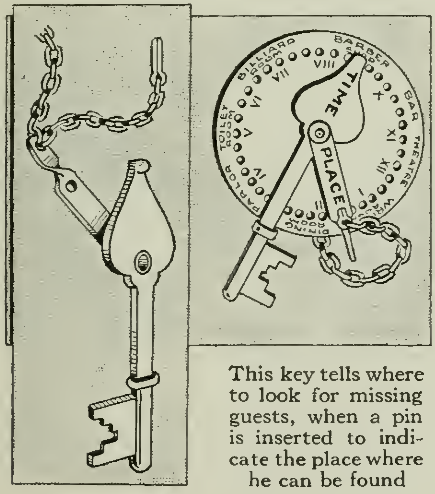
With a little practice one may become very proficient in reducing the numbers to their lowest terms, thus making the process valuable for those who have to check over their own work. Try it.

—M. A.

Hotel Keys Which Take the Place of Shouting Call Boys

NO longer will hotel clerks have to "page" the corridors, lobbies and bars when a visitor asks for a guest who cannot be found in his room. It will only be necessary to take the key which Mr. Jones has left at the desk, and after a glance say, "Mr. Jones may be found in the grill room."

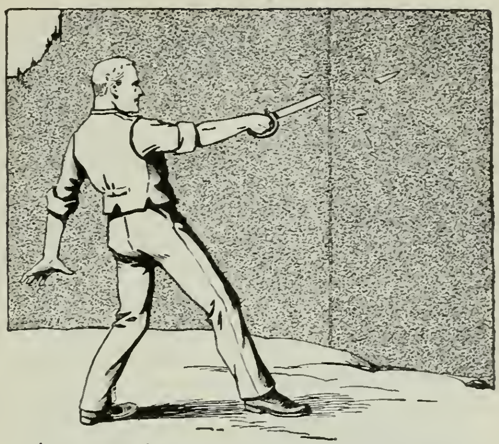
The labor-saving device which will make this possible is a novel key tag which has recently been patented by a Chicago inventor. The tag, on which the number of the room is stamped, is oval, and is imprinted with a clock face. By means of a pin in the center of the tag the key may be fastened so that it will act as the clock hand, indicating the approximate time when the user expects to return. On the outer edge of the tag are a series of small holes. Near these are stamped the names of the various public rooms of the hotel. Another pin is attached to the tag by means of a light cord or chain, and this may be placed in any of the holes, indicating the place where he may be found.



This key tells where to look for missing guests, when a pin is inserted to indicate the place where he can be found

Water That Cannot Be Cut

A FACTORY in Grenoble, France, utilizes the water of a reservoir situated in the mountains at a height of two hundred yards. The water reaches the factory through a vertical tube of the same length, with a diameter considerably less than an inch, the jet being used to move a turbine. Experiments have showed that the strongest men cannot cut the jet with the best tempered sword; and in some instances the blade has been broken into fragments without deflecting a drop of the water, and with as much violence as a pane of glass may be shattered by a blow from an iron bar. It has been calculated that a jet of water a small fraction of an inch in thickness, moving with sufficient velocity, could not be cut by a rifle bullet.

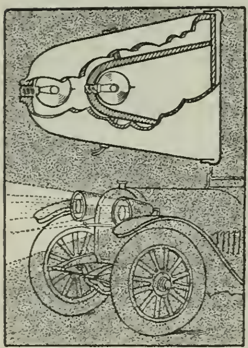

A stream of water under high pressure will break the blade of a sword if an attempt is made to cut it

The engineers of some big water power projects of the Far West are willing to wager that a two hundred pound man, swinging a four-pound ax with all his might, cannot make a "dent" in the water as it emerges from the nozzle at the power house. Burying an ax in a stream of water looks like child's play, and the average two hundred pound visitor is likely "to bite." He invariably loses. So great is the velocity of the water emerging from the nozzle in these modern power plants that an ax, no matter how keen its edge, is whirled from the hands of the axman as soon as it touches the water. The water travels under a pressure exceeding 500 pounds to the square inch in many instances, and no power on earth can turn it off at the nozzle, once it gains mometum. It has the same effect on one's fingers as a rough emery wheel, and will shave a plank with the nicety of a razor-edged plane. When, as frequently happens, it is necessary to shut down a power plant operated by one of these streams, the nozzle is deflected by means of a powerful set of gears.

What's New in Patents

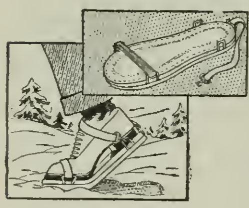
Little Inventions to Make Life Easy

A New Headlight Dimmer



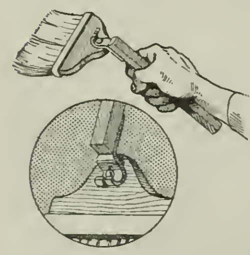
A SMALL searchlight is nested in one of an ordinary size, providing two complete headlights, one within the other. The larger one, when lighted, throws its beams in an anular ring of light past the headlight which has been nested therein. This makes a dim light. To make a brilliant light, both are illuminated at the same time.

Keeping Your Sole Warm



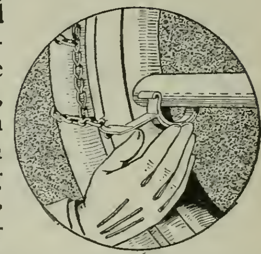
A LAYER of thick felt or rubber is sewed to a frame made of a resilient material, and shaped to follow the outline of the sole of a boot or shoe. At convenient points on the outside edge of the attachable outer sole are sewed projections or loops through which may be passed straps for securing the outer sole to the sole of the shoe.

Adjusting a Brush to Its Handle



A DETACHABLE and adjustable handle is fitted to the standard form of brush by means of a slotted fork and held to the brush by means of a bolt and a winged nut, which may be tightened or loosened by the fingers. By means of this fastening, the handle may be secured to the brush at any desired angle, or it may be removed at will.

For Applying Chains to Wheels

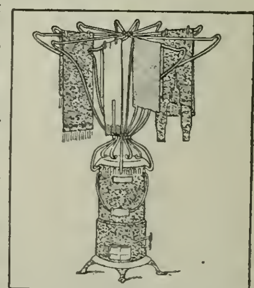


A BAR, having a central spring clip designed to grip the spoke of a wheel, is provided with two hooks on each end. In applying anti-skid chains to the wheel, after adjusting the clip, the ends of the chains are each engaged on the hooks, which are stationary, and the chains are thus held firmly in position.

An Egg-Tester and Mailing Tube Combined

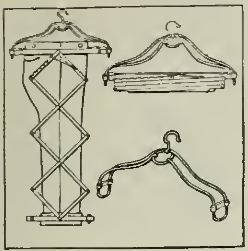
A SHEET of paper-board is rolled so that it will be somewhat tapered. On the larger end, the tube is so cut that it will fit the size of an egg held against it. A circular or other piece of printed matter may be mailed in this tube, and the recipient may use it to test eggs, by pressing an egg against the end and looking toward the light through the smaller end.

A Clothes Rack Dryer



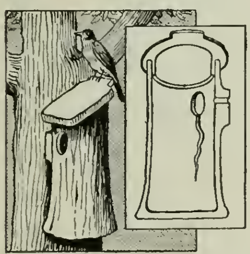
A NUMBER of heavy wires are fitted with hooks at their lower ends and sliding rings at the center and upper ends to form a collapsible clothes rack which can be fitted to an oil heater. By the sliding of the retaining rings, the device may be disengaged from the stove, collapsed, and stored in a small space.

Combined Coat Hanger and Trousers Stretcher



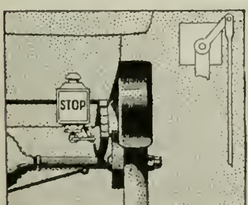
A CLOTHES hanger and trouser hanger are connected by a device which is commonly called a "lazy tongs." When the trousers have been hung on the device, the tongs are stretched as far as possible and locked, thus holding the trousers stretched. A coat and vest may be hung on this device at the same time by making use of the clothes hanger which forms the uppermost section of the apparatus.

Making it Easy for the Birds



A CYLINDRICAL bird box is made of fire-clay or pottery and is fashioned on the outside to resemble the trunk and bark of a tree. A slanting roof, which projects well above the walls of the house to prevent the leakage of rain or water into the house, is provided with deep flanges to hold it securely in place. A circular hole is made in the side near the top for the free passage of the birds, and on the inside is a climbing strip leading from the bottom to the side opening near the top to aid young birds or injured ones to reach the opening.

A Simple Signal for Automobiles

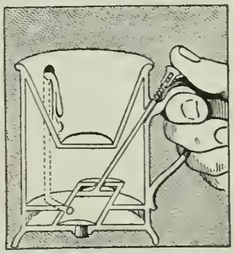


ON one side of the rear light is marked the word "Stop." The light is mounted on a pivot, being actuated by a rod connected with the brake rod. When the brake is moved by the driver, the light turns, exposing the warning signal to the rear.

Keeping Shampoo Soap Out of Your Ears

TWO ear protectors are held in their proper places by means of a resilient metal band fitting under the chin. Passing over the top and front of the protectors is a trough to catch liquid which might fall from the hair while the latter is being shampooed. The liquid passes over the top and is guided downward into the bowl, or if it falls against the front of the protector it is guided downward into two small cups or retainers which are suspended from the front of the protectors.

A Shaving Mug with a Soap Pump

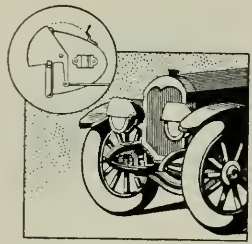


A SHAVING mug is made with a false bottom to contain liquid soap. Passing into the soap reservoir is a plunger which, when pushed, allows a sufficient quantity of soap for one shave to pass into the water reservoir.

Snapping the Snapping Turtle

A NUMBER of resilient wires are attached to the end of a long pole. Each wire is provided at its lower extremity with a hook which is first bent inwardly and then outwardly. In use, when a turtle or tortoise is seen crawling upon a river bed, the operator, with a quick downward movement of the pole, forces the free ends of the gripping wires or fingers downward upon the shell back of the reptile. The wire fingers spread outward until they ride over the edge of the shell back. The shoulders formed by the shape of the wire fingers engage under the shell and grip it tightly.

A Headlight Dimmer Operated from the Seat

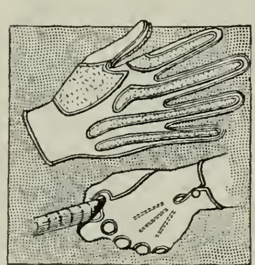


A HOOD or shield, formed of a single piece of metal, is fitted to a pivot on each side of an automobile headlight and equipped with an arm leading to a controlling lever. The shield, in its normal position, rests above the lamp, but when the control lever is actuated from the driving seat, the shield pivots to the front of the lamp and deflects the rays of the searchlight, so that the blinding light will not dazzle an approaching pedestrian or driver.

A Stepladder and Ironing Board

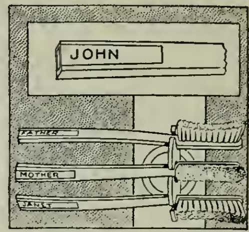
A DEVICE that will appeal to the housewife who desires compactness is a step-ladder attached to an ironing board by means of two pivots. A brace is secured to the legs of the ladder and engages the bottom rung and holds the ladder in place. A similar brace makes it into an ironing table. The combination when not in use can be folded together to save storage space.

Increasing your Grip on the Golf Club



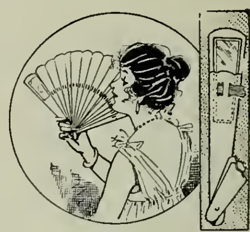
THE palm and fingers of a glove are provided with a number of gripping surfaces composed of flexible leather. These are cut to such a shape that when the glove is encircling a golf-club the maximum amount of gripping space is in proximity to the club, thus insuring a firm grip. On the back of the glove are numerous ventilating holes, which also add to the flexibility of the glove.

It's a Wise Man That Knows his own Tooth Brush



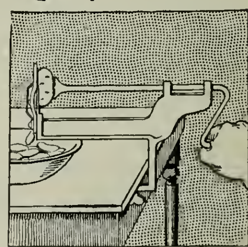
THE handle of a tooth brush is made of a transparent material and is provided with a deep longitudinal slot. In this slot may be slipped a label upon which is marked the name of the owner of the tooth brush. A plug is furnished to seal the open end of the slot, making the interior waterproof. By means of this device the name of the owner is permanently placed upon the instrument, and is not made illegible by handling or by the influence of water.

A Sop to Feminine Vanity



A FAN is made with a small mirror placed on the inside of one of the end blades. A small button on the same blade is designed for engagement with a hole in the adjacent blade. When the button is engaged in the hole, the mirror is concealed behind the adjacent blade, which does not open, with the rest of the fan. When it is designed to use the mirror, a slight pressure upon the end blade will free the button and expose the hidden mirror.

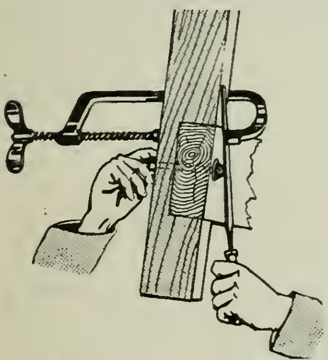
Making Potato Chips by Machine



A THREADED rod is set on a stationary arm which is provided with a clamp and set screw so that it may be secured to a table. On the arm, opposite the threaded arm, is mounted a pin and a knife blade. A potato is placed upon the pin, and by means of a handle the threaded arm is rotated, thus pushing the potato against the knife. In the process of turning the handle, the knife cuts the potato into strips suitable.

For Practical Workers

To Prevent Bolt from Turning When Unscrewing Nut



This file prevents the bolt from turning

THE bolt will often turn in unscrewing nuts, and should it be a carriage bolt difficulty is often experienced in unscrewing the nut at all.

The accompanying illustration shows a very simple method of preventing the bolt from turning, by simply clamping a coarse file over the head of it, as indicated.

Saw Box

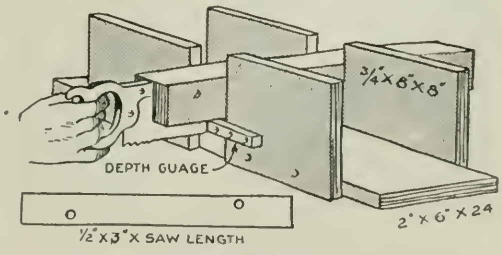
THE saw box illustrated is one which has proven itself well worth while. In cutting a large number of pieces to the same length it was found that the old-fashioned box soon became inaccurate, due to the contact of the teeth of the saw with the edges of the guides. To obviate this trouble and secure a more permanent and serviceable box this one was designed.

The drawing requires very little explanation. Hardwood, preferably maple, is used throughout. The saw is first equipped with the two strips of wood, one on either side. These are bolted on to the saw with two $\frac{1}{4}'' \times 1''$ stove bolts, heads and nuts set flush to allow the saw to pass between the vertical guides. The holes may be readily punched in the saw by means of a good punch. Hold the saw on the end grain of a block of hardwood and keep the holes at least $\frac{3}{4}''$ from the edge, in order to avoid cracking the saw.

As the saw will be found a little thicker at the heel than the point, as well as at the teeth, than the back, the boards will have to be dressed down to bring them the same thickness at every point, after they have been bolted on. Be quite certain to take the same amount from each board.

Next work out the parts for the box and carefully assemble the boards at one end. Place the saw in position and assemble the boards on the other end, being certain that there is just enough play to allow the saw to move freely, but with no shake. A little beeswax or floor wax on all the guides will keep the saw moving freely and easily and will also prevent wear.

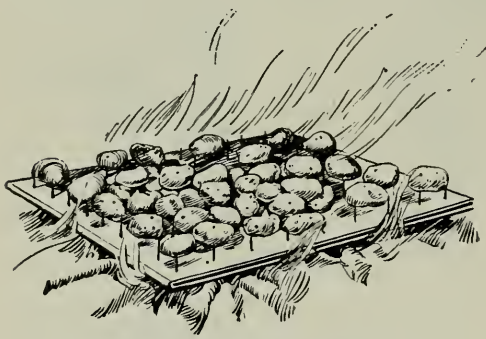
An excellent depth gage can be arranged as suggested in the sketch. A fine tooth saw will give best results. The saw is always available for other work by removing the screws and taking off the boards. The holes in no wise interfere.



This saw box will be found more permanent and serviceable than the old-fashioned box

Potato Roaster for Campers

A POTATO roaster for camping parties may be made from a sheet of stiff sheet metal—iron will usually be



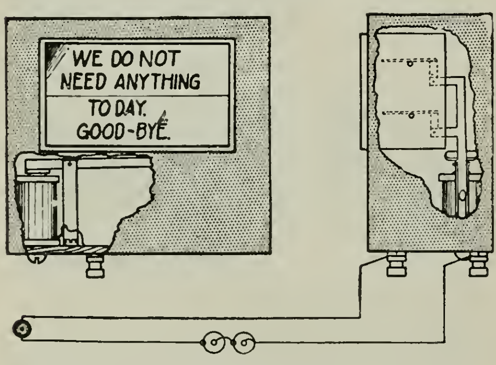
The potatoes are held on nails, and the heat circulates evenly

the handiest—through which a number of nails spaced equally distant are driven. The potatoes are pushed upon the nails and the loaded tray lowered over the glowing coals of the camp fire. The heat circulates about the potatoes evenly; so they are roasted uniformly.

An Electrical Peddler Chaser

PROBABLY the greatest source of annoyance to the housewife is answering the door-bell for agents who peddle things not worth buying.

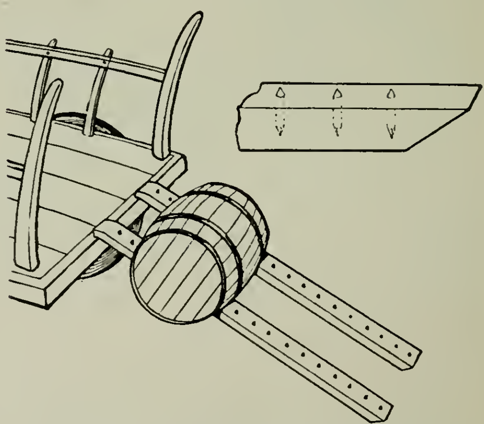
A little device shown in the accompanying sketch will save her much annoyance. The little box is placed at the front door over the bell button on a level with the eye. It contains a sign which shows through a small window. The sign is operated similarly to an old-fashioned window shutter by an electro-



This sign is guaranteed to rout any peddler

magnet; when not in use the two leaves of the shutter lie horizontal as in the right-hand drawing. In this position the sign cannot be read. The leaves are hinged to a double-armed rod, which, in turn, rests on a long lever, the lever being pinioned very near the magnet on a small bracket. This increases the lift of the magnet, so that about a quarter of an inch of movement on the left end will give about an inch and a half at the right, which is sufficient to bring the leaves in a perpendicular position and to exhibit the sign, which is drawn back by gravity.

A push button is situated at a point in the house from which a view of the front walk or porch may be obtained; or, if the front door contains a glass, near the kitchen door. When an agent rings the bell the button is pressed and he is dismissed by the sign. He can't argue with this "Agent Chaser."



The nails have their heads filed to a point, and prevent the casks from slipping

Prevents Casks Slipping While Unloading

OILY barrels or casks give truckmen much trouble when they are loaded upon wagons or drays, owing to the tendency of the unwieldy object to slip on the ways which are placed between the truck or wagon floor and the sidewalk. This difficulty can be removed by driving a row of stout nails into the ways and filing the heads to a sharp point. While not seriously marring the face of the casks, the points prevent them from slipping.

An Electric Toy Semaphore

AN electric semaphore, if used in connection with a toy electric railway, will be interesting as well as instructive.

Its construction requires an electromagnet, (F) Fig. 1, pulling down an arm (A) when the magnet is energized. The arm is provided with a small extension, so that it automatically shows the regulation colored lights at either position of the arm. When at right angles to the standard it is supposed to signify "Stop" or "Danger," and a tiny red light shows. When hanging down at 45° from the standard it signifies "Clear Track" and only a small white light is seen.

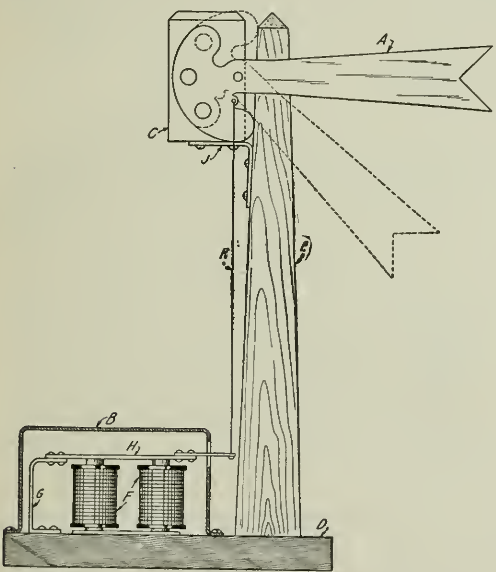


Fig. 1. The semaphore, if properly painted, has a very realistic appearance

Fig. 2 is the detail of the semaphore arm, which is made of light sheet brass or aluminum. The dimensions explain it thoroughly. The small lip which is to be bent outwards at right angles is the part to which the string (K) is attached.

Dimensions for a magnet cover (B) that will fit over a magnet taken from a medium sized bell or buzzer are shown in Fig. 3. This should be made of light sheet brass or aluminum. Small lips are provided which are bent in and soldered or riveted to an adjoining side. The dotted lines indicate where the metal should be bent. No dimensions are given for the small holes, their size depending on the size screw used to fasten the cover to the base.

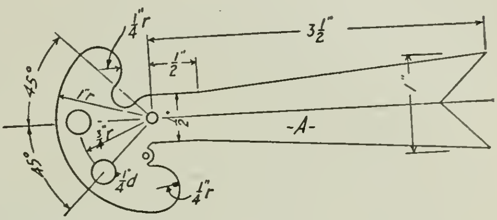


Fig. 2. Detail of the semaphore arm, showing dimensions

The lamp (C), Fig. 4, is made of hard wood, $1\frac{1}{8}''$ square, into which holes are bored as shown in the figure. Small $3\frac{1}{2}$ volt flashlight lamps fitted into miniature sockets are put into the $\frac{1}{2}''$ hole as far as they will go. The end is then filled with putty so that it is lightproof. The $\frac{3}{8}''$ holes are covered with tissue paper, the top with white and the bottom with red. The lights may be connected in multiple or series, depending on the voltage of the current. If small telephone switchboard lights and the opals which fit into the switchboard sockets can be procured the holes may be bored smaller and a much neater effect secured.

The base (D) and the standard (E) are made of hard wood. The base should be about $\frac{1}{2}''$ thick. In Fig. 5, the plan of the arrangement of the parts is shown. The four small holes shown

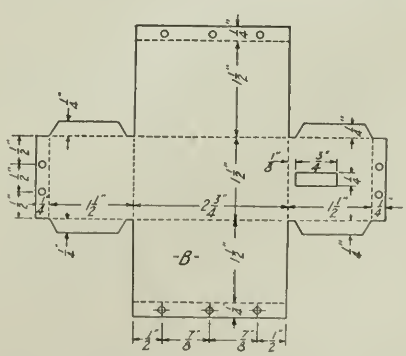


Fig. 3. Dimensions for cover to fit magnet taken from bell or buzzer

are for binding posts. Each element has its own set of binding posts. The reason for this is that some experimenters have a step down transformer which would be suitable for the lights but cannot be used in connection with the magnet.

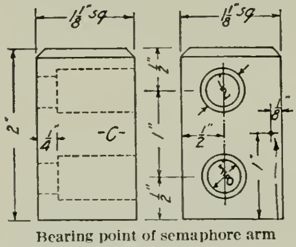


Fig. 4. Diagram showing construction of lamp

No dimensions are given for the spring (G), armature (H), or projection arm (Fig. 1), their size depending on the size magnet used. The spring (G) should be made of some spring metal, such as german silver or phosphor bronze. The armature (H) is made of soft iron and the projection arm of aluminum. The spring and arm are riveted to the armature.

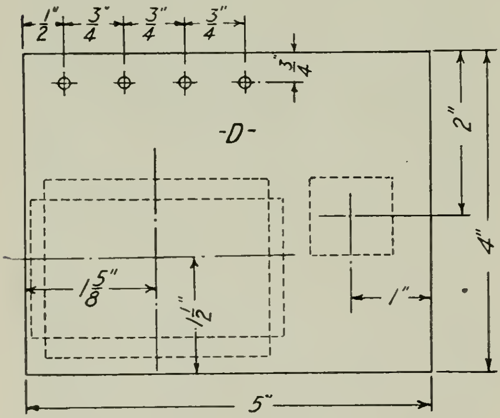


Fig. 5. Plan of arrangement of parts, with dimensions

An angle arm (J), holds the lamp to the standard. It should be about ½″ wide and each arm about 1″ long.

The string (K) attached to the projection arm is the means by which the semaphore arm is moved when the armature is pulled down by the magnet. If a light brass chain is used in place of the string, the appearance is more realistic.

Fig. 7 shows the wiring diagram when used with one source of current. The key is a strap key or push-button, placed at a distance from the semaphore. In Fig. 1, the arm is shown with the current passing through the magnet.

When completed and assembled, if the cover, base and lamp are painted black, the standard painted white and the semaphore arm painted red with two white stripes as shown it gives the semaphore a very realistic appearance.

The semaphore need not be entirely electric as the semaphore arm can be constructed so that it will move with a lever instead of an electromagnet. In such a case, its construction will be much simpler than when electricity is used.

Fig. 6

Saving Time in Tracing a Design

NEARLY every worker, from the lady embroiderer to the machine shop designer, at some time has use for a symmetrical design, yet they usually go to the trouble of drawing each side out, or tracing one side. A far quicker and easier way is to use the following draughtsman's method:

Draw one half of the design out on tracing paper, or any strong tissue paper. Fold this over on top of the blank half, being careful that the crease comes exactly along the center line of the whole design. With a silver half-dollar, pass over the top of all using a rapid to-and-fro stroke. The design is now reproduced perfectly on the other half of the paper. For this work the pencil should not be too hard, F or B, or a common No. 2.

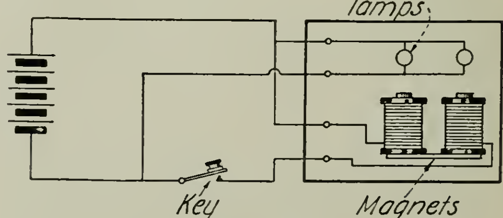
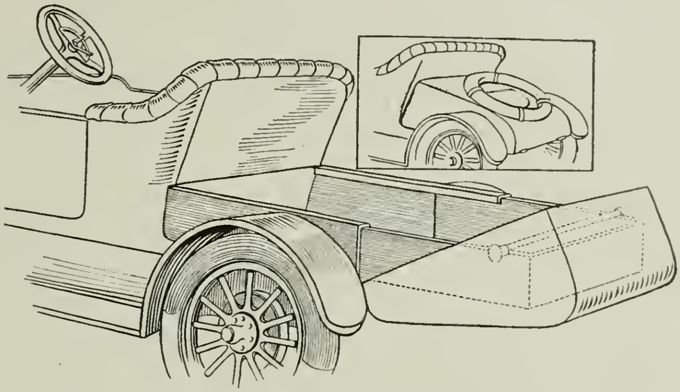


Fig. 7. Wiring diagram when semaphore is operated with batteries

Enlarging a Runabout's Capacity

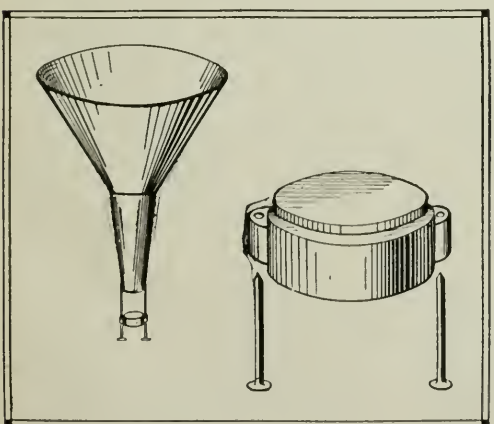
THE torpedo extension with which most runabouts are built is often inadequate for carrying packages or bundles of more than ordinary size. With some extra lumber, the capacity of a small automobile may be considerably increased, as shown in the sketch. An extra box is so constructed as to get telescopically into, and slide easily in and out of the main box on the rear of the car. When the hood is lifted and folded back, this extra drawer may be extended into the hood and supported by it. In this way an extensible box is furnished which considerably increases the capacity of a runabout without decreasing its strength or detracting from its appearance.



The extensible box is easily made and greatly enlarges the capacity of the car

A Non-Spillable Funnel

A FUNNEL which will cease flowing automatically when the vessel into which the liquid is being poured reaches a certain height, can be devised by attaching a metal float to the tapering funnel-tip. The float is a small metal cylinder closed at both ends. Small brass tubes should be soldered on opposite sides of the float, as indicated in the drawing. Nails which will fit loosely in the tubes (to give the float free play) should be soldered at their points to the tip of the funnel, with the float in place.



When the funnel is filled the float rises and stops the flow

When liquid is poured into the funnel, it will flow past the float until the vessel is nearly filled, whereupon the float will rise and check the funnel's discharge. The funnel can then be withdrawn quickly, so that little or no liquid is lost.

Mat-Making for Photographers

TAKE a few spoiled plates and clean off the film. Cut off four pieces from a roll of passepartout, one for each edge of glass. Paste these on the glass along the edges, leaving an opening in the center of the glass a little smaller than the films or plates.

In using this put the mask in the printing frame first, lay the film or plate on top, and print in the usual way.

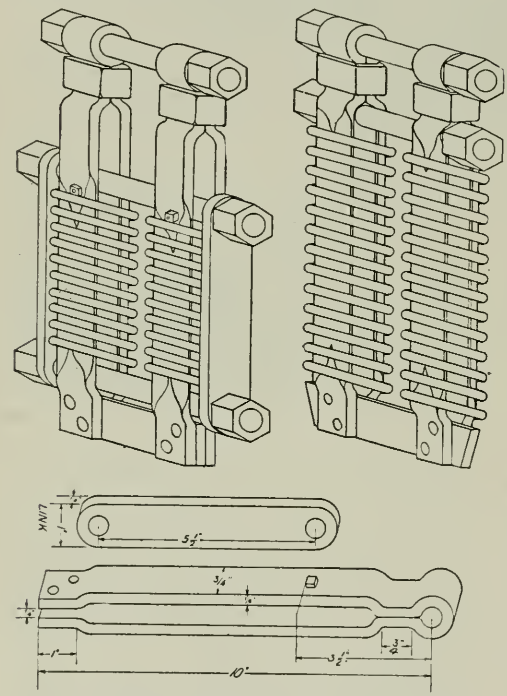
By making a number of masks with different size openings in the center, different size films or plates can be printed.

If a mask of special design is wanted, paste the loose mat on the glass, as it saves time, and also prevents the mat from being lost, torn or creased.

Passepartout tape can be bought at any art store for 10 cents a roll of 12 dozen yards. This will make all the different size masks wanted, and there will be enough left over to passepartout a number of prints.

Shock Absorbers

AFTER a season without shock absorbers on an automobile and a season with them, a driver will be thoroughly convinced of their worth. Here are given sketches and descriptions of a type which can be built by anyone handy with tools. The advantages of shock absorbers may be summed up in three words: comfort, speed and saving. With shock absorbers a light car equals in riding quality cars of much greater weight and longer wheel base. A speed of five to ten miles more per hour is practicable. The



These shock absorbers may be made with the aid of a few good tools

saving is in the general wear and tear on the machine and especially in the tires.

The absorbers shown here are fairly simple in construction, requiring no welding or other difficult forging operations and but the simplest of machine shop operations, that of drilling.

The rear absorber is somewhat simpler than the front one. Eight of the brackets shown are worked up. The hole in the top is formed by bending the piece of ¼″ x ¾″ mild steel around the proper size pin. The size of this hole is not given, as it will vary, in some cases being ½″ and in others 9/16″, depending on the make of car. This is a matter which the maker must determine before ordering the stock. Cold rolled steel is used for all bolts. The width of the spring leaf will determine the length of the bolts.

After the brackets have all been bent up a clip is placed around the neck of each. Some of the ¼″ x ¾″ stock is used for these. The clip is first made U-shaped and then placed over the neck while hot and the ends clinched or bent over. These ends should be just long enough to come together when bent over. The cross bar at the bottom of the rear absorber is made long enough to support the side of the springs. This bar is made from ¼″ x 1″ stock. The bottoms of the brackets having been bent to shape, the cross bar is held in position and the holes drilled. Rivets of ¼″ are used to hold these parts together, but before fastening finally the springs must first be provided and fit on the brackets. It is best to round the corners of the brackets to form a better support for the spring as well as to prevent the coils becoming nicked, thus causing them to weaken and finally break.

Owing to the method of attaching front springs in use on almost all types of cars, the design of the front shock absorber must be radically different from that of the back. Here the pull is up instead of down, so the coil springs must be held rigid at the upper end and links used to transmit the shock down and under the bottom ends of the coil springs, which in this case are the free ends. A study of the sketch will show the construction clearly. In order to prevent the springs coming up over the bracket too far a set screw is placed in each side of each bracket as suggested in the sketches. A ¼″ set screw is heavy enough for this. The link is detailed in the sketch, except the size of the holes which will be determined by the size of the holes in the spring. The bottom cross bar is cut off even with the edge of the bracket instead of allowing it to extend as in the case of that on the rear absorber. The corners are again ground round before assembling the springs in place permanently.

The weight of the car will determine the size wire to be used in the coil springs; 3/16" for the front springs and ¼" for the rear ones is about right for a car in the 2,000 pound class. This is figured for a touring car where five passengers are to be carried. In the case of the roadster the rear springs could be of one size smaller wire. In the case of cars materially heavier the size of the wire should be increased. In order that the springs may carry the load properly they must be made 1" longer than the place they are expected to fill. This means that when they are assembled in the finished shock absorber, they are already under compression. Accordingly those for the front absorbers should be 6" and those for the rear springs 7" long. The inside diameter of the springs should be not less than 1¼" in any case.

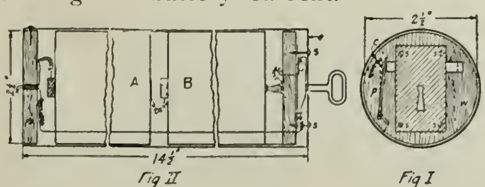
Those fortunate enough to have access to a machine shop can wind their own springs if desired, although there will be no great saving as the springs will be made up as ordered by any good spring manufacturer for about twenty-five cents each.

When placing the absorbers on the car they should first have their springs compressed and tied down with wire in order that they will not interfere with placing the bolts through. To compress them, use a cabinet clamp or vise.

The entire cost of the absorbers described was just $3.34 outside of the work.

Key Controls Battery Current

WHERE batteries are placed on bicycles or motorcycles for lighting purposes, it is a great temptation to mischievous boys to turn the current on, a circumstance which, of course, means a loss of money to the owner of the vehicle. Such happenings can be averted if a lock switch is employed for controlling the battery current.



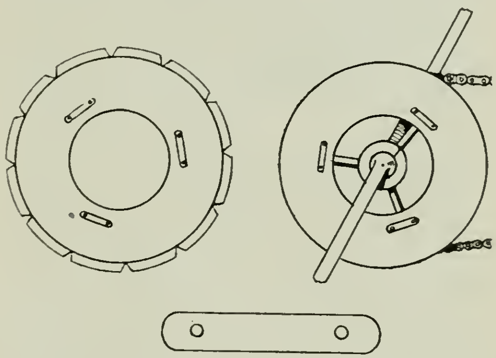
When the key is withdrawn, the auto-thief or mischievous boy is foiled

The batteries should be placed in a metal cylinder, the ends of which are plugged with wooden discs. On one of these discs a small drawer lock is fastened. At one side of the lock—the side from which the bolt emerges when the key is turned—a brass or phosphor-bronze contact spring should be fastened.. When the key is turned, the bolt pushes this spring against a brass contact, and current flows from the batteries to the lamps.

Eliminates Pants' Guards for Bicycle Riders

A CHAIN guard can be made for bicycles which will dispense with the need of pants guards.

A circular piece of stiff metal, having a diameter 1" greater than that of the



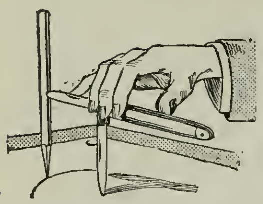
A circular piece of metal protects the trousers from the sprocket gear

large sprocket, should be cut and crimped along the edge. Clamps should be fashioned from heavy steel or iron for the purpose of grasping the spokes of the sprocket. The clamps should be soldered to one face of the protecting disc and holes bored through the two. Machine screws pass throug'. the holes, terminating in tapped holes in similar clamps on the opposite side.

A Try-Square Aid

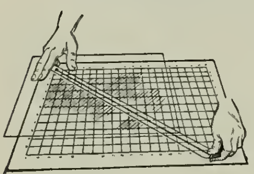
WHEN using a try-square to determine if stock is true, one cannot remember all the high and low spots. If the edge of the try-square is dipped in lamp black before using, and is then run on the piece, all the high spots will be black while the low places will remain untouched.

How a Jack Knife Can be Used as a Compass



A POCKET knife that has two blades at one end can be converted, with the use of a pencil, into a makeshift drawing compass. One blade should be opened entirely; the other only half way, so that they form a right angle. The blade that is half opened is placed point down on the paper, while a pencil is fastened to the other, and the circle drawn.

Enlarging Without Dividers



DRAW a straight line on a strip of celluloid or tracing cloth, and with a thumb tack fix the strip on coordinate paper in such a way that the line always intersects axis XX, YY. This, of course, is best done on a drawing board. By swinging the free end of the strip to any position between the axes, any proportion is obtainable.

The principle of triangles, by which the proportions are obtained, is so well known that further explanation seems unnecessary. Still, here is a concrete example:

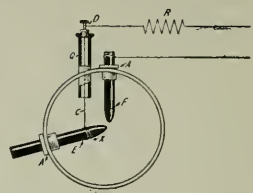
Let us suppose that we want to make a drawing twice the dimensions of an original. Measure a distance of 2″ along the horizontal as indicated and locate the point *P*. Then shift the strip until the vertical distance to the central line is exactly 1″. We then have the ratio 2 to 1 as desired. Every horizontal distance from the axis of the strip is twice the vertical distance.

Should the desired ratio be 4 to 1 or 3 to 1, or anything else, the same method is easily and consistently followed.

Bending Brass Tubes Without Kinking

BRASS tubes can be bent without kinking if they are previously filled with fine sand. Both ends of the tube should be closed with wooden plugs.

A Self-Lighting Arc Light

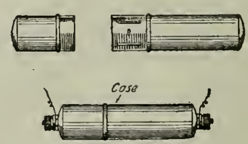


PROCURE a tin can about 6″ in diameter and cut three holes in the side about 3″ from the back, as shown in the drawing. The two holes *AA* must hold a section of rubber hose tightly. A short porcelain tube *Q* is put in the third hole. The hose holds the carbon *F* stiff while the carbon *F* is loose in the insulation. The carbon is supported at *X* by a piece of No. 25 gage German silver wire about 6″ long. This wire runs through the tube *B* to the binding post *D*. The binding post *D* is fastened to a wooden plug in the end of the tube *Q*. The tube is adjusted so that the end of the carbon *E* touches the end of *F*.

The wires leading to the light circuit are connected with the binding post *D* and the end of the carbon *F*. A resistance, consisting of about 15′ of No. 25 gage German silver wire, is inserted at *R*.

When the current is turned on it expands the wire *C*, pushing the carbon *E* away from *F*, forming an arc. When the current is shut off and the wire cools, the carbons are drawn together ready for relighting.

An Ingenious Electric Connector



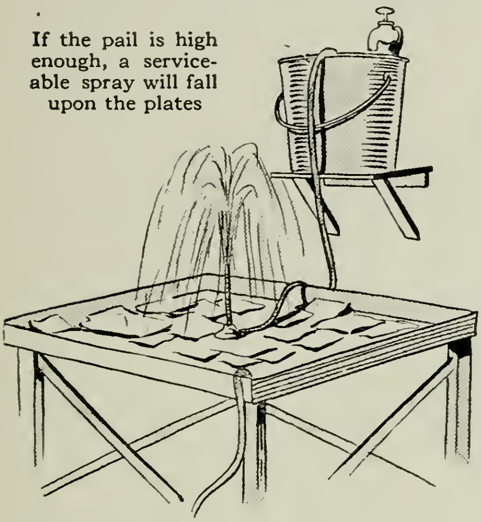
ELECTRIC connectors for low voltage circuits can be made from the small metal cases that are used for storing pen points. Holes should be bored in the ends of each half and binding posts attached, as shown in the sketch. This connector can be used for battery circuits.

To Prevent Rust

TOOLS which are kept in a damp cellar can be protected from rust very easily, if a pan containing unslacked lime is placed under the bench. The moisture is entirely absorbed by the lime.

Rinsing Photographic Negatives Without Running Water

AMATEUR photographers who are compelled to labor under the difficulties of developing prints and negatives without the aid of running water, will find the apparatus which is shown in the drawings to be of considerable assistance. Water is syphoned through a small tube from a pail, the tube leading to the center of a developing tray where it is bent upwards at a right angle.



If the pail is high enough, a serviceable spray will fall upon the plates

If the pail is elevated to a sufficient height above the tray, the pressure will cause a spray, which will be distributed evenly over the emulsion surface. The used water is syphoned from a corner of the tray by another tube.

Small Screws in Difficult Places

DAB a bit of beeswax on the head of the screw and push the point of the screw-driver through the wax and into the slot of the screw. The screw will be held in just the right position for driving home. Or again, if the screws are of steel the driver may be magnetized by stroking it a few times with a magnet. Its insertion will then become much easier. If the slot in the head is very shallow, the screw will be likely to slide over and stick to the blade of the screw-driver. In this case, use the bees-wax.

Of course, it is evident that the hold on the screw is very light and can be used only to drive a screw into its corresponding tap. For inserting wood screws the above methods are out of the question.

A Mysterious Motor

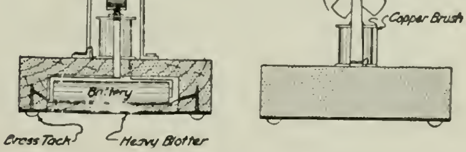
THE "Mysterious Motor" will puzzle any one. Not only the novice, but professional electricians must do a deal of thinking to decide how it runs.

The little toy consists of an electromagnet over which is suspended a four-spoked iron wheel mounted on a thick wooden base. When placed upon a flat metal surface the motor will run, but when set upon a non-conductor it will remain motionless.

The thick base is hollowed out from the bottom to make sufficient room for a small flash-light battery. Four brass tacks are driven into the base. From one of these tacks runs a wire to the thin copper brush, to which the iron wheel acts as a comutator and armature combined. The current passes through the brush into the wheel, thence through the support to the coil. From the coil it passes on to one pole of the battery and from the opposite pole to another tack. This leaves the circuit broken between the two tacks, when the brush is in contact with the iron wheel. Consequently, when the device is placed upon a conductor the circuit is closed and the wheel revolves.

The remainder of the cavity occupied by the battery is plugged with wood, and the base covered with heavy blotting paper, allowing the tacks to protrude.

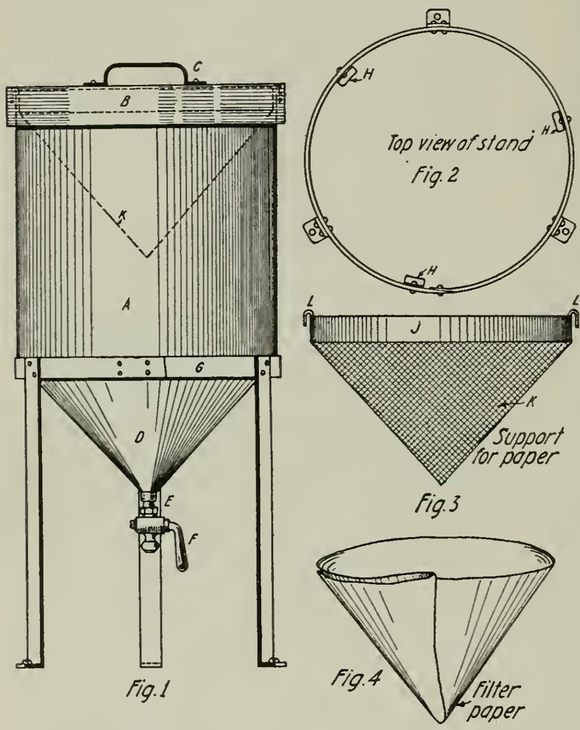
Much amusement may be derived from the "Mysterious Motor," at a party by announcing that you have a motor that will gather its power from the air, when placed upon any metal, and then giving a demonstration.



When the motor is placed upon metal it will operate; on wood, it refuses to move

Filter for Lubricating Oil

THE apparatus to be described was made for the purpose of filtering oil pumped from the crankcase of a marine gas engine after it had been used in the cylinders and bearings of the engine. The oil filtered out perfectly clear and was used over and over with perfect success.



The oil is poured into the container through the paper filter, and collects in the container to be drawn when needed

Referring to the drawings, *A* is the container, made of zinc with soldered and riveted seams, about 16″ high and 14″ in diameter. On one end of the cylinder *A* was soldered the cone-shaped part *D* with a 3/8″ brass pipe coupling *E* soldered into the small end. A brass shut-off cock *F* was screwed into this coupling as shown. A loose-fitting cover was made to fit the open end of the container. This cover *B* was about 1/2″ larger in diameter than the container, and had a handle *C* riveted on to the top.

To support this container a ring of strap iron was riveted together and three legs riveted on, as shown, with holes for holding down screws bored in the feet. Three angle pieces of sheet iron *H H H*, were riveted on to the ring *G* for the bottom of the container to rest on.

Another ring J was riveted together of a size to slip easily into the container. Then a cone was made up of copper wire gauze *K* and soldered to the bottom of the ring *J* as shown. Two or three sheet iron clips *L L*, riveted to *J* and bent over the outside edge of the container, served to hold the cone in place. This wire gauze is intended as a support for the filter paper, which is folded up into a cone as shown in Fig. 4 and placed inside the wire gauze cone. The oil is then poured into the paper and will slowly filter through and collect in the bottom of the container. It can either be drawn off by the valve as needed or be allowed to run through all the time and be collected in a can or other receptacle.

It may require some experimenting to find the best kind of paper to use, but for oil such as "Havoline" or "Monogram" ordinary brown wrapping paper or even newspaper is perfectly satisfactory. Unsized paper is of course preferable, because of its porous character.

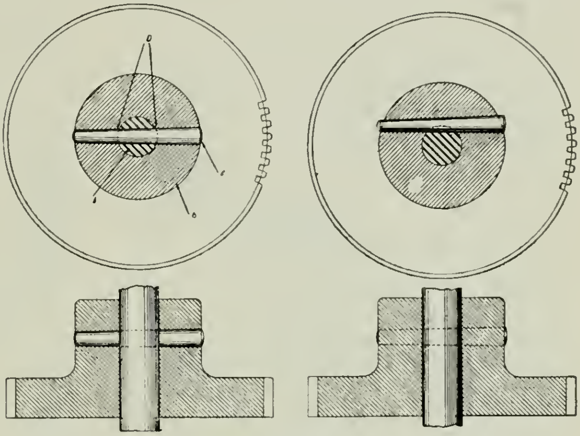
Fuse for Storage Battery Circuits

A PIECE of glass tubing of small diameter is cut into pieces about one inch long. Small holes are drilled in the bottoms of used cartridge shells. The shells should be as nearly the size of the tubes as possible. They are then put on the ends of the tubes and a short length of German silver wire is put through the holes in the shells and soldered. The size of the wire can best be determined by experiment. Two fuses made in this way are fastened to a block of wood by four small clips and the fuse block is done.

A Way of Fastening Machine Parts

IN building models of machines, engines, etc., the amateur is sometimes confronted with a case somewhat like that shown.

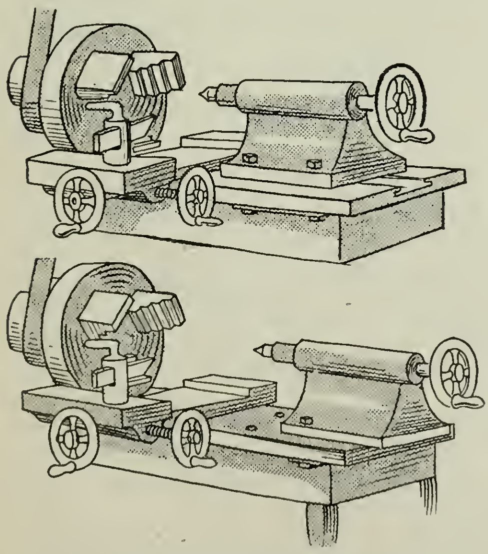
The shaft *A* is of small diameter; the hub of the gear *B* is a great deal larger than necessary, requiring a large diameter taperpin *C*. If this pin is driven in as shown in *Fig. 1*, it will weaken the shaft, but if the pin is driven in as shown in *Fig. 2*, the shaft is only weakened slightly. The pin *C* in *Fig. 1* can shear or break or twist at points *D*, but when the pin is driven as shown in *Fig. 2*, this is impossible and the shaft and pin will carry a far greater load than the old conventional way of pinning as shown in *Fig. 1*.



Old method of pinning on the left; new and efficient way on the right

A Capacity Job

SOME small stands had been designed both to length and size at the bottom so that they would fill the lathe completely. When it came to facing the top and bottom of the stands it was discovered that the carriage could not be moved far enough to the right to allow the cross slide on which the tool is mounted to be moved in and out, it lacking only a few inches.



By means of the arrangement shown in the lower cut, the lathe is able to take larger stands. The upper cut is the original arrangement of the lathe

The tailstock was fastened down by means of two bolts passing through a wide plate. The bolts were taken out and the plate removed. The plate used for holding the center rest down was used instead. As this plate was only one-half as wide as the regular plate, it was fastened under the left-hand bolt of the tailstock, thus allowing the tailstock to be moved back far enough. The carriage could now be moved to the right, thereby allowing the cross slide to shift in and out.

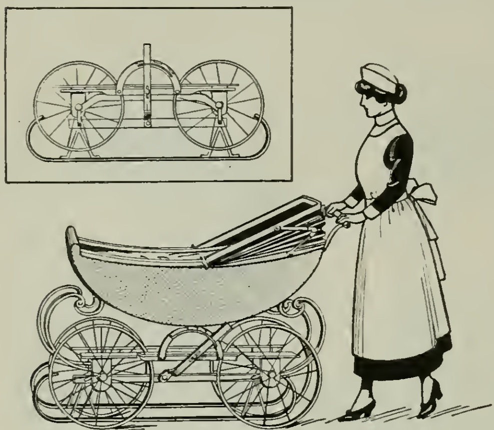
Before being able to run the carriage close up against the tailstock it was necessary to remove the split nut used in thread cutting, as this nut struck the lead-screw and feed-rod bearings. The drawings show clearly how the gain was made.

A Good Belt Compound.

A GOOD belt compound is made from equal parts of resin and light machine oil. Boil the mixture for about 20 minutes. Use when cool by pouring a little, drop by drop, on the moving belt. Not only will a good gripping surface be secured, but the compound will also act as a preservative.

Sleigh Attachment for Perambulators

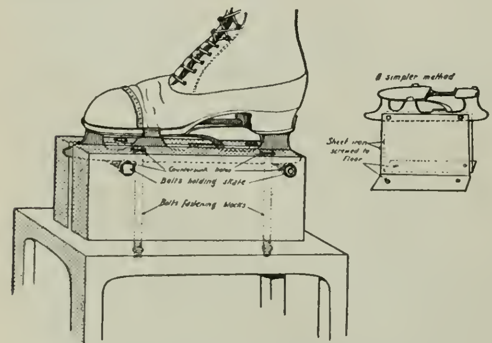
TWO runners are attached to a crank-handle, so that by moving the handle they may be suspended above the level of the wheels or dropped below the level of the wheels. Thus the perambulator may be used as a sleigh—or as a wheeled vehicle, at the will of the operator.



This perambulator may be a sleigh in winter or a carriage in summer

Ice Skates Make Shoe Shining Stand

DISCARDED ice skates of the type which clamp the soles of the shoe by the turn of a lever can be used for foot rests on shoe shining stands. The steel runner should be bolted between blocks of wood that are nailed or screwed to the foot rest base. With foot rests of this sort, the nervous customer cannot without difficulty, jerk his foot from under the hand or brush of the polisher.

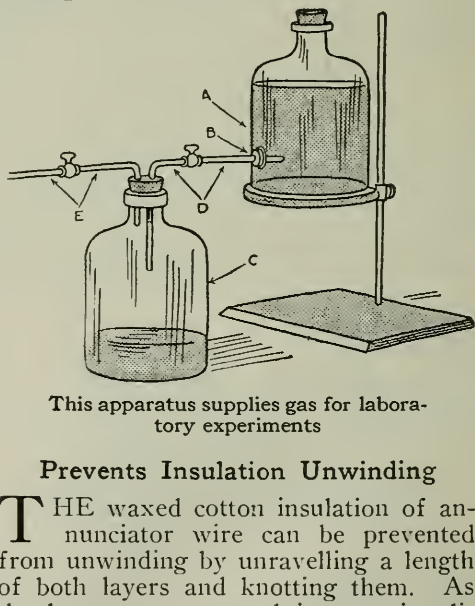


With foot rests made from ice-skates, the customer cannot escape

Substitute for Large, Gas Reservoir

AN apparatus that will take the place of the large and cumbersome reservoirs used in chemical laboratories for storing quantities of gas for experiments can be made with two four-liter bottles and several connecting tubes.

Referring to the drawing, A and C indicate the bottles. A mouth is cut in the side of A and plugged with a rubber cork bored out to accommodate a glass tube. The tube leads from B into the bottle C through a pinch cock inserted at D. Gas is generated from an apparatus leading to tube E and is stored in the lower bottle. When pinch cock D is released the gas is forced out of C through tube E until the supply is exhausted. Water in the upper bottle forces the gas from the lower bottle through the tube E.



This apparatus supplies gas for laboratory experiments

Prevents Insulation Unwinding

THE waxed cotton insulation of annunciator wire can be prevented from unwinding by unravelling a length of both layers and knotting them. As the layers are wrapped in opposite directions the knot will prevent further unravelling or slipping.

Drilling Holes in Glass

THE following mixture on the desired size steel drill, will do a neat smooth hole.

Turpentine ....3 parts
Machine oil ....1 part

Use on point of drill at high speed. This formula is one used by optical grinders.

Hydraulic Blowing Arrangement

THE apparatus here described will be found very useful for supplying air to small blow-pipes in glass-working, etc., also for wood-burning and in jewelers' work, as it leaves both hands free to work. By reversing the valve it may be used for purposes requiring a small suction.

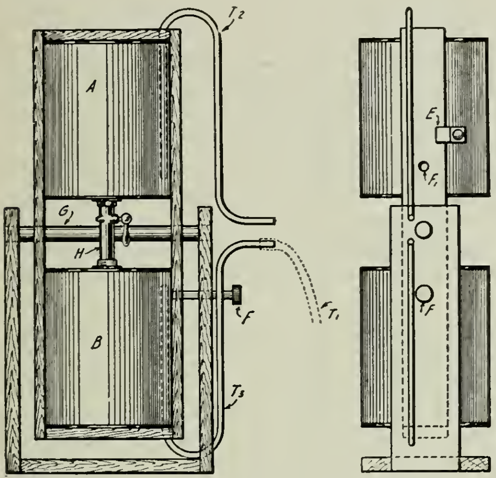


Fig. 1. The hydraulic blower is useful for supplying air to small blow-pipes, as it leaves the hands free

The apparatus is simple and easily constructed. Fig. 1 shows the general plan, where *A* and *B* are cans of the desired capacity (1 gal. being a good size) mounted on the wooden frame work with a pipe containing a faucet, *H*, soldered between them. The cans are fastened to the wood with a metal clip, *E*, which is screwed to the wood and soldered to the cans. The inner framework is mounted on a shaft, *G*, supported by the outer framework, and the cans are kept from turning by the pin, *F*. The tubes, T_2 T_3, should be made of copper or brass where they extend into the cans and the part outside the cans may be of copper, brass or rubber.

To operate, the top can is filled with water and the rubber tube *T*, which leads to the blow-pipe or other apparatus, is connected to the lower can. The faucet *H* is then opened, permitting the water to flow from the top can into the lower one, thus forcing the air out of the latter, the flow of air being regulated by the flow of water.

When the top can is empty the position of the cans is reversed and the hose is changed to the lower can.

To do away with the changing of the hose, however, a very simple valve, which works automatically with the reversing of the cans, may be used.

The materials needed for the valve are as follows: 1¼″ of ½″ brass tubing, three pieces brass tubing ¾″ long to fit in rubber hose, 1¼″ of brass rod with 8/32″ thread, four 8/32″ nuts, four ⅜″ brass washers, two ½″ leather washers, and two 4/36″ screws.

The ½″ brass tube *T* (Fig. 2) is drilled for the tubes T_1, T_2 and T_3 and drilled and tapped for the machine screws *S*. The small tubes are then soldered to the large one as shown. The nuts *D* and leather washers *B* and brass washers *C* are placed on the shaft, which is then inserted in *T* after adjustment for right between head distances. The screws *SS* are put in to prevent the moving part from slipping out either end. The valves should be oiled and the corresponding tubes connected. The weight *W* is made of lead just heavy enough to work the valve.

The valve is placed on the framework to which the cans are fastened.

When the valve is in the position shown the air comes from the lower can through T_3, through the valve, and out of T_1 to the blow-pipe or other apparatus, while T_2 is open to receive air.

Inverting the weight shifts the valve so that the blow-pipe or other apparatus is always connected with the lower can.

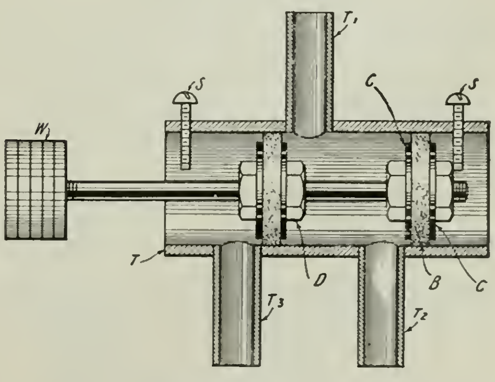
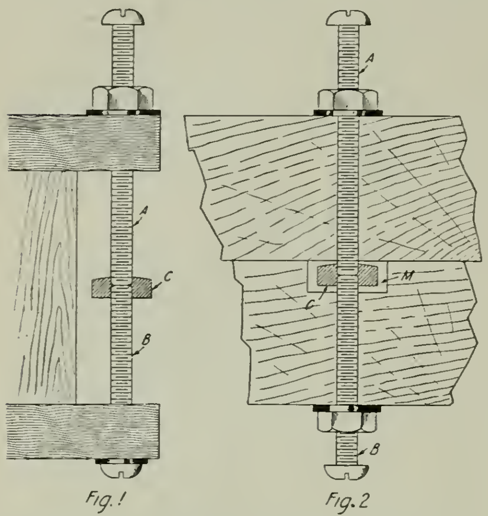


Fig. 2. Showing how the brass tube is tapped for tubes and screws

Emergency Bolts

TWO short bolts may often be made to serve as one long one as shown in Figs. 1 and 2, when no long bolts are at hand. The two bolts *A* and *B* are

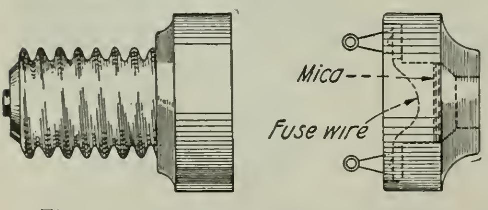


The nuts shown practically double the length of the bolts

coupled together by means of the nut *C*. When two timbers are to be fastened together as shown in Fig. 2, it may be necessary to drill a recess *M* in one of the pieces to hold the coupling nut *C* but often the bolt is used in the manner shown in Fig. 1, where there are two projecting end pieces. In this case it will not be necessary to make room for the nut.

Renewable Fuses

AN attachment plug can be converted into a renewable fuse by removing the flexible cord and connecting a length of fuse wire across the terminals. The plug should be inserted in series with the apparatus.



The attachment plug is converted into a renewable fuse

The Care of Paint Brushes

THOSE who have only occasional use for paint brushes find difficulty in caring for them, as it is expensive to buy new brushes for every job. The following will solve the problem:

Procure a dish (a tin can will do) and fill with water high enough to cover the bristles of the brushes. Then pour in a small quantity of lubricating or machine oil.

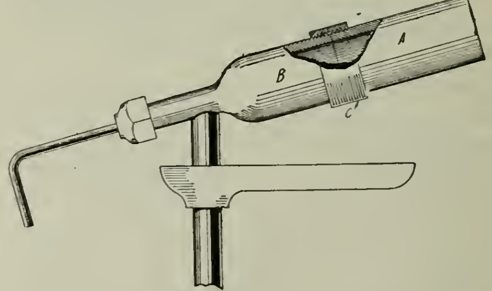
Next wrap the bristles in paper, kept in place with an elastic band or a tied string, and place in the dish of water with the oil floating on top.

The oil prevents the evaporation of the water and the rusting of the iron brush parts.

The paper wrapping keeps the bristles in shape, and prevents contact with the oil.

Lengthens Life of Blow-Torch Burners

WHEN used constantly, the brass tube through which the flame of a blow torch passes is rapidly burned away, so that complete new burners



Money is saved when the burner of the blow torch is made detachable

must be frequently attached. This rather costly procedure can be avoided if the actual "business end" of the burner is made detachable, or renewable.

Several short lengths of brass pipe, equaling in size that of the burner itself, should be procured. With a hacksaw cut off an inch or so from the end of the burner and thread the remaining end. A narrow ferrule, or coupling, should be tapped to fit the threads, and the brass tips threaded to correspond with the shortened burner. When one tip is burned down, it can be quickly replaced by a new one.

Binding Magazines Into Book Form

THIS article presents a simple method of binding magazines and the like into book form and illustrates novel and easily made tools for use in the work. The tools and the method can also be used for re-binding old books.

The principal tool required is the press, which is shown in plan view Fig. 1, and end elevation Fig. 2.

Two jaws of surfaced wood 2 x 3 x 24 inches are united by two bolts ½ x 13 inches. These bolts are common iron bolts, but the threads must be cut down to about 3½ inches from their heads. The heads of the bolts may be countersunk into the jaw and a strip of wood ½ x 2 x 24 inches nailed over them.

Strips of wood ¾x1½x6 inches are nailed to the under side of the jaws, close to their ends. These strips slide in contact with the outside of the wooden box upon which the press is placed and serve to keep the press in position over the box. Two press boards 1x6x16 inches, having beveled edges, are used with the press. The drawings show the assembled sections of a book in the press, ready for making the saw cuts into the back as described later on.

Fig. 3, represents the sewing frame. This is made by nailing a board upon

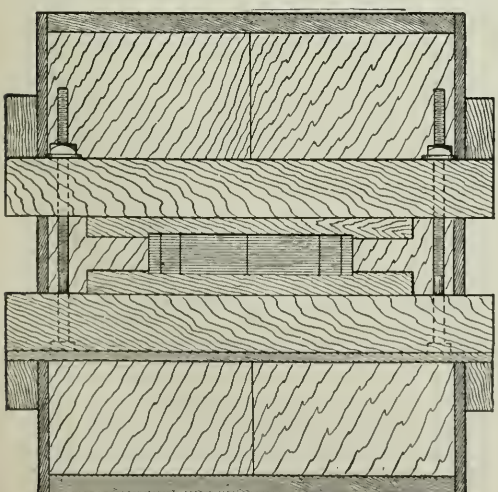


Fig. 1. The press-plan view

two strips of wood 2x2x12 inches. The board may be about 10 inches wide. An iron rod ⅜ inch in diameter is bent to the form shown and its ends are inserted into holes drilled into the projecting strips, about ¼ inch from the edge of the board. These holes are not

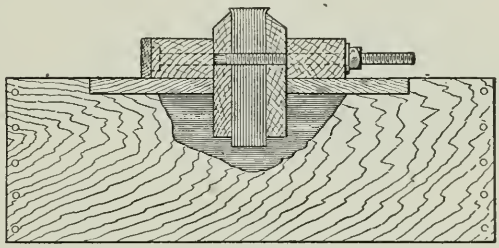


Fig. 2. The press: end elevation

drilled entirely through the wood. Horizontal holes are drilled to meet the vertical ones and the ends of the lower horizontal rod are inserted therein before the top board is nailed upon the strips.

Arrange the numbers of the magazine which are to constitute the volume in their proper order. Carefully separate and remove from the magazine or old book, one at a time, the sections of which it is composed and stack them in order in a pile. Take four sheets of strong white paper, about ¼ inch larger all around than an open sheet of the magazine and fold them the same way the magazine sheets are folded, to be used for end papers. The folds or joints of two of these sheets should be strengthened by pasting upon them strips of thin white cloth 1 inch wide, using white paste. When the paste is dry, re-fold the sheets and press the folds down flat.

Arrange the four end sheets in order with a plain folded sheet and a sheet having a cloth joint, for each side of the book. Gather the sections of the volume, with the end papers in place, between the thumbs and fingers and rap them into line along the back and top edges. Place a press board upon each side of the book as shown in Fig. 2. The boards should be placed parallel with the book and about ⅛ inch from it. Hold the book between the press boards with the thumbs and fingers and carefully lower it between the jaws of the press. Now hold the book with the left hand, and, using a wrench with the right hand, clamp the jaws of the press against the press boards.

Mark five lines across the back of the book in the relative positions shown in

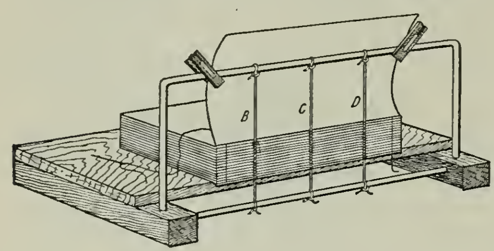


Fig. 3. The sewing frame

Fig. 3, using a pencil and a try square. If a try square is not at hand, a squared piece of card board may be used.

Guided by these lines, make five saw cuts into the book. The depth of these cuts should be 1-16 inch or less, or just sufficient to show when the sections are again opened. A miter box or "back" saw is best for sawing the two-cuts nearest the ends but a wider saw may be used for making the three central cuts. After sawing, the book is removed from the press.

Tie three strong cords to the rods of the sewing frame as in Fig. 3. These cords must be long enough to project about 1½ inch on each side beyond the edge of the book after it is taken from the sewing frame. Cords may be made of strong linen threads folded and twisted together several times. Usually the operator sits in front of the sewing frame, but it is best to sit at the end of the frame, since one can, in this position, see the inside as well as the back of the sections and the arm has more freedom when sewing with long threads.

The upper halves of the sections may be opened and fastened to the upper rod by means of spring clothes pins, so that the center of the sections will be visible and the leaves will be kept out of the way while sewing.

Place a section of the folded end papers upon the sewing frame and slide the cords B, C, D, upon the rods until their position corresponds with the three central saw cuts. The right size of thread to use for sewing will vary with the size of the book and the number of sections it is to contain. For six numbers of magazines No. 25 linen will be about the right size. It is best to use unbleached thread. The method of sewing is shown in Fig. 4, B, C, D, representing the cords that are tied to the sewing frame and the fine line S, the sewing thread.

With the right hand, pass the threaded needle in at the end saw cut E, receive the needle with the left hand and pass it out at the next saw cut. Carry the thread around D and in again at the same cut. Sew around the cords C and B in the same way. Pass the needle out at A, draw the thread out until about two inches are left projecting at S. Lay the title page section of the book or magazine face downward upon the end papers already sewn.

Pass the needle in at catch stitch mark A of this section, sew around B, C, B, and pass the needle out at E and draw the thread down with fairly strong tension, looking to see that it lies straight within the section. The thread should now be tied to the projecting thread S of the previously sewn section. Proceed in like manner to sew all the sections to the cords. When the needle has been drawn out at A, after sewing the third section, it is passed between the first and second sections, back of the connecting thread, Fig. 4, the thread drawn out, the needle passed upward through the loop of thread and the thread drawn down with good tension; but the ends of the sections must not be drawn too tightly together or the middle of the back will appear swollen and will be somewhat inflexible. As the sewing progresses, every time the needle is passed out at A or B, the thread is caught around the thread that connects the preceding sections in the manner just described, before sewing on a new section.

Be careful that the needle does not penetrate the sewing frame cords. As the work advances, the sections should occasionally be pressed together at the points where the cords emerge.

After a few sections have been sewn to the cords the ends of the sewing thread will be reached and a new length must be added. Tie a sliding knot in the end of the new thread (Fig. 5), slip the loop over the projecting end of the old thread, draw the old thread down through the loop and draw the loops snuggly together to form the knot. After the needle has passed out at the last catch stitch mark A or E as the case may be, the thread should be securely connected to the preceding catch stitch thread, so that it will not become untied.

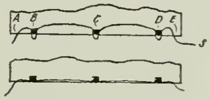
The cords may now be untied from the sewing frame and the book removed from it. The cords should be cut about 1½ inch from the edge of the book and their ends frayed out flat by scraping them with a knife.

Place the thumb and fingers of the left hand upon the back of the book and with the fingers of the right hand, press inward along the frone edge to form the usual rounded shape (Fig. 7). Adjust the press boards so that they will be parallel with the back of the book and at a distance from it slightly greater than the thickness of the mill board to be used for the cover. Lower the book into the press and screw the jaws together just sufficiently to keep the book from slipping through the press. Give the book a final adjustment and screw the jaws of the press tightly together. Now take a hammer and hammer up and down along the edges of the back of the book with diagonal or outwardly inclined strokes, until the ends of the sections spread outward over the press boards as shown in Fig. 6. Hammer along the center of the back also, to keep it in well rounded shape.

Loosen the jaws of the press slightly and brush hot glue over the back, allowing it to penetrate for a short distance between the sections. Tighten the press again, but not so tight as when rounding the back, and having cut a piece of fairly strong cloth to a size about two inches shorter and two inches wider than the back of the book, lay it in place upon the back and press it down firmly upon the fresh glue.

When the glue is fairly dry but still flexible, trim the end papers to size and take the book at once to the printer who will rap the book straight from its rounded form, clamp the book in his power cutter and trim its edges.

After cutting the edges of the book they may be ornamented by placing the book between the boards in the craftsman's press and spattering the edges with red or brown ink.



Figs. 4 and 5
The method of sewing

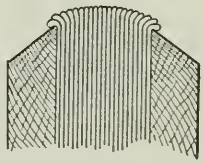


Fig 6

Dip a tooth brush in a small saucer of ink, rap off the surplus ink and draw the brush across the coarse teeth of a comb. Practice first on a sheet of waste paper.

The book is now ready for the cover. Obtain some mill board of the desired thickness, lay it upon another piece of mill or straw board and using a sharp knife guided by a straight edge, cut the mill board to the proper size. For a book of magazine size, there should be a space of about ¼-in. or more between edge of the cover and the back edge of the book. This space should be greater when using heavy cloth like buckram, than for cloth of light weight. Fold a strip of paper around the back of the book and place the trimmed mill board in position on the book, Fig. 7. Make pencil marks upon this strip of paper close to the edge of the mill board covers.

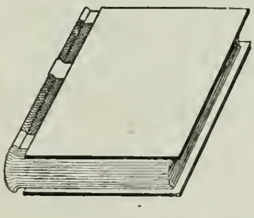


Fig. 7
Shaping the book

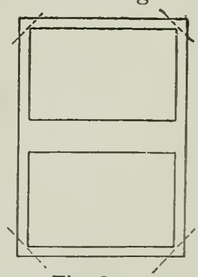


Fig. 8
Forming the covers

Lay the mill boards upon the table with a space between them equal to that indicated by the marks upon the paper strip and measure the size for the cloth for the cover, which size should be about ¾ inch larger all around than the outer measurements of the boards as shown in Fig. 8. Buckram is usually the only cloth suitable for covers that can be found in small cities. It should be of good quality and color. Thin, split leather can be handled the same as cloth.

Having cut the cloth for the cover, lay it right-side down upon the table, and upon it lay the cover boards. Carefully arrange in position with the measured distance between them and mark around their edges with a pencil, marking upon the buckram. Remove the boards from the cloth. Lay one board upon a piece of waste paper and brush hot glue over it and replace and press it down upon the cloth cover in its final position, glued side down. Turn the cloth cover and the attached board over, spread over them a clean cloth and finish the pressing with a flatiron which should not be too hot. Press around the edges of the board as well as over its face. Proceed in the same way with the other cover-board.


Fig. 9

Trim the projecting edges of the cloth all around to about ½ or ⅝ inch from the boards. Cut the corners from the cloth as indicated by the dotted lines in Fig. 8. Do not cut the corners close to the board but leave about ⅛ inch of cloth and be careful to make the cuts at an angle of 45 degrees.

Brush the glue upon the projecting cloth along the top edge of the cover and fold the cloth over upon the boards. Glue and fold the cloth at the lower edge in the same way. Before folding the cloth at the front edges, fold in a little corner of the corner cloth as along the dotted line Fig. 9.

Place the book between its cover and carefully adjust it to its final position. Lightly mark around the four front corners of the leaves of the book, marking the buckram to show where the book should lie within its cover. When all work is finished the marks may be erased. Lay the book upon the table and open the top cover back upon it as in Fig. 10.

Take a sheet of waste paper larger than the book and slip it beneath the end paper to protect the book from glue. Throw the strip of backing cloth and the cords backward and quickly brush the hot glue over the end paper. Fold the cords over upon the end paper, taking care to spread their ends open as shown in the drawing and brush them down into place. Fold over the backing cloth and brush glue over it. Pass the smooth handle of the brush up and down over the backing cloth, and along the raised edge at the back to insure its contact with the book at this point.

Slip the fingers of the right hand beneath the front edge of the glued end paper and press down firmly upon the book to keep it from slipping out of place. With the left hand lift the cover, draw it snugly around the back of the book, hold it at an angle to allow room for the right hand and press the cover firmly into contact with the book all along by the back edge or joint. Remove the right hand from the book and lightly lower the cover upon it. Open the cover and proceed to press the end paper into smooth contact with the board. Upon opening the cover, if it is found that the book has shifted badly from position, it may be well to strip the end paper from the board and try again. This is a risky operation, however.

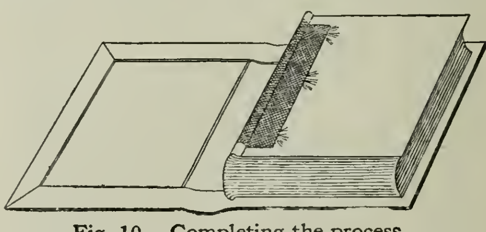


Fig. 10. Completing the process

Proceed in like manner with the opposite cover. When the covers are on, the edges of the flatiron or handle of the brush should be passed up and down along the depression at the joints of the book covers and the covers should be carefully opened and closed several times. The covers may be left slightly open while the glue is drying, or if they are closed, sheets of waxed paper or celluloid should be placed between them and the end papers to keep the leaves from absorbing moisture and becoming wrinkled.

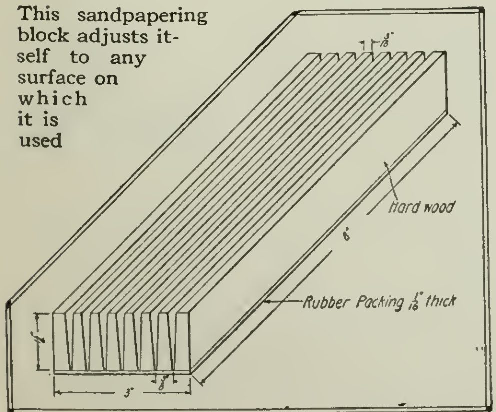
The easiest way to letter the cover of the book is to make a stencil of the paper cover of the magazine, as this will save the labor of laying out the letters. Lay the cover paper upon a hot plate and saturate it with paraffine wax. Wipe off the surplus wax while it is still hot. Lay the waxed paper upon a piece of straw board and cut the letters out, stencil fashion, using the sharp blade of a penknife. Use a good waterproof India ink and a stiff brush from which surplus ink has been removed. Draw the brush inward from the edges of the cut out letters. The letters may be finished by filling in the blank spaces with a pen.

A Self-Adjusting Sandpaper Block

A SANDPAPERING block that automatically adjusts itself to both convex and concave surfaces of any radius is very easily constructed by using a piece of rubber packing for the face and glueing to the back or fabric side wedge-shaped strips of hard wood of the general dimensions shown in the drawing. These strips should be about 1-32 inch apart where they fasten to the rubber, so that the face will bend easily.

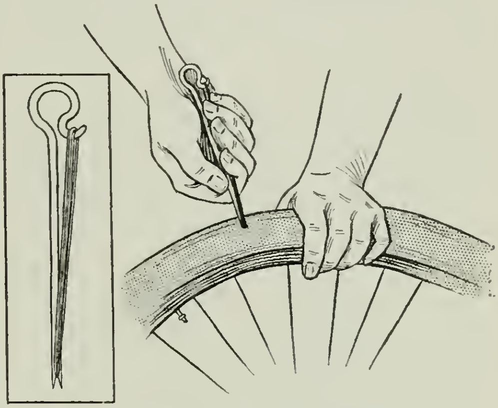
The sandpaper is folded over the block in the usual way and with very slight pressure the face will conform to the surface to which it is applied.

This sandpapering block adjusts itself to any surface on which it is used



A Handy Way to Repair a Tire

A VERY convenient instrument which may be used to repair punctured tires can be made from a common button hook. Straighten or cut off the hook part with a pair of pliers. Saw a slit about 1/8 inch from the end up the stem of the hook with a hack saw and round off the ends into a fairly sharp point. With a knife cut all the sharp edges from the slit so it will not tear the rubber bands. Make a hook as shown in drawing, and passing the rubber band first through the slit and then over the hook enough times to fill up the hole in the tire, dip the rubber and hook in tire cement and push through hole. Unhook the rubber band and draw out the hook carefully with a twisting motion so as not to remove the rubber band. Cut off the protruding rubber and you will have your puncture repaired in excellent shape.



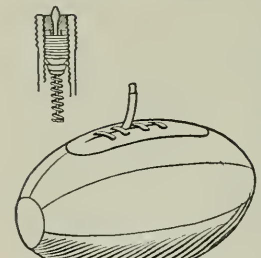
With this tool rubber bands can be pushed into a puncture, to make an excellent quick repair

A New Use for Broken Drills and End Mills

BROKEN drills and end mills should not be thrown away, as they will be found useful if a special socket is to be made for the lathe or miller, when a drill or end mill is to be held.

By grinding the tang off, it can be turned around in the socket to ascertain if the taper has a bearing the whole length. If a drill or end mill is used without thus changing it, the tang will prevent its being turned around.

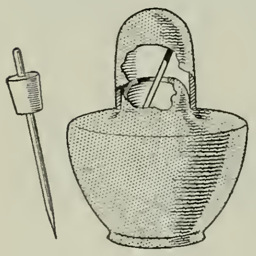
A Home-Made Football Inflater



A VALVE from an old bicycle tire or an inner tube is a very serviceable substitute for the expensive and delicate pumps used to inflate footballs. Cut the metal ring and the rubbed pad from around the valve, and the inflater is ready for use.

Insert it into the neck of the football, attach the outer end of the valve to a bicycle pump, and your football may be quickly inflated.

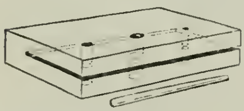
A Dust-Proof Bottle for Acid



A GLASS spirit lamp makes an excellent bottle for keeping small quantities of nitric acid, soldering spirit or other acid liquids. A glass rod may be left in the lamp and covered with the ground cap as shown in the illustration. The cap usually makes a very good fit, and for many purposes no other stopper is required.

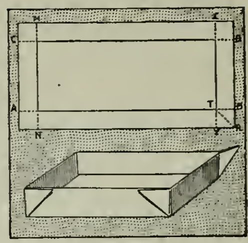
When used to contain nitric acid, for testing gold, however, the other device shown may be adopted. A piece of glass rod is drawn out to a rather fine point at one end and passed through a perforated India rubber cork, which forms an air-tight stopper.

A Multiple Punch



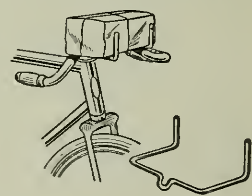
A PUNCH for making a number of holes in sheet fibre or metal can be made from a block of steel machined as shown in the accompanying drawing. A punch of this type is intended for work that must be repeated with uniform results.

An Oil Tray Made Without Solder



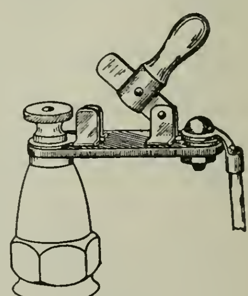
OIL trays which require no soldering may be made from a piece of tin of such thickness that it may be readily bent. The tin should be marked off as in the illustration. Bend the sides up on the lines AB and CD; then bend them back to their former place. Do the same with the ends on the lines XY and MN. Take the corner BY and bend along the line RT until the side and end come together and form a square corner, as in lower drawing. Bend the projection up against either the end or side. Do likewise to the remaining corners.

Parcel-Carrying Rack for Bicycle



THE accompanying line drawings show a simple package-carrying attachment for a bicycle, which can be cheaply and easily made and removed or attached simply. The drawings show clearly the method of bending and the dimensions. Make the pocket to suit the handle bar of the bicycle.

Switch Detects Bad Ignition



IT is often a tedious and troublesome matter to determine which cylinder of a multiplex cylinder engine is missing explosions. A very simple little instrument, shown in the accompanying sketch, renders the discovery of the missing cylinder easy. It is simply a switch, to be fastened to the spark plugs in succession.

RADIO SECTION

Devoted to the Encouragement of Amateurs and Experimenters in the Field of Radio Communication

Aeroplanes, Wireless and the War

By William Dubulier

The author of this article is an American radio engineer, who has performed experimental work for the United States Government and whose investigations for the British and Russian governments have attracted attention abroad. His wireless apparatus is now used on British military aeroplanes. His article may therefore be considered as an exposition of the subject of radio communication from aeroplanes from first hand knowledge.—Editor.

THE art of warfare has been transformed by wireless and wireless has in turn been transformed by modern warfare. We can safely say that the one great electrical event of the war is the use of wireless even between trenches, and the directing of artillery fire. While the regular telephone and telegraph are also used, the wires are so frequently broken by shrapnel and shell fire that wireless proves to be the only uniform and trustworthy means of communication. The men themselves at night (the only time when they dare leave the trenches) stumble over regular telephone and telegraph wires and break them, and often there is no opportunity to repair the damage. Not only have the Allies tried to get wireless trench sets, but the Austrians, Germans and other powers as well. The trench set in question is one in which one man and certainly no more than two men are needed to carry, set up and operate. The transmitting distance need not be more than five miles. Such instruments are now being built and supplied. One type weighs only eight pounds.

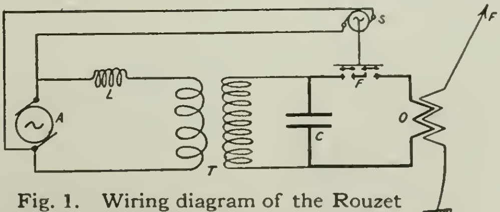


Fig. 1. Wiring diagram of the Rouzet system, showing synchronized revolving spark gap now being used by English and French governments

For aeroplane use, the instruments must have a greater range. They vary in power from twenty watts to two kilowatts, which latter is the power of the instruments now being installed on big aeroplanes made in England and employed not only to signal the hits and misses of heavy artillery, but also to jam the enemy's stations.

In a wireless installation of this aeroplane type, light weight and compactness are the most important requisites. Let us begin by describing the small installations which require about twenty watts to operate and which are used almost exclusively by the French army for directing artillery fire. In designing this instrument old principles were revived—principles quite the same as those in vogue when wireless first came into being. There is a small induction coil with a vibrator and a spark gap, and an aerial and ground or counter capacity connected across the secondary. This is shown in Figure 1. The efficiency is greatly increased by connecting the condenser across the interrupter and primary as in the Dubilier system instead of the condenser across the interrupter, the former custom. The battery is a small case containing ten, eight ampere-hour cells of twenty volts, and the secondary is connected with the discharge electrode or oscillator mounted on top of a small case within which the rest of the apparatus is fastened. The oscillator is mounted outside to take advantage of the rush of air in the aeroplane track along, thus cooling it. The aerial and equivalent capacity is connected directly across the spark gap, thus eliminating the necessity of tuning by means of a condenser and tuning coil. The arrangement is much the same as that which Hertz and Marconi used in their initial experiments. It will be seen, therefore, that the operating circuit produces a natural wave without the necessity of adjustments such as are necessary for most spark transmitters.

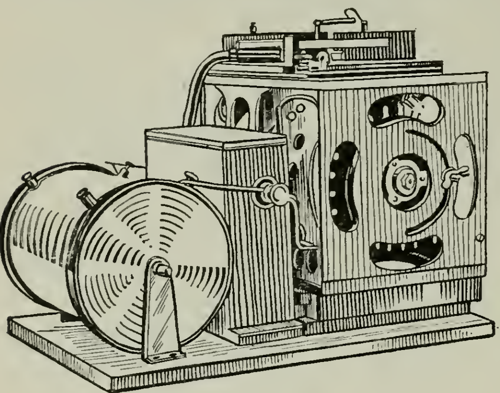


Fig. 2. The apparatus in detail. It weighs, complete, about 30 lbs, for 150 watts, and includes one self-exciting 250 cycle generator with synchronized spark gap, one Dubilier condenser, one transformer in oil, and a loose coupled tuning coil

The primary input is about twenty volts and one-half an ampere. The interrupter produces a musical note of about 250 frequencies. The trailing wire, which is used as the aerial, is about 150 feet long, and has a three-pound lead weight attached to it. With this small power we were able to obtain five-tenths of an ampere in the aerial wire circuit, the capacity of which was about 0.00003 m.f. It was found that communication could be effected a distance of fifteen miles. This served the purpose very well, especially for directing artillery fire. The receiving wireless station was situated about one mile behind the guns. Between the receiving station and the gunners a regular telephone line was set up.

The position of the aviator is obviously very perilous. He must be right over the enemy's trenches if he is to direct every shot of the artillery. When a shot falls short or long or too much to the right or to the left, he flashes the information at once to his station. The next shot follows the course that he indicates. This is the most effective electrical work which has been done in the war.

The aeroplane employed in this dangerous service is a two-seater containing a pilot and the observer. The observer sends his messages as quickly as he makes his observations.

Another set of instruments is used, of 150 watts capacity, the energy being obtained from a generator driven by the engine of the aeroplane. Various installations are used of this capacity, some utilizing direct current and some alternating current. The best instrument in my opinion is one which has a 250 cycle alternator attached by a belt to the gas engine. This generator is of remarkably light weight and is so constructed that it is self-exciting. The whole installation, including the generator, a closed core transformer in oil, a key, condensers, loose-coupled tuning coils and hot wire meter weighs complete but 27 pounds. How remarkable is this installation may be gathered from the fact that the ordinary machine

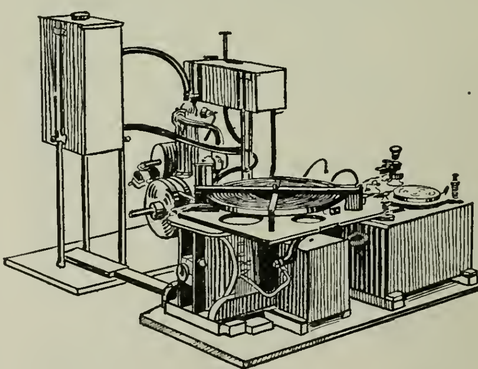


Fig. 3. The apparatus with a small engine for portable use

weighs between 75 and 100 pounds. An installation which I have been supplying the United States Government for aeroplane work, weighs 60 pounds. Yet here we have a complete apparatus weighing but 27 pounds.

It would be practically impossible for one to build such a set in this country for government use because the government tests would automatically eliminate the instrument itself. For example, the generator if run under ordinary conditions in a room would not stand up under fifteen minutes' continuous use. The United States Government insists on a test of eight hours' duration in a closed room. The French and English have wisely concluded that since the generators are used in an aeroplane travelling through air at the rate of sixty miles an hour, a cooling effect is obtained which may be utilized and which will simplify the task of the radio designer. This generator seems to work most satisfactorily and ought, it appears, to be employed by our own navy for aeroplane work. On one end of the shaft of the motor is attached a rotary synchronized spark gap. A small closed-core transformer mounted in a fibre tank full of oil and generating about 20,000 volts is included in the secondary. The condenser used is of the Dubilier type. This is the standard for aeroplane installations in Europe for the Allies.

The condenser is the most important element of the aeroplane wireless installation; for it is obviously impossible to use fragile Leyden jars. The condenser must be unbreakable, have high efficiency, and occupy very little space. Figure 2 shows such an installation.

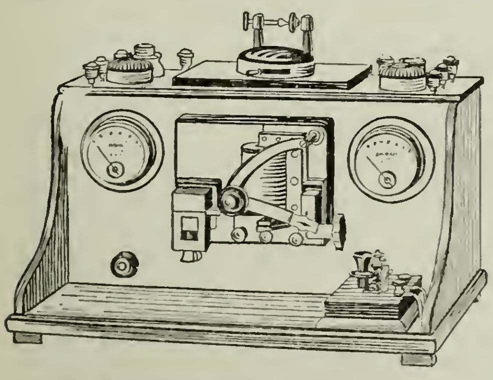


Fig. 4. The small apparatus used mainly by the French for directing artillery over trenches. This apparatus weighs about 12 lbs. and is capable of utilizing about 40 watts

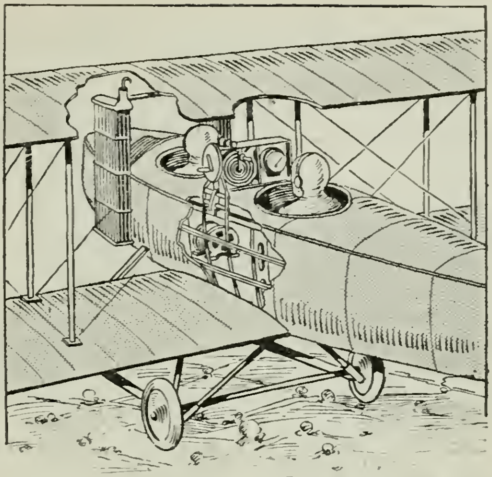


Fig. 5. A 750 watt equipment on aeroplane using the resonance alternator of J. Bethenod. This alternator generates an alternating current of 1500 cycles, 750 watts, at a speed of 4500 R.P.M. The outfit consists of a generator, a transformer, oscillating circuit and a system of manipulation. The generator complete weighs but 42 lbs., and is built for an overload of 20%. It is driven by the motor of the aeroplane. The transformer has a closed core, and is air cooled without magnetic leakage. The oscillating circuit provides for operating on a wave length up to 600 m., and is self-excited by a condenser with 0.01 M. F. capacity

By means of a small aeroplane aerial it is possible to radiate one ampere with this installation. Communication can be held over distances of fifty miles. The English government is building its own installations along these lines.

Duplex Wireless Telegraphy.

DUPLEX wireless telegraphy, in which two messages are simultaneously sent in opposite directions between two radio stations, is entirely practical. The system is used between Glace Bay and Clifden, and in the trans-Pacific stations. This arrangement makes it possible to handle twice as many radio messages between two stations in a given time.

Recent Radio Inventions

New Patents on Wireless Instruments

By A. F. Jackson

AMONG the most interesting patents of 1915 is No. 1139226, issued to E. Raymond-Barker, for a system of radio-telegraphy using two wave-lengths for transmission of a single message. Instead of sending Morse signals in which the dots and dashes are distinguished by the difference in duration of impulses, this method uses signals all of the same impulse length but distinguishes between dots and dashes by sending each at a different wave frequency. That is to say, only short signals which correspond in length to ordinary Morse dots are sent, but these are emitted at two different wave lengths, one of which is for dots and one for dashes.

Figure 1 shows the way in which the invention may be applied to a Poulsen transmitter. Here the power lines *G* supply energy to two oscillating arcs, *F F*, through suitable impedances. The central contacts or levers of two telegraph keys *A* and *A1* are connected in the shunt oscillating circuits of the two arcs, and serve to connect the arcs either to radiating resonant circuits *C D* or to non-radiating resonant circuits *C1 D1*. Considering the operation: When neither key is depressed both arcs are connected to their non-radiating circuits through contacts *H H*, and generate in these circuits oscillations of different wave lengths. If it is desired to send a dot the left-hand key is depressed; this connects the left-hand arc to the antenna, and waves of a certain length (say 3,000 meters) are radiated. If a dash is to be sent, the right-hand key is pressed for an instant, and for that time the right-hand arc is connected to the antenna and allowed to radiate waves of its different wave length (say 4,000 meters. Thus combinations of dots and dashes corresponding to the letters of the Morse code are transmitted.

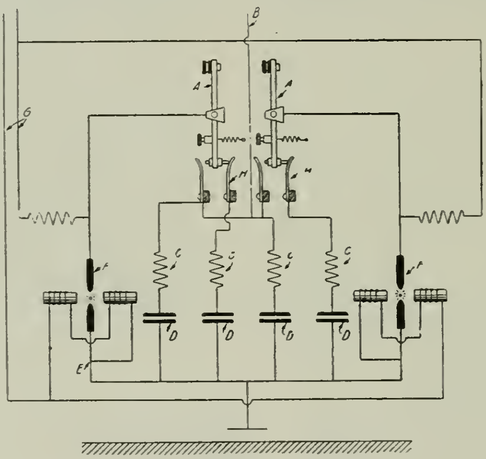


Fig. 1. Raymond-Barker double-wave transmitter

At the receiving station it is necessary to pick up signals on either wave length and to indicate that one represents dots and the other dashes. Fig. 2 shows one way in which this may be done: The receiving antenna *B1* is connected to two parallel tuned primary circuits, *C5 D5*, one of which is tuned to the "dot wave" and the other to the "dash wave." Each primary has coupled to it a tuned secondary *C6* which acts upon a tikker detector *P1* with telephone *P* and stopping condenser *D6*. One telephone is held to each ear of the operator and the dots distinguished from the dashes by noting which 'phone gives the response. A simpler way of distinguishing the dots and dashes is by adjusting the tikker-interrupter speeds

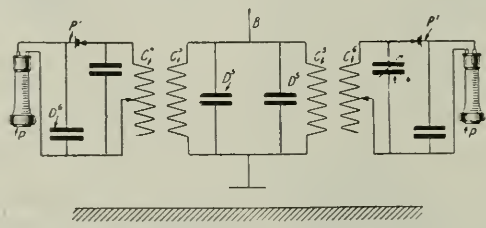


Fig. 2. Telephonic Receiver for double-wave system

and the condensers *D6* so that the sound of the dots is somewhat different from that of the dashes. This gives in effect a two-tone system, and obviously permits higher signaling speeds than does the usual dot-and-dash method. In addition to the increase in speed the two-wave lengths feature offers excellent security from interception of the messages by ordinary radio receiving stations.

When the signals received are sufficiently strong to operate a sensitive relay it is possible by this method to make a siphon recorder pen-and-ink record corresponding exactly to cable "slip." If a relay is connected to each side of the receiving system, the two contacts may be used to control a third polarized relay which will remain in an open neutral position so long as no signals are received, but which, when waves are arriving, will close its local circuit and permit current to flow in one direction or the other according to whether it is operated by a dot-impulse or a dash-impulse. A siphon recorder in this last-named local circuit will record the signals by a wavy line having a hump above its neutral position along a central line for each dot, and a hump below for each dash. Fig. 3 shows the actual connections of apparatus set up to accomplish this result, and in this diagram the action may easily be traced from the sensitive relays *U U*, which are connected to the two detectors, to the siphon recorder *g*.

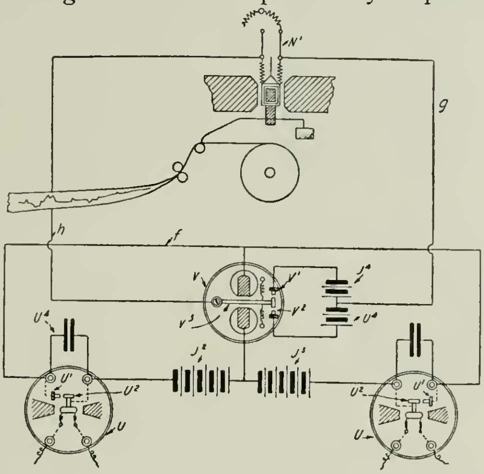


Fig. 3. Relay connections for recorder operation

U. S. Patent No. 1127921, issued to G. W. Pickard, is on an important detail of receiving tuning apparatus. Before the adoption of inductance varying arrangements similar to that shown in this specification it had been customary to rely upon either sliding contacts, variometers or roller inductances for tuning. Each of these methods has disadvantages; sliders give poor contact at times, and cause loss of energy through short-circuited turns; variometers are limited in range of adjustment, and have their total resistance in circuit even at minimum inductance; roller arrangements are bulky, and slow in operation. All these difficulties may be overcome by the use of multiple-point switches connected to the turns of the coils, but it would be practically impossible to have a switch-point for each single turn of a long coil. If a saving in the size of the switch is attempted, by making each point cover a number of turns, it is not found possible to get sharp enough tuning unless an auxiliary variable inductance or condenser is used.

The plan of wiring shown in Fig. 4 makes it possible to get single-turn steps of inductance on a long coil by using two small switches. One of these, indicated by *S*, has taps taken off the body of the coil at each tenth turn. The other, *S1*, has its points connected to each of the last ten single turns on the coil. The leads to the coil, *A* and *G*, run to the levers of the two switches; and each terminal may be connected directly to the tenth turn of the coil by placing its respective switch lever on a button marked "O." This *common zero* of the two switches seems to be the novel point in the present patent, and is the artifice by which it is possible to adjust to any inductance from zero to full value by steps

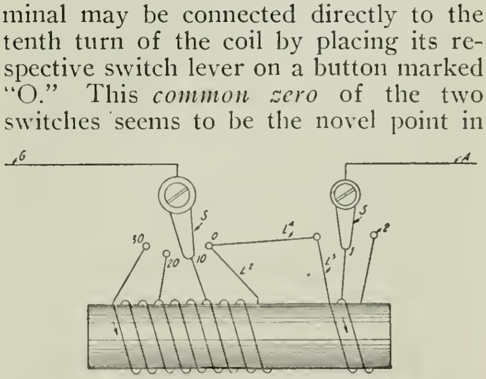


Fig. 4. Common zero switches on inductance coil

of a single turn. Reference to Fig. 4 shows that each step to the left of switch S adds in circuit ten turns of the coil, and that these large jumps of inductance may be filled in by the smaller steps secured by moving switch I to the right.

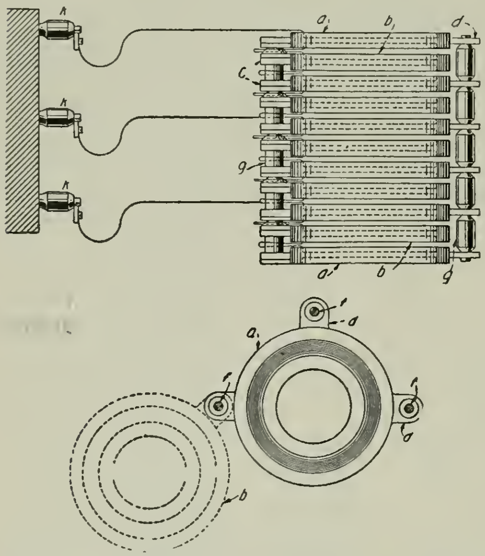


Fig. 5. Arco and Rendahl high power variometer

This switching system has come into wide use within the past few years.

One of the difficult problems of radio engineering is the construction of an easily varied inductance capable of carrying such high currents as are encountered in the oscillation circuits of powerful transmitting stations. Flat spiral coils have proved useful, but if they are to be used for final adjustment some way is needed to change their inductance gradually without interfering with the current through them. 1915 patent No. 1131187, issued to G. von Arco and R. H. Rendahl, shows an interesting way of doing this. Referring to Fig. 5, two sets of flat spiral coils *a* and *b* are seen to be mounted in a framework which permits the group *a* to be moved away from the others by swinging them about the pivots *f* as an axis. The whole set of coils is connected in series, with taps taken off at terminals *k*, and the units are carefully insulated from each other. When the moving group is in the position of closest coupling to the fixed coils the system has its maximum inductance, since the magnetic fields of all the coils are co-operating; when, however, the *b* coils are swung out into the position indicated by the dotted lines at the bottom of Fig. 5, the maximum addition of fields no longer occurs and the inductance of the system is very much reduced. The special advantages of this method of mounting arise from the fact that parts having large differences of potential are kept well separated. Although the simple two-coil variometer construction used in receiving coils will give an inductance variation as large as 1 to 15 when insulation difficulties are small, in the two coil form as applied to high-powered transmitter the coils have to be kept so far apart that the maximum inductance is only about twice the minimum. With the sub-divided form shown in this patent, however, heavy currents can be carried and yet a considerable inductance variation attained.

Fig. 6 shows an interference preventer arrangement patented in 1915 by T. B. Miller, specification No. 1127368. In the ordinary interference preventer of Fessenden two primary circuits connected to the antenna act on two opposing secondaries; one primary is adjusted to receive the desired signals selectively and to impress them upon the detector, while undesired signals are caused to affect both branches of the circuit equally and oppositely and so produce no final effect. The circuit of Fig. 6 differs from this earlier arrangement in that a single antenna primary circuit is used with two secondaries and two detectors,

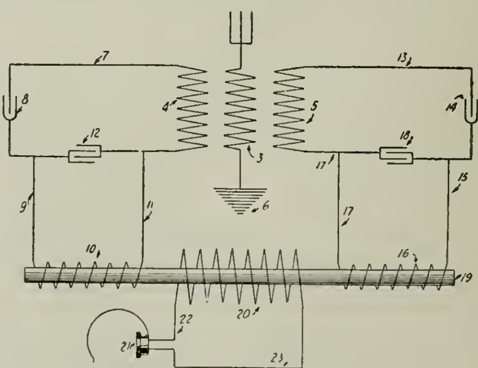


Fig. 6. Interference preventer

and the neutralization of interfering signals is accomplished by opposing their effects in the telephone circuits.

The primary 3 is coupled to secondaries 4 and 5, with their corresponding detectors 8, 14, and stopping condensers 12, 18, in the usual manner. The leads from the condensers 12, 18, which ordinarily go direct to telephone receivers, are in this case carried to the two primary windings of a telephone transformer. These two coils, 10 and 16, oppose each other's effects upon the secondary 20, which has in series with it the telephone receivers 21. This transformer is adjustable, so that either of its primaries may be caused to induce stronger signals in the secondary than will the other.

The operation of the device may be considered in connection with a condition assuming simultaneous sending by two wireless stations, one nearby and the other distant. Suppose that with an ordinary receiver the strong signals from the nearer station practically drown out those coming from a distance, and yet that it is desired to read messages on the weaker waves. With the apparatus of this patent the receiving operator would adjust one of the detectors, say 8, to a sensitive condition in which it would respond well to the weak signals. The other detector, 14, is then adjusted to receive only the strong signals. Thus there are set up telephone currents in primary 10 from both stations, that from the distant one being much weaker than that from the interfering set, and telephone currents in the opposite direction in coil 16, these latter being only from the interfering station. Since the sensitiveness of detector 14 has been reduced, the interference currents in 16 will be weaker than those in 10. By loosening the coupling between 10 and 20, the signals from the interfering station will oppose in their magnetic effects on the secondary, and so produce no response; if it has not been necessary to weaken the coupling too far, the signals from the distant station should still be heard.

Thus, if detector 14 is of the type which requires a certain fairly large current before it gives any response, and if the difference in signal intensities is not too great, some very advantageous interference reducing effects may be had.

A Cheap Ground Clamp

A hose clamp can be purchased at any hardware store at two for five cents and a binding post taken from the zinc side of an old dry battery. A hole is then drilled in the hose clamp and the post soldered fast.

Insulators can be made by taking a broomstick, sawed into 4 inch or 5 inch

Strain insulator made from a broom stick

lengths and having a screw eye put in each end. Baked and thereafter boiled in paraffine these make first-class strain insulators. To prevent splitting, a hole should be drilled in each end a trifle smaller than the screw eye and then filled with glue. The screw eye should have a coarse thread. The tough hardwood holds the eyes so they will stand a heavy strain. Two coats of black asphaltum make them resemble hard rubber.

Crystal Detector Hints

WHEN the best results are to be obtained, the crystal should be mounted in a fusible alloy. This can be easily made by melting equal parts of ordinary fuse wire and tinfoil and adding a little mercury.

In selecting pieces of galena the parts that are very shiny and have the most vein will be found to be the most sensitive. When breaking galena do not hit the mineral one hard blow: tap it three or four times lightly with a hammer, breaking it into square pieces, and there will be no waste.

With silicon or ferron as a mineral, use a gold wire having a sharp point. A fairly heavy pressure may be used, and results in a firmer adjustment. The resistance of a crystal is great, and therefore as small a piece as possible should be used.

Different combinations of minerals will often work better than one mineral. Galena and graphite, silicon and graphite, zincite and bornite, or chalcopyrites (perikon), ferron and silicon, and galena and tellurium will all work better in combination than alone.

Antenna Circuits in Radio Telegraphy

By John Vincent

IN the two earlier articles of this series, the simple relations between capacity, inductance, wavelength and resonant frequency were explained. It was shown that in a closed circuit such as that of Fig. 1, the maximum current would flow when the impedance (or alternating current resistance) was made as small as possible. It was also shown that by adjusting the circuit capacity C and inductance L, they could be made to neutralize each other's effects for the particular frequency of the alternator E, and that when the circuit was in this resonant condition, the current flowing was dependent only upon the voltage generated at E and the resistance R.

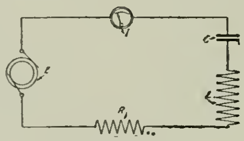


Fig. 1

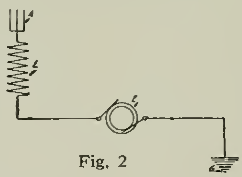


Fig. 2

The relations of inductance and capacity to frequency and wavelength, and those of voltage and impedance to current, exist in "open" antenna circuits such as that of Fig. 2, exactly as in closed circuits like Fig. 1. For most purposes the computations explained in the January article will give good results for either open or closed circuits. The only error likely to cause trouble depends upon the fact that in the elevated part of an antenna circuit there are *both* capacity and inductance. In the closed circuit (Fig. 1) practically all the capacity is lumped together at C and nearly all the inductance at L. In the antenna, however, for short waves the inductance L may be quite small and so the *distributed inductance* of the antenna wires may play an important part in determining the resonant frequency of the system. For most radio telegraphic purposes waves considerably longer than the natural wavelength of the aerial are used, and with these the antenna may be considered to be the equivalent of an inductance, a capacity and a resistance all connected in series.

If one thinks of capacity as a property possessed by any pair of conductors separated by an insulator (which is a correct idea), it is easy to see that an antenna has capacity with respect to the earth. As the two plates of a condenser are separated by an insulator and have capacity with respect to each other, so, in the antenna system, the aerial wires and the earth's surface, (both of which are conductors) are separated by the intervening air. The capacity of the aerial system is a definite quantity depending upon the distribution of current in it, and like that of any other condenser may be computed or measured.

Inductance is a property of conductors which makes itself known by the magnetic effects produced upon these conductors when the currents through them *vary*. Since direct current is usually of uniform strength, in direct current circuits inductance is not often considered; nevertheless, the property is always present and ready to become prominent when the current varies. In radio antenna systems, alternating current flows and therefore the inductance of the wires is important. One hundred feet of antenna wire stretched out straight has about 0.07 millihenry inductance, which is equivalent to about *twenty* turns of No. 24 wire wound in a coil of 4″ diameter. For a given length of wire a coil has much more inductance than a straight wire, because each portion of it can act magnetically on the turns beside it. Thus the inductance of an antenna wire can be represented by that of a small coil, just as its capacity may be represented by that of a condenser.

Antenna systems, like other conductors, possess electrical resistance in addition to their capacity and inductance. This resistance is made up of several parts, one being of the wires themselves and another that of the earth's surface in the neighborhood of the antenna-base. All power losses in the antenna, including that due to the radiation of energy, represent additional parts of the effective resistance. All these component parts are added together to get the true total antenna resistance. For instance, in a large flat top aerial the wires might represent an effective resistance of 0.3 ohm, the ground 0.4 ohm, losses by brush discharge 0.2 ohm, losses at the insulators 0.2 ohm, and the radiated power 0.8 ohm. Added together, the total resistance becomes 1.9 ohms; a closed circuit having the same capacity and inductance as the antenna, and including a resistance of 1.9 ohms in series, would permit the same current to flow as would the aerial when excited by the same frequency and voltage.

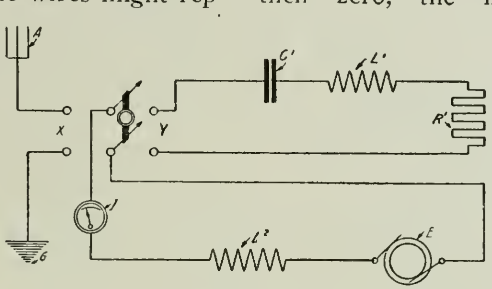


Fig. 3

From the foregoing the fact appears that, for wavelengths long compared to the fundamental or natural wavelength, the electrical properties of an aerial system are in many ways equivalent to those of a circuit containing lumped inductance, capacity and resistance. An experiment with the arrangement of Fig. 3 will show this to be true. In the diagram *A* and *G* represent antenna and ground, which are connected to the "*X*" side of a double-throw double-pole switch. The "*Y*" terminals lead to a condenser C_1, inductance L_1 and resistance R_1, in series. Across the center points are connected the radio frequency alternator *E*, the inductance L_2, and the ammeter *I*. Suppose the switch to be closed on the "*X*" side and the alternator to be generating at 100,000 cycles per second frequency (which corresponds to a wavelength of 3,000 meters). Assuming the natural wavelength of the aerial to be considerably under 3,000 meters, if the inductance L_2 be slowly increased the current reading of *I* will also increase, at first gradually and then rapidly, till it teaches a maximum value. If the inductance is still further increased, the current will grow smaller and smaller. The largest current flows when the effect of the inductance just neutralizes that of the capacity for the frequency used, or, in other words, when the antenna impedance is a minimum. The aerial system reactance is then zero, the impedance is equal simply to the effective ohmic resistance, and the antenna is *resonant* or *tuned* to the alternator frequency. In this condition the current is determined only by the total antenna resistance and the effective applied voltage, irrespective of other factors.

If, now, the condenser C_1 is made equal in value to the capacity of the antenna and the coil L_1 adjusted to equal the aerial inductance, the right hand circuit will have a reactance equal to that of the antenna. If the switch is thrown to the "*Y*" position, with the alternator running at 100,000 cycles, and the inductance L_2 is again gradually increased from zero, the current reading of *I* will first increase and then decrease exactly as before. The point of maximum current will appear for the same value of L_2 as when the antenna was connected; if the resistance R_1 is set to a value equal to the total antenna resistance the greatest current in amperes will be exactly the same as with the switch in the "*X*" position.

Thus it is evident that any antenna may be considered as an inductance, a capacity and a resistance in series, and that so far as current and voltage effects are concerned the true aerial circuit may be replaced by an *artificial antenna* consisting of equivalent condenser, coil and rheostat in series. This means that the considerations regarding the impedance of closed oscillation circuits and its arithmetic calculation, as given in the January article, may be applied almost without change to antenna circuits. It is only necessary that the wavelength used be somewhat longer than the fundamental of the aerial, which is the usual condition of practical wireless telegraphy.

In all the discussions up to this point the use of sustained or undamped radio frequency current has been assumed. The generators indicated by the symbol *E* in the diagrams have been supposed to be radio frequency alternators of the Fessenden type, which produce continuous alternating current of a definite radio frequency depending only upon the speed of the machine. Such an alternator forces any attached circuit to oscillate at the machine's generating frequency, but the amount of the current set up in the circuit depends strictly upon the dynamo's voltage and the circuit's impedance to that frequency. Transmitters of this general type are coming into wider use day by day, as is seen from the work of the Goldschmidt, Fessenden and Telefunken companies. The circuit effects described are substantially identical with those in alternating current circuits operating at commercial power-distribution frequencies of 25 or 60 per second; in the radio work, however, resonant or zero-reactance effects are made useful, and condensers are used directly in the circuits. In low-frequency practice, resonance is usually carefully avoided and series condensers are almost never used.

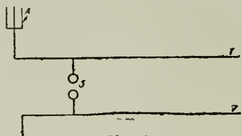


Fig. 4

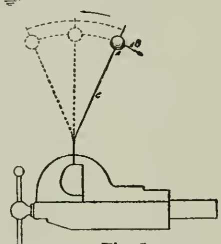


Fig. 5

By far the greatest number of radio telegraph transmitters in use today are of the spark condenser-discharge type. The circuit behavior in these senders is somewhat different from that in the sustained wave alternator transmitters, but most of the basic principles already explained hold true. The main difference arises from the fact that with the alternator the frequency of the oscillations developed depends entirely upon the speed of dynamo and is independent of the circuits connected to it, while in the spark transmitter the frequency depends mainly upon the capacity and inductance of the discharging circuit.

Consider for a moment the arrangement of Fig. 4. Here an antenna *A*, which possesses inductance, capacity and resistance, has connected between it and the earth *E* a spark gap *S*. Across the spark gap, by means of terminals *TT*, a high voltage transformer, inductance coil or other charging source is connected. If the potential of this charging source gradually increases, a current flows into the antenna and, because of its electrostatic capacity, this aerial system takes a charge. If the voltage continues to rise until the electrical pressure is so great that the air between the spark gap terminals at *S* breaks down, a spark will pass and the electric charge previously impressed upon the aerial will rush to earth. In an ordinary antenna this discharge to earth will be such that the electrical inertia of the system will cause the charge to "overshoot," in a sense, and the antenna will take on a polarity opposite to that which it had originally but somewhat weaker. The insulating properties of the air gap *S* are not regained in the brief time of the charge's passage, and so the current rushes up to the antenna once more; at each swing or partial electrical oscillation the electromagnetic inertia due to inductance causes the effect of "overshooting," and the oscillations continue until the energy of the original charge is used up. The electrical phenomenon is in many ways similar to the mechanical effects which may be observed when a weight at the top of a springy rod (which has its lower end clamped in a vise) is swung back and forth.

Consider such a mechanical system, as shown in Fig. 5. If the weighted end *A* is pulled to the right by drawing on the light thread *B*, the spring *C* will be more and more strained until at last a point is reached at which the thread snaps. This is a fairly close analogy to the straining of the air in the spark gap *S*, Fig. 4, as the charging voltage gradually increases to the breaking point. Referring again to Fig. 5, as soon as the "charge" of mechanical energy placed in the spring *C* is released by the breaking of the thread, the weight *A* swings to the left. By reason of its inertia the weight does not stop at the central normal resting position unless the friction is very large, but "overshoots" and travels off to the left side. But its motion to the left does not carry it so far from the center as it was originally. When it again swings back to the right the displacement is still less; the successive partial mechanical oscillations to right and left gradually become smaller until the energy originally imparted is used up, when the swinging stops.

For every complete oscillation of the freely vibrating antenna system a certain definite time is required. This time, which is usually measured in fractions of a second and is called the *period* of oscillation, depends upon the capacity and inductance of the vibrating system. It is a definite quantity for each amount of capacity and inductance, and, when the resistance is not abnormally high, depends only upon these. If the capacity of the circuit is stated in farads and the inductance in henrys, the time of one complete oscillation in seconds may be found by (first) multiplying the capacity by the inductance, (second) taking the square root of this product, and (third) multiplying the result by 6.28. Thus if the capacity is 0.002 microfarad (or 0.000000002 farad) and the inductance 3.2 millihenrys (or 0.0032 henry), the product is 0.0000000000064, its square root is 0.00000253, and the period (multiplying by 6.28) is about 0.0000161 of a second. The frequency is obviously the reciprocal of this, or 62,000 periods per second, which (as shown last month) corresponds to a wavelength of 4,800 meters.

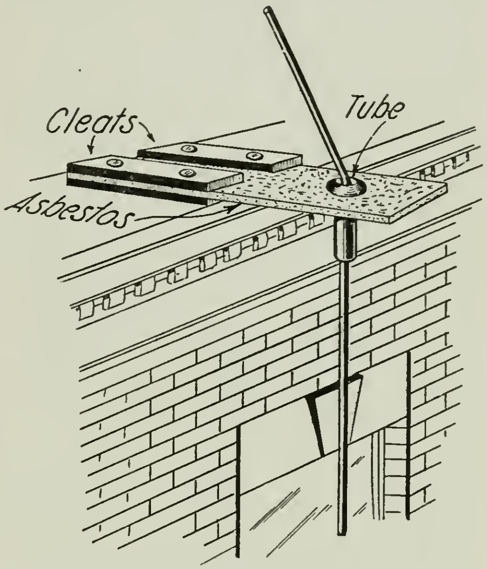
In the next article some of the effects of changing inductance, capacity and resistance in both open and closed circuits will be discussed.

Edison's Railroad Wireless

WIRELESS was used on railroad trains as long ago as 1885, but the system then devised by Edison depended upon static induction and not radiated waves. It has been only recently that radio telegraphy has proved useful in railroad work.

A Roof Insulator

AN insulator for lead-in wires passing over the edge of a house roof may be made by cutting a piece of stiff asbestos and placing it between two pairs of porcelain cleats. A hole is then made in the asbestos and a porcelain tube insert-



This insulator for lead in wires is efficient and easy to make

ed; the entire insulator is then nailed to the roof and is ready for use. The drawing shows the construction in detail.

International Conference at Washington

INTERNATIONAL conferences on radio telegraphy were held at Berlin in 1903 and 1906 and in London in 1912. The next is to be at Washington, D. C. The regulations adopted have been agreed to by most of the countries of the world.

Radio Has Velocity of Light

IN THE experiments between the powerful Navy station at Arlington and that of the French government at the Eiffel Tower, Paris, which were carried on two years ago, it was found that the velocity of electromagnetic waves as used in radio was substantially identical with the speed of light. The measurements were made by taking carefully timed photographic records of signals sent across the Atlantic.

The Static Coupled Receiving Tuner

By John L. Hogan, Jr.

NEARLY all experimenters are familiar with the action of the ordinary inductively coupled receiving tuner illustrated in Fig. 1. With this arrangement of apparatus, if the elements are well designed and manipulated, excellent results in tuning may be secured. The construction is not always easy, however, since the primary and secondary coils must usually be so built that one may slide within the other. It is difficult to devise ways to connect conveniently to various taps on the movable coil without introducing losses in lead wires. Such losses invariably result in weakened signals, and prevent reception of signals from the greatest possible distances.

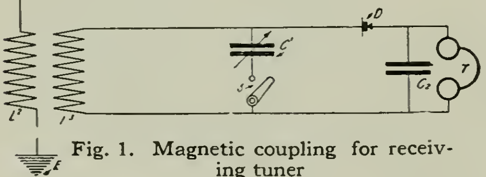


Fig. 1. Magnetic coupling for receiving tuner

A somewhat different type of tuner, which is now coming into rather extensive use, usually gives sharp tuning and loud signals, yet is very easily assembled. The connections are shown in Fig. 2, and may be seen on examination to bear some resemblance to the inductively coupled layout of Fig. 1. In both diagrams the antenna and earth are shown by *A* and *E*, the primary circuit loading coil by *L1*, the primary by *L2*, the secondary by *L3*, the secondary tuning condenser by *C1*, the blocking condenser by *C2*, the detector by *D* and the telephone by *T*. In Fig. 1 the primary and secondary coils are placed rather close together, so that energy may be transferred electromagnetically by the action of the lines of magnetic force linking both coils. In Fig. 1, the mutual inductance of the primary and secondary (and therefore their coupling) is altered by moving the coils toward or away from one another; when near together the coupling is close and the selectivity poor, when far apart the coupling is loose and the selectivity or sharpness of tuning greater. The gain in selectivity is often accompanied by a reduction in signal strength.

In Fig. 2, the primary and secondary coils are set far apart, so that there is practically no magnetic coupling between them. A third condenser, *C3*, which is preferably variable and of small minimum capacity (say of from 0.00005 to 0.001 microfarad range) is put in circuit as shown. This additional condenser governs the coupling of the system; when *C3* has small values the coupling is loose and the tuning sharp, and when *C3* is increased the opposite condition is approached. The two coils need not be moved at all in order to secure any of the desired coupling effects; therefore, either primary or secondary or both may be variometers and the end-switch losses thereby eliminated.

In tuning with the condenser-coupled circuit the ordinary procedure is followed. The coupling is made close and, with the secondary condenser disconnected by opening switch *S*, the primary is adjusted until the desired station is heard with the greatest loudness. The switch *S* is then closed and the secondary system tuned by varying *L3* and *C1*. If interference is present, or if the incoming signals are very sharply tuned, the best results are secured by gradually loosening the coupling and at the same time adjusting *L2* and *C1*, to keep the signals at maximum strength. The resonant wave length of the coupling circuit *L2*, *C3*, *L3*, is generally much shorter than that which is being received. Testing this static-coupled received will be well-spent effort.

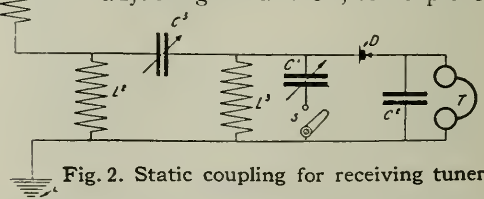


Fig. 2. Static coupling for receiving tuner

A Mexican Radio Station

By Stanley E. Hyde

IN MEXICO at present there are eight radio stations, situated at Vera Cruz, Campeche, Obispo, Maria Madre Island, Mazatlan, San Jose del Cabo (end of Lower California) Santa Rosalia and Guaymas. During the recent troubles in Mexico the rebels destroyed the station on Maria Madre, which is one of a group of three Pacific Coast islands belonging to Mexico, situated about ninety miles southwest of the State of Tepic. These islands, extremely barren and practically void of vegetation, are surely a most uninviting place for a radio operator.

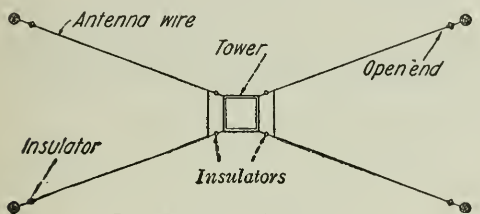


Fig. 1. Plan of Antenna

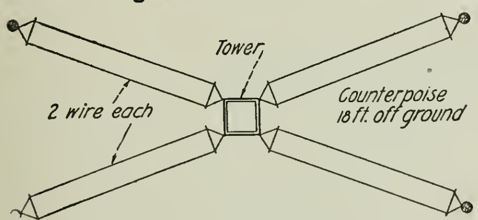


Fig. 2. Plan of counterpoise

The station illustrated is that of the Federal government completed during the present year at Mazatlan, Sinaloa, the largest Mexican city on the Pacific Coast. The station is on the top of a hill back a little from the city, and overlooks the ocean. On the side of the hill are broken down barbed-wire fences in great confusion, erected by the Federals to hinder the advance of the rebel forces which about a year ago tried to capture Mazatlan by land and sea. Upon reaching the station one is greatly surprised to find a modern steel tower for supporting the antenna. It is square and gradually tapers to the top, on which is an observation platform which can be made useful for military purposes. The whole, constructed of thin structural steel, is 250 feet high, and guyed by steel cables anchored firmly in the earth. The antenna, which is illustrated in Fig. 1, has distinct features not found in the ordinary radio station, and is especially adapted to the tropics where the static is troublesome. It consists of four wires spread out umbrella style, but not connected together at the bottom. The four spans are brought together near the top and the leads run down from the highest point, as illustrated in Fig. 3.

On such rocky and dry soil it would be impossible to obtain an efficient earth connection so a counterpoise or artificial serial is made use of. Fig. 2 shows a plan of this, which consists of wires supported 18 feet off the ground and insulated from it. These wires are also connected together at the tower terminal and brought into the station through a large lightning switch.

The radio building is constructed of brick and has a red tile roof. Two rooms are used for the transmitting and receiving instruments, while the other three are for the use of the operator and his family.

The transmitter is a 1½ kilowatt Telefunken set, using a 500 cycle alternator, belted to a ten horse-power distillate engine. Directly connected to the

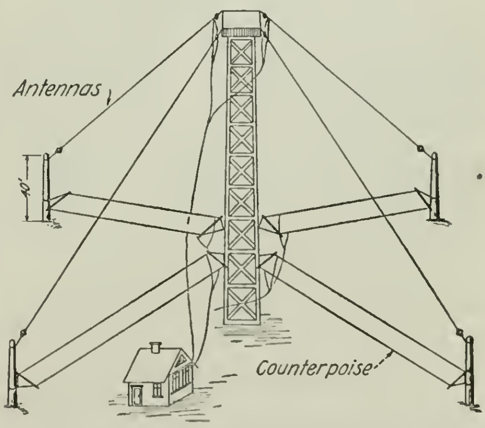


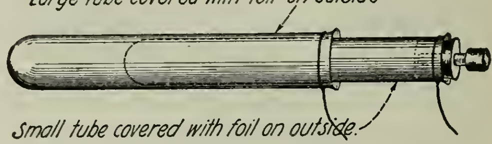
Fig. 3. Diagram of station at Mazatlan, Mexico

alternator shaft is a small direct current exciter. Engine and alternator are situated in a separate room from the rest of the apparatus. The engine is water-cooled by rain water collected in a large tank outside. The receiver consists of a Telefunken loosely coupled set with variable condensers, telephones, two sensitive Galena detectors and transfer switch. To the left of the receiver stand a high voltage tube condenser, the quenched, and variometer inductances. A hot-wire ammeter is included in the antenna circuit.

It is remarkable that this small station can work with Vera Cruz, over mountains and dry places, a distance of nearly 800 miles, but strange things happen in the tropics.

A Variable Condenser

A VARIABLE condenser can be made of two test tubes covered outside with tinfoil, one tube being a little smaller in diameter than the other. The smaller tube is placed inside of the large one, a flexible card being attached to the tinfoil on each. The condenser is varied by sliding the smaller tube in and out of the larger. There may be several sets of these condensers made and hooked up in either parallel or series.



A variable condenser made from two test tubes

Radio Club News

THE Technical Association of Licensed Operators, was formed on October 21, 1913. Meetings are held fortnightly, at which papers are presented and discussed. The present officers are: W. Woodrow, President; E. T. Dickey, Secretary and Treasurer. Other clubs are invited to address communications to the secretary's office, 1649 Amsterdam Ave., New York City.

Radio Club of Redlands

The Radio Club of Redlands, Calif., was recently formed, with an initial membership of nine. The following officers were elected: President and Chief Operator, Ezra Moore; Vice-President, Arthur Munzic; Secretary-Treasurer, Rudolph Kubias, and Asst. Secretary-Treasurer, Harry Williamson. Meetings are held every second Friday evening, at 7:30 P. M.

Amateurs in nearby towns are requested to communicate with the club, at 108 Eleventh Street, Redlands, Cal.

Wireless Club in Salt Lake City

At a recent meeting officers were again elected to positions in the Granite Wireless Association. The club is beginning its second year in amateur radio work and is now studying some of the latest works on Radio under the supervision of Prof. S. H. Besley. Most of the members have stations entirely of their own make and have secured excellent results. They hope to have the largest club of the Middle West and invite communications from other clubs. These may be addressed to Pres. Merton Stevenson, Granite High School, Salt Lake City, Utah. The club's station call is G. W. A. and practice work is carried on the last Saturday evening in each month. Business meetings are held every Friday afternoon, beginning at 2 P. M. at the school building.

Pensacola Junior Radio Club

The Junior Radio Club of Pensacola, Fla., recently held its first meeting. The following officers were elected: Edwin Copas, President; Oliver Williams, Secretary; Fred Gillmore, Operator. Nearby amateurs are invited to join. Address communications to Fred Gillmore, 127 W. Gregory Street, Pensacola, Fla.

What Radio Readers Want to Know

Indoor Aerial

C. J., Detroit, Mich., asks:

Q. 1. Would it be possible to use the lighting circuits in the house for an aerial, it being understood that the main switch is open?

A. 1. While not a very efficient aerial system it might be used under certain conditions. If the wires are not placed in metal conduits or in no way grounded, the system could be used. Nothing but local stations would probably be received. Better run a few wires across a ceiling in the top of the house than to try to use the light wires.

Q. 2. If the wires could be used, what would be the wave length of the system? The house is a two-story frame house, with one light in the attic and four in the cellar.

A. 2. It would be impossible for us to estimate the wave-length of the system.

Q. 3. If the bulbs were unscrewed, could this aerial be used to transmit on by using a small coil?

A. 3. No. The potential from the coil would be too high for the wiring and would puncture it at such points as fixtures. Similar trouble is experienced where currents are induced in the house wiring from an outdoor system of aerial conductors.

Radio Telephone

E. J. O'B., Black River Falls, Wis., asks:

Q. 1. Will you please give me the information which will enable me to construct a radio telephone set capable of transmitting one-half mile or farther if possible?

A. 1. We would judge from your letter that you would prefer to have instructions for a set which you could set up yourself, without involving expensive construction costs. For details of larger or more efficient sets we would have to refer you to a text book on the subject as it would be far too long to cover in this column. However, there is in vogue a type of radio which will cover the distance which you desire and which is fairly reliable. Such a set consists fundamentally of a transformer, such as would be used for radio telegraphic work, shunted by a carbon micrometer gap. Connected across the gap are two small condensers in series between which is the primary of an ordinary oscillation transformer. The secondary of the oscillation transformer is connected on one side to the aerial and on the other to the transmitter, the other side of the transmitter being grounded. The condensers are about 0.0025m.f. in capacity and the transformer about ¼ K.W., and should operate on 60 cycles or at a higher frequency if available. The April, 1914 *Popular Electricity and World's Advance*, page 1,466, has a description of such a set and shows the micrometer gap in detail, giving the necessary working drawings. Page 666 of the May, 1914, *Modern Electrics and Mechanics*, describes a similar set, but omits details of the spark gap.

Multiple Tuner

A. F., Rochester, N. Y., asks:

Q. 1. Is it absolutely necessary to use No. 24 wire on the multiple tuner described in the September issue of the *World's Advance?*

A. 1. By changing the size of the wire the most important change in the characteristics of the tuner will be the wave length, to which it will respond. By increasing the size of the wire the wave length to which the tuner would respond would be decreased.. By using smaller wire the respondent wave length would be increased. In this particular tuner it would be possible to use any size of wire from about No. 22 to No. 28, bearing in mind, of course, the change in the respondent wave length. For your purposes we do not believe this change would be of any great importance to you.

Q. 2. Is it also necessary to use enameled wire?

A. 2. Enameled wire permits the greatest number of turns to be placed on the coil and increases the respondent wave-length over that available with other types of windings. Spaced bare wire or single cotton or silk covered wire may be used quite satisfactorily.

Receiving Set

E. E. Z., Long Island City, N. Y., asks:

Q. 1. Please give me the dimensions of a receiving transformer to use with an audion detector to have a range of 200 to 1,500 meters. I desire to use switches instead of sliders.

A. 1. Wind 150 turns of No. 28 S. C. C. magnet wire on cylinders 5¼ and 4¾ inches in diameter respectively and five inches long. You can arrange the taps to suit yourself. On the primary we would suggest that you make arrangements for tuning to every other turn, and on the secondary ten points would be sufficient.

Q. 2. Please give me the dimensions of a loading coil to increase the range to 4,000 or 5,000 meters.

A. 2. Wind No. 28 S. C. C. magnet wire

on a cylinder 5¼ inches in diameter and 15 inches long. You should place about 500 turns on this coil.

A. 3. What is the approximate capacity of a 17 plate rotary condenser whose plates are 4½ inches in diameter and a separation of about 1-16 inch?

A. 3. We assume by a 17 plate condenser you mean 17 rotary plates. This condenser would have a capacity on the order of 0.0008 m.f.

Receiving Distance

B. R. J., Omak Wash., asks:

Q. 1. I have a circuit of No. 14 copper wire, 475 feet long, strung from comb to comb of buildings. I wish to use this as an aerial by placing a gas pipe in the center of the span, raising it to 92 feet above the ground. Using silicon or other crystal detector, what is the prospect of getting at least time signals from Mare Island Navy Yard, 800 miles south of here or from Bremerton, about 140 miles west of here. I am located east of the Cascade mountains in the Okanogan Valley of Washington.

A. 1. It is very difficult to say just what a station will do when the station is located behind a mountain range, but if you use an efficient set we do not see why signals should not be received from Mare Island. If you used galena instead of silicon you would probably have better luck. Be sure to insulate your antenna well from the gas pipe pole. This will prevent serious difficulties.

Armstrong Circuit

F. F. L., New Rochelle, N. Y., asks:

Q. 1. Can the Armstrong circuit be used on wave lengths of from 150 to 3,000 meters? If so what size coils should be used?

A. 1. The circuit itself is all right, but it is very difficult, if not impossible to get the audion to oscillate satisfactorily in a wave length of 150 meters. It is possible to get it to work on the longer wave length you mention. As the sustained waves are almost by absolute necessity of a long wave length there is very little need to get the audion to respond to the shorter lengths, as it is fully as effective to receive there the spark frequency rather than the radio frequency.

Single Radio Receiving Station

C. O. T., Easton, Md., asks:

Q. 1. What instruments do I need to receive messages 500 miles?

A. 1. Some form of tuning coil, preferably a loose coupler, many of which have been described in the columns of this publication; a detector, a mineral such as galena would probably be most satisfactory to start with; a high resistance receiver, a 2,000 ohm set is quite satisfactory, and a small stoppage condenser is all that you would require. Better results would be obtained by adding a variable condenser across the secondary of the loose coupler, but this is not absolutely necessary.

Q. 2. What kind of an aerial would you use?

A. 2. The easiest to erect, is about the usual answer. Almost anything will do. Look around and see a few other aerials and you will get a good idea of what you think would best suit your needs. We would suggest that you buy, if not otherwise possible to obtain, a copy of Edleman's book on "Experimental Wireless Stations." This book will answer both questions 1 and 2 with far more detail than is possible for us to do here. It will also give you a very good elementary knowledge of the entire subject.

Q. 3. We have a 32-volt storage battery house lighting system for house lighting. Can I use this on my receiving set?

A. 3. No battery is required for your receiving set.

Loose Coupler

J. F. E., Pittsburgh, Pa., asks:

Q. 1. Is it necessary for me to build two loose couplers in order to receive wave lengths of 150 meters up to 3,000 meters, or would one loose coupler be sufficient without bothering with the dead end effect?

A. 1. Unless you desire the highest possible efficiency, one loose coupler will be sufficient for your needs. The amount of dead end effect will be small and will not cause a great deal of loss. If so desired you could sectionalize the coils by inserting one or more switches, but we would not consider this absolutely necessary. Unless you have a very small antenna it will not be possible for you to receive wave lengths as low as 150 meters without inserting a condenser between the aerial and the primary of your loose coupler. If you desire to receive wave lengths of 150 meters, your aerial including all leads should not have a total length of over 50 feet. Satisfactory operation may be obtained from aerials whose total length is 125 or possibly 150 feet if the series condenser above referred to is used.

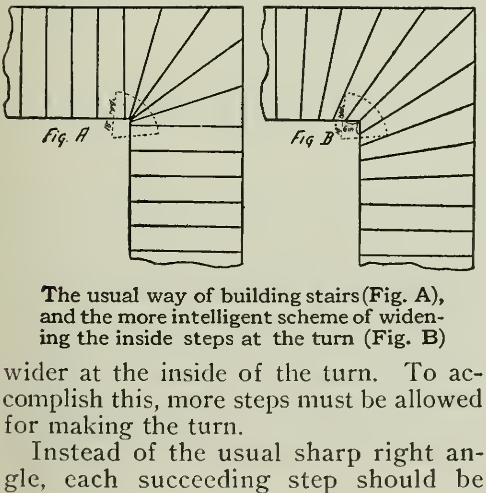
Q. 2. What number wire should I use to build a loose coupler which will tune to 3,000 meters?

A. 2. Wind the primary with No. 24 S. C. C. magnet wire, and the secondary with No. 26. The primary cylinder should be 5¼ inches in diameter and the secondary 4¾ inches. Both cylinders are 7 inches long.

The Home Workbench

Avoiding Dangerous Stair Turns

THE turn of an ordinary narrow staircase is so sharp and the steps at the inner part of the turn so narrow that a person in a hurry is likely to stumble and fall. The danger of injury can be considerably reduced by construcing the stairs with the steps



The usual way of building stairs (Fig. A), and the more intelligent scheme of widening the inside steps at the turn (Fig. B)

wider at the inside of the turn. To accomplish this, more steps must be allowed for making the turn.

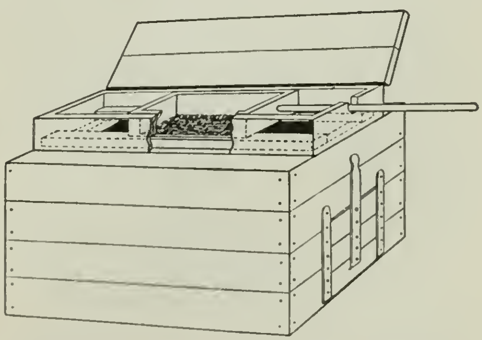
Instead of the usual sharp right angle, each succeeding step should be cut at an increasing angle, so that double the number of steps are required in constructing the turn. By a comparison of the two drawings, it is readily seen that the breadth of the step on the inside of the turn meant comfort and safety in a narrow passage.

A Dustless Ash Sifter

THAT unhappy Saturday morning task of the small boy—sifting ashes—may be brightened to some extent by a comparatively dustless ash sifter. Certainly, a device of this sort will be welcomed by the housewife, who listens with consternation to the grating sound of the ash-sifter, fully aware of the disaster that powdered ashes wreak on lace window curtains and polished wood work and furniture.

The dustless ash sifter consists of two boxes, one for sifting the ashes, the other for receiving the waste. The lower box is large, and fitted with a sliding door at one end for removing the ashes when it is filled. The upper box is nailed over a long hole in the top of the other, and is provided with a hinged cover. At one end of the small box a hole is cut to admit the handle of the sifter. The sifter, itself, consists of a flat wooden frame, made box shaped, from four narrow boards. It is open at the top and screened at the bottom.

The ashes are placed in the sifter, the hinged top is closed, and the handle is moved back and forth. Unusable ashes fall into the bin below; clinkers and unburned coal remain on the screen.



A packing box, properly adapted, becomes an excellent dustless ash sifter

An Outdoor Window Bed.

A CLEVER Los Angeles clubwoman has invented a window bed which can be used for several purposes. It may be used, for instance, as an attachment on a window, whereby a fresh air lover can sleep with his or her head out in the open (Fig. 1). The head is protected from mosquitoes in summer by a metal screen box fitting tightly over the head of the bed.

By making a few changes in the framework, floored tent or movable playhouse for children is erected. This can also be made 7 feet tall for adults, merely by extending the metal posts.

Figure 2 shows how the device can be converted into a flower stand outside the window and a table inside the window. In Figure 3 it is a plain bed.

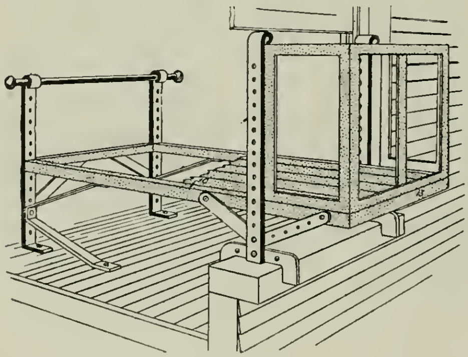


Fig. 1. Outdoor sleeping becomes simple without a sleeping porch

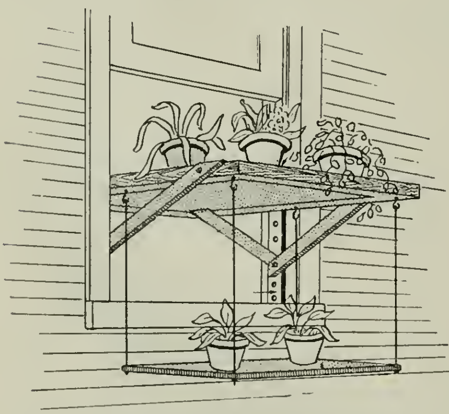


Fig. 2. In summer the arrangement can be used as a flower pot support

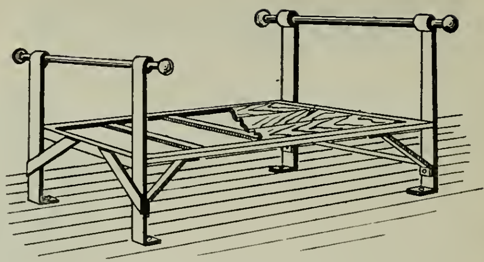


Fig. 3. How the arrangement becomes a plain bed

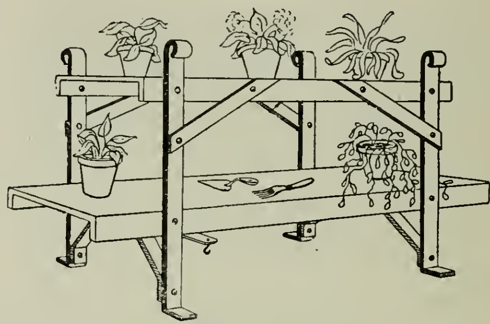


Fig. 4. The same piece of mechanism made into portable two-shelf flower stand

There are many further possibilities of this versatile bed as an elevated platform for travelling speakers, as a children's theatre stage, as a display stand for itinerant peddlers, and patent medicine men. For further outdoor uses it can be transformed in a few minutes to a portable two-shelf flower-stand (Fig. 4), or a lawn settee.

For the Amateur Painter

WHEN painting sash-windows it is very hard not to get any paint on the glass. Any attempt to wipe off the paint from the glass means wiping paint from the freshly-coated sash, too.

To remedy this take a cake of soft soap and rub it on the glass close to the sash, making a 2″ margin. The sash can then be painted without being careful about the glass. When the paint is dry wipe the soap from the glass and the paint will come off the glass, too.

How to Make a Simple, Automatic Window Closing Device

THE object of this device is to enable one to sleep in a room with the windows open during cold weather without the disadvantage of having a cold room in the morning. Briefly, it consists of an electro-magnetic latch which holds the window open during the night until at some predetermined hour, early in the morning, an alarm clock operates a switch in the latch circuit which releases the latch and allows the window to close.

The operation of this latch is as follows: When a current passes through the magnet winding (Fig. 1) the armature is drawn in toward the magnet which releases the hook. As the hook falls, the window no longer being supported, closes. It is, of course, necessary to fasten a weight to the window, or remove the window weights, so that when it is not supported by the hook it will close because of its weight. When the window is closed the hook remains in the position shown in dotted lines in Fig. 1. As soon as the current ceases to flow through the magnet winding, a spring (not in the drawing) moves the armature back to its original position. When the window is again raised the top of the ring striking against the hook carries it up with it until the hook automatically locks into position. The window will then remain open until a current again passes through the magnet winding.

The construction is as follows:

The yoke piece may be cut out of a piece of iron or cold rolled steel 2½″ x 1½″ x ¼″. Two pole cores of the same material about ⅜″ in diameter are riveted to this yoke piece as shown in the drawing. The magnet spools may be formed out of brass, or some insulating material, and wound with No. 20 B. & S. gauge single cotton covered wire. About 5 oz. of this wire will be required.

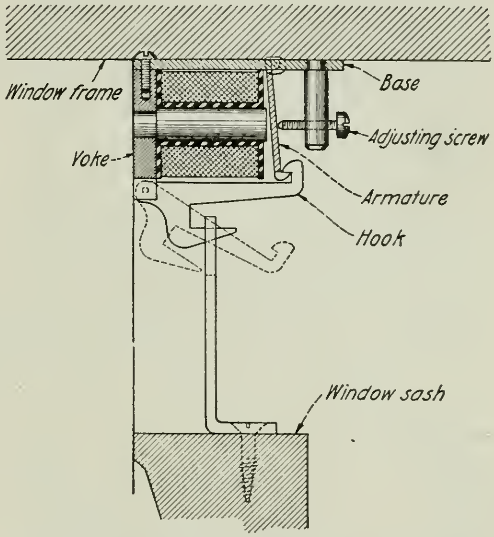


Fig. 1. The latch, showing its operation

The armature should be cut out of a piece of 1/16″ sheet iron and bent up at the top to form a bearing and at the bottom to form a support for the hook. The base, the hook, and the ring should be cut out of ⅛″ sheet brass. A spring must be provided to keep the armature over against the adjusting screw when the magnet is not energized. A suitable spring for this purpose may be formed by winding No. 23 B. & S. gauge phosphor-bronze wire on a rod 3/16″ in diameter. This spring may be supported on a rod between the two magnet spools. This spring support rod should be just long enough to keep the armature from coming into contact with the pole core ends when the magnet is energized.

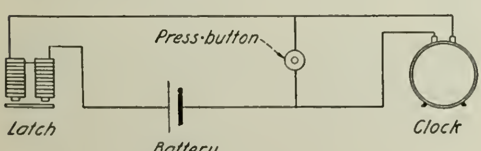
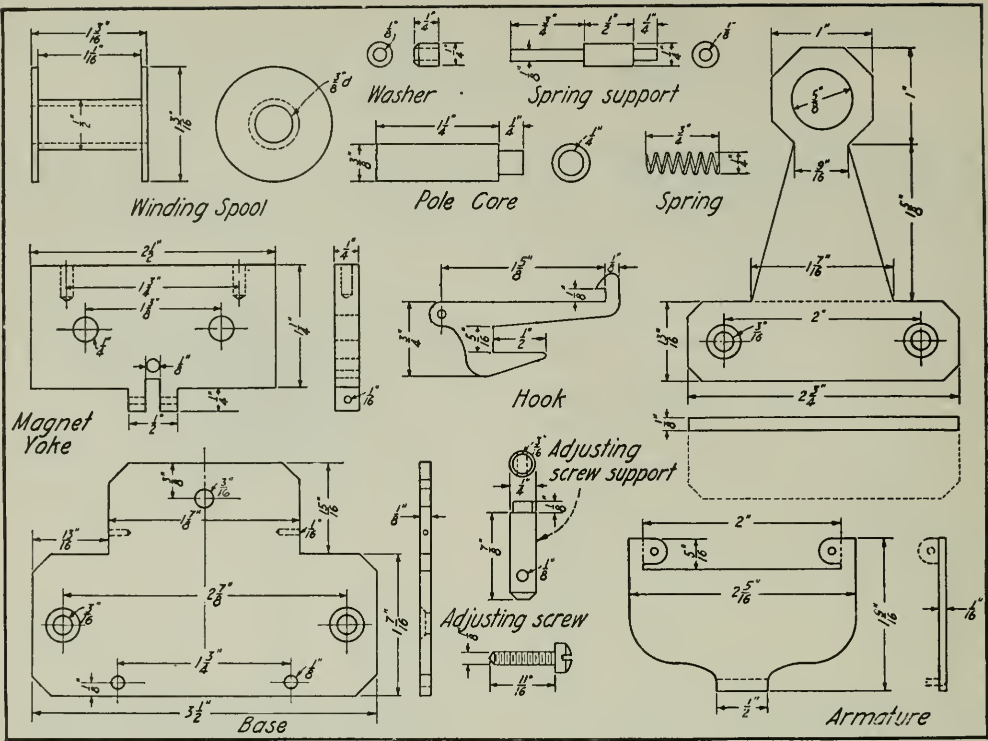


Fig. 2. Diagram of connections

For operating this device use an ordinary alarm clock, the only requirement being that it shall have an alarm winding key which rotates as the alarm rings.



Details of construction of window opening device

Two binding-posts are fastened to the back of the clock. One post is in electrical contact with the frame of the clock while the other is carefully insulated from it. A flat spring is attached to the insulated binding-post and bent into such a position that the alarm key will come into contact with it as it rotates. It is not necessary to wind the alarm up completely but only to give it a fraction of a turn so that in unwinding it will touch the flat spring in passing.

The apparatus should be connected up as shown in Fig. 2. One dry cell is sufficient to operate this device. A press button switch may be included in the circuit as shown in Fig. 2. This press-button is for use when it is desired to close the window at any time other than that for which the alarm clock switch is set.

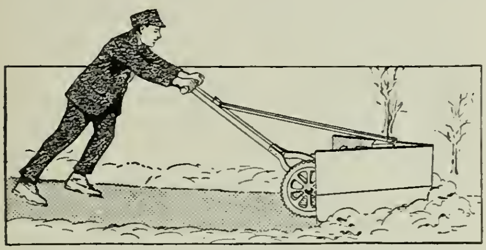
One alarm clock switch may be used to close any number of windows at the same time by simply connecting the magnetic latches on the different windows in series. It will, of course, be necessary to increase the number of cells in the battery if more than one window is to be operated.

For Conserving Heat in Steam Pipes

An excellent covering for steam pipes may be made from materials that are almost always available. Take some fine sawdust and screen it through a sieve to remove any foreign bodies. Prepare a thin paste of flour and water, and mix the sawdust thoroughly with this paste. With a small trowel, the mixture so prepared should be applied in about 5 coats to the steam pipes while they are slightly warm. Each coat should be thoroughly dry before the next is applied. If the steam pipes are in an exposed situation, 3 or 4 coats of coal-tar should be applied after the paste has dried; if inside a building, this waterproofing is unnecessary. Steam pipes treated with the sawdust as above lose very little heat and, in addition, the mixture is much cheaper than patented preparations.

How to Make a Snow-plow to Clean the Sidewalk

THE plow is built on a lawn mower, the blades of which have been removed. In the drawing the plow is made from a shovel. One of the halves is put on each side and brought to a point in front. The frame is made of one board about 1″ x 12″ or two boards 1″ x 6″.



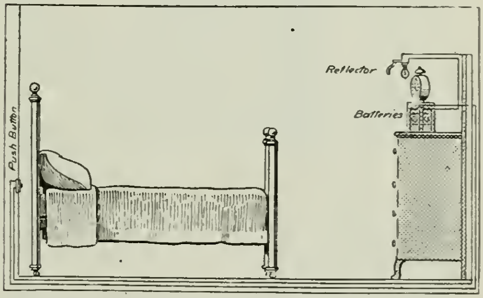
This snow-plow is made from a lawn mower from which the blades have been removed

As the sizes of lawn mowers vary, so will the plow have to vary to fit. The cross-bar is the width and thickness of the handle of the mower, and can be adjusted. It keeps the nose of the plow on the ground.

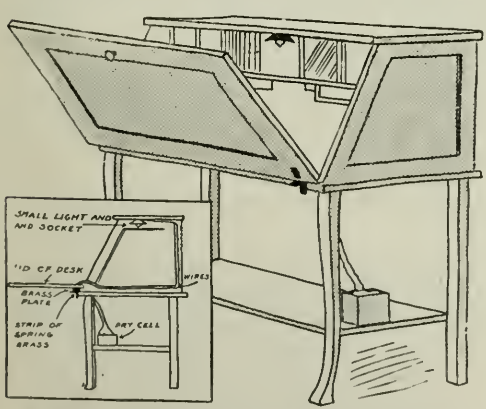
A Clock Light for Dark Mornings

A BOY of fourteen, who has had no instruction in electricity, and whose home in a little Iowa town has no electric service, invented the device illustrated. In this home, early rising is the rule, partly from necessity and partly from choice. In the winter time, when the days are short, he must rise before there is much daylight. This arrangement enables his father or mother to illuminate the dial of a clock and to see what time it is without getting up.

As the diagram shows, two dry batteries are connected in series and put into a little wooden box, on top of which the clock rests. To the back of the box is fastened a light bracket made of strips of soft wood. This bracket overhangs the clock, and to its underside is fastened a three-volt searchlight bulb in a minature base. From one pole of the battery a wire is run down behind the dresser, under the carpet to the bed, up one of the bedposts, to a height about a foot above the mattress. Here a push-button is attached. The return wire goes back over the same route, up behind the dresser to the lamp, and from the lamp to the other pole of the battery. Hanging in front of the lamp is a little piece of tin bent so as to make a crude reflector, at the same time that it serves to keep the light of the lamp out of the observers' eyes. By pushing the button the dial is illuminated, and the occupant of the bed can read the time without rising.



A push button beside the bed allows the boy to see what time it is without getting up



When the lid is lowered the switch automatically closes the circuit and lights the desk lamp

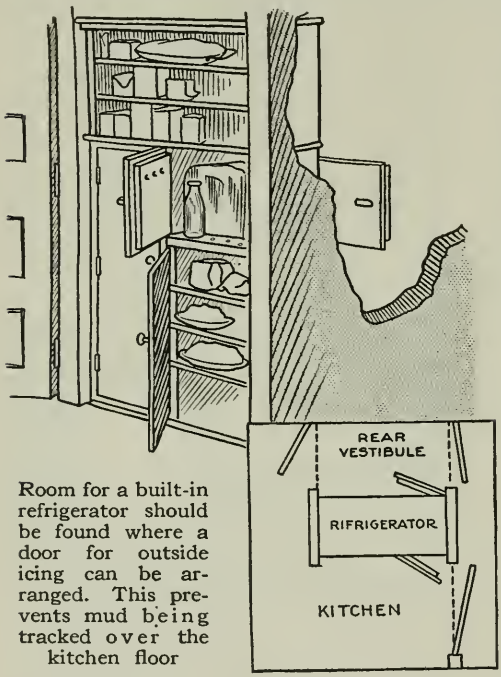
An Automatic Desk Lamp

A CONVENIENT automatic desk light may be easily constructed from two pieces of thin brass, a small light bulb with socket, and a dry battery. A piece of brass is screwed to the desk lid, as shown, and the other piece is fastened underneath it, so that when the lid is lowered the two pieces close the circuit to light the lamp. A switch may be placed in circuit so that the lid may be lowered without lighting the lamp. The wires are placed as illustrated.

Making Use of Cupboard Space for Refrigerator

THE location of a refrigerator in a certain home was an afterthought. No convenient space was available—apparently. The housewife tackled the problem and finally had a bright idea. There was a large cupboard built into the wall separating the kitchen from a small rear vestibule. It had large drawers beneath and shelves closed by doors above.

She measured the space occupied by



Room for a built-in refrigerator should be found where a door for outside icing can be arranged. This prevents mud being tracked over the kitchen floor

the drawers, and she and her son divided up the list of dealers in refrigerators, spending each half day in the search of an ice box to fit into the drawer space. Persistence was rewarded at last. A carpenter was hired to remove the drawers, cut the wall, and install the refrigerator, which was chosen with a rear icing door. The doors were also removed from the upper part of the cupboard and the shelves, now open are used for staple groceries.

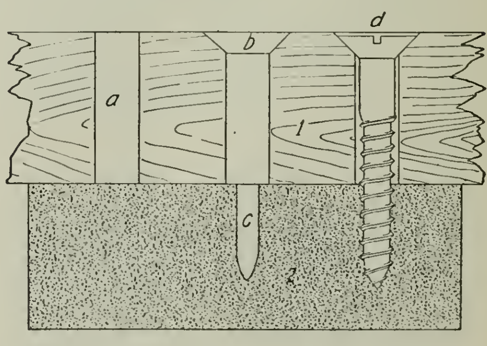
The location of the icebox is convenient in its relationship to the other working equipment of the room. The iceman can fill the box without tracking mud over the kitchen floor. If the family is away the two inner doors of the vestibule can be locked and the outer left open for the delivery. During the late fall and the winter the icing door is left open and the refrigerator keeps food well without ice, which would not be possible were the box entirely within the warm room.

Fastening Wood With Screws

WHEN the wood screw is used for fastening wood together, its functions are, firstly, to draw the pieces into close contact, and secondly, to hold them firmly. Driving a screw, as illustrated, is one of the simplest processes in woodworking, but until experience has taught the amateur better, he usually tries to force the screw through piece 1 by main strength or bores a hole so small that the screw must be turned in with a screw driver. In neither case will the screw draw the pieces more closely together than when the screw entered piece 2.

The hole at *a* should be large enough to allow the thread and the shank to be pushed through with the fingers, but not so large that the head of the screw will not have a good bearing at *d*.

It is not customary to countersink the screw hole in soft wood as at *b*, or to bore a hole in piece 2 to receive the thread as at *c*, as the screw head can usually be turned into the wood by the drawing of the thread in 2, until its head is sunk a little below the surface of 1 as at *d*. In hard wood the hole in piece 1 should be countersunk as shown, and a hole about the size of the core of the thread bored at *c*, in piece 2; if this is not done the screw may be twisted off



The correct way to use wood screws

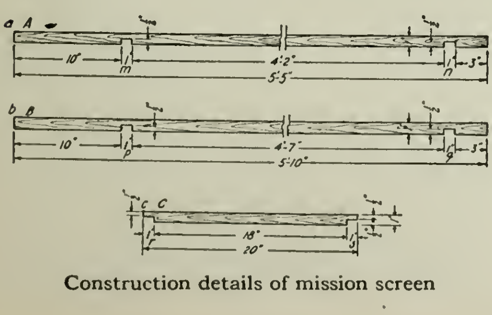
by the force applied to the screw driver, though if the screw is lubricated by being pushed into a piece of yellow soap it may be driven more easily; this is often necessary even if hole *c* has been bored.

To Make a Mission Screen

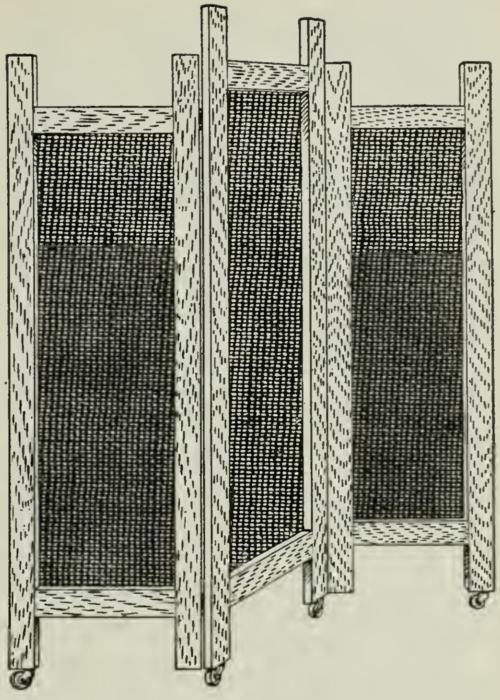
ALL the tools necessary for making a screen are a hammer, a few fine nails, a saw, plane, gimlet, rule and glue pot. The necessary material may be found at most sash and door factories or planing mills free of cost. They are: Four pieces like *A*, 2 like *B* and 6 like *C* in 1″ boards. If possible obtain pieces of the same wood, ash or elm being preferred.

If no work bench is available, nail a ½″ piece to the floor and by using this to keep the stick from sliding, plane sides smooth and sandpaper. Then take two pieces of *A* and the two *B's* and at *a* and *b* bore holes for the casters. Cut in all the *A's* and *B's* ½″ cuts at *m, n, p, q.* Then with knife or chisel break out the pieces and square the holes. Cut out the pieces in the *C's* at *r* and *s,* and smooth the openings. Next procure 2 pairs of suitable hinges and fasten one pair on each of the *A's* which have not the caster holes. Place the hinges on the face shown in the cut. When this is done, varnish or stain all the pieces thoroughly.

When the stain has dried, the pieces are ready to assemble. Take 4 of the *C's* and 4 of the *A's* and glue firmly; a few fine nails may be used, care being taken that the wood does not split. Then assemble the 2 *B's* and the remaining *C's.* When glue has set, put up the frame, put in the castors and stain or varnish again. When this is dry, a suitable cloth may be attached to this frame. This screen is cheaply made and if carefully built will serve the purpose of an expensive screen. One thing in which care must be taken



Construction details of mission screen



A mission screen easy to make

is the hinges, which must be on opposite sides, so that the screen when open must form a Z.

Seam Ripper from Old Safety Blade

A HANDY device for the housewife may be made from a safety razor blade. Cut a wooden handle 5 inches long. Bore holes to conform to the holes in the blade. Two screws, passed through the blade and the wooden handle will hold the blade firmly. This device will be found exceedingly useful to rip the seams in cloth while sewing.

To Open a Molasses Jar

TO remove the top of a honey or molasses can which sticks, the following will be found practical: Take a piece of stiff wire and bend it into a circle the size of the top. Put this around the top, and with pincers, twist till tight.

A Simple Ruby Light

IF a 220-volt carbon lamp of 32 candle-power is used in place of the ordinary 110-volt lamp, a dim ruby light will be obtained which will not injure negatives exposed to it in the dark-room.

A Combined Ice House and Cold Storage Room

AN arrangement of a cold storage room for keeping milk, butter, eggs, fresh meats and small fruits in combination with an ice-house seems to meet the requirements of many country houses. Where perishable articles are purchased or obtained elsewhere in quantities, there is felt a need for some cold storage place other than the ordinary ice-box, which after all, is intended chiefly for articles in use from day to day and is rarely of sufficient size to accommodate large quantities of food.

The ice-house must necessarily be filled in winter, and the trick of using the chilled air from the ice-chamber to keep a storage-room below cool through the summer is an economical one, for there is no great waste of ice. Ice is a cheap commodity in winter, but rather an expensive luxury in summer. Its waste in hot weather in taking it from the ice-house to the kitchen almost daily represents about thirty per cent of the whole harvest. The daily opening of the ice-house, which admits warm air, causes a rapid shrinkage of the supply.

The combination ice-house and cold-storage room eliminates, to a certain extent, this daily waste. Most of the articles kept in the kitchen ice-box can be retained in the cold-storage room until actually needed. Consequently, there is less transportation of ice to the house than by the old method.

So far as possible this combination house should be located as near the back of the kitchen as conditions will permit, for if made easy of access, it will be utilized to its full extent both summer and winter. As the storage-house is a few feet underground, easy steps must be built to reach it, and not steep, narrow or awkward steps. The ice compartment of the house is filled at the back so that as little muss as possible is created either in putting in or taking out ice.

The cost of building a combination ice-house and cold-storage room is one-third to one-half greater than that for a simple, old-fashioned ice-house, but in the end the extra investment is well paid for both in the convenience and greater saving of ice. There is another saving that is even more important. Many people living in country houses could reduce the cost of living by buying perishable articles in wholesale quantities, but through lack of proper storage facilities they cannot do so. Butter purchased by the tub or firkin in the season when prices are the lowest would alone represent a big saving. Meats can also be made a big item of saving by buying in quantities, not to speak of small fruits in their season.

With an ample cold-storage room, such as that illustrated, one could buy nearly all perishable articles by the wholesale and be sure not to waste any through deterioration. The saving in this way alone would more than pay for the extra cost in one year.

The foundation of the combination house may be built of rough stones up to the ground level, cemented firmly together, and lined on the inside with a coating of good concrete. All parts of the house below the grade should be waterproofed in order to keep the moisture out. This is very important, for it is quite essential that the storage room should be dry as well as cold.

In the center of the cold-storage room there should be an iron or wooden pillar to support the load of ice overhead. Likewise, the floor girders above should be extra heavy to support the tons of ice. The outside walls of the ice-house can be built of brick or stone, or even of wood, according to the style of the house with which it is connected. If wood is used the upright supporting-beams must be extra heavy—four by six at least—so that they will be strong enough to carry the load of ice. Ordinarily, the ice is carried on the ground, and the construction of the ice-house may be made very light, but in this case the ice is above, and the load is considerable.

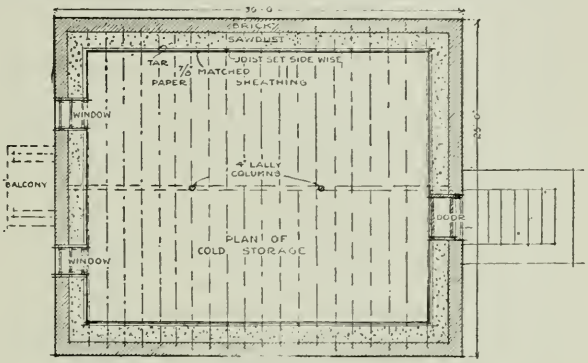
Another point that requires special emphasis is the necessity of building a water-tight flooring for the ice above. Otherwise the water dripping from the ice will leak through the ceiling and spoil the storage room. Also the ice must not rest directly on this flooring; otherwise heavy cakes when put in will destroy the waterproof lining. A platform is made of unmatched boards, supported on short joists laid on edge and nailed rigid with strips of wood. This platform should be strong and steady, but it must be arranged so that one can get under it easily when the ice is out. It will be necessary every autumn before putting in a fresh crop of ice, to clean the space underneath, examine the drainage-pipe, and look for leaks in the waterproof floor.

A good method to make this floor of the ice compartment watertight is to lay down rubber sheeting, and then nail zinc sheets down over it. The rubber strips make the joints watertight. The flooring must have a gradual slope toward the drainage pipe, which should be at one or more corners of the building. The laying of this waterproof flooring, and the installation of the drainage pipe are the most technical parts of the construction, for on their success depends the serviceableness of the storage room.

There is no sawdust or inclosed air space between the ice-chamber and the top of the storage room. This permits the chill from the ice to penetrate downward and keep the room below cold.

As the lower part of the room is underground there will be little chance for the temperature to rise in summer. The bottom and sides of the storage room, on the other hand, are well insulated either with sawdust or air spaces. One can take his choice in regard to filling the air spaces. Some find spaces of dead air between the walls just as satisfactory as layers of sawdust or any other filling. That is merely a matter of individual choice, although most of the big commercial ice companies still stick to the sawdust filling as the most satisfactory method of insulation.

Your storage room is thus inclosed on all four sides, and at the bottom with double walls either filled with sawdust or dead air, and with an uninsulated ceiling above. The chilling of the room from above is satisfactory, for the hot air naturally ascends, and the cold air descends. Of course, this produces a certain amount of waste



Ground plan of combined ice-house and cold storage plant

in the ice, but far less than one would imagine. When the room is once chilled the change in temperature is very slight. Little or no warm air can come up from the ground or through the sides, except through the window and the door.

To make the storage room serviceable it needs at least one or two windows on the side opposite the door, but these windows are double and have two sashes, which can be darkened at will with heavy shades. Between the double windows there is a dead air space, which forms a pretty good insulation against the outside air. The window can be opened on cold days just enough to get ventilation. Further ventilation is obtained by tubes that run through the walls on opposite sides. These ventilating pipes should be of a kind that can be closed from the inside at will, so that too much air may not be admitted.

This can be arranged very easily by having a cover to fit in the mouth of each pipe, so that it can be removed and easily cleansed at any time.

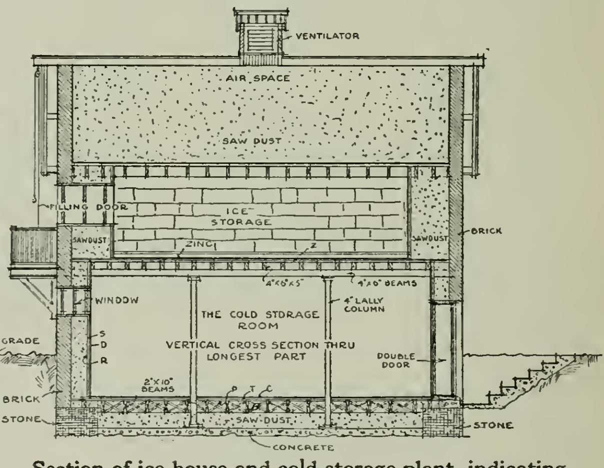
The entrance is through a double door. This is better arranged with an outside door opening outward and the inner door opening inward. A vestibule of a few feet between these doors is a great convenience and very economical. On a very warm day in summer one can then enter the vestibule and close the door behind him before opening the inside one. There is then no rush of hot air from the outside to raise the temperature of the room, an important consideration where one must enter the storage room several times a day. The mere admission of a current of warm air on a hot day may raise the temperature of the room several degrees, and cause the melting of a ton of ice in the course of the season.

The compartment above, in which the ice is stored is not very different from the inside of the ordinary ice-house. The ice must be packed economically and in regular layer fashion, and then covered with saw dust. There should be a ventilator in the roof. This is essential to the preservation and sweetness of the ice below. The filling door should be placed as high up under the eaves as possible, but not so high that there is no room for a block and tackle arrangement. This will facilitiate the handling of the ice enormously, and almost save the cost of one man in filling it.

With the house once constructed it is merely a matter of individual taste in dividing the storage room into compartments for keeping milk, butter, eggs, meats and small fruits. Any convenience of tables, shelves and bins that suggests itself can be installed later. The floor of this storage room is of cement, so that the spilling of any liquids will not cause damage. To keep the floor clean and sweet an occasional flushing with a hose will suffice. The drain for it should be at one side to permit the water to pass off quickly. But as a rule the room should be kept as dry as possible, since flushing the floor with water may cause an excess of dampness that will take days to evaporate.

The economy and convenience of such a combination house can readily be seen from the illustration. Ice for the house can be taken out from the back in the ordinary way, and that remaining in the compartment will be utilized at all hours for chilling the storage room below. There will be a little waste through melting in hot weather, but not to any extent. To offset this an extra ton of ice should be placed in the compartment each winter, and then the supply will last through the summer.

A combination ice and storage house of this character can be built from



Section of ice-house and cold storage plant, indicating construction of floors and walls

$500 upward, depending upon the size, cost of materials and of labor. A good size is 25′ square, outside measurements, which will give a storage room of at least 20′. If properly built and filled with ice, a temperature of 34° can be maintained in winter, and from 35° to 36° in summer, which is suitable for the preservation of practically all food products.

DRY batteries can be brought back to their electrical life for a time by punching holes in the zinc covering after having removed the cardboard filler, and soaking them in warm salt water.

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Forts on Rails to Travel Along Our Defenseless Coasts

A New York inventor, Lawrence Luellen, proposes the mounting of heavy guns on rails, to be run between concrete emplacements at suitable points. General Crozier, the foremost ordnance expert of the United States Army, has thought well enough of the proposal to sketch mountings for the guns. The guns can be quickly mobilized and used wherever an attack is threatened or actually begun. Any desired number of guns can be concentrated at a single spot—something which is not possible with permanent fortifications

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Railroad Forts That Go Where They Are Needed

A New Idea in Preparedness

WE have large cities, long coast lines and borders, also extensive areas that must be protected. It would be impracticable to fortify most of them by expensive fixed fortifications even though such fortifications were considered efficient.

The conditions of our roads, bridges and general topography of the country make it impracticable to move very heavy artillery rapidly, and we must look to the railroads both to transport heavy guns and to provide suitable bases from which to fire them rapidly and accurately.

The vastness of our areas, coasts and borders, demands that we have an extremely flexible as well as powerful land armament which can be operated by comparatively few men and used anywhere.

Railroads can mount twelve, fourteen and sixteen-inch guns for defense through a new invention patented by L. W. Luellen of New York, which makes it possible to protect with heavy mortars and guns our inland cities and five thousand miles of coast line, instead of the three hundred miles now protected by fixed fortifications.

Heavy guns are permanently mounted on especially constructed railway cars, which are to be quickly locked on solid concrete foundations for instant use, to secure accuracy and rapidity of fire control. These mobile armament cars are designed to utilize the present coast and inland railways to protect our seaboard, thus increasing the flexibility and strategic value of high-power guns such as are now mounted on fixed foundations.

Mr. Luellen would install at fixed points along existing railroads or at desirable strategic points, suitable concrete foundations, from which the highest powered guns may be fired. A specially-designed car will permanently mount high powered guns which may thus be swiftly transported to the point of attack, located on the foundations and brought into action.

These concrete foundations may be situated, at a very nominal cost, on main lines, spurs, or side-tracks, either singly or in groups, behind hills, in railway cuts and in secluded spots along the region it is desired to protect, as compared with the cost of placing fortifications at such points.

Should the enemy locate and obtain the range of one of the mobile batteries, the car can be quickly unlocked and moved to another location.

Present railroad facilities along the coasts of Massachusetts, Rhode Island, Connecticut, New York,—including Long Island—and New Jersey, are so located that ample gun foundations could be placed on spurs or side tracks so that any boat attempting to land must come within range of any desired number of guns. By properly grouping the concrete bases and placing one hundred and forty of them on the coast line mentioned, no landing party could reach the shores without coming within the deadly nine-mile range of six mortars.

These concrete bases would cost approximately three thousand to four thousand dollars each—total cost of one hundred and forty bases, including labor, about five hundred thousand dollars.

The mortar armament cars should be located at stations along the coast, where, upon an hour's notice, several of them could be moved into position for action.

It is estimated that to cover this shore line would require in the neighborhood of fifty mortars and ten rifle armament cars. This would mean that there would be one hundred and ten guns on mobile car equipment with total outlay (estimating the car and guns to cost one hundred and fifty thousand dollars) about nine million dollars.

Approximately twenty to twenty-five men would be required per car. Thus, for the cost of one modern battleship, we could equip these shores with new mobile armament containing one hundred and ten guns, which could be more accurately fired and which would be strategically more effective, with little risk of losing a single battery.

This is not the first time that railway forts have been proposed. The idea is at least twenty-five years old. The famous Creusot works of France about three years ago actually built a railway battery. How successful it was we do not know. Mr. Luellen has made a distinct contribution in suggesting concrete emplacements.

This hen stops at a hotel. Lady Eglantine, the prize egg-layer of history, is worth anything you please because she transmits her admirable proclivities to her progeny

Lady Eglantine: The One-Hundred-Thousand-Dollar Hen

A HEN whose value ranges all the way from $1,000, to a prince's ransom (whatever that may be), because money cannot buy her, recently attracted the crowds that frequented the poultry show held at the Grand Central Palace.

There was nothing about this clucking heroine to distinguish her from other white leghorns, and she is as modest in her fame as world's title holder as if she had not laid one of the three hundred and fourteen eggs that she deposited to her credit in three hundred and sixty-five days. Furthermore, she was bright and lively and exhibited none of the temperament that one reasonably looks for in any great *artiste*.

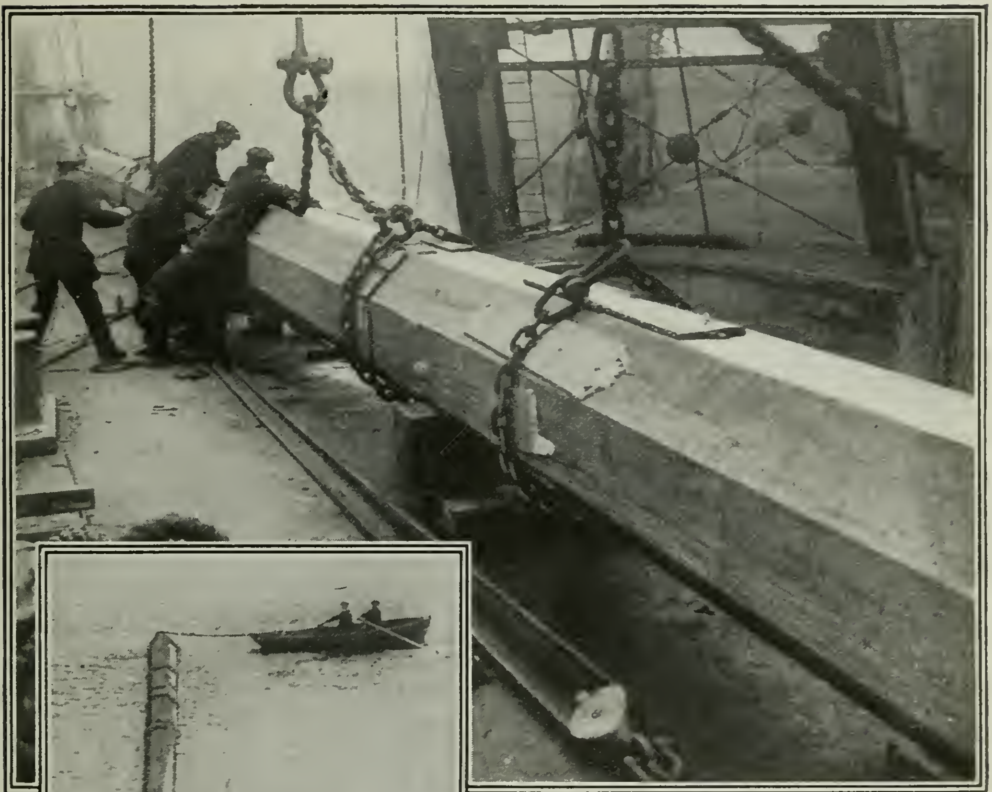
In the first place, and so that your understanding of this item of the day's news may be well based, the bird was hatched at Greensboro, Md., April 15, 1914, on the Eglantine Farms, run by A. A. Christian. She was one of five single-comb white leghorns placed in a pen at the egg-laying competition on the grounds of the Delaware Agricultural Experiment Station at Newark, Delaware, from November 1, 1914, to October 31, 1915. In this time she made her record. She is black-eyed, fourteen inches high and weighs four pounds. She has a perfect figure.

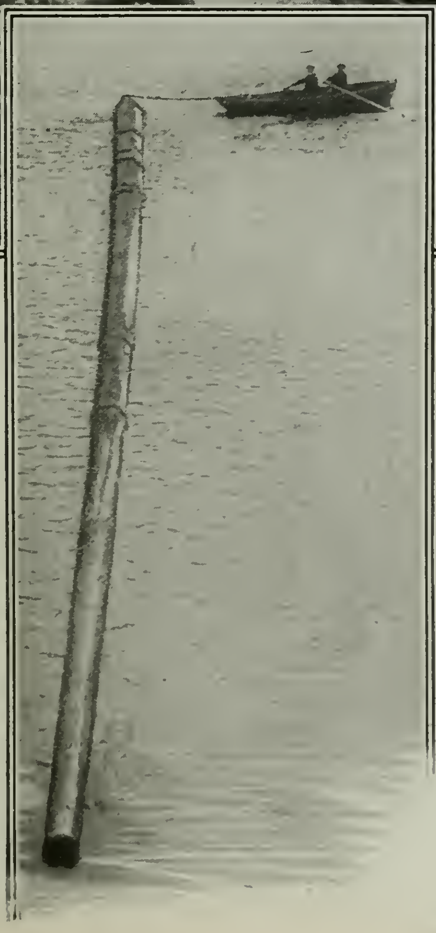
Mr. Christian was offered a great deal of money for Lady Eglantine but he will not sell her. No price, he says, will tempt him. When Mr. Christian's attitude on this became known somebody said the bird was worth $100,000, whereupon she was called the "$100,000 hen." But she might just as well be called a $1,000,000 hen, for nobody can estimate her value.

THERE was a large decline in the industry of mining precious and semi-precious stones in the United States during 1914.

The April Popular Science Monthly will be on sale Wednesday, March fifteenth (West of the Rockies, Tuesday, March twenty-first).

The World's Largest Flagstaff





Unloading the largest flagstaff in the world. This huge timber was brought to London from British Columbia, and is shown being towed up the Thames to Kew, where it will be erected in Kew Gardens

A HUGE log, two hundred and fifteen feet long, and weighing eighteen tons, was recently transported from British Columbia to London, to be erected as a flagstaff in Kew Gardens.

The transportation of this great timber across the ocean presented unusual difficulties. The pole was finally secured to the deck of a steamer, close to the rail, much to the discomfort of the ship's passengers.

Upon its arrival in London, a number of cranes, operating simultaneously, slid the timber free from stanchions and deck houses, and dropped it into the water, where a line was secured to its butt to tow it up the Thames River to Kew, where it will be erected.

The Giant Task of the Subway Diggers in New York

By Charles Phelps Cushing

IS there anywhere in New York to-night a cross section of street-life more dramatic in contrasts than the bit of Broadway in front of the Metropolitan Opera House? The Great White Way is gay, thronged, and glittering. The opera is just over; crowds in evening clothes, silk-hatted and the bejeweled, are pouring out to their waiting limousines. There, as in past years, the pageant of wealth parades—but this season with a difference. The sidewalk and the pavement of Broadway are now rough planks, and from below this rumbling floor the shrill tattoo of a drill resounds upon rock. Picture this cross section:

Above that plank floor, the silks and jewels and glittering lights; below it, in half-darkness, a squad of laborers in greasy overalls, stained with sweat and mud, risking their lives to build another subway.

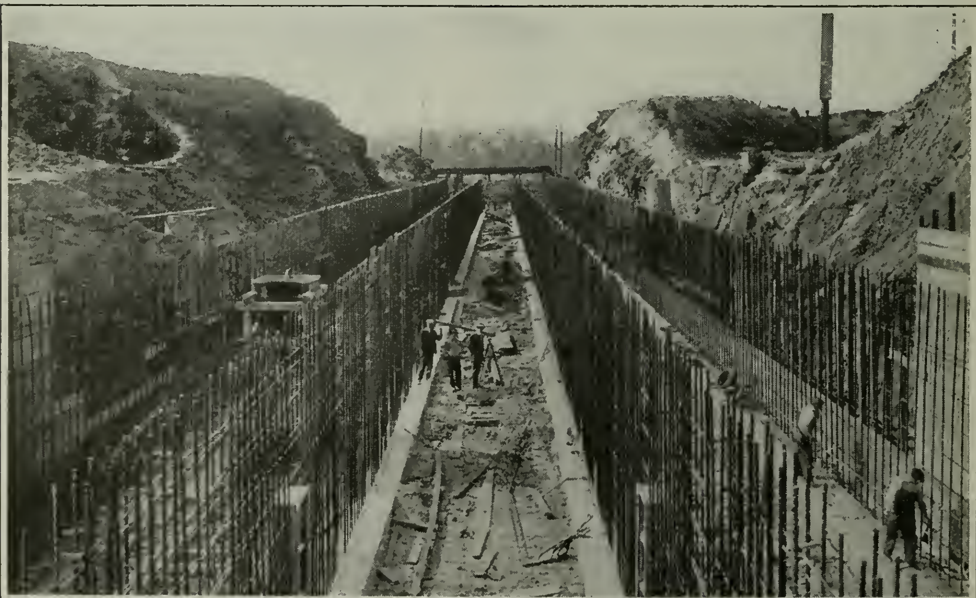
New York rarely gives a thought to its thousands of sappers and miners.

"Building another subway," it says. "Wish they'd hurry and get it over. They've torn up half the town."

So a khaki army in the subway trenches hurries, by day and by night, risking life and limb like soldiers. The peril of the job is a story in itself, not to be told in a paragraph. Suffice it, for the present, to say that only a few yards farther down the same street one person was killed and three persons were wounded a short time ago when a layer of "rotten stone" slipped into the subway ditch and half a block of the floor of Broadway followed it.

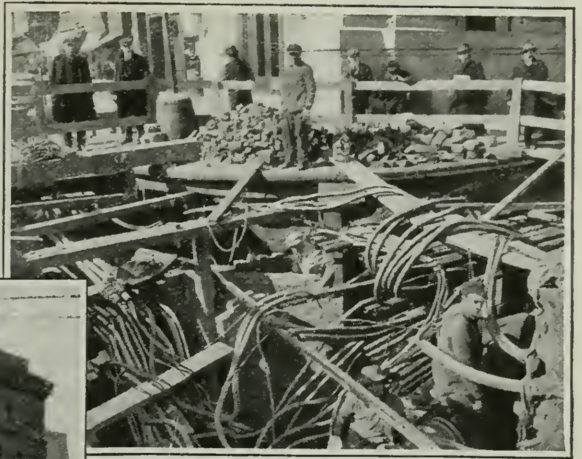
Transporting Three Billion People in a Year

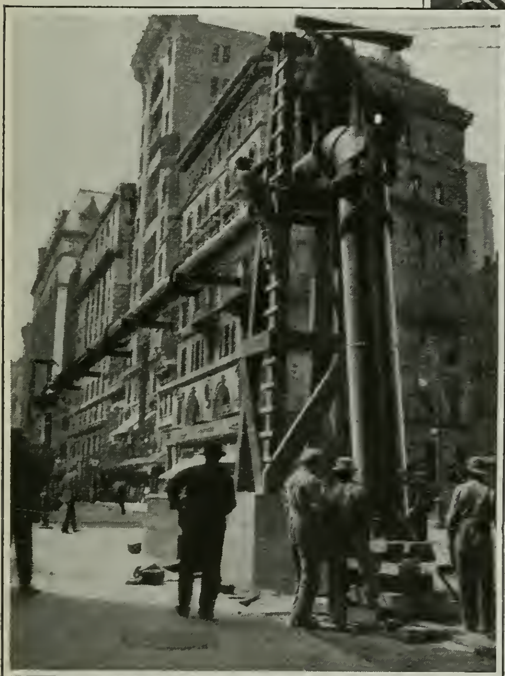
The average resident of New York has very little comprehension of the vastness of these great engineering operations. Is the human mind able to picture



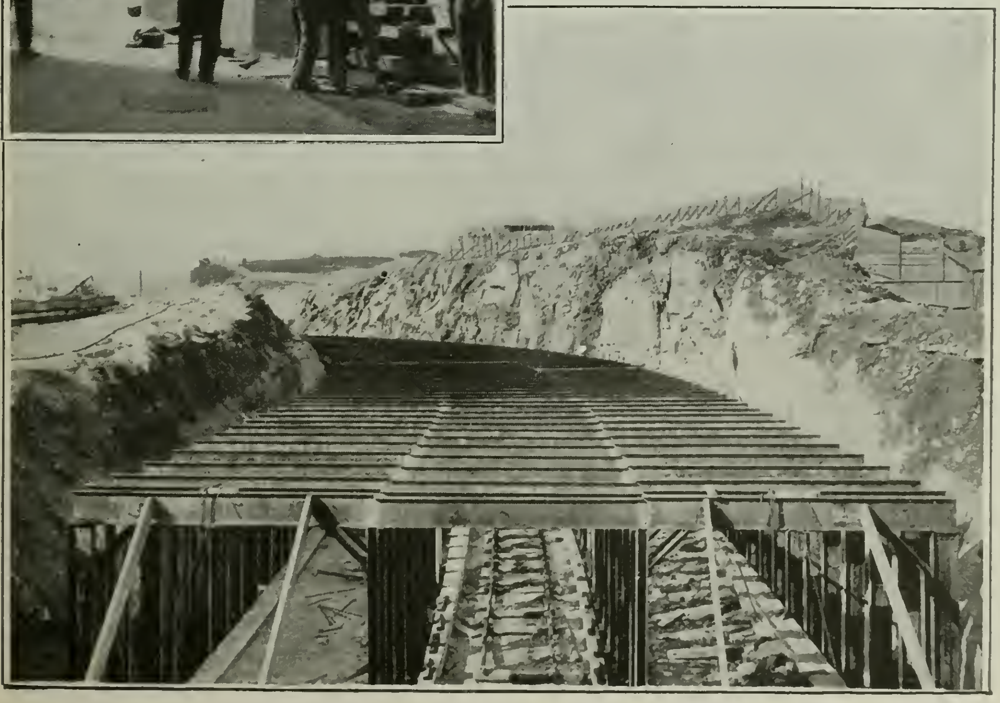
The simplest method of building a subway, known as the "cut and cover" method. If the entire length could be built with open construction, the engineers would have a comparatively simple task. The twisted vertical steel rods are the reënforcing members for the concrete walk

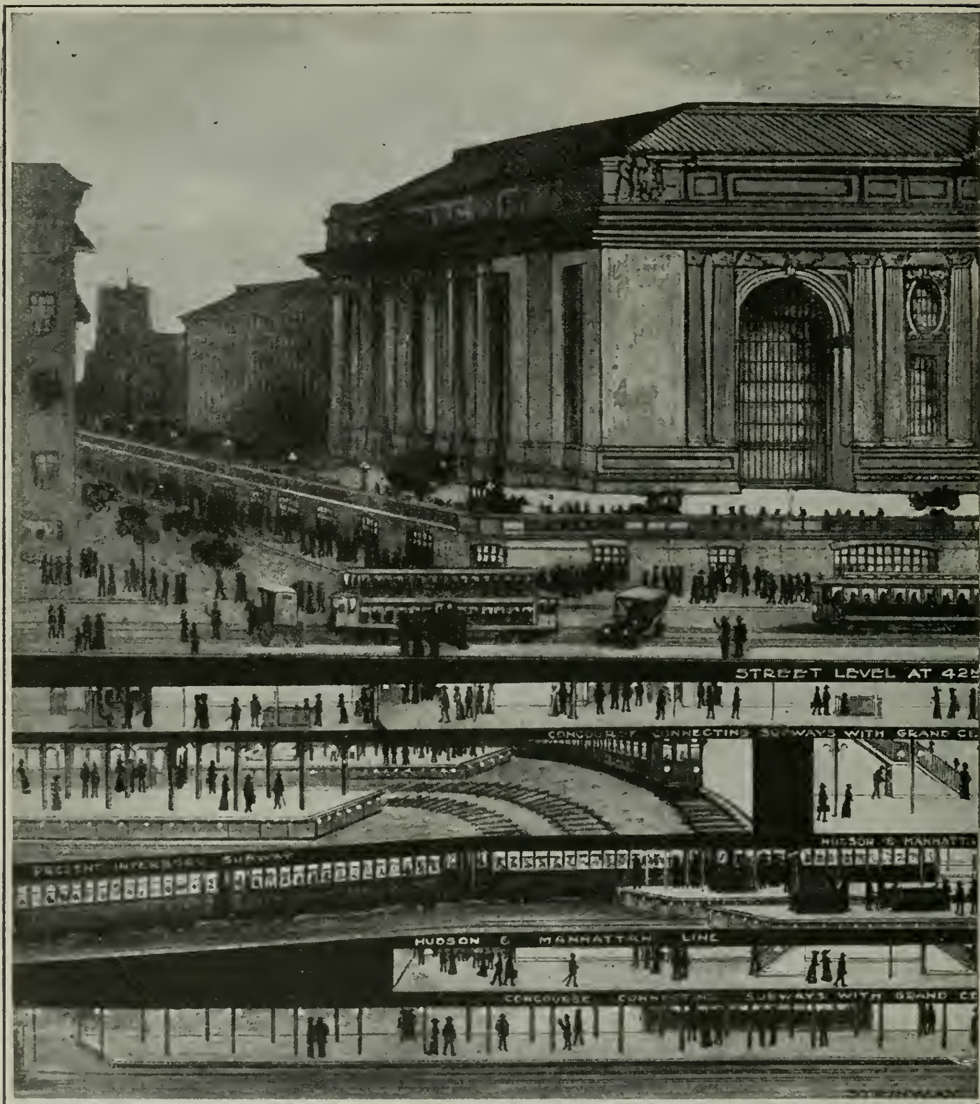
In the illustration below may be seen one of the many trestles which carry gaspipes across a torn-up street. After one serious explosion, New York put these pipes in the air where leaking gas would escape without danger of a catastrophe. The average cost of doing this is twenty-five hundred dollars; and where larger distribution mains must be handled, the cost runs as high as ten or eleven thousand dollars





The great tangle of pipes and conduits shown above must all be separated and placed within narrow confines, since they interfere with the progress of the tunneling. Great patience, as well as ingenuity, must be exercised in unraveling these tubes without accident. Below may be seen a section where open construction is employed. Many square miles of pavement have to be torn up to prepare for the digging operations. After constructing this part of the subway, the earth is again filled in above, new pavement has to be built, and the interior work is then completed

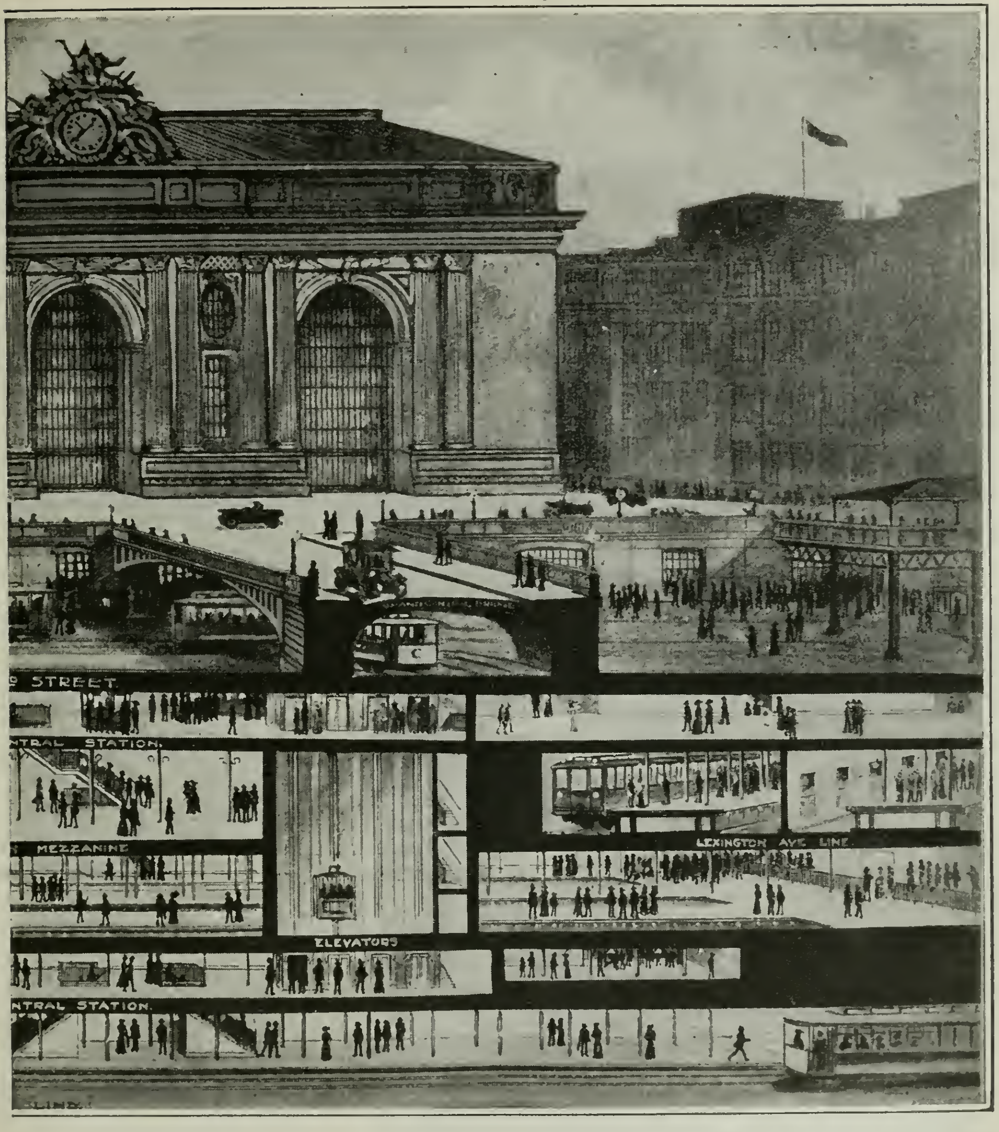




An engineering undertaking of tremendous difficulty. This honeycomb of tunnels at the Grand Central Station, at Forty-second Street and Park Avenue, New York, is being dug

eight hundred million people? That is the number of passengers the present system of rapid transit in New York (elevated lines and subways combined) can transport in a year. This carrying capacity is being increased to three billion! When the new system is completed it would stretch, in single track, from New York's city hall into the borders of Eastern Tennessee, some six hundred and twenty-one miles. The cost of the new lines and extensions amounts to three hundred and thirty million dollars, which is to say, as much as the government has thus far expended at Panama. No other urban rapid transit system in the world will compare with New York's in magnitude.

The new subways—in single track, the total amounts to more than one hundred and fifty miles of tube and trench—are the most interesting side of the construction now in progress; for this work is at once the most difficult and the most



through treacherous and rotten rock, and has to be built without disturbing the traffic in the present interborough subway, which is to be seen on the second level in the illustration

perilous. New underground routes are being driven through some of the world's most crowded streets, and without materially interfering with the traffic. Though the typical construction is a covered ditch with a roof which is only a foot or two below the floor of the street, there are many places where real tunneling and mining operations are required. The digging goes on under a variety of conditions: through underground swamps and watercourses, through treacherous rock, through sand and even through quicksand. At the south end of Manhattan Island two new sets of tubes are being driven under East River; at the north end a set of tubes was built on shore and then towed out into place and sunk on the bed of the river. In Lexington Avenue a new idea in subway building is presented in the form of an underground double-decker. At Grand Central Station the earth is being honeycombed into five levels.

The new local tracks beneath Lexington Avenue near 74th Street. It will be noticed how free the street is from serious obstruction. This system, extended in a single track, would reach from New York's city hall into the borders of Eastern Tennessee, some six hundred and twenty-one miles

These are some of the more striking features of the work; but even the matter-of-course features loom big when one comes to inspect them closely. To make room for the subways, the space just below the street level has to be vacated of all its various pipes. The expense of moving them is enormous. Take, for example, one item, the cost of relocating sewers. Sixty miles or more of new pipes are being laid. The bill for these changes comes to more than six million dollars. One of the largest of the diverted sewers is in the neighborhood of the Pennsylvania Station, at Seventh Avenue and Thirtieth Street. Now that a new subway is coming up Seventh Avenue, this sewer is being rebuilt to give outlet into North River—at a cost of five hundred thousand dollars.

Or consider the fact that while construction is in progress under the street, many gas-mains must be carried over the roadways on trestles. The average cost of doing this is twenty-five hundred dollars; and where larger distribution mains must be handled, the cost runs as high as ten or eleven thousand dollars.

Street-Cars and Wagons Carried on Dry-Land Bridges

Or, again, in accounting for where so many millions must be spent in building subways, consider that the engineers never vacate more than half of the roadway at a time, and that the street-railways overhead and all the stream of vehicles and pedestrians are literally carried, while the digging is in process, upon miles and miles of dry-land bridges. They are the longest bridges in the world, and bear as much traffic as the busiest in the world.

Then, too, hundreds of buildings must be shored up, for many of them are not built upon the solid rock; and rotten strata of treacherous stone must be braced to prevent slides. In a number of instances buildings had to be torn down. The famous old Astor House was one of these. It stood on sand at a corner under which a tube had to pass.

But one of the most ticklish operations of all is a section of new subway in William Street, where the underlying material is quicksand. William Street is a narrow winding lane of old downtown New York. It is barely forty feet in width between building fronts, and in the half-mile section where the subway is being dug (from Beekman Street to Pearl) it bears twenty buildings of from seven to twelve stories in height, and ten of from thirteen to twenty stories. When the digging was first proposed, owners of abutting property assessed at forty million dollars protested and carried the case into court. The Public Service Commissioners had so much confidence that the work could be done safely that they assumed responsibility for any damages that might result.

Building on Water

"The conditions encountered are unique," writes John H. Madden, Asst. Division Engineer, "in the number of large and heavy buildings, few of which have foundations to rock or hardpan, and with these exceptions all other foundations are above the subway subgrade and uniformly above water level as well." The subway's floor is, in general, three to five feet below mean low water; and below ground water level the material is swimming sand. "To guard against any possible flow of material into the subway trench, continuous bulkheads, either in the form of rigidly held, tight sheeting or concrete cut-off walls, will be introduced between the underpinning piers so as to form an integral portion of the latter and will be carried to such depth below the subgrade of the subway as to eliminate any tendency of the quicksand to flow under the toe and be released into the excavation." The total estimated cost of the section is two million, two hundred fifty-four thousand, six hundred and seventy dollars, of which six hundred and four thousand, five hundred dollars is for underpinning.

William Street is not the only place where the subway diggers have to be particular about building stanch floors and sidewalls. At Broadway and Canal Street an underground watercourse was encountered and a very heavy floor had to be built to resist the water's upward pressure. Pumps with a capacity of twenty million gallons a day were kept

One of the serious difficulties often met by the engineers. Underground water is seeping into the tunnel near the corner of Broadway and Canal Street so fast that a set of pumps removes twenty million gallons a day from this one spot. The flooring here is reënforced to resist the upward pressure of the water and quicksand busy for a while, discharging a volume of water as great as the daily supply required for a city the size of Atlanta. Care had to be taken, meanwhile, not to pump out sand along with the water, or the adjacent buildings would have come tumbling down, just as in a certain engineer's vision of the most effective way of destroying the city of Boston:

"An enemy need not bother mustering battleships or waste his time bombarding from afar the intellectual Hub of this land of ours. In time of peace let him have his spies build a big pumping station right in the middle of that city, and at the proper time start drawing indiscriminately from the ground below the water saturating the subsoil. You know a large number of Boston's big buildings rest upon floating foundations. Pump out the water in the supporting quicksand, and down those structures would tumble into the yawning cavities so created. It would be far more effective in its demolition than the projectiles of a hostile fleet!"

Up near the north end of Manhattan Island, at Lexington Avenue and One hundred and Twenty-ninth Street, the subway diggers had to construct another stout waterproof floor when they encountered what evidently was once a swamp.

We mentioned, in passing, the razing of the old Astor House, which was built upon sand. The tunnel which comes up Vesey Street and cuts under the site of the old hotel curves around into Broadway through big cylinders of cast iron.

Underground swamps and watercourses, sand, quicksand, sand mixed with boulders (as in Brooklyn)—all these the diggers encounter and vanquish. But what the subway builders fear most is something different from all of these: a material known to the geologist as Manhattan Schist and to the rest of us as "rotten rock." No material is more treacherous than this, for along with layers of extreme hardness are pockets and seams of disintegrated stuff, some of it so soft that, after it has been exposed a little

Under the old Astor House, which has been torn down because an underground swamp made it extremely hazardous to tunnel beneath the building. The illustration shows an underground dinner of celebration when a section of the iron tubes for one of the subway lines was completed. The arch of the big tubes shows in back of the posts at the left of the picture while to the air, it can be crumpled in the hand like earth.

When New York built its first subway, the engineers encountered some of this "rotten rock" in Park Avenue near the Grand Central Station. Serious slides resulted; houses caved in. And the builders of the new subways have not come off any more fortunately than their predecessors. Of several cave-ins the most serious recently was one in Seventh Avenue, near Twenty-fourth Street, where seven persons were killed and eighty-five were injured.

Try to conceive, then, how cautiously the engineers must work in building the Lexington Avenue double-decker subway and in tunneling the treacherous rock in the vicinity of Grand Central Station where (as an accompanying illustration tells better than whole pages of description could do) the ground is being honeycombed into five levels — this in the same perilous ground where the engineers first learned how gingerly they must proceed in a locality where the "rotten rock" literally abounds. And today an extra factor of difficulty must be confronted here from the fact that the operation of the present subway cannot be interfered with while the new tubes are being constructed.

Rebuilding and moving sewers to vacate space required for the new subways. The sewers alone mean an expenditure of from six to seven million dollars. The illustration shows a large tube making a new outlet for the sewer system emptying into the Hudson River. This outlet will cost the city half a million dollars. To the left of the picture is the magnificent new Pennsylvania Terminal

Following a blast, a slide of "rotten rock" knocked out the shoring of the wooden bridge which forms the temporary street, and engulfed a loaded street car, a large motor truck, and scores of pedestrians. Spectators said that the structure fell like a house of cards. The maze of gas pipes and electrical conduits added a grave danger, for a spark from the tangled wires would have exploded the leaking gas, and would have added many more names to the list of killed and injured.

On Saturday, of the same week, a section of Broadway fell in, endangering many lives. Fortunately, there were few pedestrians in that section of the street and only one vehicle, a taxicab, so that the casualties were few. But New York's confidence was sadly shaken.

Much of the danger of driving on snow is eliminated by the use of these skiis on the front wheels. They travel lightly over the snow, and by responding promptly to the wheel make skidding less likely

Motoring on Skiis

MOTORISTS who know the difficulties and dangers of piloting their cars through heavy snow, will greet with approval a new device which is claimed to make snow-driving safe, practical and comfortable.

Two kiln-dried white ash skiis are fastened securely to the front wheels, and carry them over the surface of the snow. In deep snow the full width of the skiis carries the load, while on a hard path only the steel guide runner touches the road. The guide runner also makes steering easy and prevents the skidding of the front wheels.

Does Your Child Suck It's Thumb?

IT is very seldom that we see a straight, well-formed mouth. Sometimes it is spoiled by protruding teeth, sometimes by a large overhanging upper jaw, generally we find the upper lip much larger than the lower. This is not, as might at first be supposed, a characteristic of the American people just as flat noses are a characteristic of the Negro race. It is due to one of the most unfortunate habits that can be formed in childhood — the sucking of the thumb.

The bones of a baby's jaw are extremely plastic, and subject to almost any amount of deformity by long-continued impact and strain. If even as soft an object as a thumb is placed in the mouth for any length of time, the inevitable result will be that the upper jaw and the teeth will be pushed out of place.

Many mothers are aware of the danger in making such a habit, and they resort to what they think is the next best thing — which is in reality the next worst thing— the pacifier. Imagine a bit of hard rubber and ivory in a child's mouth during all of its waking hours, and many times its sleeping ones. It is nothing more or less than an instrument which rapidly and skilfully dislocates the teeth and the jaws. A child should not be permitted to carry any object in its mouth aside from the rubber nipple of its bottle, and even here care should be taken to see that this is removed promptly after the feeding is over.

It is not easy to prevent the baby from putting its fingers into its mouth, as this is more or less of a natural inclination. In rare extreme cases it is necessary to tie the hands. Many parents put a bitter solution on the fingers which is sufficiently distasteful to break up the practice, but this is a doubtful procedure and one to resort to only by the advice of a physician.

PENNSYLVANIA leads all other states in the country in the use of steam power, using twenty per cent. of all that is used in the entire United States.

The wreck of the steamer "Socotra," on the Brittany Coast of France, lay in two sections, wide apart, and its cargo, dumped into the sea, was protected from pillage by armed guards

Steamer Breaks Back in Storm

DURING one of the heaviest storms of the season the Peninsular and Oriental steamer *Socotra* was blown ashore opposite Paris Plage, in Brittany, France, on a night during the latter part of November. In spite of the desperate attempts of tugs to tow her away from the dangerous shoals, she broke in half a few days later.

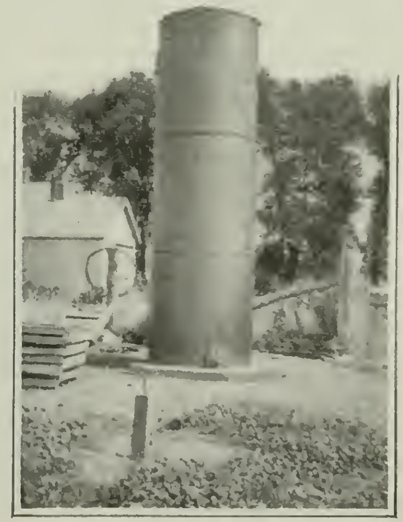
As soon as the ship was broken the packet freight with which she was loaded tumbled out of her cargo hold and was washed ashore by the waves. The local inhabitants immediately proceeded to pillage the valuable wreckage, but guards were soon called to the scene, and they remained on duty until the entire contents of the ship were safely removed.

It can be seen from the photograph that the *Socotra* was broken a few feet forward of the engine, the two halves being forced several hundred yards apart before the storm abated.

An Old Boiler Used for Stand-Pipe

OLD boilers, like the one shown here, can be found in most every junk yard and can be obtained at a very reasonable price. One Iowa farmer bought an old boiler of a near-by City Council, transported it to his farm and set it up on a concrete base. He uses it for a water supply tank which gives him water under pressure in all departments of the farm.

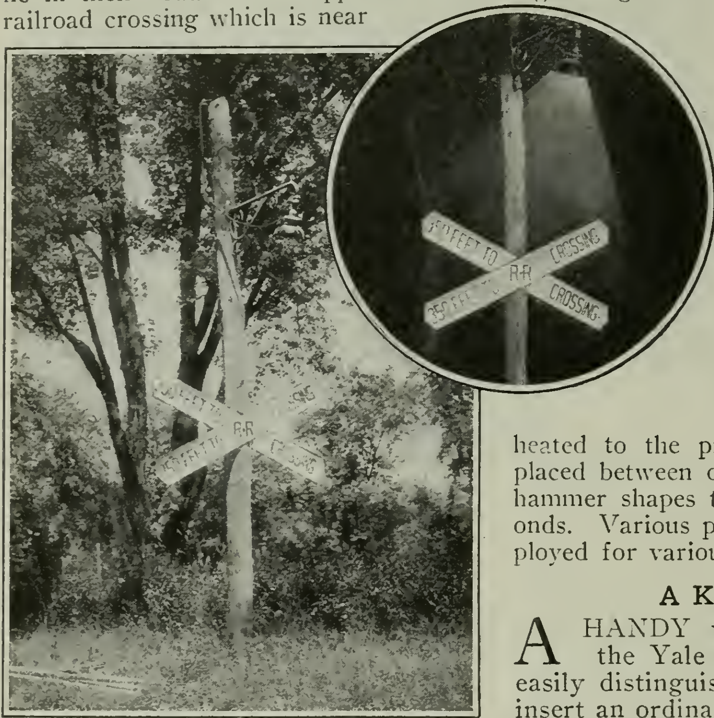
He took all the old tubes out of the old boiler and sold them for junk which paid him for hauling the outfit to his farm. The old boiler was given a coat of asphalt paint inside and out. During the cold winter months this Iowa farmer prevents the water from freezing by packing straw around it.



A farm stand-pipe made from an old boiler

Railroad Warning for Motorists

IN order that motorists who happen to be unfamiliar with the dangers that lie in their road on the approach to a railroad crossing which is near



Day or night this roadside signal guards the wary autoist against the dangers of a grade crossing

Lutherville, Md., a railroad company whose tracks run to that city has installed warning posts which can be plainly seen day or night. After dark, a powerful electric lamp behind a reflector illuminates the warning posts which can tells them that a dangerous railroad crossing exists three hundred and fifty feet ahead of them. The cross arms can be seen and read easily in the daytime, as they are placed in a conspicuous position. A bright red glass in back of the lamp, the conventional danger signal, makes the warning sign doubly effective. The scheme was devised by Walter R. Moulton, an illuminating engineer.

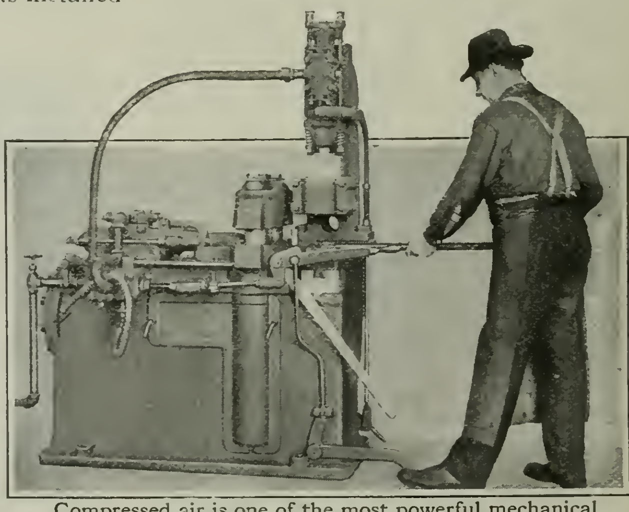
Sharpening Drills by Air

AT quarries and mines, one of the most time-consuming tasks is the regrinding of dull drills. Expert forges are required if the work is done properly. To obviate the large amount of time spent in this way, a pneumatic drill sharpener has been installed in some mines and quarries. It shortens the task of drilling to a fraction of the time formerly required when the job was done by hand.

The drill heads are heated to the proper temperature and placed between dies, and the pneumatic hammer shapes the head in a few seconds. Various patterns of dies are employed for various drill heads.

A Key Marker.

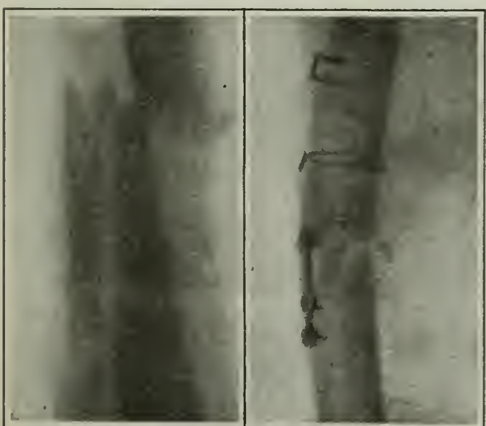
A HANDY way to mark keys of the Yale type so that they are easily distinguished in the dark is to insert an ordinary office paper rivet in the hole in the handle of one of the keys and flange it in the usual way with the punch. There is no mistaking the "feel" of a key so marked.



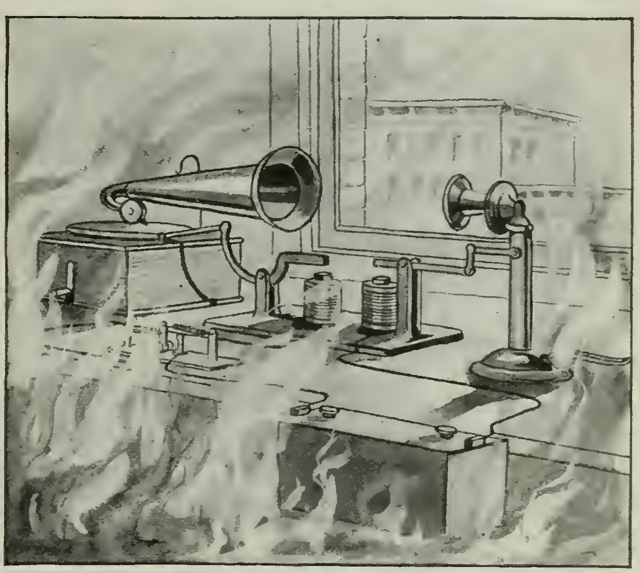
Compressed air is one of the most powerful mechanical agencies of to-day. Here it is harnessed to the job of sharpening rock drills

Mending Bones with Rivets and Wires

THE accompanying X-Ray photographs show the result of a nineteen hundred pound flywheel falling across the legs of a machinist who was handling it. The first radiograph, taken shortly after the accident, shows how the thigh bone was crushed and splintered by the heavy weight. Such is technically known as a "comminuted fracture." It was at first thought that on account of the splintering of the bone it might be necessary to amputate the leg, but a surgeon was found who undertook the splicing and reinforcing of the bone as shown in the second radiograph. This was made through a heavy plaster cast eight weeks after the bone was set. Three hours were required for the setting operation, the thigh bone being laid bare by an incision ten and one-half inches long. A vanadium steel plate secured to the bone by means of the screws bridged the main fracture, which may be clearly distinguished. The dark lines are silver wires which hold splintered pieces to the main bone. These fragments were removed, and holes to receive the wires were bored with a hand drill. Holes to correspond were drilled in the main bone and the pieces were then wired in place as shown. A wire passes entirely around the main bone (which was splintered down the center), and this serves to hold the two halves together. This wire is bronze. A vanadium steel staple holds the large middle piece to the bone below it.



Rivets, steel plates and silver wires helped to save this shattered leg



"Fire, fire, fire," loudly shrieks this phonograph into the telephone when the flames burn its restraining string

Something Is Wrong with this Unemotional Phonograph Fire Alarm

A FIRE alarm apparatus that calls "central," telling her in a calm, dispassionate, mechanical voice that the factory of Smith, Jones & Co., at No. 1 Jones Street, is in flames, and to please call the fire department immediately, is the proposal of an inventor in South Carolina. A phonograph, with its horn close to the mouthpiece of a telephone, is fitted with a record bearing the fire warning. The phonograph starts when an electro-magnet placed near it draws down the releasing lever.

The circuit of which the magnets are part, is closed by an automatic switch which is held open by a cord. A fire burns the cord, allows the switch to close, and "central" is promptly notified. But suppose a fire breaks out in the night and the operator fails to answer before the record is finished. What then?

A Giant Grinder Which Goes to Its Work

IF you have an axe to grind, it is no longer necessary to bring the axe to the grinding wheel, for a portable grinding wheel of full-sized proportions has been brought into the grinding field.

The newest thing in portable tools is a grinder which goes to the blade to be sharpened

Numerous small grinding equipments intended for light work have been introduced from time to time, but only recently has a man-sized portable grinder been a reality. A huge motor mounted on a three-wheeled truck supplies the driving energy to the abrasive wheel through flexible tubing. In operation when the speed has been adjusted to suit the needs of the workman, he grasps the handles of the wheel on either side and brings it against the object to be ground at any angle or any pressure desired. Grinders of this type are intended for use in foundries or in factories where there is a great deal of heavy abrasive work to be done.

For the mechanic who values convenience and neatness of work, this new appliance is well-nigh perfect.

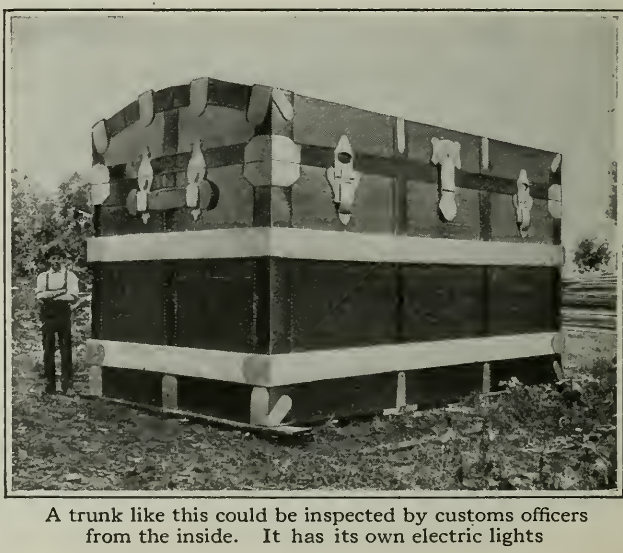
A Test for Baggage-Smashers

EXPRESSMEN who are accustomed to slamming trunks around like pasteboard boxes may not have to be cautioned to handle with care the baby elephant of a trunk pictured, for they will do well if they budge one corner of it. It was built in Fargo, N. D., and is eighteen feet long, ten and a half feet high, and ten feet wide.

To build this monster nearly two thousand feet of lumber were used as well as five hundred bolts, eighty-seven yards of canvas, ninety yards of lining, fifty-four pounds of nails, half a ton of iron, and ten gallons of paint and pastes.

The trunk is made in sections, and can be knocked down and stored under cover when not on exhibition. It is canvas-covered. The slats are made of planks; the corners and binding are of heavy iron and are bolted on. The lock is made of bronzed wood, so that it looks like brass. The handles are of wood and are covered with imitation leather. The trunk is wired for electric lights.

On the inside are a ten-foot showcase and two dray loads of trunks, bags, etc.

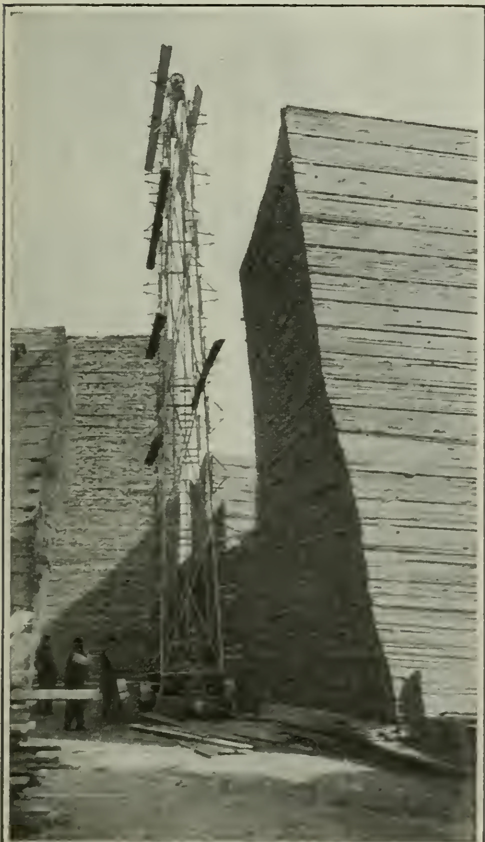


A trunk like this could be inspected by customs officers from the inside. It has its own electric lights

Piling Lumber in Forty-Foot Monumental Stacks

A MECHANICAL lumber - stacker which has recently been placed on the market has made possible a great saving in lumber yard space in our large cities. The *Edison Monthly* states that it is now possible to pile planks to the height of forty or more feet with a crew of four men, while in the past piles seldom reached a greater height than twenty-four feet.

The machine is electrically operated, and consists of a steel skeleton tower of the desired height, over which revolve two endless chains. Carriers are attached to these chains at short intervals. On these, planks are placed by workmen on the ground. Ten boards a minute are delivered by the carriers to the men on the top of the pile. One of these stackers is said to have piled one hundred and twenty-five thousand feet of lumber in ten hours.



This electric stacker will pile lumber forty feet high with perfect facility

This round barn is made of reinforced concrete, eight inches thick. The loft has neither beams nor posts

Circular Barn Built of Concrete

A PIONEER reinforced concrete, round barn, the first of its kind, and only one known to exist in the United States, has been completed on the farm of Harry McDaniel, near Dover, Del.

The barn is seventy-two feet in diameter and sixty-four feet high, the concrete walls being twenty feet high and eight inches thick, reinforced. It has a cupola five feet high and ten feet in diameter, with eight windows. It took thirty-one thousand shingles to cover the building.

The most remarkable part of the building is the loft, which has no posts, no beams, no girders of any kind. The loft has a capacity of about three hundred tons of hay. There is a circular track, thirty-five feet above the floor, used in conveying the hay to the remotest part of the loft.

The lower floor of the barn has thirty stalls for milch cows and eighteen stalls for horses, with a space in the center for twenty-five head of young stock. The building is two hundred and twenty-six feet in circumference.

ACCIDENT insurance is compulsory among the workmen in Holland, but other insurance is optional.

A back-yard swing and two hobby-horses made a new plaything for children

The Hobby-Horse Turned Into a Swing

A CHILD'S lawn swing with a hobby-horse for the chair, is the invention of a Missouri man (James W. Moore, of St. Joseph, Missouri). The hobby-horse is pivoted on a platform. It is connected with hangers, by which the platform is supported from the framework. The hobby-horse is rocked automatically by the oscillation of the swing, giving its juvenile riders a very agreeable thrill.

Lifting a Wagon to Dump Its Load

A NOVEL method of solving an unusual difficulty met by a contractor at Hamilton, Ohio, is shown in the accompanying illustration. Upon commencing his work he discovered that the gravel storage-hopper above the concrete-mixer was in an inaccessible location for the traffic. Owing to the street traffic there was no room for a gravel pile. It became necessary to resort to drastic measures.

When a gravel-wagon comes to the spot to discharge its load, the horses are unhitched and the wagon tongue is removed. Then a pair of hooks is attached to the front axle, and a pair of rings slipped over the hubs of the rear wheels. By means of a crane the wagon is lifted bodily over the hopper. Upon arriving at the desired location the driver pulls the dump lever and the load of gravel drops into the hopper.

A Shell That Melted Money in a Ship's Safe

ONE of the most telling samples of the terrific effect of naval gun fire is a piece of metal recently taken from the hulk of the famous German commerce destroyer *Emden*. This souvenir consists of a lump of metal which was smooth on one side, but on the other side resembling a piece of jagged rock. The metal consisted of a portion of the fireproof safe of the *Emden* and some silver coins from a drawer in the safe. The explosion of a shell probably blew some of the dollars into the steel, the heat fusing the whole into a mass of iron and silver.

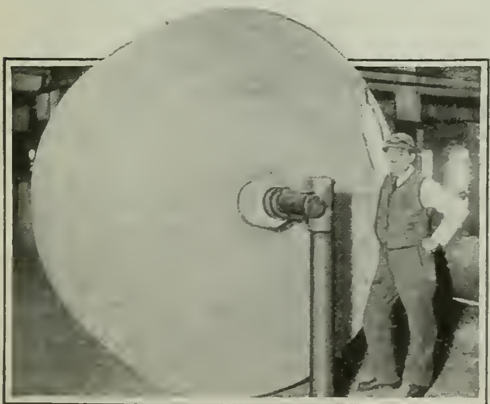
The wagon is raised bodily and its load dumped in the chute. The scheme saves shoveling or a conveyor system

This Belt Breaks All Records

A GIGANTIC conveyor-belt which has recently been installed in a California sugar refinery is said to have broken all records in the conveying of sugar. The belt is truly remarkable in size, being one thousand four hundred and forty-three feet long, thirty-six inches wide, and weighing nearly six tons.

In its operation this conveyor continually sustains a load of sixty bags of sugar, a total weight of seven thousand five hundred pounds. These bags are delivered to the belt every nine seconds and are carried to their destination at great speed, as the belt makes twenty-six complete revolutions every eight hours.

At the close of its service this belt will have exceeded the remarkable record established by its predecessor, which carried over two billion pounds of sugar before there were any evidences of wear.



A belt which is destined to carry over two billion pounds of sugar before it wears out

Delivering Mail by Aeroplane

IN his annual report Postmaster General Burleson has recommended the appropriation of fifty thousand dollars for the establishment of aerial postal routes. He has submitted a list of routes over which much time could be saved by delivering the mail by aeroplanes instead of by railroad.

The Largest Card Holder in the World

THE tree in the accompanying picture is rightly named when it is called "the largest card case in the world" for it is literally plastered with thousands upon thousands of cards of all kinds.

This is where you leave your card, with thousands of others, to record your visit to the famous California redwoods

The tree is one of many in the famous redwood grove of big trees in the Santa Cruz mountains and is about eighty miles from San Francisco. Each year finds the tree covered with a fresh coat of calling cards, personal cards, business cards and other cards too numerous to mention. Not only is the outside made use of but the interior, which, due to some forest fire in the past is hollowed out into a large room, is thickly covered with pasteboards.

The exposition at San Francisco attracted more people to the grove than usual and a close observation will reveal the cards of foreign ambassadors, ex-presidents of the United States, Senators and so on down to the scrap of paper placed on the tree by a passing "knight of the road."

Although there are dozens of trees many times larger than this one, it is the only one used as a card-case.

WHEN the new water system of Madrid, Spain, is completed, it is estimated that the supply will exceed two hundred and six thousand gallons per minute, and that, in addition, there will be a hydro-electric production of twenty-one thousand horsepower.

Three Slender Wires Form a Bridge

THREE wires make a bridge in Maine. It is probably the cheapest one ever made, if the good old subterfuge of a log thrown across a stream is excepted, but it is as serviceable as concrete for spanning the fifty-foot creek over which it does duty. The bridge was built by a Portland electric light company for the use of the patrol maintained over its high-tension power lines, which run across country. Twice a day it is used by this one foot passenger.

Three hours a day are saved by the man who patrols this part of the transmission lines into Portland. Before its construction it was necessary for him to make a long detour to a road bridge in order to cross the creek. The stream is deep and cannot be forded. The bridge came after several row boats had been stolen by tramps and small boys.

Short telegraph poles were erected on each side of the stream, above the high water line, and light cables strung across; two waist-high and one for the feet. The patrol can get across in fifty seconds, grasping two wires with his hands and sliding one foot ahead of the other on the bottom cable. After his first attempt the patrol reported that he would not use the bridge, because he was no tango dancer. The wires sway back and forth and impart a rythmic motion, terrifying at first. But after a few times the patrol liked the sensation. Now he invites others to tango across with him.

Cross this fragile bridge and you will be so engrossed with the problem of maintaining your balance that you cannot admire the scenery

A Trolley Company Which Repairs Automobiles Damaged by Its Cars

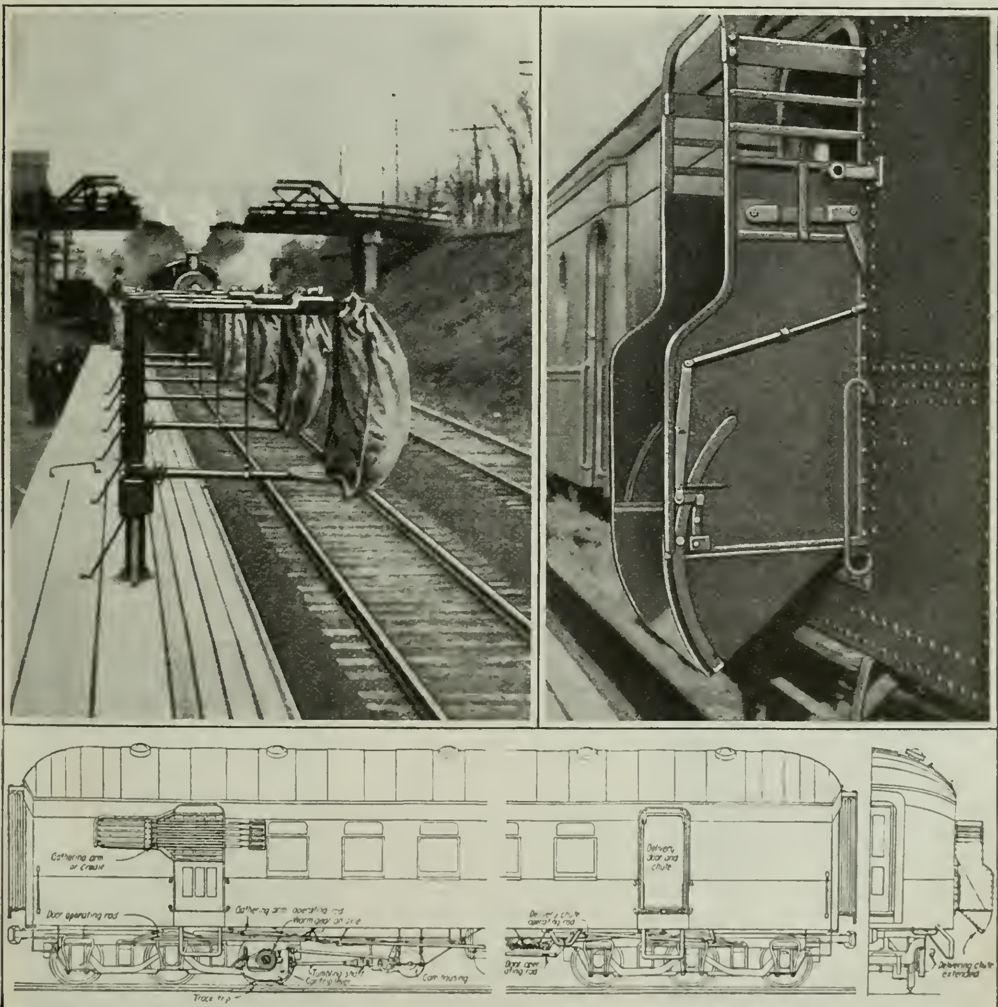
AN electric company which operates street cars in Iowa, finds it cheaper to repair motor cars damaged in collisions than to have the work done by an outside repair-shop. It is estimated that about fifty per cent of the expense of having this work done outside has been saved. Moreover, the practice is said to have gained the good will of those whose automobiles have been damaged. As it is, the company had a large number of cars in its own garage with a staff of repairmen. It was necessary only to add a few men to the regular staff to repair the damage caused by accidents.

Catching Mailed Eggs from Swiftly-Moving Trains

EGGS may now be delivered from a station platform and caught with ease and safety by the mail car of a fast-speeding express train, by means of an automatic mail exchange system recently adopted by a large western railroad.

This device works with great speed. When the train nears a station a lever on the truck of the mail car is operated by a track trip, thus setting in motion the system of cams which perform the functions of discharging and receiving the mail from the station.

A set of arms move out from the side of the car, and as the train passes, the suspended pouches of mail are caught by the arms and drawn into the car. Another cam, deriving its power from the car axle, picks up the mail pouches which are to be delivered at the station, and deposits them in a chute, where they slide into a trough on the station platform. This chute extends down until it nearly touches the platform, and the pouches fall but a few inches. They slide on the smooth surface of the trough until their fall is broken. As soon as the train has passed the station, the apparatus is automatically drawn inside the car and the doors are locked.



The much advertised delivery of eggs by parcel post has produced many patented devices for handling mail sacks without breakage. This one is already carrying eggs

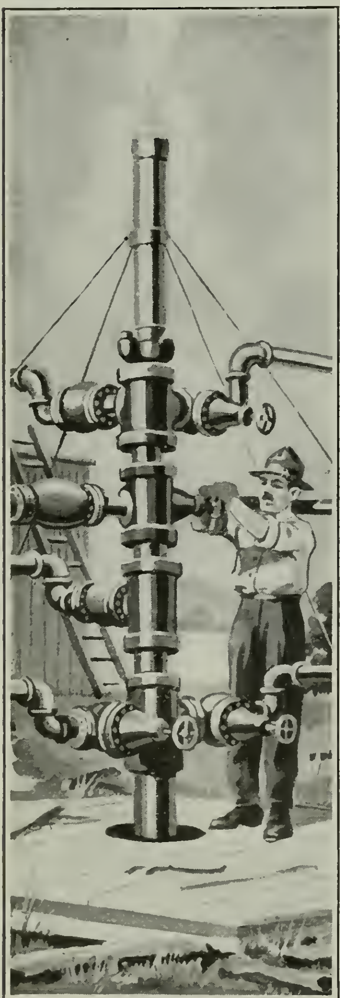
A Gas Well Which Wasted $200,000

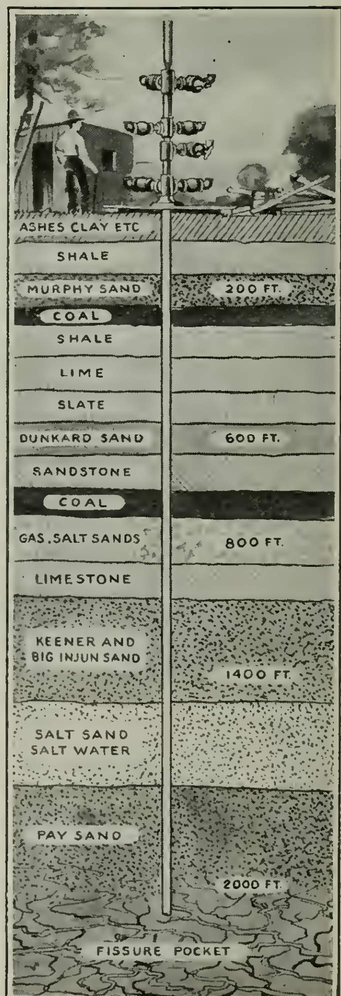
By Harry Knowlson

"BLOWING WILD" with a deafening roar for over a week and wasting upwards of two hundred thousand dollars of natural gas is the record of the largest gas well ever drilled in Pennsylvania. The Spiegel well—for it was named after the owner of the land—is in Versailles Township, near East McKeesport, Pa., that is, in the "Pittsburgh district," a section rich in "pay sand," which has produced several notable gas wells.

This remarkable gas well goes down into Mother Earth as straight as an arrow for two thousand feet. In that region geologists say there is a layer of sand permeated with natural gas. Once an opening is made in the earth's crust, the gas rushes upward with terrific force.

Between six hundred million and eight hundred million cubic feet of natural gas were lost before the well could be capped and the flow controlled. Almost immediately after workmen struck the "pay sand," the gas rushed forth with such destructive force that it demolished the wooden derrick used in connection with the drilling. Several laborers narrowly





The workmen who bored this well sent their drills down two thousand feet through ledge after ledge of earth and rock to tap the fissure pocket full of gas. When the pocket was opened, the gas, confined under those two thousand feet of earth and rock, burst out to the surface, demolishing the derrick and nearly killing the workmen. Over six hundred million cubic feet of gas escaped before the cap was put on and its stop-cocks closed. The cap was of heavy steel, with six valves, all of which were of course left open until the cap was in place, when they were closed. The loss of gas before the process was complete was estimated at $200,000. Great care had to be exercised during the week that the gas escaped unchecked. No lighted matches or other flames were permitted within a great distance of the well. The family living near by were obliged to forego cooking and had to go to bed without light escaped being killed. Thereafter, for more than a week, the flow of gas continued unabated in quantity and pressure.

This gigantic "gasser" was capped eventually with a long piece of steel tubing, larger in diameter than that in the

The gas blew off at a pressure of one hundred feet per square inch three feet above the outlet

well, and having six valves on the sides and another on top. Of course these valves were left open while the tubing was being placed in position and made secure to the casing in the well, to which it was attached by threads. One at a time, the valves were closed until a pipe was fastened to each to carry off the gas to a reservoir. As soon as the pipe was attached to a valve that one was opened again, so as to relieve the enormous gas pressure. Thus the entire flow was harnessed and taken away for consumption in the neighboring locality and nearby towns.

After considerable difficulty and several unsuccessful attempts, a venturesome engineer finally succeeded in measuring the flow of gas. When a gage was applied a few days after the well struck "pay sand" and the flow of gas was at its height, it was found that there were one hundred pounds open flow three feet above the outlet. And on this measurement the estimate of seventy-five million to one hundred million cubic feet of gas per day was based. The men on duty continuously suffered severely from earaches because of the terrific noise made by the outrushing gas. Fortunately, there was no electric storm or the well might have caught fire. Had this happened, the blaze could not have been extinguished. While the gas was flowing freely, the Spiegel family, living in a house within thirty yards of the "gasser," had to forego cooking and all went to bed at sunset because they dared not have a light.

The value of the lost gas was estimated at the Pittsburgh rate of thirty cents per one thousand. This means a daily loss of not less than twenty-two thousand, five hundred dollars. The actual value may be more, since higher rates obtain in other cities. Since the well ran for seven days and twenty-one hours before it was checked by capping, the minimum total loss was one hundred and fifty-seven thousand dollars. Others put it at close to two hundred thousand dollars.

Why Can a Fly Walk Upside Down?

YOU have seen a boy use what he calls a "sucker," a round, flat piece of leather which is soaked in water and flattened against a stone so that all the moisture between the stone and the leather is pressed out. He picks up a brick with a string attached to the leather. Since there is no air between the leather and the stone the atmosphere presses the leather so firmly against the stone that the stone can be picked up by the leather.

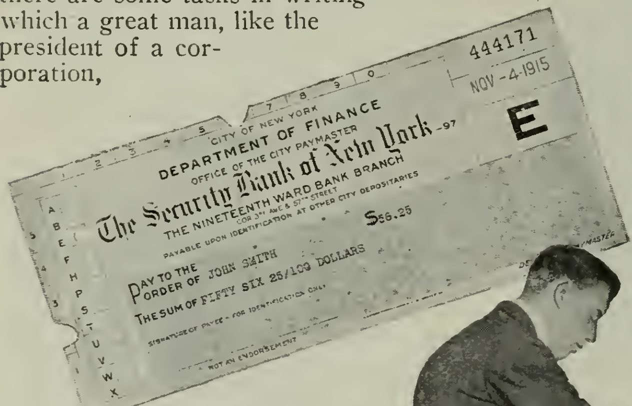
A fly has suckers on his feet which act very much on the same principle. As soon as he puts down a foot he automatically squeezes the air out between it and the surface upon which he is walking. The atmosphere, therefore, presses him against the ceiling or wall.

If you want further information about the subjects which are taken up in the Popular Science Monthly, write to our Readers' Service Department. We will gladly furnish, free of charge, names of manufacturers of devices described and illustrated.

Spending Money by Machinery

By Herbert Francis Sherwood

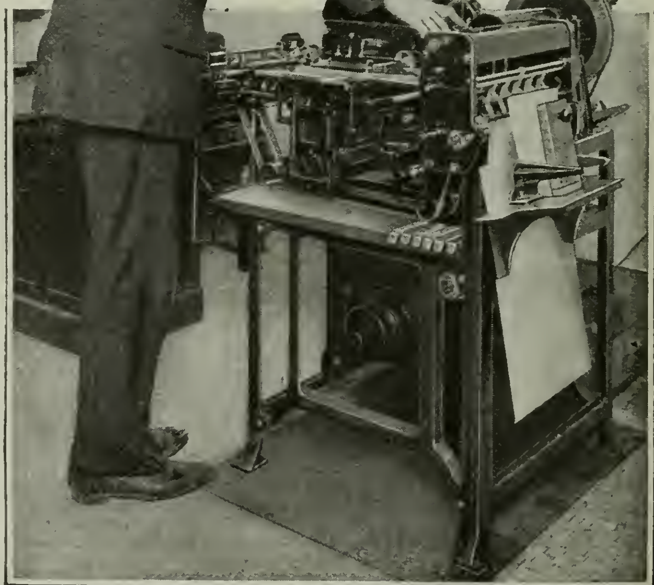
THERE were no commercial typewriters in Abraham Lincoln's day. The great President often wrote his letters himself. Even with the invention of the time and labor-saving typewriter, there are some tasks in writing which a great man, like the president of a corporation,



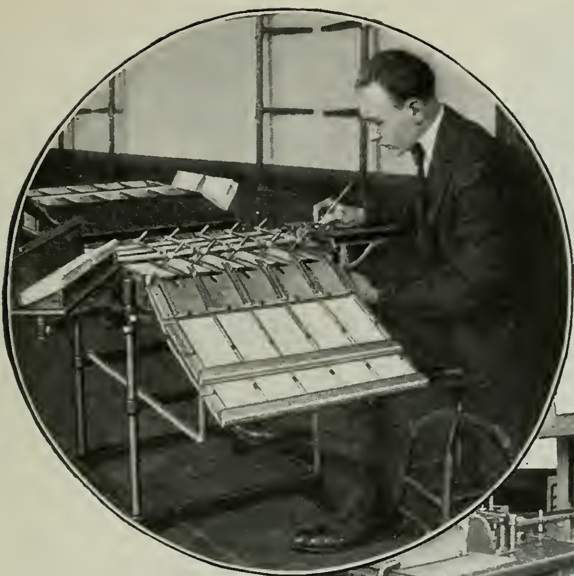
One of New York's new pay checks which are printed, filled in, and signed by machinery

could not well leave to subordinates and which were impossible of accomplishment on a machine. Such are the signing of checks and the signing of stock certificates and bonds. The average executive accustomed to the signing of papers, cannot, without fatigue, attach his name to more than twenty-five hundred in a day. In these times, when governments and corporations issue bonds representing millions upon millions of dollars, and have payrolls carrying thousands upon thousands of names, the task of signing a name in some cases has become an indescribable drudgery. Yet it must be done by responsible persons whose time is especially valuable.

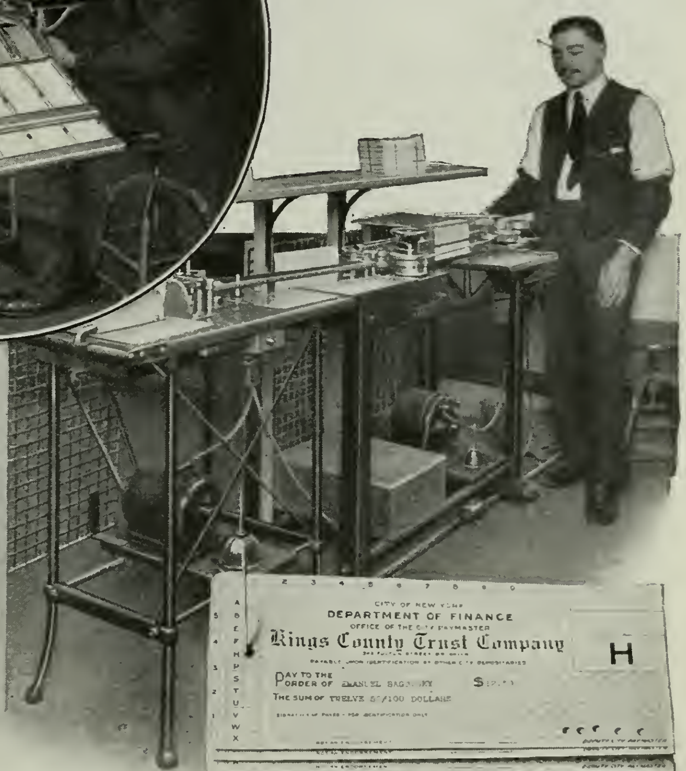
One of the greatest corporations in the world is the municipality of New York. It has more than ninety thousand emp oyees receiving more than one hundred and five million dollars in wages and salaries in the course of a year. In 1915 the finance department of this corporation introduced a method of filling,out pay checks and signing them by machinery, and thus saved seventy-five per cent in cost, and accomplished work formerly requiring more than sixtyoffice-holders.



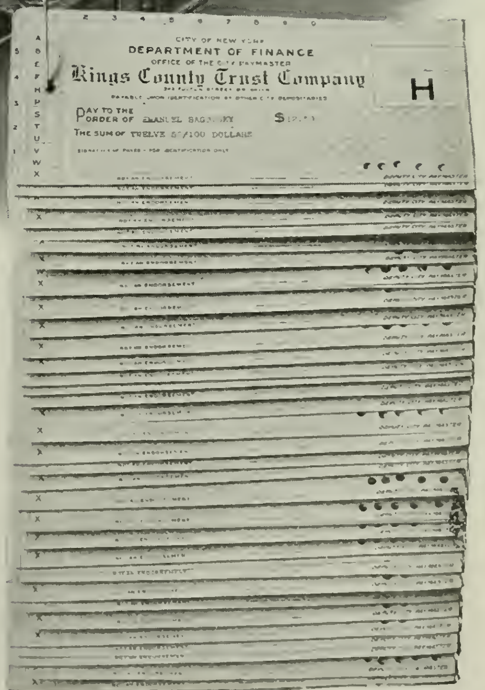
The electric machine which fills in the checks with the name and amount at the rate of seventy-five hundred an hour or about twenty per second



Ten fountain pens obey the impulses of the master pen in the operator's hand, and one man can sign twenty thousand checks a day



A machine for numbering and dating checks. The checks are carried forward in a vertical position by means of long belts



For each employee there is a type plate bearing his name. These plates are placed in a machine which can be operated by a clerk receiving $540 a year. The individual checks are printed with names and appropriate amounts at the rate of seventy-five hundred an hour. The machine is almost human. It stops automatically when the supply of check blanks is exhausted, or the reservoir of name-plates has been emptied.

The checks are numbered and dated in a container whose principle of operation is that of the machine used in cancelling stamps on letters in post offices. In order to make the checks valid, of course, they must be signed. This is done on a machine so designed that ten will receive the signature simultaneously. The penholder, which traces the signatures when grasped in the hand of the deputy paymaster authorized to do the work, rests on a ball bearing and is connected with ten fountain pens. With this device, a novice can trace twenty thousand signatures in a day without fatigue.

To photograph a spark like this is no feat of simple "snap-shot" work. It takes some preparation, but it can be done by any careful experimenter

How to Photograph Electrical Sparks

THE following experiments can be performed with a ¼″ spark-coil. The ordinary photographic plate is used in all cases, its size depending on the objects. The experiment is conducted in a darkroom or in a room lighted only with a ruby photographic lamp. Any white light will spoil the plates instantly. After exposing the plates they must be developed.

Take a small bottle with a wide mouth and fill it half full of any talcum powder. Over the mouth place a thin piece of gauze to act as a fine sieve. Tie the gauze around the neck of the bottle with a fine string. Place the photographic plate on a metal plate with the coated side up. Connect the metal plate with one of the secondary posts of the spark-coil. Sift a thin layer of the talcum powder over the photographic plate. Now place a very fine metal point in the middle of the plate (a pin is excellent). Connect the pin with the other post of the coil and make *one* spark, lasting one second or less. Wipe off the powder and the plate is ready for developing.

Trimming Veneered Edges by Electricity

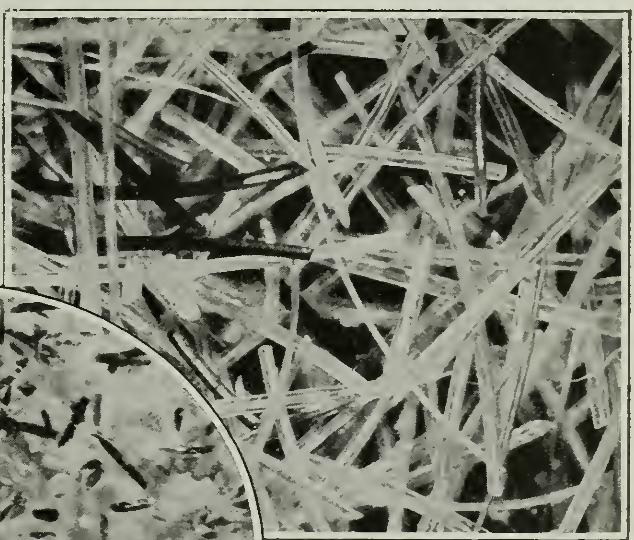
IT has been the custom to trim the edges of veneered work with a draw-shave or rasp, but this is always accompanied by danger of injury to the work. The importance of having veneered work perfect has prompted a manufacturer to bring out an electric-trimming device, which makes injury to the work impossible.

Built within an aluminum case, which protects the saw on all sides except the cutting edge, is an electric motor. This drives the special saw for trimming the veneered edge at very high speed and makes possible the perfect removal of the delicate wood and the glue as well. The saw is adjustable to any height by means of a screw, so that the veneer may be removed flush with the work or the edge extending to any desired height. Power is supplied from a lamp-socket.

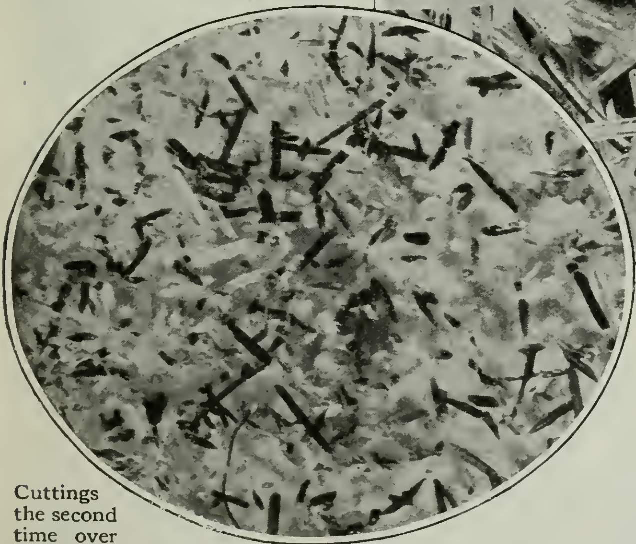
A boy can operate this electric planer (for it is nothing else). The concentrated power of electricity makes perfection easily attainable by the modern workman

Your Razor Is Like a Scythe

IF we had eyes like microscopes, the process of shaving would seem not much different from mowing with a bush-scythe. A razor is practically a miniature bush-scythe, and its cutting action is similar. Some of the bushes are cut squarely across and others at an acute angle. When the bushes are upright, and the scythe is swung directly against them, the cut is made nearly at a right angle. But if the bush man cuts his bushes a little too high and then wants to go over them again, "grubbing" them down to the ground, as he would phrase it, especially if the bushy stumps are in a marshy place where the ground does not hold them firmly, he strikes at them several times in succession, and the cut is likely to be more and more at a slant, depending upon the resistance with which they hold their own in the ground.



Microscopic views of the cuttings after shaving. The long hairs in the picture above are from a three days' growth of an Albino Irishman. Note that the hairs were cut nearly at right angles



Cuttings the second time over

When the barber applies a heavy coat of lather to a long beard, the lather tends to hold the hair upright. In the first shaving, the microscope shows that the cuttings are nearly at a right angle to the length of the beard, but the "second time over," when the call is for "a close shave, Mr. Barber," short rapid strokes are made, several times repeated. When the lather is off, the barber will occasionally wet his fingers, because the face gets too dry. Indeed, there is nothing to maintain the perpendicularity of the beard. It bends over and the barber rapidly whacks away at it like the bushman grubbing the bushes to the ground.

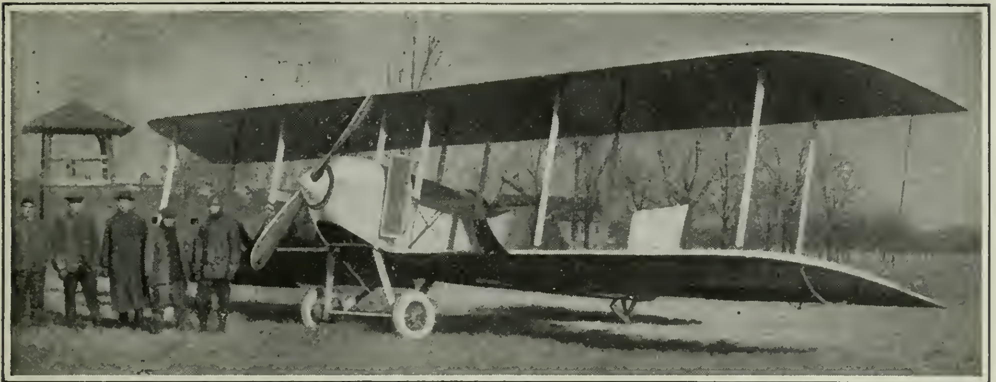
In connection with these views of the human beard, there is something very surprising in Dean Swift's "A Voyage to Brobdingnag," where he describes a mythical traveler to the land of the giants and what he had to say of giants' beards. He writes:

"I used to attend the king's levee once or twice a week, and had often seen him under the barber's hand, which, indeed, was at first very terrible to behold: for the razor was almost twice as long as an ordinary scythe. ....I once prevailed on the barber to give me some of the suds or lather, out of which I picked forty or fifty of the strongest stumps of hair. I then took a piece of fine wood, and cut it like the back of a comb, making several holes in it at equal distances with a needle....I fixed in the stumps so artificially, scraping and sloping them with my knife towards the points, that I made a very tolerable comb which was a seasonable supply, my own being so much broken in the teeth, that it was almost useless."

Hovering over the battle lines in Europe are battle 'planes of great size. The engines turn over slowly, giving the 'planes a lazy speed of sixty miles an hour. When a machine rises to fight them off a sudden transformation takes place. Powerful engines are switched on, and at tremendous speed the birds of prey rush to the battle, with their guns belching fire

Destroyers of the Air

By Eustace L. Adams



An all steel battle aeroplane, manufactured near Boston. These machines may revolutionize the aeronautical industry, since, with proper machinery, they may be stamped out in almost unlimited number. They will doubtless be models for pleasure craft

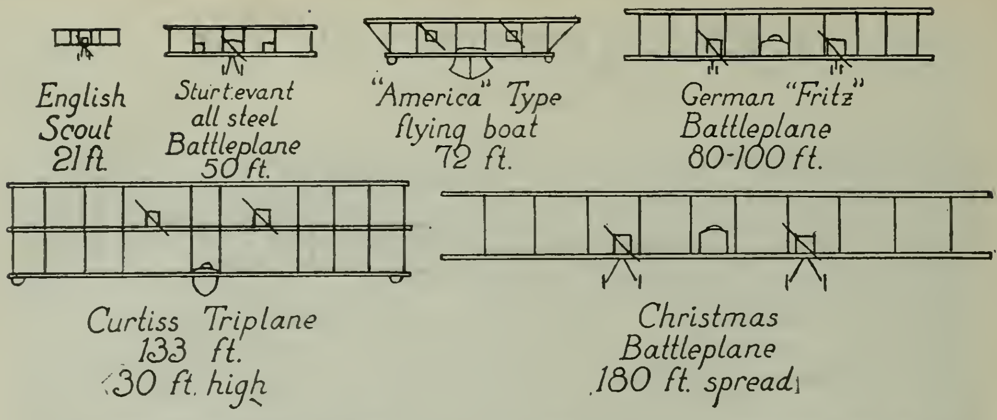
THE navy with the greatest number of super-dreadnoughts wins in a modern naval engagement. Since the launching of the *Dreadnought*, which gave the type its name, the nations of the world have been feverishly engaged, attempting to outdo one another in the building of great sea fighters.

The race for supremacy in dreadnoughts and super-dreadnoughts of the air is as keen at this moment as the race for supremacy on the water. Armies are finding that if they have no giant aeroplanes to drive away the armored battleplanes of the enemy they are fighting under an almost impossible handicap.

France, England, Russia and Germany have all developed their aerial dreadnoughts during the last year of fighting, and the development of the aeronautical industry has progressed the equivalent of many years during the last twelve months, measured by past progress. Those who have seen aviators "loop the loop" and break records at aviation meets and country fairs, can form but a slight conception of the huge machines now hovering over the battlefields of Europe. Giant aeroplanes, heavily armored, and carrying a crew of several men, ward off attacks with two or three guns, shooting high explosive shells in an aerial contest. They are capable of remaining in the air for several hours. Were they devoted to peaceful pursuits, they could carry mail and passengers almost with the certainty and regularity of an express train.

Although Americans have never seen these machines, this country is playing no small part in developing the battleplane of today and the aerial express of tomorrow. Two builders of aircraft in the United States are reported to be constructing aeroplanes which will be among the largest that the world has ever seen. The average exhibition aeroplane with which most of us are familiar measures about thirty feet from tip to tip. A company with factories in Washington is said to be manufacturing some aeroplanes which have a wing span of one hundred and eighty feet. Heavily armored with steel, and carrying a two-inch gun in each of its two fusilages, each great machine will be driven through the air by two motors developing sixteen hundred horsepower together.

Immediately before the outbreak of the war, the eyes of the world were upon a flying boat named the *America*, built for the first trans-Atlantic flight, but destined to cross the ocean in the hold of a steamship, to play an important part in British operations against enemy submarines. The *America* was one of the pioneers of the present battle-planes. Equipped with two motors, and with a comfortable cabin for the operators, this



Showing the growth of the aeroplane and the comparative sizes of the more important machines now in use or building. The first shown, the scout machine, is very little smaller than the standard size 'planes in use in the United States. Compare it with the others, and an idea may be gained of the great progress recently made in this infant industry

aeroplane was at the time a distinct advance over anything previously built. Under war conditions this machine proved so successful that Glen H. Curtiss is now building them at the rate of one every day.

The *Canada*, a land machine, was the next aeroplane of note designed by Curtiss. Machines of this type are all manufactured in a Canadian factory, and the plans are sedulously kept from the public. Reports from Canada indicate that these aeroplanes have an eighty-foot wing span, and are able to carry two guns and one ton of explosives. Trial flights made at the testing grounds have resulted in speeds but little under one hundred miles an hour, since the machine is equipped with two motors of great power.

The newest designs of Curtiss call for a triplane, with a wing span of one hundred and thirty-three feet. This great flying boat weighs, fully equipped, nearly eleven tons. When on the water it is driven by a propeller similar to those used on large motor boats, but when it is to be lifted into the air, the great power of its two heavy engines is transmitted directly to the aerial propellers, and the huge machine rises like a seagull. A crew of several men is sheltered by an ample cabin, and a number of guns project from the sides of the compartments. The speed of this craft is probably high, and its cruising radius, when fully loaded, should be about six hundred and seventy-five miles.

European War-planes of Huge Dimensions

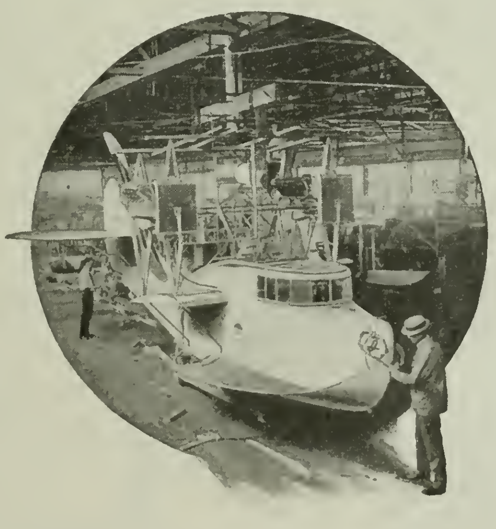
From the haze of the European war fronts come reports of aeroplanes which transport unheard-of weights for many hours, and which carry large crews to operate machine guns and cannon, but the censors have been remarkably successful in suppressing all definite news of these marvels.

Before the outbreak of war the Sikorsky biplane, a Russian machine of great size, had startled the world by making successful flights with seventeen passengers. Luxurious accommodations were provided for the guests, and meals were served in the air. This machine, while propelled by four Salmson motors of five hundred horsepower each, had the great disadvantage in war times of being slow, since it could fly but little more than fifty miles an hour. Little has been heard of this aeroplane since it was converted into a battle-plane, but it is certain that numerous machines of similar size and design have been added to the Russian aerial fleet, and that the speed has undoubtedly been greatly increased. The luxurious passenger compartments have been remade into cabins for gunners and bomb droppers, and gun mounts now take the places once occupied by comfortable chairs and dining

The Sikorsky biplane, the first of the aeronautical giants of to-day. Before the outbreak of war, this machine startled the world by making successful flights with seventeen passengers

tables, luxuries replaced by explosives.

With the exception of the Sikorsky biplane, the first reports that filtered into the press of both continents concerning aerial dreadnoughts was the appearance over the English lines of a huge German machine, which hovered at a great height over points of vantage, refusing to be driven away by anti-aircraft guns. The engines turned over slowly, driving the biplane at a lazy speed of sixty miles an hour. British aviators who rose to fight off this stranger were received with a hearty welcome. Powerful motors were switched on, and the machine flew to the combat at a tremendous speed. From the fusilage two guns blazed forth, and the hardy British were quickly driven to cover. For some time this machine held the supremacy of the air, and not until France and England built their aerial dreadnoughts did the odds again become even. As nearly as can be ascertained, *Fritz,* as this new machine was soon christened by the English, has a wing spread of between eighty and one hundred feet. In the central fusilage are mounted two heavy guns, and there are accommodations for two gunners and a pilot, with usually an observer to watch the enemy's lines. In two fusilages on the wings are two heavy motors, with the necessary room for mechanicians and engineers. The great power of the motors gives the battle-plane wonderful flexibility of speed.



Scene in the Curtiss factory at Buffalo. Mechanics are seen working on one of the many aeroplanes of the "America" type, which are being turned out at this factory at the rate of one finished machine a day

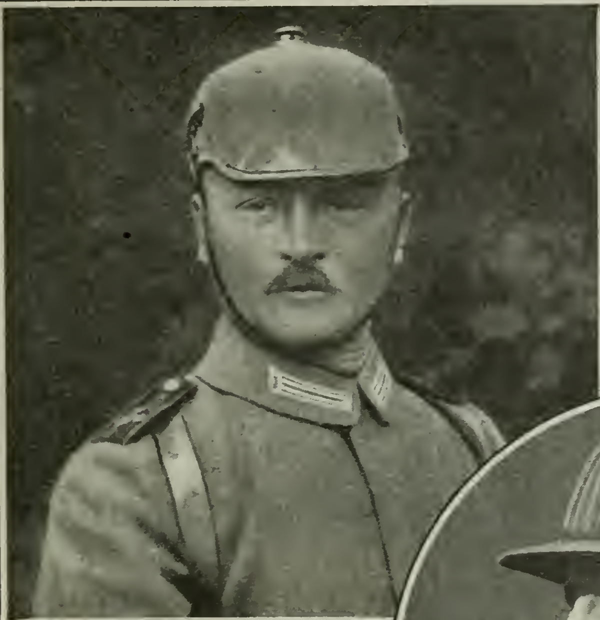
Unsubstantiated reports from Europe credit the Germans with a new triplane which carries a crew of twenty men, eight motors, and five guns, including an anti-aircraft gun throwing high explosive shells of heavy caliber. This super-dreadnought is said to be sheathed with armor.

(*Continued in the April issue.*)

Exit the Black Charger—Enter the Gas Mask

© Underwood and Underwood

The modern officer no longer dashes across bullet-swept fields on a snorting steed. In this war he gets orders by telephone and traverses the perilous gas-swept first-line trenches on foot. The hand-grenade at his belt is his surest weapon. In the oval is a naval turret captured in the German trenches in the Battles of Champagne.



The German spiked helmet of gleaming nickel was hidden, early in the war, with a gray cloth cover. Now the spike has disappeared, though the helmet itself is still of metal and still carries its cloth cover. The picture on the left shows the newest German officers' uniform, free from almost every distinguishing sign that would make the officers a special target for the enemies' sharpshooters

The British have adopted the steel helmet of construction similar to that of the French. It is now in general use and is shown to the right. Below are shown the new German uniforms for the Russian winter campaign, consisting of caps and overcoats of white slipped over the regular uniforms, making the wearers almost invisible against the snow over which they are now engaged in fighting

This dining table is not to be recommended on rainy days. The table and individual chairs have been cut out of the earth by French soldiers behind the trenches in their moments of relief from the strain of fighting. All's well so long as the sun shines

This picture continued on opposite page

Convalescent German soldiers who have been so seriously wounded that they will never be able to do heavy work, are being taught stenography and typing by government instructors. A large number of men are now employed in capacities requiring a knowledge of typing

Hobbling Prisoners with Their Own Trousers

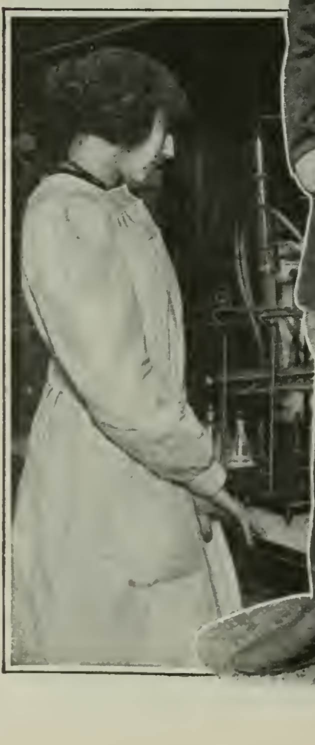
The scissors are mightier than the rifle. Instead of placing a heavy guard around these German prisoners, the French officer merely cuts off the suspenders of the prisoners' trousers and cuts out a "V" from the belt, making a running escape impracticable

This picture continued from opposite page

reduced by losses in the war, and by filling in their ranks with men who are fitted to do nothing else there will be an economic gain to the country as a whole. The illustration shows one of the classes practicing upon batteries of hundreds of typewriters

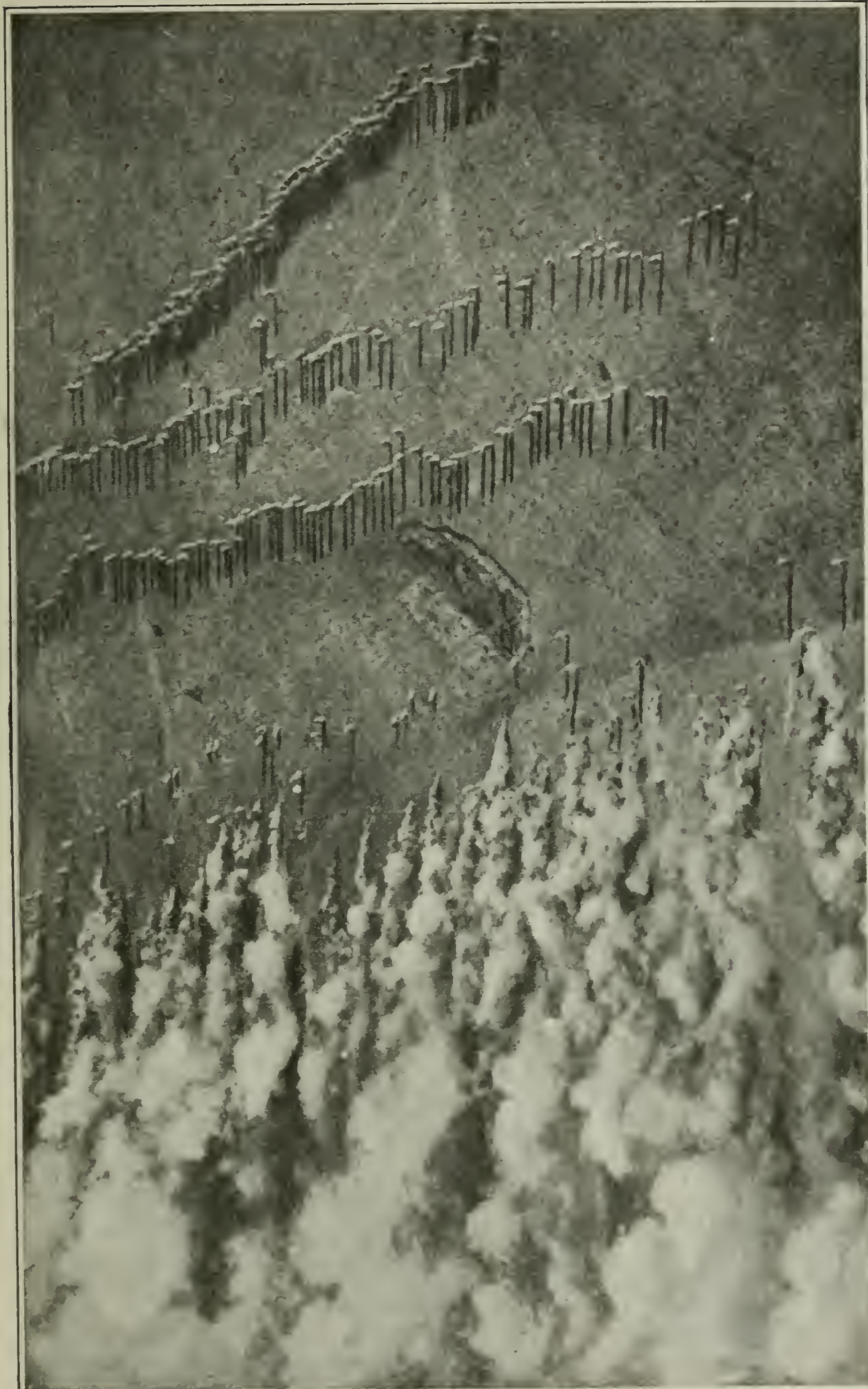
Women Who Do Men's Work in War

Women of the belligerent nations are doing men's work of a kind not usually allotted to them. Here we see them studying the trajectory of a projectile by means of a stream of water emitted from a vessel at various pressures



The standing figure is that of Fräulein Jarema Kuz, who volunteered with a regiment of Uhlans, and has served her colors so well that she has been promoted and decorated. The other two pictures show German women at work in the laboratories. These German women have added much to the strength of the German arms in the field. Much of the laboratory work connected with the war is now done by women

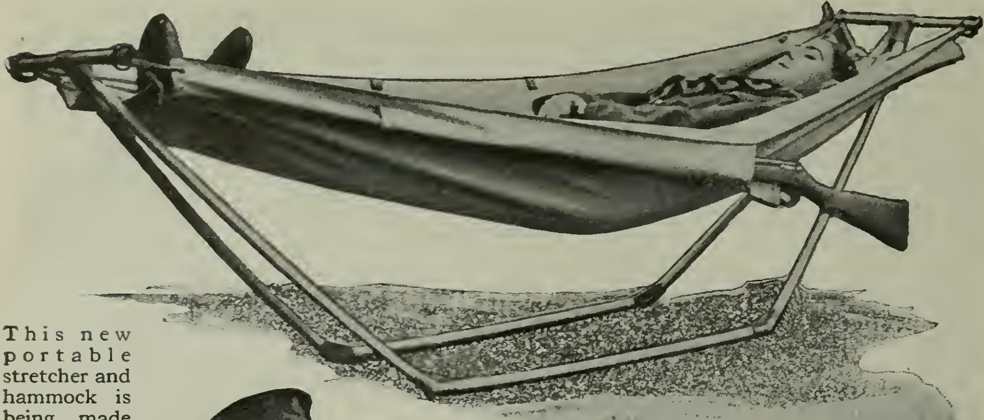
What the Gas Clouds Look Like



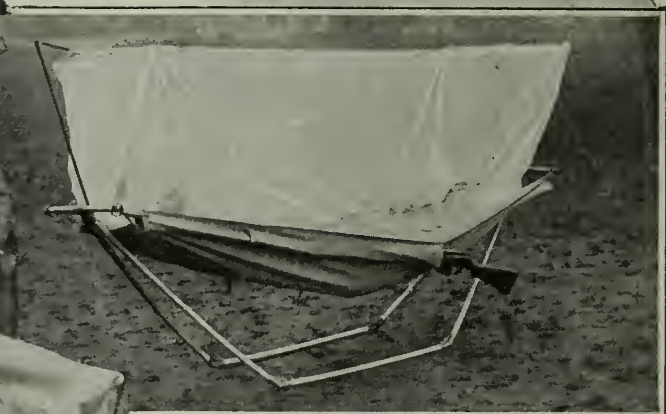
© International Film Service

This extraordinary photograph was taken from a Russian aeroplane while the Germans were launching asphyxiating gas before an attack on Russian trenches. Behind these clouds, troops may be seen drawn up in three lines ready to charge

Simplifying the Problem of the Hospitals



This new portable stretcher and hammock is being made for the Belgian Army. A sling is made for the folded bed to be hung from the shoulder



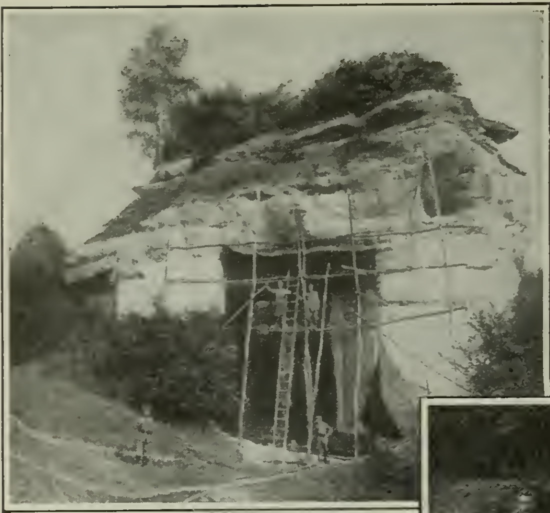
Safe from rain and wind the sleeper also has his gun ready in case of an alarm

A Sister of Charity astride her horse on the way to visit a trench

Courtesy of L'Illustration

Companion aeroplanes above the clouds. This remarkable, official photograph was taken from a French aeroplane just as a comrade's machine flew past. The sea of clouds over which the aeroplanes are flying may be clearly observed in the illustration

Cave-Men of the Trenches

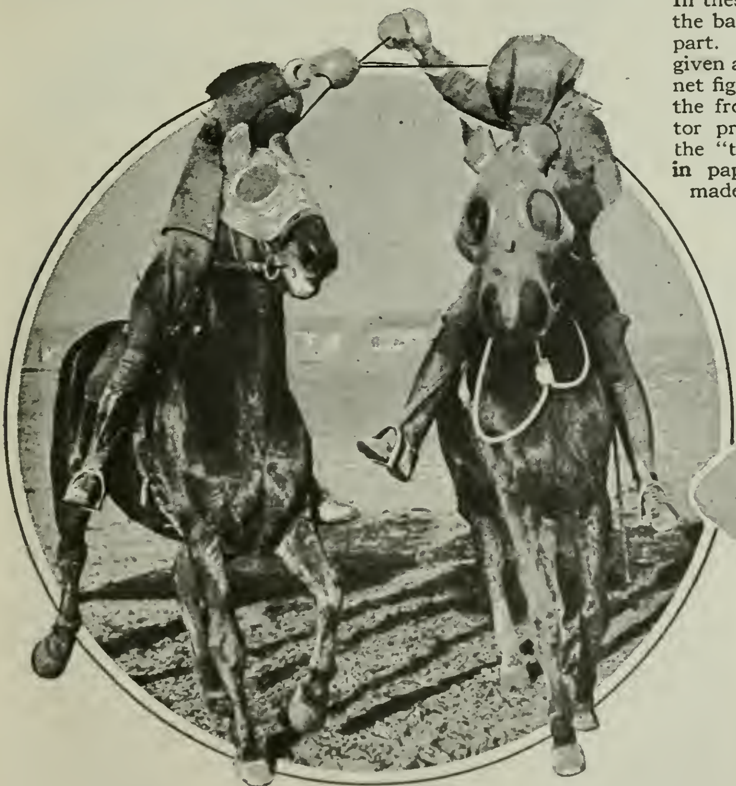


On the right bank of the river Oise, near Noyon, France, there are several caves and chasms so extensive that they can give shelter to a whole regiment of troops. The great arch shown in the photograph to the left has been named by the Germans "Bismarck Rock." Soldiers are shown building a scaffolding in order to place an appropriate inscripticn over the entrance

An officer's underground home in "The Forest of the Saxons," so called because a regiment of German Saxons are quartered there. Much time and care have apparently been spent in the construction of this bomb-proof, as it is complete to the smallest detail. Below, a realistic picture of the "home life" of the French soldiers in an underground grotto

Preparing for the Crises of Battle

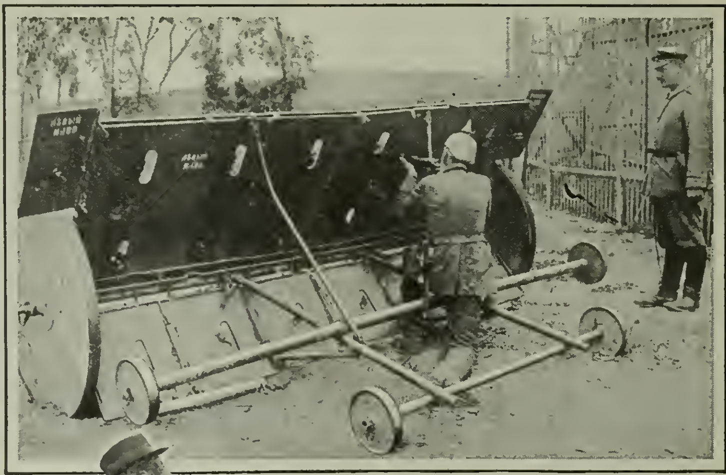
In these days of trench fighting, the bayonet plays an important part. Recruits in all armies are given a thorough course in bayonet fighting before being sent to the front. Below, a French aviator profits by the example of the "tramp" and wraps himself in paper. This novel suit is made of a special paper, and is intended to be worn beneath the uniform



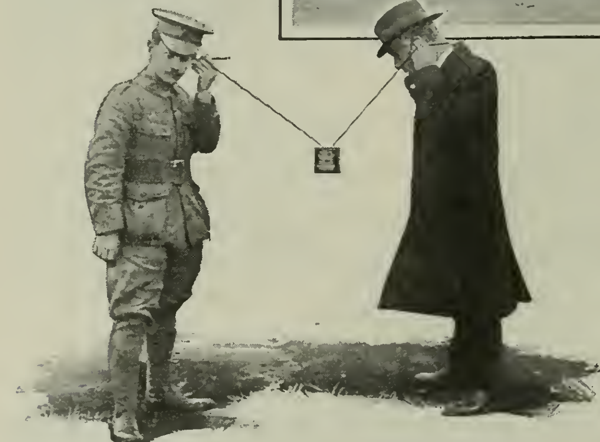
While awaiting their orders to start for the front, Canadian cavalrymen spend many hours practicing with the sword. Horses and men are well padded, and special swords are used to prevent injury

Inventions the War Has Brought Out

A Russian portable shield captured during a retreat and now used by the Germans. This shield is made of bullet-proof steel and is admirably designed to shelter five riflemen who protect their trench-digging comrades. The shelter may be taken to pieces in a very short time and packed for transportation in motor trucks



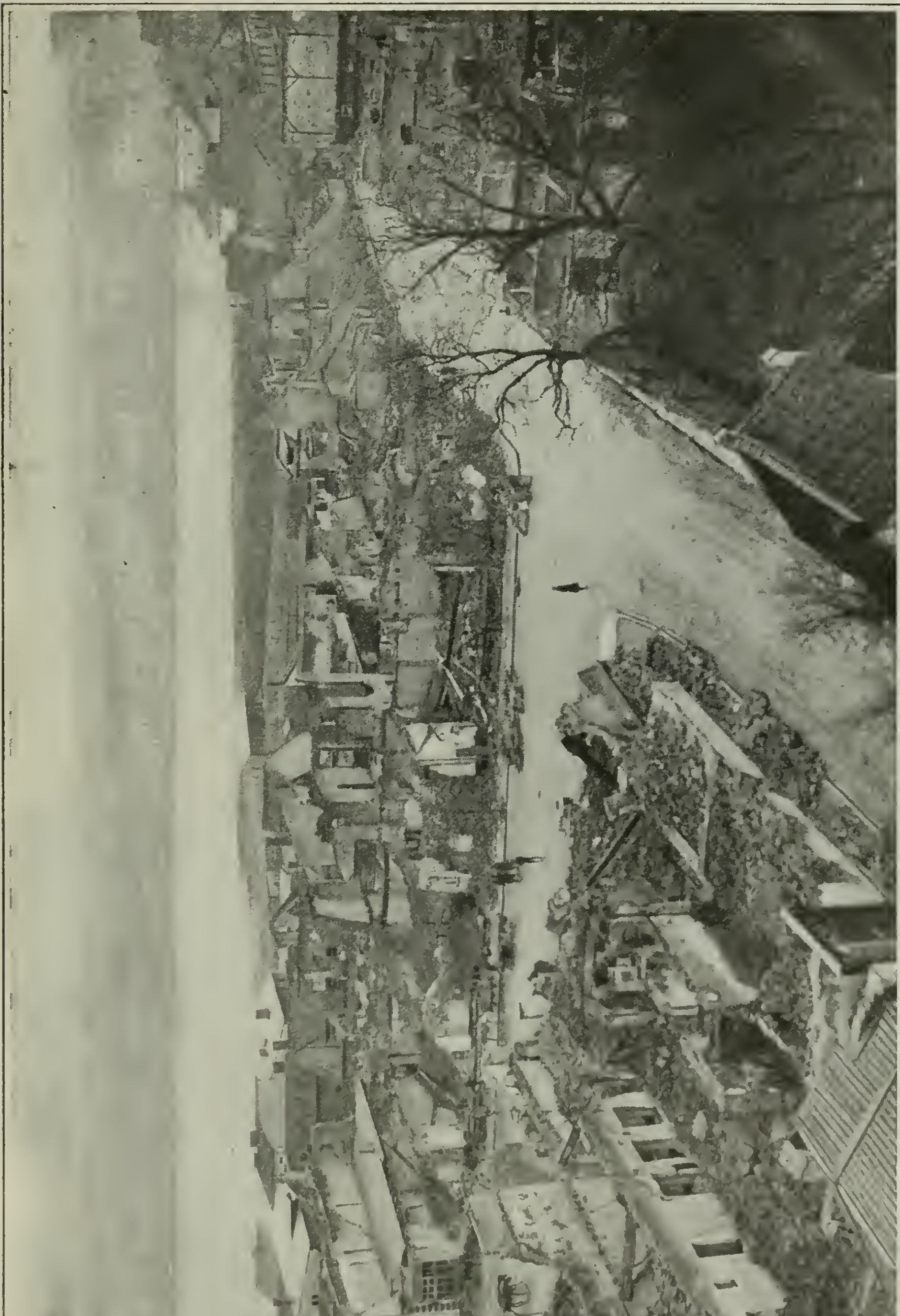
© American Press Association



Listening to the sound of heavy guns with the aid of a tin-can telephone receiver. A tin can, suspended from a copper wire which is wound about a pencil or penholder pressed against the bone back of the ear, makes an excellent instrument for detecting these sounds when they cannot be heard otherwise

An ingenious French device for photographing the German positions. A special camera is attached to a kite, and when the proper altitude is reached, the photographs are taken automatically. Occasionally the kite is sent up from an automobile, and is towed to the desired locations. One of the interesting phases of the war has been the use of kites, even man-carrying kites, in war observations. A camera can well take the place of the man, especially in a kite. The distance from the ground can be accurately estimated by means of a theodolite, the instrument used by surveyors

This Was Once a Peaceful Russian Town



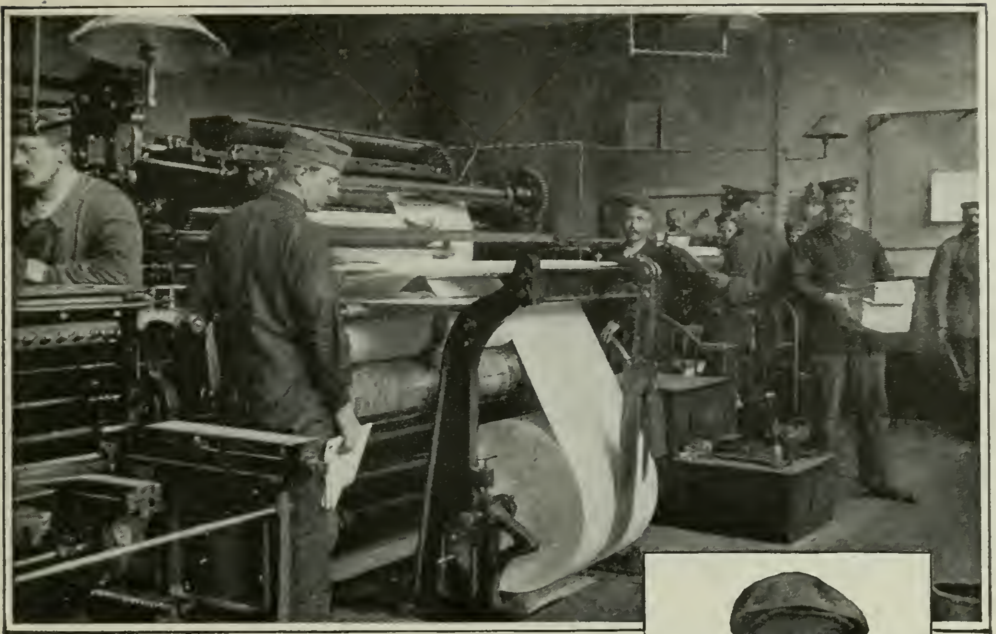
Archeologists of the future will find the ruins of the European war zone almost as full of horror and interest as those of Pompeii and Herculaneum. No disasters of ancient history are more tragic. It is likely that many such little towns as Iretelsburg, pictured here, will never be rebuilt on their old foundations, but that new sites will be chosen in the farming country near by. The cost of removing such ruins as these is prohibitive where land is cheap and the destruction so complete

Two Phases of War Transportation

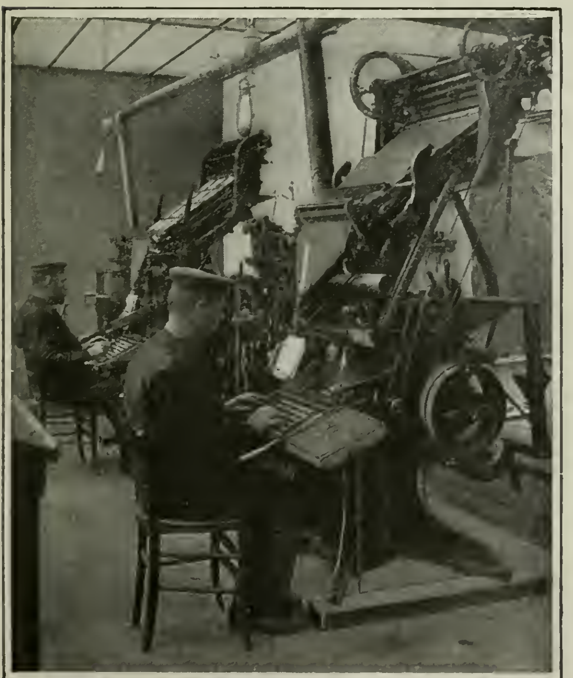
One of the new French battle 'planes, equipped with a three-inch rapid-fire gun. Owing to the substantial construction of modern aeroplanes, it has been found that a spray of bullets from a machine-gun or a shrapnel shell does little damage, unless one of the bullets strikes a control wire or seriously wounds the pilot. The latest development is the installation of guns which throw explosive shells. These shells, if correctly aimed, will tear the framework of an opposing aeroplane to pieces

Below is pictured an incident by no means uncommon in military service. A French staff car has become mired in the bed of a flooded stream. Repair cars are within easy calling distance in almost any district in the war zone, and the mechanics are equipped to handle any kind of an accident, from that shown, to the removal of a car which has been hit by a high-explosive shell

Printing a Newspaper Is Part of the War Game



The home of the "Gazette des Ardennes," a French newspaper published by the German Army in the captured French town of Charleville. The paper is chiefly intended for the inhabitants of the territory occupied at the present time by German troops. The first issue appeared in November, 1914



The first anniversary number was, like its predecessors, printed in French and sold by little French boys

Revolving fan blades beneath the hopper of this sand truck throw the sand over many feet of street surface which has been freshly oiled

Spreading Sand over Oiled Roads by a Motor Truck Attachment

IT is the custom in some cities to sprinkle sand over freshly-oiled streets to prevent oil from adhering to vehicle wheels or from being tracked upon sidewalks by pedestrians.

To accomplish this work more rapidly, Mr. Charles H. Rust, City Engineer of Victoria, B. C., attaches a wooden hopper to the back of a motor truck. At the bottom of the hopper is placed a small door to allow sand to run out of the hopper at any desired rate. Just below this door is a revolving disk with wrought iron vanes or ridges riveted to its upper surface. The disk is driven through bevel gears and a chain and sprockets from the rear axle of the truck.

Shovelers within the body of the truck keep the hopper filled with sand, and as it runs out upon the whirling disk, the vanes throw it out over a space ten feet wide.

The disk is thirty inches in diameter and revolves at a rate of two hundred and eighty-five revolutions a minute. The truck travels at a speed of three miles per hour.

Nine Thousand German Aeroplanes

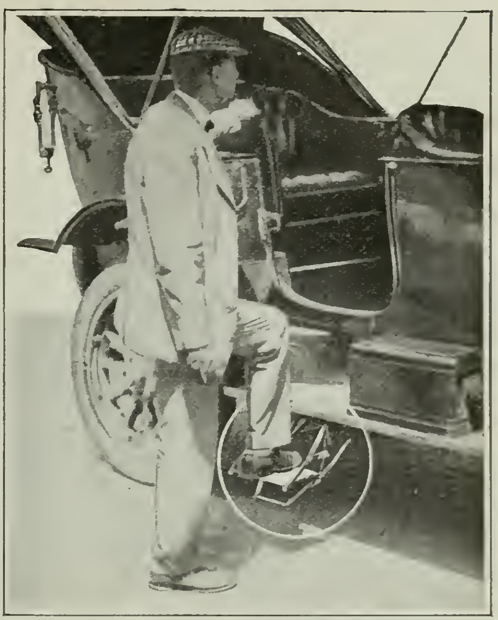
ONE of the most closely guarded secrets in the military establishments of Europe at the present time is the strength of the flying corps. That Germany at present has at least nine thousand war aeroplanes in active use, is the statement attributed to one of the higher officers last month. This officer, when the military attache of one of the South American nations commented on the plans of the British government to build ten thousand aeroplanes, remarked casually, "We have more than nine thousand ourselves!" In this connection it is also reported that along the Russian front, only an exceedingly thin line of infantry holds the trenches, and that nearly two thousand aeroplanes are cruising above the battle lines in the East, notifying the German headquarters in ample time of any movements along the Russian front. The crying need of the Russian armies now is flying machines, of which they need at least two thousand to be able to cover their own movements of troops. The greater the number of machines an army possesses, the fewer are lost. Hence the demand for a large corps.

A Convenient Step for Automobiles

THE running board of an automobile is not an easy step for many people, especially women and children. To make the boarding of the car easier a folding step has been put upon the market by an Indiana inventor.

The step is mounted under the running board and is operated by compressed air. The driver of the car simply presses upon a pedal when the step is required, and it lowers itself. When folded into place it is entirely out of sight and is so constructed that there is no rattling. It adds but small weight to the car.

A similar step has also been perfected by the inventor for railway trains. When opening the vestibule door of a car at a station, the porter simply pulls a lever and the step drops into place. This saves the handling of the wooden step usually carried on Pullman cars.



An automatic step lowered by pressure on a pedal. By its aid a small child may board the car with no great difficulty

Pull Yourself out of the Mud

THAT perpetual horror to the motorist of sliding down a bank into a ditch at such an angle that he cannot get out under his own power is banished to a fairly comfortable distance by a compact block and tackle arrangement so easily operated that it can be used without danger of soiling the clothes. The apparatus consists of a hand crank, pulleys, steel cable and chain. One of the chains is fastened to the three stakes driven in the ground. The other chain is attached to the framework of the automobile. The pulleys and wire cable are in the middle. Turning the crank exerts a leverage of great power—actually seventy times as great as the force applied—so that little difficulty is experienced in dragging even a large motor out of a deep rut or ditch back into the roadway.

Turning the crank exerts seventy times as much power as the force applied, so that the car is easily dragged out of the ditch or up an embankment

An Owl Darkens the Town

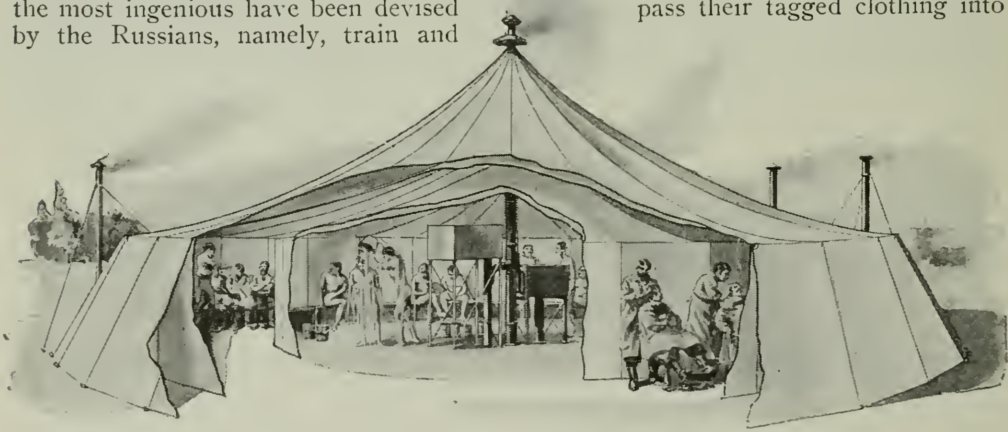
ON a recent evening a large horned owl plunged the town of Van Buren, Ark., into darkness when it alighted upon a steel tower and caused a short circuit of the main feed wire which supplied the town with electricity. The bird, which measured five feet across the wings, was killed by a current strong enough to kill a horse. The lighting company secured the body of the dead bird, and put it on exhibition.

Train and Tent Baths in Use by the Russian Army

FILTH, vermin and disease are among the most deadly foes to which an army is subjected. This is proved by the wars of the last century in all of which far more soldiers died from epidemics than from wounds. The combatants of the present day are more fortunate in these respects than those of the past, for owing to the great advance in sanitary science much better hygienic regulations are enforced. Many problems, though, are not yet solved, one being that of the personal cleanliness of the men. Among the various methods brought forward to meet this difficulty two of the most ingenious have been devised by the Russians, namely, train and tent baths. The bath train consists of a series of cars, one for dressing, one for disinfecting the clothing with formalin at a temperature of two hundred and twelve degrees, another for the baths, still another for putting on clean underwear and the disinfected uniforms, and a final one for rest and refreshment. The equipment of such a train costs about twenty-five thousand dollars to thirty-five thousand dollars and baths can be given to from two thousand to three thousand men a day at a monthly expense of about five thousand dollars.

The tent has the advantage over the train that it can be set up at the actual front. It can be raised and struck easily, the equipment can be separated into parts not weighing over six hundred pounds, which can be transported on two-wheeled carts; the interior is protected from cold, and one hundred men per hour can bathe, have their hair cut and their clothes disinfected. There are two concentric tents supported by the same center-pole. The inner tent forms the steam-chamber, where fifty men at a time can have a steam bath. The circular corridor between the two tents is divided into five compartments, two dressing rooms, a mechanical hair-cutting section, a laundry for towels, etc., and a disinfecting chamber with four disinfecting appliances. The men enter the first dressing room, pass their tagged clothing into the disinfecting chamber and enter the hair-cutting section where one man's hair is cut per minute, and then go into the steam chamber. The temperature here is one hundred and twenty to one hundred and fifty degrees; there are hot and cold water cocks, pails for the men to use, and benches—not tubs. After half an hour the men enter the second dressing room and receive their disinfected clothing at the window. Besides the heat supplied by the various appliances, four stoves warm the exterior corridor.

While the expense of maintaining this institution may seem high, it is more than offset by the advantages derived in the way of sanitation.

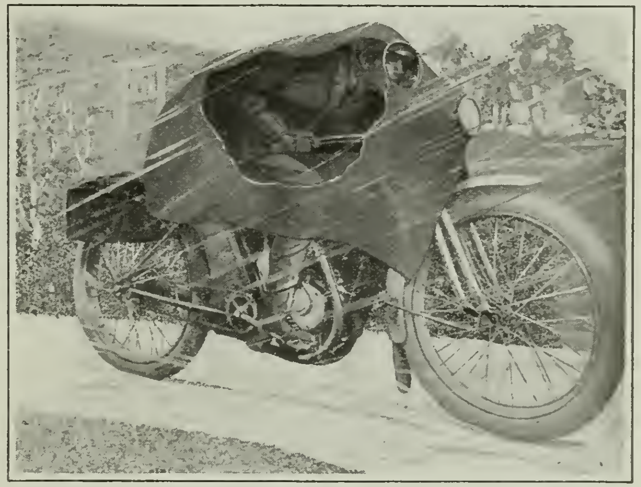


The Russians have devised as many sanitary short cuts and mechanical engines of war as any of the battling nations. Here is a picture of one of the big tents which help to make cleanliness possible to soldiers who come from the muddy trenches

A Cold or Wet Weather Suggestion for Motorcyclists

A SIMPLE yet convenient hood or cover for a motorcycle can easily be made from a piece of heavy brown canvas (brown for looks only) or a piece of rubber cloth about 36″ by 48″.

The canvas should be cut into the shape shown in the picture, then hemmed to prevent raveling. The hood may be securely tied to the handle-bars with pieces of rawhide; but care should be taken to place them far enough forward to allow free movement of the grips. In the same manner as above rawhide strips are run through to tie the hood firmly under the head light. Likewise, in the rear, pieces of rawhide or soft iron wire are fastened to the mud guard braces to hold the hood in place.


The motorcyclist is usually exposed to wind, rain and sleet. An ingenious cyclist has devised this covering to protect himself

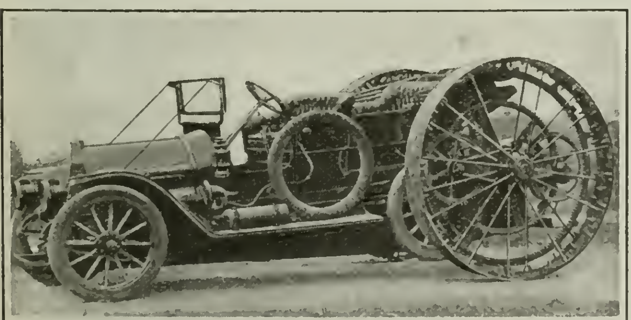
The hood is now finished, and the illustration shows how it looks on the machine.

Automobile and Tractor, Too

TO design a farm-tractor is not difficult, as is evidenced by the thousands of such machines in use in the western states. Nor is it difficult to design a pleasure vehicle. But to combine a touring car and a farm-tractor suggests problems that do not appear easy of solution. Yet the designer of the curious-looking vehicle shown herewith has experienced no particular difficulty in successfully combining these two types of widely differing vehicles.

The basis of the vehicle, as may be seen by the picture, is an ordinary five-passenger touring car, complete even to its top, its windshield, and its spare tire. It is converted into a farm-tractor by the simple expedient of jacking up the rear wheels and attaching the great tractor-wheels. These wheels are driven by spur-gearing attached at the ends of the driving axles of the touring car.

To adapt the tractor to different kinds of work it has gearing which permits two speeds, the high gear giving four miles an hour and the low gear two miles an hour. In addition to its usefulness as a tractor, the vehicle can also be used for power purposes about the farm, there being a power shaft, not shown in the illustration. At the rear is an extra radiator to prevent overheating when plowing at slow speed. In action, the tractor will drag three sixteen-inch plows through soft or wet ground, and will accomplish the work of four to eight horses.


The rear wheels are jacked up and the tractor-wheels are attached. Thus an automobile is changed into a tractor when it is not wanted for touring, and the machine is used at least twelve hours a day

A Civilized Man's Totem Tree

GEORGE E. CARR, a Civil War veteran of Union Springs, N. Y., has carved a totem tree that is "different," as he says, from the totem which

This white man has no use for coats of arms, but he has expressed his personality in a carved totem pole of his own making

the Indians regard as a family tree. He made it after his own fancy, spending two summers in decorating it with animals, birds, portraits, and curious figures.

At the top he placed neat little bird houses. To heighten the artistic effect, he painted the objects a variety of colors. The tree is eighteen feet high and six feet in circumference, and has thirty-four figures carved on it. These figures are part of the tree, not carved and placed on it.

THE commission form of government is in effect in eighty-one of the two hundred and four cities in this country that have a population of over thirty thousand.

Huge Twin Lanterns Light Entrance to School

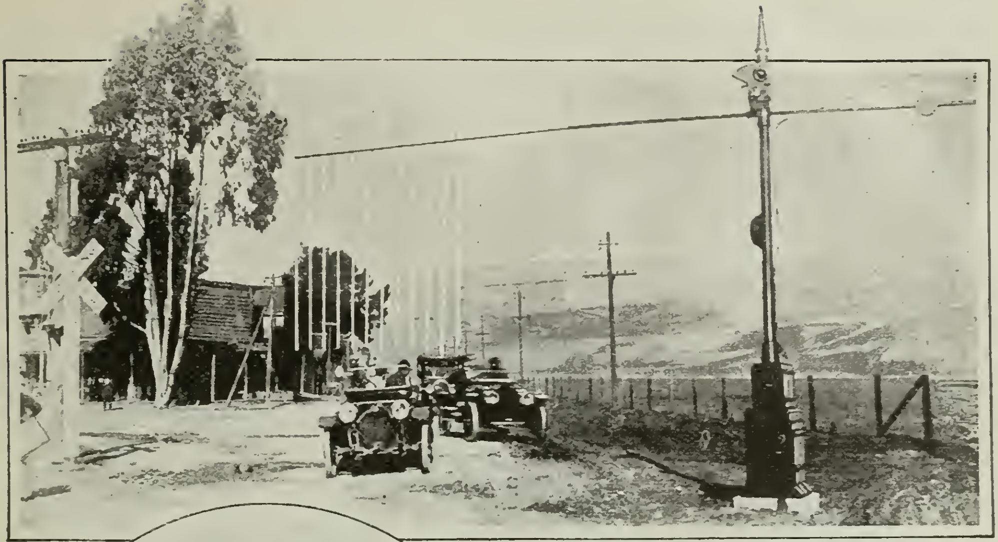
THE lantern shown is one of two which are to be used in lighting the entrance of the new Pullman Memorial Training School in Chicago.

The lantern is eight feet in height, the diameter of the cap is four feet, and the panels are three feet high and twelve inches wide at the top, tapering to nine inches at the bottom. The material is cast bronze; each lantern weighs six hundred pounds.

A one thousand watt lamp is set in the base of each lamp in a specially constructed reflector. This causes the rays of light to be directed on a much larger reflector in the cap, which distributes the light uniformly on each panel. The objectionable "lamp spot," or halo, is thus done away with, and the even glow is pleasing to the eye in spite of the brilliancy of the light.

THE province of Saskatchewan, Canada, pays a mother twenty-five dollars every time she gives birth to a child; it also pays the attendant physician a fee of fifteen dollars.

The light of learning will gleam like a beacon from this school lantern and its twin



When the train approaches, a bell rings, a signal light flashes, and the arm of the pole drops down, thus lowering a number of heavy spiral wire tell-tales which should stop the most reckless motorist

Railroad Gate Warns and Stops Reckless Motorists

A NEW safety gate has been put in use on crossings to warn motorists when a train approaches and stop them if they do not heed the warning. Electrical contacts are fastened to the railroad track a few hundred feet from the road crossing. When a train rolls over them, current is sent to an iron box on a pole at the side of the road. A bell clangs loudly—this is the warning—and at the same time, a long steel arm swings out over the road. At equal distances along the arm "tell-tales" are hung. These are steel wires wound in a spiral, usually about eight feet long. A motorist, no matter how reckless, will think twice before he risks these tell-tales. At night, in case an automobile driver should misunderstand the bell, a bright ruby light shines down the road, while a white light, fixed at right angles to the other, illuminates the safety arm and dangling tell-tales.

When Will This Reservoir Be Emptied?

SUPPOSE we have a reservoir a mile square and one mile deep and we assume that the water in it does not evaporate and is not added to by rain or other causes. Again, let us suppose that there is an outlet in the bottom of the reservoir through which the water escapes at the rate of one hundred gallons per second (more water than most families use in a day). When will the reservoir be empty?

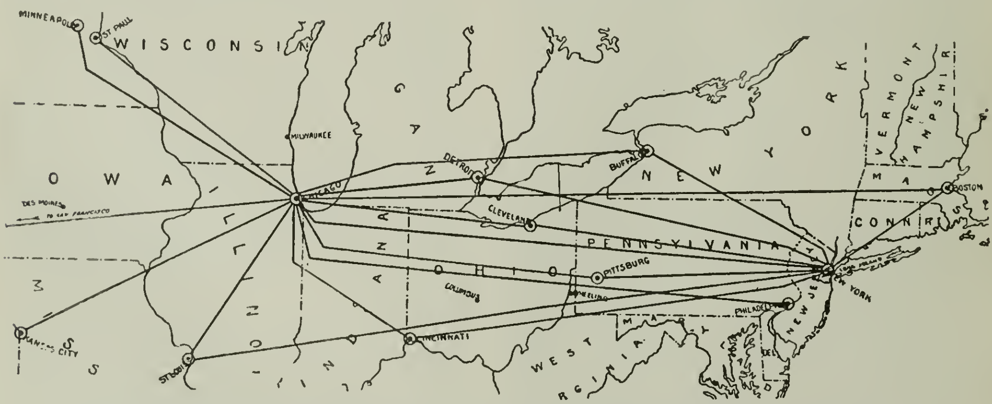
A few minutes work with pencil and paper will suffice to show that you would never see the bottom of this artificial lake—no, nor your great-grandchildren. In fact it would take some three hundred and fifty years to empty the tank.

Typewriting Eight Telegrams Over a Single Wire

WHEN the possibilities of sending messages over a wire by electricity were first realized, soon after Morse demonstrated the first telegraph, the limitations in the message-carrying ability of a plain circuit were encountered. The ordinary good operator could send only about one complete message per minute, and to do this he required the full use of a wire connecting him with the receiver. Each line was thus limited to about four hundred messages per business day, and it became clear that extremely high rates would have to be charged for messages over expensive long distance wires. The greatest cost of the telegraph system was due to the erection and maintenance of the lines, and therefore the best way to make lower charges possible appeared to be to increase the number of messages which could be handled on each wire.

The first step toward solving the problem of message limitation came with the duplex telegraph, which made it possible for four Morse operators to use a single wire at the same time. In this system two streams of messages pass over the wire simultaneously, in opposite directions, so that the capacity is doubled. The next step was the quadruplex, in which four messages are sent simultaneously, two in each direction, over the same wire. In this system one line carries about sixteen hundred messages per day, and large saving, as compared to plain or simplex single-message telegraphing, results. The duplex and quadruplex are very greatly used today, and the latter is not easy to keep in full operation during rainy weather. An octuplex system was devised, but has not been found practical.

Since the hand-telegraph systems are limited in message capacity by the speed of the Morse operator, automatic receivers and transmitters were devised to speed up the impulses passing over the line. In the Wheatstone system, which is perhaps the most successful of the plain automatic telegraphs, it is possible to send three hundred or four hundred words per minute over one wire, thus increasing the normal capacity some ten or twelve times. In this system the messages are first punched into special tapes by perforating operators. The tapes which are simultaneously punched out by ten perforators, will usually keep one wire in full operation. At the receiving station the messages are printed in dots and dashes on a second tape; this is divided into suitable lengths and distributed amongst a number of transcribing operators who



This remarkable telegraph system has been in operation over the lines shown for many months, and has resulted in the saving of much time and money to the company, and eventually to the senders translate the Morse code and write out the messages for delivery. The system is entirely practical, and is used in connection with the ocean cables. In the United States it is not favored for intercity telegraphing because of the loss of time which results from the series of processes through which messages must pass.

The receiving instrument. A telegraph blank is inserted in the instrument, and as the perforated tape passes through after receiving its impulses over the wire, the message appears in typewritten form, ready to be delivered

A sending operator at the keyboard perforator. This instrument is much like a typewriter, but instead of printing the letters a group of punches are controlled by the keys and punch a tape with various combinations of holes

Automatic telegraphy suggested printing telegraphy, in which the message received appears in typewritten form. The first of these instruments, like the stock-ticker, printed their messages on paper tapes. Soon it became possible to operate page-printers over considerable distances by wire. In these a typewriter keyboard transmitter, either directly or through a punched tape, operates over the line a typewriter receiver. The message is thus printed ready for delivery almost as soon as the transmitting operator punches it out on the sounding keyboard. Such printing systems usually operate up to fair typewriting speeds of fifty words per minute or so, and can be duplexed. By their use much time and expense in message handling are saved, and the good features of present-day rapid wire line service are largely due to these installations.

The newest and most perfect page-printing telegraph is that which the Western Electric engineers have recently completed. In this system a single wire is used not only to carry eight messages simultaneously, four in each direction, but to print them on blanks at the receivers, ready for delivery. Thus the speed of direct printing operation (fifty words per minute) is combined with a distribution of one telegraph line among eight pairs of sending and receiving operators. The increases of speed and economy produced by such an arrangement are almost self-evident.

The apparatus used in this new quadruple-duplex system is built up in a group of transmitting, receiving and accessory units. One of the illustrations shows a sending operator at the keyboard perforator. This instrument is much like a typewriter, but instead of printing the letters a group of punches are controlled by the keys and perforated on a paper tape with various combinations of holes. In the illustration the fresh tape may be seen unrolling from the reel back of the rack carrying the message about to be sent. After perforation at the left end of the keyboard machine, the tape passes under the pivoted arm of an automatic stop and then into a transmitter unit (at the extreme left of the photograph). The operator ordinarily punches tape at about the speed of transmission, so that a little slack tape hangs under the control arm of the stopping device. Should he fall behind, however, as soon as the transmitter uses up the loose tape and so begins to stretch it tightly between the two machines, the control arm is lifted. This operation automatically stops both the local transmitter and the receiver at the distant end until more letters are perforated. Then the tape slackens, the control arm drops and transmission begins again. Thus the printed message appears complete and without blanks, even though the transmitting operator is forced to stop in the midst of perforating.

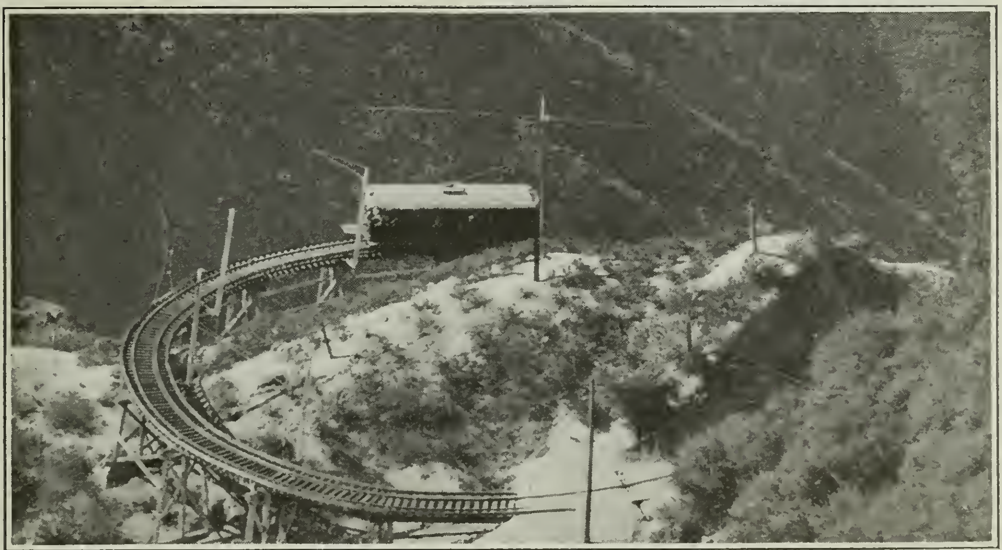
These eight operators work at one end of a single trunk line. Four are sending and four receiving, and they are kept busy every minute. The same number work on the other end of the wire, and it is possible to send more than six thousand messages over one wire in a single working day

The printing receiver is shown in another photograph. Inside the case a message is being typewritten as the perforated tape corresponding to it passes, letter by letter, through the transmitter. Each group of five impulses (one for each row of punched holes in the sending tape) prints a single letter, makes a space between words or starts a new line on the printed page by returning the paper-carriage to the right and turning up the paper. At the end of each message a short time is allowed for the receiving operator to take out the printed telegram and insert a fresh blank; while the new message is being typed he checks over that which has just been received and, if it seems correct, turns it over to the delivery department.

The printing, ready for delivery, of keyboard-perforated messages, could be accomplished by any of the older successful page-printing telegraph systems. In fact, the same line could be duplexed and messages sent at about fifty words per minute in both directions, so keeping four operators at work on a single wire. But the new printing telegraph is capable of handling the telegraphic output of eight transmitters and thus keeping sixteen operators busy over one line. This simultaneous transmission of messages is made possible by the use of a pair of special distributors, one at each end of the line, which successively switch in and out each of four sets of instruments. The line is duplexed and therefore permits messages to travel in both directions at the same time; for each quarter revolution the distributors connect on the line four operators using one duplex "channel" set, which consists of a sender and receiver at each end.

The operation of the two distributors is perhaps the most important new thing in this system, since it is through them that the line can be used successively by each of the four groups of four operators. The simple fact that in printing telegraphs over three-quarters of the total time of operation is used for preparing to send, and in printing the letters, while less than one-quarter will suffice for the actual transmission of the five electrical impulses, has made possible this distribution and simultaneous operation. The distributors are merely special rotary switches which revolve, one at each end of the wire, at exactly the same effective speed. For each quarter revolution the duplex line is connected to one set of instruments and the impulses forming one letter are transmitted in both directions. If the distributor rotates at three hundred revolutions per minute, three hundred letters or fifty words per minute will be sent in each direction through each of the four channels, making a total of four hundred words per minute. Each revolution of the distributor is accomplished in one-fifth of a second, and during each quarter of this period, or one-twentieth of a second, each set of instruments is connected to the line. In the three-twentieths of a second the receiving printer operates and the transmitter prepares to send the set of five impulses corresponding to the next letter in its message.

The other photograph shows the eight operators, four sending and four receiving, who work at one end of a trunk line using this new quadruple-duplex printer.



The problem of bridging a mountain stream, circling the edge of a precipice and "tacking" up a steep grade forced the engineers responsible for the electric railway up Mt. Lowe to make this queer "circular bridge"

A Circular Bridge on Stilts

THE circular bridge shown in the illustration is unusual both in its design and in its location. The trestle work forming almost a complete circle, practically all of which is "on stilts," is a part of a mountain inclined road. At the point where the roads almost meet, one track is about six feet higher than the other. The circle formed by this track is seventy feet in diameter.

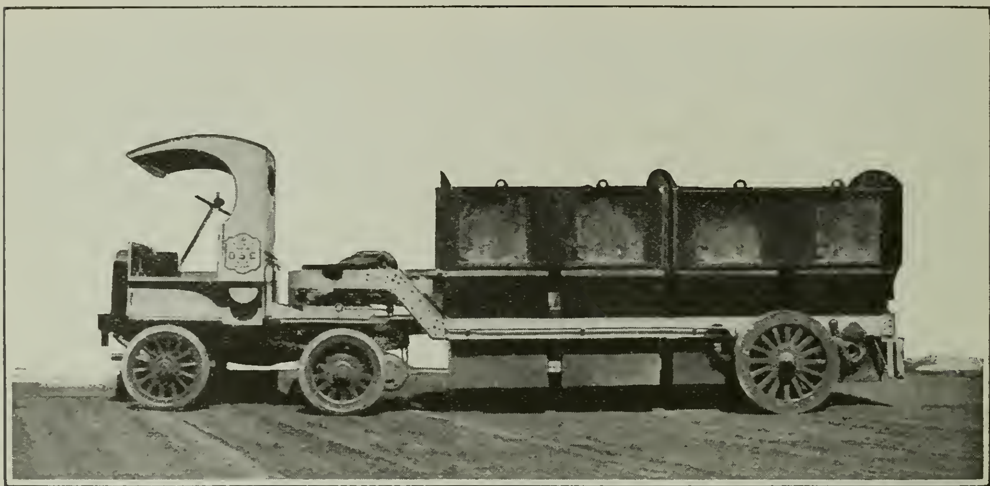
This bridge is also noteworthy because it is located nearly five thousand feet above sea level. It is a portion of what is known as "The Mt. Lowe incline railway," a line which winds its way up the side of Mt. Lowe. The turn seems to show how crooked is this three-mile line.

Cleaning New York Streets with Modern Mechanical Appliances

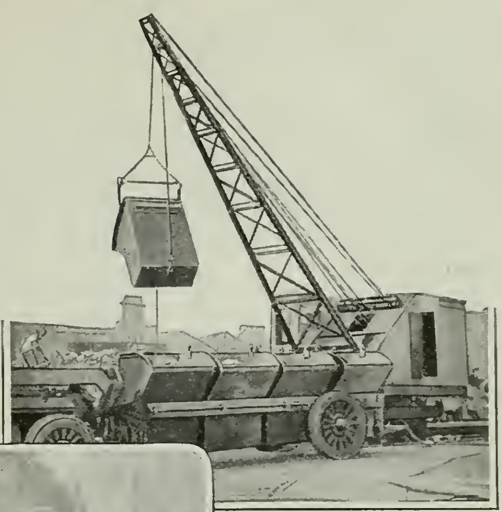
COMMISSIONER J. T. FETHERSTON, of the Street Cleaning Department, of New York City, recently began the operation, in a so-called "model district," of machinery for collecting refuse and cleaning streets. There is nothing just like it in this or any other country. The ideal which the commissioner undertook to demonstrate in this district, which took in many phases of the city's life, Fifth Avenue stores, wealthy homes (such as that of J. P. Morgan), tenement houses and factories, was a dustless job, with refuse collections made in a given locality day after day with the regularity of a train schedule, at a minimum of cost and a maximum of efficiency. For refuse collection, for instance, he replaced horse carts with motor trucks of great capacity, and capable of transporting every kind of refuse simultaneously.

His problem was solved by the combination of a gasoline-electric tractor and trailers designed to perform the different functions required. As it is intended that the streets shall be cleaned by power, and that power plows shall be employed when snow is to be removed, economy and efficiency suggested that the tractor be designed to meet the needs of all these services, and be available for twenty-four hours a day, if required.

The tractor, therefore, is a power plant on wheels and provided with a heavily constructed fifth wheel by means of which the different kinds of trailers can be attached. The tractor has a wheel base of only seventy-two inches, in order that the long trailer may be swung around in a thirty-foot street. The power plant consists of a four-cylinder, forty horse-power gasoline motor coupled to an electric generator on the same shaft. The generator supplies power for driving the tractor and the motors used in operating the flushing and sweeping machines. Such a type of tractor combines the simplicity of control of an electric vehicle and the relatively large mileage capacity of straight gasoline equipment. The motor is equipped with a governor and special devices which automatically regulate its speed according to the load. The motor may be started at the stable. It runs slowly until the driver moves the controller, turning the electricity into the driving motors or into



Huge tractors of this type have recently appeared in New York streets, and have aided wonderfully in the refuse removal work of the Department of Street Cleaning. They are so built that the driver has no control over the gasoline engine. He simply operates the electric current, thus making the power machinery more nearly "fool-proof" the motors on a trailer. It then automatically starts up at full speed of nine hundred revolutions a minute. When the electricity is switched off, the speed is again automatically reduced. The driver has no control over the operation of the gasoline engine. He controls the electric current alone. The value of this is that the power machinery is made more nearly "fool-proof." A less skilled man may be employed to run the machine, for the job consists simply in steering it, switching on and off the electricity and applying the brakes when necessary. The machines cannot be run above eight miles



On the piers the refuse is discharged into barges by locomotive cranes which take their power from a third-rail. The various sections of the trailer are lifted bodily and their contents dumped into the barge. The rapidity of operation and the fewer men employed actually reduce the cost of the work

A crew of five men accompany these great tractors, and refuse is emptied into their ample bodies with great rapidity. The upper trays receive barrels, boxes and papers, and the lower sections the ashes and garbage

an hour on an ordinary level paved street.

The refuse trailers, which have already been placed in operation, consist of a massive steel-frame arranged to carry a series of eight deep rectangular steel cans, and, resting on top of these, two big trays for barrels and boxes. In the sides of these big trays are rectangular openings by which the ashes, street sweepings and garbage can be thrust into the cans underneath. These openings are closed by swinging steel doors horizontally hung so that the pressure of an ash can or a shovel will open them, and gravity will close them instantly when the pressure is removed.

On the piers where the refuse is discharged into the barges are four locomotive cranes taking their power from a third rail. The various sections of the collecting trailer are lifted bodily and their contents dumped on to the barge.

Twelve of the tractors and refuse trailers are now in operation, and the crew of five men go through a block with a speed and resultant cleanliness marvelous to the eyes of New Yorkers accustomed to the antiquated methods in use elsewhere in the city.

ONLY ten per cent. of the inhabitants of the Phillipines speak Spanish.

Will Germany Live on Sewage?

THE problem of securing food, which confronts Germany, has occasioned a thorough, scientific investigation of the subject and its economic solution. The scarcity of fats has been especially felt, due partly to the large consumption of fat-containing foods by German people. Direct sources of fat, such as olive oil, have ceased to be imported, and indirect sources, like meats, nuts and grain, though domestic products, are diminished in their output. The dry summer affected the fodder for grazing animals, especially since more vegetable food has been consumed by the entire population than formerly.

One of the first questions considered was whether the fat consumed was necessary for proper nourishment. Physiologically, fat stands next to protein in importance, the other foods being carbohydrates (starches and sugars), salts and water. The Germans as a people, consume more fat than other nations,—in fact, all people eat more oily food than is necessary. Nevertheless, for energy-production, 3.6 ounces of fat are equivalent to 8.8 ounces of carbohydrates. Fat also prevents too rapid breaking down of the protein in the body, which fact, together with its resistance to cold, makes it highly important for the troops in the field.

In Germany today, the consumption of oil, butter and other fatty foods, per day, is less than two ounces, though formerly it was nearly double that amount. It has been found that a strict economy would practically solve the problem. If the rich would not waste food, the poorer classes could be relieved. Large crops of linseed, hemp, poppy, mustard, sunflowers, walnuts, beech-nuts, hazelnuts and even Indian corn and sesame, all containing oil in varying degrees, will be reaped this year. They require land, however, which would otherwise be used for other necessary foods. Peach-pits and the seeds of other fruits have been considered as sources of oils, but as yet little has been done in that direction.

The committee in charge of the food question, authorized the Agricultural Banks to buy and distribute last year's crop of beech-nuts and flax. Beech-nuts have heretofore been wasted, but now even the royal Prussian forests are to be stripped, and their output placed at the disposal of the committee. School children have been enlisted to gather nuts and turn them in to the common store. A ton of fresh beech-nuts brings approximately from fifty to sixty dollars; air-dried nuts, from seventy-five to eighty-five dollars. Provision has also been made for gathering the sunflower harvest.

These measures pertain more to the future than to the immediate needs, however. Accordingly a general collection of fatty refuse from meat-shops, slaughter-houses, hotels, etc., has been ordered. The system used is the work of Bovermann. The refuse, mixed with water, passes through a receptacle very slowly to allow the fatty substances and oil globules to rise to the surface, while the heavier bodies sink to the bottom. The top layer can then be drawn off and the fat easily extracted and purified.

This method, of course, only takes care of a fraction of the fats which may be found in refuse. The slime at the bottom could also be used for some purposes, such as feeding swine. All sewage from households and manufactories is largely impregnated with fat in various forms, such as soap particles and oils. According to Professor Bechhold, in *Die Chemiker-Zeitung*, .35 ounces of fat per person, are wasted in sewage, every day. In peace times, such waste would be fourteen million, two hundred and eighty thousand dollars, while in the last few months, it would be forty-seven million, six hundred thousand dollars. A further stringency may necessitate the use of sewage also.

The fisheries are another source of fat and also protein, which as yet remain unclaimed. Only one-fourth of all catches are used for food, though the small fish, thrown back, contain much available nutriment. Even bones and various hides could be made to yield some fat, if their use became imperative.

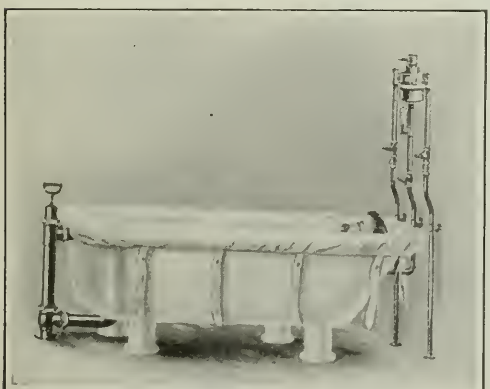
Sleep in Hot Water to Rest Your Nerves

SLEEPING in a bathtub full of water kept at blood temperature is claimed by some physicians to give the required amount of rest in half the time that sleeping in bed requires. In other words, four hours sleep in a bathtub filled with water at the proper temperature—and always maintained at that temperature—will result in the exact amount of restfulness that eight hours in bed will give.

The explanation is that warm water completely relaxes the nerves, which ordinary sleep does not necessarily do. The most difficult part of this treatment is in maintaining the water at a constant temperature, and for the purpose of accomplishing the result, a middle-western manufacturer has recently brought out on the market a thermostatic water control apparatus, which, as its name implies, maintains the water at any desired temperature.

In practice, the patient climbs into a bathtub filled with water, his head protruding through a hole in a rubber blanket, which is strapped around the edges of the tub. Water constantly flows in at one end of the tub, and out at the other.

For the harried business man, who complains that his working day is too short, such a sleeping couch as this should have a distinct appeal. He should be willing to rest four hours at least.



Here is a system of heat regulation that makes it possible to sleep in a bath that is always at the same temperature

With this invention, telephone line work is as comfortable as sitting or standing in the shop would be

A Machine Which Climbs Poles

A POLE or stack-climbing apparatus in which the pole or stack climber sits comfortably while elevating or lowering his position, as the work progresses, by a simple arrangement of clutches, has been constructed and put in use by a young telephone lineman in Arizona. The climber (the machine, not the man) consists of two parts, an upper and a lower. The mechanism in the upper part contains clutches which grasp the pole firmly, being manipulated by ropes from the seat below.

To climb the pole, the lineman or stack-climber takes his seat as far above the ground as possible in order to expedite matters. The clutch mechanism is pushed upwards as far as he can reach by means of a wooden pole. The clutch is then set, and with a rope and pulley arrangement, he elevates the seat. By continually repeating this operation, pushing the clutch box upwards as he progresses, he literally crawls to the top of the pole or stack.

Running a Newspaper Plant with an Automobile

AS a result of a blizzard last December, all of the towns along the New York, New Haven and Hartford Railroad between Stamford and Mount Vernon were without electric light and power, since they draw their supply of current from the high-tension system of the railroad. Mount Vernon, which has its own municipal plant, was the only exception.

This little automobile furnished the power for an entire newspaper plant, which had been crippled by a blizzard

The publishers of the *News and Graphic*, of Greenwich, Connecticut, were unable to operate their presses. Manager Barton thought of utilizing a portable gas engine, but this was not to be had. He happened to drop into an automobile agency. The manager offered the services of a touring car. A few minutes later the machine was backed up in front of the newspaper office and one of the rear tires was removed. With very little difficulty the jacked-up wheel was belted to the main driving pulley of the shop, the other wheel being allowed to rest on the ground. Soon the twenty horsepower engine of the small car was running not only the two big cylinder presses, but the folding machine, the power cutter, and several small job presses as well. Needless to say, the paper appeared on time to the amazement of the citizens of Greenwich, who had not expected to see newspapers for days.

Wandering Motion Pictures

CARRYING movies to the people by automobile is the latest advertising scheme of a well known motor car manufacturer. The car not only carries the apparatus, but supplies power for driving an electric generator which furnishes the projecting light.

A small dynamo is bolted to a two-inch plank, which in turn is fastened to the running-board of the car. A pulley attached to one of the rear wheels of the auto, which is for the time being jacked up from the ground, is belted to the generator and the power for driving is thus transmitted from the car's engine.

The switchboard controlling the current is hung upon the windshield and the screen is attached to any covenient building or billboard.

Scenes about the plant of the manufacturer are shown upon the screen and it is claimed that the entire outfit can be unpacked and put into operation in a few minutes.

THE largest commercial gasoline-engine has been built for installation in a double-ended ferry-boat used for the transportation of trains across an arm of San Francisco Bay. This engine weighs nearly fifty tons and develops six hundred horse-power.

This car not only carries the apparatus, but generates the power for the motion picture machine

The Peril of the Fur Coat

By A. M. Jungman

DID you ever see a rosy-faced child with a pretty white fur piece around its neck and its hands thrust deep into the comforting warmth of a white fur muff? An altogether innocent and charming sight, you would think. It is rather a disillusionment to find that death and disease lurk around that snowy fur. Not for the child, to be sure, but constantly, from the minute that fur was opened in the garment furmaker's shop to the minute when it is placed around the little one's neck, at least one person's health was in danger because of it.

That this particularly dangerous trade may be made comparatively safe has been discovered by the physicians of the Occupational Clinic of the Department of Health of the City of New York. With a view toward obviating many of the hazards which surround the fur garment makers, an exhaustive study has been made of the fur and allied trades in this city.

The new method of beating fur. The machine is designed on the principle of a vacuum cleaner. A rattan beater inside the machine beats the fur and the particles of dust and fur are sucked up into the bag instead of filling the air about the workman as was the case with the old method

In the garment makers' trade the workers have better surroundings than do the hatters' fur workers. Their perils are to be found in the making of childrens' sets. These are made of angora skins and other pelts. The angora skins are brought from China, and when they reach the factory they are more or less curly. The hair is combed to straighten it and to give it an appearance of uniform fluffiness. For this purpose a combing machine is used. This means that a man holds the skin under a revolving cylinder on which are set fine

A fur worker beating fur by hand. The workman is not protected from the particles of fur and dust which are raised by his beating wire bristles. If you want to see the fur fly, watch one of these combers. The floor on which the man stands is covered inches deep with fur and the air is thick with it. In passing through a room where one of these machines is in operation, one's hair, eyes, ears and clothing become full of the indescribably fine particles of angora fur which are loosened by the machine. Sometimes the operator wears goggles and a respirator; sometimes not. Some factories keep the combing machines in box-like compartments so the operator does not suffer.

Another harmful practice is the beating of finished fur garments by hand.

When the fisherman is not-a-fishing he takes off the sail of his boat and uses it as an awning for his house

The beater uses two rattan sticks with which he belabors the garment, causing hair and dust to fly into the air and settle all over him. Recently a machine has been invented which does away with the dirt and dust of the hand-beating method. It consists of a vacuum device in which is placed a rattan beater which can be operated at any one of three speeds electrically. The vacuum principle is employed to draw all the dust and particles of fur into a bag, instead of permitting them to be blown about the room. It is believed that asthma is contracted particularly by those persons who handle dyed wolf, racoon and coney skins. Unfortunately, many of the fur workers were exceedingly reticent and offered the physicians very little help toward determining their physical condition, fearing to acknowledge any ailment lest their working capacity might be curtailed. It is a noteworthy fact that of the workers in the fur and allied trades, seventy-two per cent were under forty years of age and ninety per cent under fifty. This is conclusive evidence that the fur and hatters' fur trades are dangerous to health. As getting rich at these trades is out of the question, so far as the workers are concerned, the only reason for such an early retirement from the work must be disability.

There are many ways in which the evils of the fur trades can be mitigated. As sixteen thousand persons are engaged in these trades in New York City, their condition is of vital importance to the public health. For this reason the Department of Health has made an exhaustive study of these trades and efforts are being made to improve present practices.

When one considers that some of the things suffered by the victims of mercurialism are diseased gums, black teeth, severe headaches, nosebleeds, violent tremors of limbs, face and tongue (hatters' shakes), and that other diseases among fur workers are bronchitis, asthma, tuberculosis, skin diseases, loss of finger nails, blueness of hands, etc., it would seem that the animals whose pelts are used are not the only ones to suffer in order that you may wear a felt hat and a fur-lined coat.

A House with a Sail

THE sail on the little shack pictured is not for the purpose of propulsion. It is used as an awning so that the sun will not make the contents too warm. The hut belongs to a fisherman, who catches fish and crabs and sells them to the motor tourists between Los Angeles and Santa Barbara. The fisherman uses the sail when out in his boat, but when he gets back he removes the sail from his boat to his hut.

Simplifying the Inspection of Farm Produce

The device was invented and patented by a New York food inspector who wanted to see the whole consignment, not one or two selected sacks only

Each sack of vegetables or fruit can be dumped in the device, examined and re-sacked, all in a few seconds

DEALINGS in such commodities as fresh fruits and vegetables are peculiarly unintelligent. There is but the roughest approach to uniformity in standards of quality. Neither the buyer nor the seller knows accurately the quality of the goods bought and sold. To better this condition a device has recently been invented which is here illustrated.

Ordinarily such goods as potatoes are delivered to the buyer in a truck-load of bags. The buyer's inspector makes a rudimentary inspection. Because the bags are so tightly packed together on a truck, only one or two from the tail end can be dropped off at a time. A bag is stood up and the string is cut; the bag is thrown over, and its contents are spilled out by lifting the lower end. As the average bag of potatoes weighs about one hundred seventy-five pounds, this entails considerable manual labor and time. After the inspector passes on the potatoes they must be shoveled up and thrown back into the bag and the bag must be sewed up. This process must be repeated for all inspected bags. If as many as five are inspected out of, say, one hundred on a truck load, the inspection is considered adequate. It frequently happens that when the potatoes reach their consumption destination a large proportion are found of inferior quality; they have never been seen by the inspector. Knowing that only the bags at the tail end of the truck can be inspected, the seller places there those of the best quality.

The device illustrated is intended to afford opportunity for better inspection and for the inspection of a larger proportion of the goods and the reduction of time and labor. The device is wheeled up to the end of the truck, a bag of potatoes is placed upon the small dumper and the string cut; it is then tilted over so that its contents spill and spread out in the tray. The inspector, standing upon the platform at the side, views the entire contents at a glance, and then pulls the lever. The weight of the potatoes in the tray causes the front end to descend; the potatoes run out through the spout into the bag held under it, and the bag is sewed up. There is little or no manual labor. The process is much faster than the old-fashioned way, and as many bags of potatoes throughout a delivery may be inspected as may seem desirable.

This device is suitable for inspection of the coarser vegetables—such as potatoes, carrots, cabbage, onions, turnips, parsnips and the like. It is also suitable for such fruits as lemons, oranges, apples and pears which need not be carefully handled.

The floor of the machine is constructed of slats, so as to allow the dirt to fall between them. Hence the buyer pays only for the goods bought. These slats can be fastened at varying distances so as to act as a sorting device for size. Undersized fruits or vegetables drop through and are discarded.

By means of a small tray fitted into the permanent one and having a solid floor, grains can also be inspected—such as oats and corn. Thus the entire contents of a bag can be properly inspected, instead of simply a handful.

The device described was invented by Hugh M. Foster, examining inspector of purchase and supplies for New York's Board of Estimate and Apportionment. After years' experience he became impressed with the lax methods in use. By law an employee of the city is prevented from profiting directly or indirectly by the sale of an article to the city government; therefore the inventor gave permission to the city to construct as many of these machines as would be needed for its own use. This permission has been accepted by the Board of Estimate and Apportionment on behalf of the city, and the machine has been constructed and is now being used in the institutional departments which buy such supplies.

Why Do Moving Pictures Seem So Life-Like?

It takes a certain amount of time to affect the eye. You do not see things instantaneously. If you move a lighted cigar in a dark room very rapidly you see what is apparently a continuous curve of light.

The motion-pictures reproduce movements faithfully for the same reason. Before the eye has a chance to see a picture in its entirety a new picture is flashed on the screen. The pictures appear and vanish at the rate of sixteen a second, in other words, so rapidly that the effect of continuous motion is produced.

Advantage is taken of this to produce very curious and unnatural effects; for example, an old building tearing itself down, a hole digging itself in the ground, a skyscraper growing up from a foundation without the aid of human hands. The camera operator has simply taken a picture of the demolition of the old building and the construction of the skyscraper at the rate of perhaps one an hour, but projects them all in twenty minutes.

Recruiting Britain's Army with Motor-Trucks, Motion-Pictures, Mirrors and Brass Bands

ALTHOUGH the British Army in the field at the present time is estimated at between one and two million, the regiments are located on so many fronts and fighting under such adverse conditions that the wastage of life is simply appalling. The problem of the British has been to fill the gaps caused by this wastage. Extraordinary measures have been taken to drive home the necessity of enlisting.

First, Lord Kitchener tried his hand at recruiting and then Lord Derby. What success Derby achieved has been due to very aggressive methods. He shrank from nothing. Thus a fleet of motor-trucks was employed as portable recruiting stations. They journeyed from town to town on the principle that if the men would not come to the recruiting stations, the recruiting stations would have to go to the men.

These trucks traveled over prescribed routes in England, Scotland and Ireland, going even to the remotest hamlets and villages where there was any likelihood of procuring a few able-bodied soldiers for the king. The first unit of this modern motor caravan to be put into service is shown in front of the Dublin Town Hall in the accompanying illustration. When in Dublin the truck was accompanied from section to section by no less than three complete military bands of music to help create recruiting interest.

Instead of asking recruits to come to his office, Lord Derby sent recruiting stations to them in the form of elaborately equipped motor-buses. Thus Dublin was canvassed with the vehicle shown. Orators appealed to Irish patriotism from the top of the vehicle and a military band supplied musical enthusiasm

One of the street mirrors used in London to shame reluctant cockneys into fighting for their country

The truck equipment also included a motion-picture outfit, which was used at the night meetings to show actual war scenes at the front as arguments why more men should enlist.

It was under Lord Derby's direction that lackadaisical English city-dwellers were spurred into taking a more active interest in their country's dire need by mirrors. Every Englishman was given an opportunity of seeing the man his country wanted.

Exposing the Tricks of the Short-Weight Tradesman

THE efficient management of the modern household is greatly promoted by the careful use of well-selected measuring appliances. Improved systems have been slowly evolved from the guesswork of earlier times. For example, terms like the "pinch of salt," "speck of pepper," "handful of rice," "sweeten to taste" (units of vague magnitude) have gradually been replaced by definite amounts, specified and measured. The Bureau of Standards has devoted much attention to this subject, so neglected in the average kitchen. Household appliances ought to include:

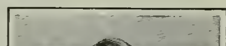
1. A test set of weights and measures for checking purchases and other purposes.

2. Meters for measuring the delivery, for household use, of gas, water and electricity.

3. Special measuring instruments, such as thermometers, hygrometers, barometers, hydrometers and time pieces, for measuring temperature, moisture, pressure, density and time.

4. Special measures used in cooking.

The housewife's safeguards—accurate measures. These are glass graduates, pints and half pints, and accurate spoons, from table to quarter teaspoons

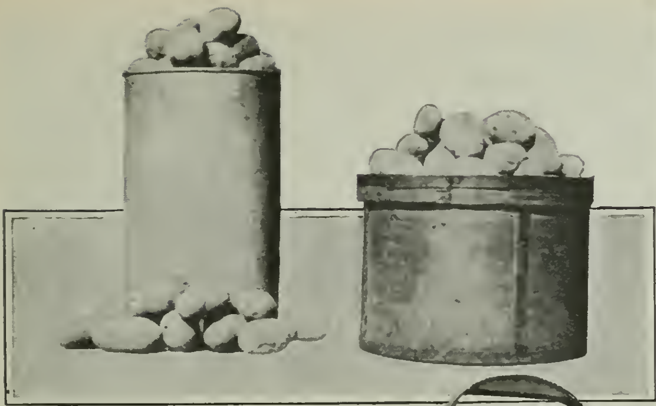


A "crab" or "handcuff" scale. By combining its parts incorrectly, results greatly in error are obtained, the commonest method resulting in shortages of 25 per cent

The basis of the kitchen system of weights and measures is the standard cup. Ordinary china cups cannot be used, since they vary in size. A special set of spoons will also be found convenient.

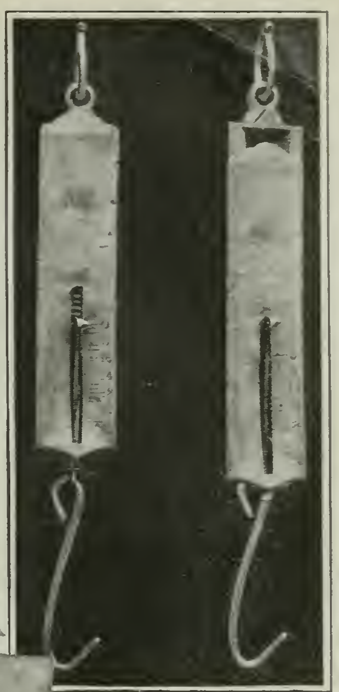
Accuracy in measurement should not be confined to baking and cooking, but should also extend to buying. In this regard, it is a fact that many housewives scrutinize the cost and quality of goods, but fail to realize that unless the quantity is determined, the actual cost price is not ascertained. Dishonest merchants, whose prices are low, may be making big profits by giving short measure.

The Bureau of Standards discovered that only a few states and a few of the larger cities maintained any efficient inspection service, and that negligence in this regard was costing the consuming public large sums of money, and putting a premium on dishonesty in competition. Shortage in weights and measures was found to be common. The honest dealer, as well as the purchaser, suffers from the existence of such fraud, since the possessor of a lying scale can apparently undersell him



These two measures have the same capacity, but the tall measure, which has no bottom, has so small a diameter that a proper heap cannot be obtained. Note the overflow

The purchaser of gasoline sees only the five-gallon measure, but the three-gallon measure inside is the one really filled



This straight-face spring scale has a fraudulent sliding face. The left one is used in buying. The seller slides the face downward, as on the right, thus greatly decreasing the indicated weight and defrauding the unsuspecting buyer

and yet actually receive more for his goods. As an example, it was estimated that the consumers of the country lost annually more than eight millions on short-weight deliveries of one staple article of food.

The methods of cheating and the types of false apparatus exhibit great variety. Among the different types of false capacity measures may be mentioned those having movable or false bottoms; measures having a portion of the height cut away from either the top or bottom; measures with staves removed and the hoops and bottom adjusted accordingly; "bottomless" measures which have relatively small diameters and high sides, and which—although they may contain the proper number of cubic inches—give incorrect quantities, as they do not permit a proper heap; measures with false interiors, such as have been found in milk cans and measures for selling gasoline; and liquid measures used for dry commodities. This last expedient is in use to some extent in practically all parts of the country and results in a shortage of about fourteen per cent. It is one of those practices which has come into use largely through "trade custom."

The use of correct measuring scales of high quality is not always in itself a guarantee that correct amounts will be given, for it is possible for the user of correct scales to manipulate them to his advantage. A type of scale, which was formerly common among certain classes of dealers, is the straight-face scale, designed to be held in the hand, with the graduated face made movable, so that the dealer might lower or raise it so as to make the pointer indicate an amount less or greater than the true weight, according to whether he was buying or selling. Many other forms of false scales have been used for years.

A large hospital for infants has recently been equipped with a number of rooms with glass walls, so that without entering the rooms nurses may observe the babies as easily as if they were so many fish in an aquarium

Babies in Glass Cases

TWO years ago the Hebrew Infant Asylum at Kingsbridge Road and University Avenue, New York, adopted the plan of using glass cases for babies admitted to the observation building. As a result the children may be observed without the necessity of entering their rooms.

Each child is supplied with its own utensils, towels, bath, etc. If one baby develops a communicable disease it is impossible for it to give it to another. This is the first building of this kind to be erected in the United States. The idea was taken from some European institutions and adapted to the needs of this asylum. There are glass chambers enough to accommodate twelve babies ranging in age from a few days up to one and a half years.

Why Is the Sun Hot?

IF we could build up a solid column of ice from the earth to the sun, two miles and a half in diameter, spanning the intervening distance of ninety-three million miles, and if the sun should concentrate his entire power upon it, it would dissolve in a single second, according to a calculation made by Professor Young. To produce this enormous amount of heat would require the hourly burning of a layer of anthracite coal more than nineteen feet thick over the entire surface of the sun. If the sun were composed of solid coal and we derived our heat from the burning of that coal the sun would burn out in less than five thousand years. Since the earth is millions of years old the sun can not be burning. Its heat must be generated in some more persistent way.

The great German physicist Helmholtz was the first to explain satisfactorily what keeps the sun hot. The sun is not burning; it is heated to the glowing point, like a piece of white hot iron. Helmholtz found that if we suppose the sun to be contracting by only two hundred and fifty feet a year we would receive our present amount of heat. In other words heat is being literally squeezed out of the sun. Professor Newcomb estimated that when the squeezing process has continued for about seven million years, the sun will be one half its present size.

A Dollar Made of Corn

A REMARKABLE reproduction of a silver dollar was recently made by George Herren, a cabinet maker of Pella, Iowa. This reproduction which is thirty-two times the size of its model, is constructed entirely of kernels of corn, glued to a backing of heavy pasteboard.

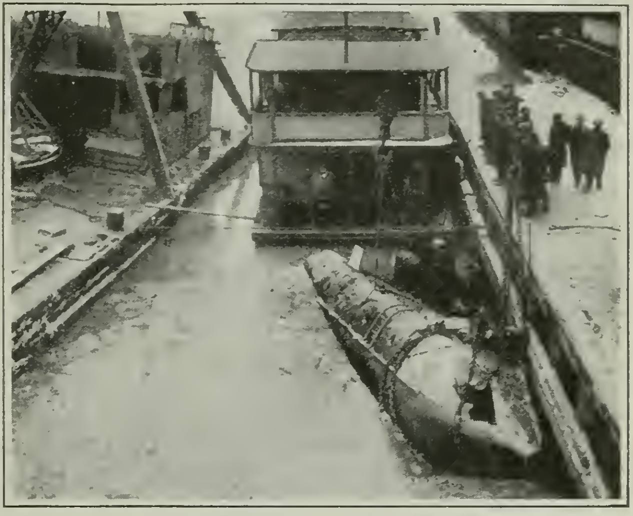
As shown in the illustration, the resemblance is very close. It is estimated that over a quarter of a million kernels of corn were used, and its construction occupied the maker's time for more than six months. More than thirty different shades of color are to be found in the "dollar," which is to be found on exhibition in the home of the patient cabinet maker.

A CHURCH, claimed to be the smallest in America, was recently dedicated in Manchester, N. H. The main auditorium is eighteen by twenty-eight feet, with seats for about seventy persons. In a tiny gallery are seats for twenty-eight. There is also a vestry and a basement.

The Lady on the Dollar appeared on a giant disk of corn kernels after George Herren had spent many winter evenings on his mosaic

A Submarine That Dived But Once

TWENTY years ago an aspiring inventor in Chicago designed and built a submarine which he claimed would revolutionize the construction of underwater craft. The public, being somewhat skeptical, christened the marvel "Foolkiller Number One," and turned out in large numbers to see its trial trip in the Chicago River.



This is the "Foolkiller," a submarine boat which Chicago watched disappear twenty years ago, and saw reappear only a few weeks ago for the first time since it was "tested" so disastrously

Its ability to dive was at once demonstrated, for the new boat immediately submerged, and appeared no more. A few months ago, the ill-fated craft was raised to the surface after several unsuccessful efforts had been made to drag it out of the river mud. It is said that the "Foolkiller" will be placed on exhibition on dry land, as it is feared that its natural ability for submerging will be demonstrated again if the ship is left in the water.

IN New York City, one person is injured by a motor vehicle every seventy-five minutes. One victim out of every twenty dies.

THE bones of all flying birds are hollow, thus combining the greatest strength with the least weight.

The type furniture awaits the make-up man in a rack attached to the "turtle" table

A Motion-Saving Rule-Case for Printers

HERE is pictured a little invention, just out, which will be appreciated by every printer. It is a time saver in newspaper offices, and a saver of many steps to all those who make up type into the forms.

This is a new style of rule case for printers to be connected with the form chase within easy reach of the make-up man who has occasion to use the many-sized rules required in making up his page of type matter.

Heretofore the make-up man had his rules somewhere in a separate case near at hand but never within easy reach, so that whenever he wanted a certain-sized rule it was necessary for him to go to the case and get it.

With this new invention, all the different-sized rules are right at the page he is making up, and all he has to do is to reach over the page and pick out just the kind of rule he needs without even changing his position over the type.

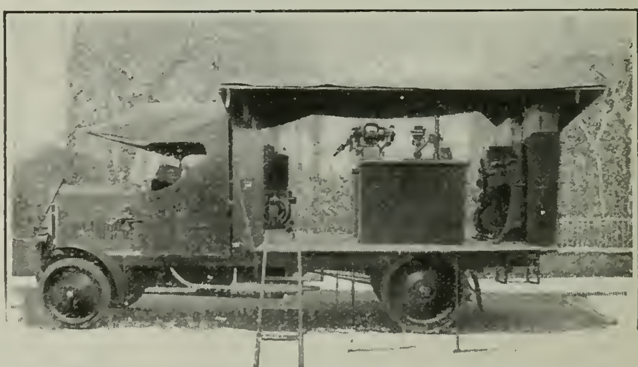
The case of rules extends over the end-screws in the chase, and when the page is made up and ready to lock, the case is lifted off the end screws and hooked on to the next page to be made up. The invention is being used in the make-up room of one of Cincinnati's largest newspapers.

An Automobile Machine-Shop for the Battlefield

BECAUSE of the great number of automobiles and aeroplanes which are being used by the armies in the field in Europe, it has been found necessary to provide a practical traveling workshop which may be hurried to any point along the road where a breakdown has occurred.

One of the most complete of these workshops is shown in the accompanying illustration. Upon a powerful motor-truck is mounted an independent power unit, consisting of a dynamo, switchboard, and a charging-set. Two work benches are provided for the workmen who accompany the car, and these are equipped with a five-inch lathe, drills, grinders, and a complete set of tools.

One of these traveling workshops will soon be attached to each column of the Royal Flying Corps and to the British Army Service Corps, in order that all repairs may be made at the front without the necessity of requisitioning aid from the service stations at the army headquarters.



Traveling automobile repair shops were a novelty at the automobile shows two years ago. To-day they are common necessities of war

A Steel Hill to Test Automobiles

THE ability of a motor car to climb a hill "on high" has long been considered a necessity by motorists and a selling argument by manufacturers. And because Detroit, where many motor cars come from, is in a flat section of the country where hills are the exception, one manufacturer has built the steel test-hill illustrated. Furthermore, this same manufacturer has also constructed a half-mile track for speed tests and what is termed a "sand pit."

Detroit automobile dealers had to build this steep hill to order so as to have grades where they could demonstrate the hill-climbing proclivities of their cars in that city of level highways

The track permits speed tests, and in the "sand pit" the testers alternately sink the cars to the hubs and then drive them out of the clinging sand.

But the test hill is perhaps the more remarkable. The hill is located in the center of the speed track and is built entirely of structural steel. It is five hundred and forty-two feet long and thirty feet wide. The two approaches have grades of varying steepness so that cars can be tested on gradual and steep inclines.

The speed track is built of wood, more than two hundred and fifteen thousand square feet of lumber being required. It is built on a foundation of clay and cinders with the turns banked and is surfaced with pine planking, creosoted to afford a dustless surface for the tests.

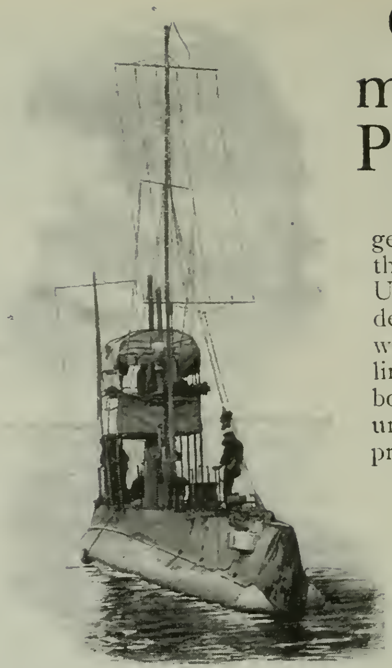
The Noisy Motor-Boat and the Unabashed Fish

CONTRARY to general opinion, a number of motor-boats cruising about a harbor with more or less noisy engines have no appreciable effect upon the fish in nearby waters. It has long been thought, particularly by fishermen, that the presence of a noisy motor-boat would drive the fish away. Exhaustive experiments recently conducted by the Bureau of Fisheries prove this theory to be incorrect.

In testing the effect of motor-boat noises, on fish, a number of young scup, known to be sensitive to sounds, were placed in a large wooden cage. This cage was fastened in quiet water at the end of a wharf, and a motor-boat with a very noisy engine was run at varying distances past the cage. At no time did the fishes appear to be disturbed by the noise, except when the splash from the boat hit the cage. Then the scup would generally dive to the bottom of the receptacle.

Another test was made with baited lines. When a number of fish had commenced to nibble at the bait, a motor-boat was backed up under its own power until its stern was directly over the lines. The fish continued to nibble until driven off by the backwash from the propeller.

Can Battery Explosions On Submarines Be Prevented?


The United States Submarine E-2, the latest victim of a naval accident which has been attributed to the explosion of battery gases

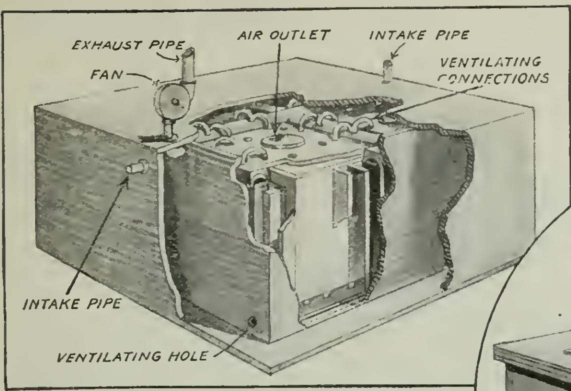
HARD upon the disaster which befell the F-4 off Honolulu—a disaster which resulted from a storage-battery lining and rivets being corroded by sulphuric acid fumes — comes an accident sustained by the E-2 which seems to be due to the explosion of gases generated by the storage battery. When lead-plate storage-batteries are employed, gases or fumes are likely to escape from the battery compartment and to suffocate the crew; the fumes (a fine spray containing dilute sulphuric acid in suspension) are very penetrating and eat into the machinery of the boat and parts of the hull, causing corrosion and destruction of the metal. At least one French submarine was lost as a result of this corrosion. In the Edison type of battery, which does not employ lead, hydrogen gas is generated, which when mixed with the proper volume of air, is highly explosive. Whether the old lead battery or the modern Edison battery is installed, a ventilating system must be provided in order to remove the gases. From the very first, then, we find that submarine designers have bent their minds to the installation of blowers and ducts which will suck out the dangerous gases and conduct them to the outside of the vessel. The illustrations on the opposite page show very clearly the fundamental principles on which these ventilating systems are based.

But, after all, this is a makeshift. The storage battery is inherently dangerous. Recognizing this, the Navy Department has for over a year been at work trying to do away with storage batteries altogether. It seems likely that before long the United States Navy will develop a submarine in which the same propelling engine will serve both at the surface and under the surface. At present Diesel engines drive the vessel when she is above water, and electric motors deriving their current from storage batteries, are employed for underwater propulsion.

While nothing definite is as yet known about the Navy's experiments, it is certain that compressed air will be used, which will be stored in tanks occupying the space now taken up by the batteries. The air will not only serve to feed the engines but also to provide a purer atmosphere for the crew. It seems certain that with the compressed air system the radius of the submarine will be increased. Why? Because the electric motors for underwater propulsion will be dispensed with and their place taken by compressed air tanks. In other words, the space formerly occupied by storage batteries and by electric propelling machinery is to be taken up by compressed air tanks, representing so much stored power.

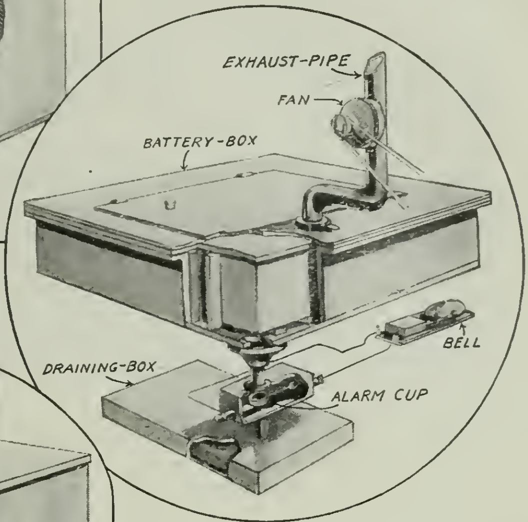
As soon as the submarine reaches the surface it will suck air in automatically through its pumps. In other words it will breathe when it reaches the surface just as if it were a mechanical whale.

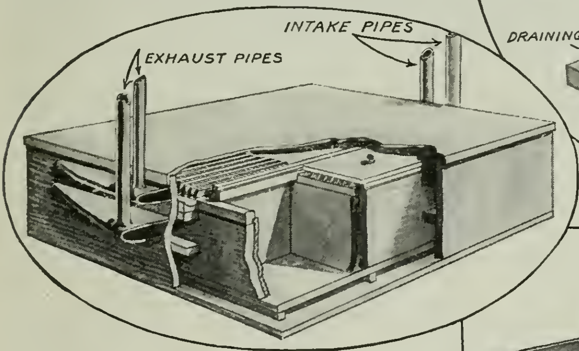
The United States Navy has been freer from terrible submarine accidents than that of any first-class power. But even the two accidents which American submarines have had are two too many.



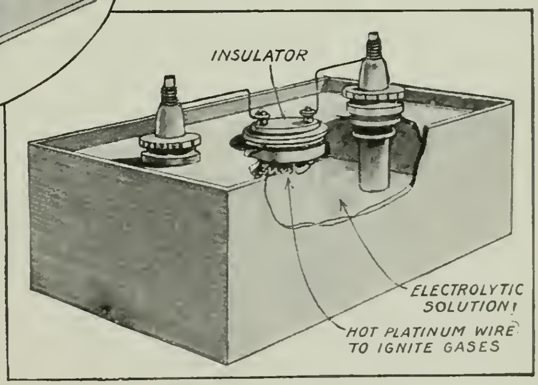
Above and below are shown the usual methods of ventilating. One cell is insulated from another

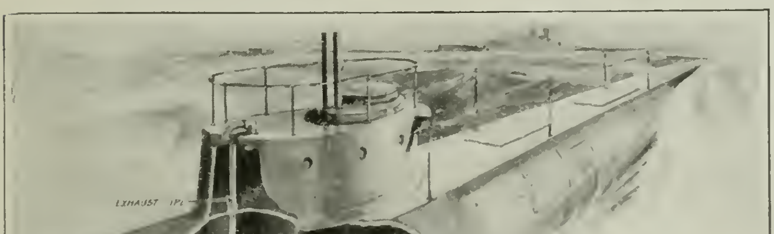
The method of ventilating batteries shown below was patented by the builders of the Holland boats. An alarm rings when a jar has been broken. An insulated tank collects the leakage





Edison patented the method on the right of coping with the hydrogen and oxygen gases of his battery. These form an explosive mixture, which is ignited by a red-hot wire. As Edison says "By my process I cause the combination of the oxygen and hydrogen to take place at shorter intervals before the quantity of the gases evolved have become sufficient to render explosion dangerous"





To the left, Simon Lake's way of ventilating storage batteries. An air-duct extends through the battery compartment. It is connected with a suction fan discharging into a pipe, leading through the top of the hull. A non-return exhaust-valve prevents water from reaching the air-duct and cells

Capturing Jamaica for a Film Play

By George F. Wörts

A Moorish city, covering thirty acres of ground, with castles as well as huts, and costing thirty thousand dollars, is but part of the gigantic setting of the new film play

WHEN Annette Kellerman and her large company of players arrived in Jamaica one day last August with the intention of making a moving picture that would cost somewhere in the neighborhood of one million dollars, she found that the entire group of islands was under martial law. Jamaica was heavily garrisoned, all sorts of restrictions were placed upon strangers, and into this unfriendly atmosphere of British colonial red tape came an invading army of actors and actresses, cameramen, electricians, property men, scene painters, directors, and what not. Besides all these there were, of course, heavy artillery in cameras, and the ammunition to be fed to them, tons of chemicals, properties enough to stock the Metropolitan Opera House for a Wagnerian season, and just for good measure an entire menagerie, consisting of lions, tigers, elephants, camels and other creatures calculated to lend Oriental atmosphere when the right time arrived.

Whether or not the estimated cost of one million dollars has undergone the usual press agent's expansion, the fact remains that the picture will be one of the most spectacular that has ever been produced in the whole history of films.

A fair idea of the amount of materials required for the stage settings, costumings, handling of films, etc., can be gained from the knowledge that five shiploads went down to Jamaica from New York the first time. The first consignment of actors, actresses and workmen alone amounted to twelve hundred persons. One thousand tons of properties and stage settings have been shipped.

To insure the proper attention to the cinematographic film, chemical laboratories, storehouses and printing and developing plants have been constructed. An ice plant for chilling the tropical water used in development was erected.

One of the first tasks to which the director in charge, Herbert Brennon, set himself was the construction of the largest stage that has ever been built. It measures over all five hundred by two hundred feet, and is being used for the erection of giant "sets" of all varieties. More than six different companies occupied with different scenes of the film can work at one time.

Probably the most cumbersome task is the construction of an inland Moorish city which covers thirty acres of ground. Contrasted to the usual flimsy structures used, it was necessary that these buildings be made of durable materials, owing to the destructiveness of the West Indian hurricanes. Thirty thousand dollars is the estimated cost of this city.

Another important feature which will be unique in film history is the storming of the historic old fortress of Augusta. Before reconstruction of this aged ruin could be attempted, it was necessary to make the locality thoroughly sanitary. For putting the fort in presentable shape several boatloads of concrete, stone and steel—all of the stuff of which fortresses are made—were shipped down from New York. It has taken five months to complete the restoration.

A section of the big stage floor, with the executive offices at one side. A portion of a Moorish house may be seen in the foreground

Now that it has been rebuilt, Fort Augusta is to be destroyed and the task of destruction falls to the lot of the West Indian squadron of the British navy. Real powder and real shells will be employed. Needless to say, it required several weeks of persuasion before the permission to stage this battle could be obtained. Before this issue of Popular Science Monthly will have reached the newsstands, the West Indian fleet with decks stripped as in actual battle, with gun crews stripped to the waist, with range finders perched in the conning towers, will be bombarding the fortress—and Fort Augusta will have again crumbled into ruins.

Quite as interesting as the construction problems that have been involved is the number of players who will appear in the film. In addition to the twelve hundred actors and "mermaids," there are scheduled to appear ten thousand Hindus who have been held in Jamaica since the completion of the Panama canal, five thousand British cavalrymen and more than five thousand native Jamaicans who have been recruited for the various mob scenes.

The exact nature of the film has not yet been divulged, nor has a name been decided upon. A few of the facts that are known is that besides the bombardment of Fort Augusta, and the use of a Moorish city, there will be a number of mermaid scenes; Trinidad asphalt lake will figure; some of the scenes will take place in the heart of the jungle; and a submarined ship is included somewhere on the programme. Just how consistent the plot will be with all this array of the spectacular, is something for time and the audience to decide.

A Transfer Solution

PRINTED pictures from magazines, newspapers, folders, etc., may be transferred to paper, cloth, cardboard, glass or china with the following solution:

One bar of common soap is dissolved in a gallon of hot water, to which one-half pint of turpentine is added. After it has stood for a night, stir well and bottle. The solution is applied to the print with a soft brush or one's fingers, and the material to which it is to be transferred is placed upside down on it. The back of the material is then rubbed and the design is transferred.

A picture may be transferred to glass for the purpose of a lantern slide. In such a case the glass must be varnished with a perfectly transparent varnish before transferring; then proceed as before. Pictures are transferred to china in the same way.

The Cost of the Great War

A chain of double eagles extending forty-four thousand miles is the cost of the war to date

$12,100.68—The Cost of Killing a Man in War

By Herbert Francis

WHEN walking along the Ringstrasse in Vienna one day a few years ago, I found myself in the neighborhood of the Hofburg, the Imperial and Royal palace. It was one of the days when visitors were admitted to the "Treasury of the Imperial House of Austria," so I turned through the gate and having witnessed the impressive ceremony of the changing of the guard, paid my krone and marched in. Purchasing an official catalogue of the treasures, I looked at the display of royal insignia, crowns and swords, the sacred relics such as a nail from the true cross and a tooth reputed once to have rested in the jaw of John the Baptist, and the diamonds, emeralds, pearls and rubies included in the list. Of all that I saw, I was most impressed with a sentence in the introduction to the aforementioned catalogue. It read that in 1876 it had been "decreed that in the future the Hapsburg - Lorraine private treasure should only include those objects which were held to be essential as demonstrating the power and wealth of the reigning family."

It costs over twelve thousand dollars to kill a man in this war

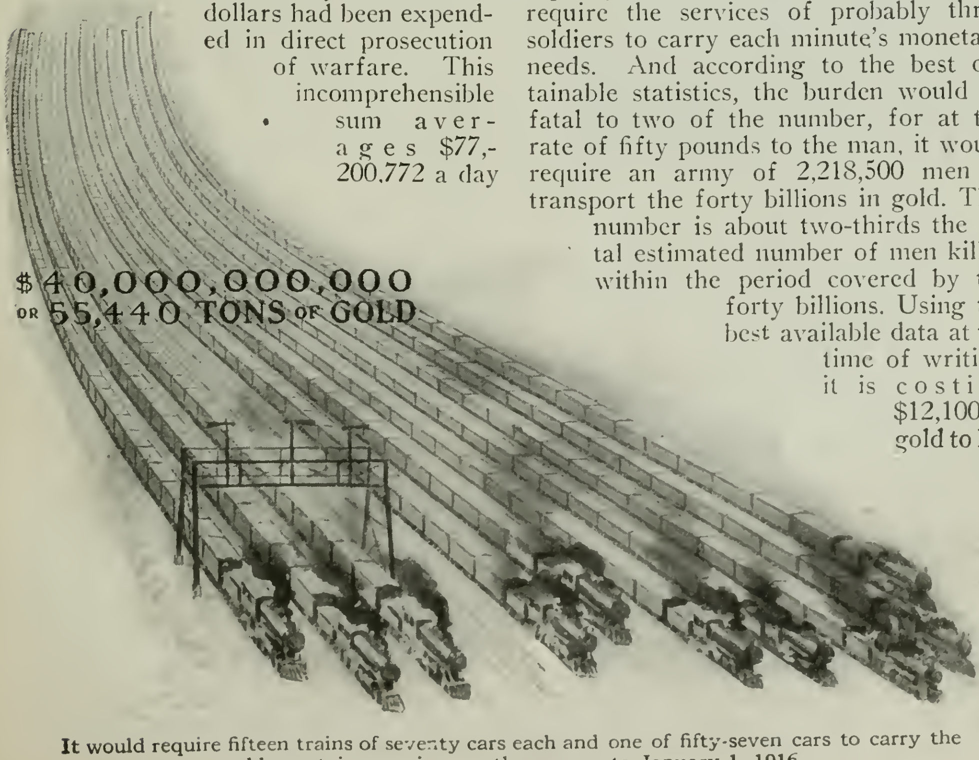
This might do very well for the consumption of the ignorant peasant of the Austro-Hungarian empire, but I imagined what would be said of the taste of a democratic American family which should thus blatantly announce in opening its gallery of art objects and relics to the public that the collection had been made with the purpose of "demonstrating the power and wealth of the family."

Later I visited the royal palace in Berlin. My chief recollections are of the plaster imitations of curtains with which a number of apartments were bedecked, the great felt slippers with which every visitor was equipped in order to protect the polished wood floors, and the theatrical manner in which the Kaiser's gold plate was displayed in the throne room. The golden vessels reposed on a metal framework so designed as to give opportunity for the close examination of each piece. The whole was enclosed in a glass cabinet with mirrors at the back. As the visitors entered the room an attendant would open a small door in the wainscoting and throw an electric switch, lighting up the interior of the glass case with invisible globes. By means of these footlights it was possible to see clearly both the front and the back of the golden dishes. With truly Teutonic efficiency, the attendant cut off the current as soon as the visitors turned to leave the apartment.

I have described these two exhibitions by which the Teutonic rulers chose to demonstrate their wealth and power by way of showing how standards change. For more than a year now a method of demonstrating wealth and power has been exhibited in continental Europe which makes the old seem disgustingly cheap and picayune. All the jewels and gold plate in the palaces of Vienna and Berlin taken together would not foot the war bill for one day.

Three men would be required to carry the gold used to run the war for one minute

While exact figures showing the cost of the war will not be compiled until after it has come to a close, yet estimates have been made which show what a great destroyer of wealth it is. The best estimate is that up to January 1, not less than forty billions of dollars had been expended in direct prosecution of warfare. This incomprehensible sum averages $77,200.772 a day since war began and does not take into consideration the billions of dollars' worth of property wiped out in the countries invaded and through the deaths of millions of workers. For each minute of the day, the nations at war are obliged to pay out $53,611.64. Imagining this to be in gold and put into bags having a capacity of fifty pounds each, it would require the services of probably three soldiers to carry each minute's monetary needs. And according to the best obtainable statistics, the burden would be fatal to two of the number, for at the rate of fifty pounds to the man, it would require an army of 2,218,500 men to transport the forty billions in gold. This number is about two-thirds the total estimated number of men killed within the period covered by the forty billions. Using the best available data at the time of writing, it is costing $12,100.68 gold to kill



It would require fifteen trains of seventy cars each and one of fifty-seven cars to carry the gold spent in carrying on the war up to January 1, 1916 a man. War is a costly undertaking.

It was once even less efficient and more costly. In the Civil War, the number of Northern soldiers who died was 360,222, while the South lost, at the lowest estimate, 250,000. That war cost the North $6,189,929,908, while the South's bill was at least $3,000,000,000. It therefore cost approximately $15,059.97 to slaughter a man. Killing is done in a more wholesale fashion nowadays.

Fortunately, the warring nations are not obliged to gather together the forty billions and transport it at one time to the front. If they did, it would require fifteen trains of seventy cars each, and one of fifty-seven, each car being of the fifty-ton pattern used in hauling coal from the Pennsylvania mines to tidewater at New York harbor. This would interfere with the movement of food supplies, guns and other munitions of war for the time being. The weight of the gold would be 55,440 tons.

Even if it were desired to do this, there is not enough visible gold in the world to permit it. According to the figures of the director of the mint, the world's production of the precious metal between the years 1850 and 1913 inclusive, was $12,072,058,618, or less than one-third the estimated cost of the war. This, added to the $225,000,000 assumed to be in the hands of the potentates and other wealthy Europeans prior to the discovery of America, and the $3,383,224,000 figured to have been brought to view between the time Columbus first saw the Western Continent, and the discovery of gold in California, still leaves a deficit of nearly twenty-five billions to be made up otherwise.

But let us suppose there were forty billions of gold in the hands of mankind, and that through some gigantic financial operation it had reached America and been coined into double eagles. There would be, if the gold were alloyed with other metal to the usual degree of fineness, 2,222,222,220 of them, enough to cover the site of the Woolworth Building to a depth of seven feet eight inches, or form a pillar the height of the building, seven hundred and fifty feet, and twenty-two feet square. If placed on edge and face to face, they would form a roll 3,653.42 miles long. This roll would extend from New York to a point in the Pacific Ocean about six hundred miles west of San Francisco. Or, taking their diameter as one and five-sixteenths inches, they would pave a boulevard three hundred and fifty-one feet wide extending from one end to the island of Manhattan to the other a distance of thirteen miles. What a shining road that would be! The Irishman who expected to pick up dollars in the streets as soon as he landed, would literally be able to do it, assuming that the gold pieces were no better secured than is the surface of some of New York's thoroughfares. That great highway, broader than Broadway, would be the nearest approach to the streets of the New Jerusalem described by John, that the world could ever expect to see. And if all these gold pieces were laid flat in a single row, edge to edge, they would extend 43,841.12 miles around the waistcoat of the globe.

This would, indeed, be a "demonstration of power and wealth" that would make the display of jewels, relics and gold plate of the Teutonic ruling families look like a penny peep show.

A Mystifying Chemical Trick

A PLAIN blue handkerchief is shown to the audience. When the handkerchief is warmed it turns white and when heated resumes its former color.

Make a starch paste and add enough water to the paste to thin it. Then add sufficient tincture of iodine to color the liquid blue; a few drops will be enough. Dye a white handkerchief with this blue liquid and when the handkerchief is dry it is ready for the trick.

Raising a Motorcycle Stand Automatically

A MOTORCYCLIST may save the time and trouble of raising the stand when the machine is pushed off, by fastening one end of a door-spring to the stand near the bottom, and the other end to a convenient place on the luggage carrier. While the machine is on the stand, the spring is stretched, but the removal of the weight releases it, and the stand is pulled back into place.

What Makes an Electric Lamp-Bulb Glow?

WHEN you heat iron in a forge it becomes either red hot or white hot, depending on how hot it is. It sends forth light. The hotter it is the more light it gives. Finally there comes a point where the iron melts away.

The best light-giving material is that which will melt at the highest temperature. Carbon is a material which cannot be melted easily; but it burns up in the open air long before it reaches the melting point. Edison conceived the idea of making a little thread of carbon, of placing that thread in a bulb, and of heating it by the electric current to the highest possible point. In order to prevent the carbon filament from burning up he pumped out all the air in the bulb. The result was that the thread of carbon was heated to the glowing point, so that it gave a very bright light.

Tungsten is a metal which melts at the highest melting point. It ought to be the best light-producer, since it can be heated higher than any other metal without melting. The trouble is that tungsten is exceedingly brittle, so that a thread cannot easily be made of it. This difficulty was overcome about twelve years ago by making a paste of powdered tungsten and forming a thread of this paste. Later still a way was found of so treating the tungsten that it could be drawn into a hair-like thread a mile long if necessary. All modern electric incandescent lamps have such tungsten filaments. They consume very much less current than the older carbon-filament lamps and give a much whiter light, simply because tungsten can be heated so very much before it melts.

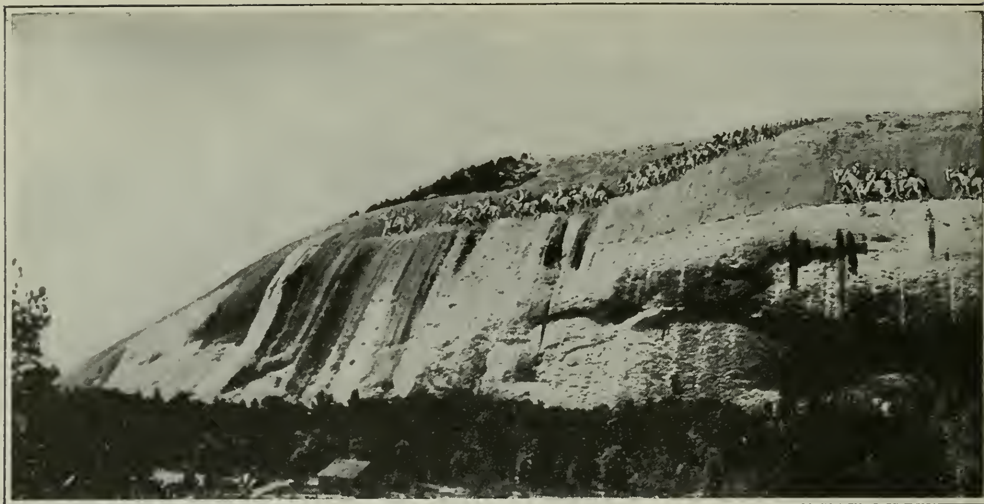
THE Department of Agriculture asserts that on the average farm a flock of one hundred to one hundred and fifty hens is more easily made profitable than a flock of one thousand.

A Top That Never Stops Spinning.

ELECTRICITY has invaded the young boy's field of sportsmanship. The record spin in the game of whose-top-can-stay-up-longest has been shattered so badly that the cord-spun top, in comparison, really does not spin at all.

A top which will keep on spinning forever —or until its battery wears out. It affords indeed "endless" amusement

Like most other things that electricity takes a hand in, the electrical top does not topple after a mere spin; it whirls on for hours, according to the desire of its youthful operator. The top, in reality, is a miniature electric motor turned on end. In place of the steel peg and the sidewalk, there is a steel shaft which revolves in a bearing, and instead of the wooden pear-shaped body, there is an iron armature wound with wire. At the top of the shaft varied colored disks are placed. When the current from a dry battery is turned on, the shaft revolves and the disks spin, giving a pleasing effect in rainbow colors.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The march of the Confederate Army as it is to be immortalized in the living granite of Stone Mountain, near Atlanta, Georgia. On the face of this mountain hundreds of men will be

Carving the Confederate Army in a Granite Mountain

A MONUMENT to be carved out of the living granite of a mountain, a monument of flawless granite two miles long and a thousand feet high—to be built as an everlasting memorial to the people of the South and the cause of the Confederacy—such is the gigantic task allotted to Gutzon Borglum, one of America's foremost sculptors.

This great monument is to be carved from the solid granite composing Stone Mountain, which is located near Atlanta, Georgia, and which is called "the largest pebble in the world," since it is one solid stone, two miles long, without a flaw or a fissure in its entire surface.

Upon the face of the mountain hundreds of men will be engaged for eight years in carving companies of giant figures representing the Confederate Army and its famous generals on the march. Should Mr. Borglum wish to complete the task alone, he would have to live for centuries. The central portion of the group, bearing the likeness of the leaders of the army on horseback, will be approximately thirty-five to fifty feet high. The line of marchers will be nearly two thousand feet in length.

Each State of the Confederacy will be represented by one of the generals who led the Southern Armies, and the characters will be selected by committees from the various states. Thirteen immense columns will also be cut in the base of the mountain, to represent the thirteen Confederate States.

The difficulties of construction, Mr. Borglum asserts, will not be great. He will build a studio, about one hundred feet long, squarely upon the axis of the face of the mountain, and from three-quarters of a mile to one mile from its face. In the side of the studio he will have a window of such length as will show the full field of the mountain intended for the figures. Then he will draw the figures on the window to scale, cross-lining it, and on the mountain, as it appears on the window, he will draw in the entire work on the window itself. By a little imagination, the drawings on the glass will appear as figures on the actual stone.

By shifting his position the sculptor can shift the whole scheme of his design to any part of the mountain; and by moving towards or away from the

engaged for eight years in carving scores of colossal figures, representing the Confederate Army and its famous generals on the march. The portait studies are all to be likenesses

window he can increase or decrease the scale of the figures.

Cut into the heart of the mountain will be a memorial hall, running the entire length of the colonnade. In this imperishable hall will be kept the valuable records and relics of the Daughters of the Confederacy, as well as records of the Southern States.

A park of eighty acres will be laid out at the foot of the mountain, and from its path a suitable view may be obtained of the principal figures carved in the rock.

The cost of the work, which is now estimated at about two million dollars, will be raised by individual contributions from the entire people of the South. It is said that several wealthy people have offered to finance the entire project, but it was deemed best to make this a popular undertaking, so that it may more truly represent the spirit of the American South.

The Bridge That Telephones Built

THE building of the great railroad bridge which spans Hell Gate, was greatly expedited by the telephone. The work started last January, and in October of last year the steel arms that had been insistently creeping over the river from shore to shore were joined with the aid of a telephone system, which in itself was a fitting climax to one of the greatest construction feats the world has ever seen.

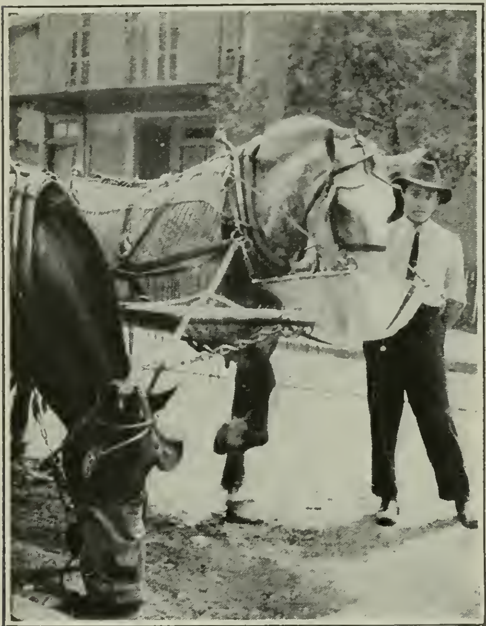
Telephones were located in the power houses, the offices, in the erector cabins, at the jacks, at the compressor house and on the structure in close proximity to the boss riveters.

The critical moment came on the day when both arms were completed and were ready to be lowered into alinement. The completed arms hung in midair exactly twenty-two and one-half inches out of alinement. The traveling erectors had been shoved out to the last eighth of an inch, another shove and they would have tipped everything over, and ruined a year's work, to say nothing of some twelve million dollars in steel.

Gages were affixed to the sides of the final beams marked off to the thirty-second of an inch, and at the exact spot the foreman stood with the telephone attached to a girder directly in front of him and with every station cut in and open. Every man knew his job and every man repeated back his telephonic order. It was a gigantic and responsible task to put up to the telephone, but the 'phone faultlessly carried the orders of the foreman over steel girders and under the East River to the men who stood at the pumps, the erectors and the riveting machines.

A Sensible Feeding Bag for Horses

A NEW feeding-bag for horses, devised by George W. Waddell, of Wilkes-Barre, Pennsylvania, makes it possible for the horse to feed in comfort.



The old and the new way of feeding a horse

This feeding-bag is bowl-shaped and not of cylindrical form. As it has hooks at its four corners from which straps and buckles extend to the horse's collar, it is much more readily fastened to the harness than the old-style bag. It is readily cleaned and emptied, which cannot be said of the old feeding-bag. Besides, it can also be used for watering the horse. Unlike the old-style feeding-bag, it can be folded perfectly flat when not in use and placed under the wagon-seat.

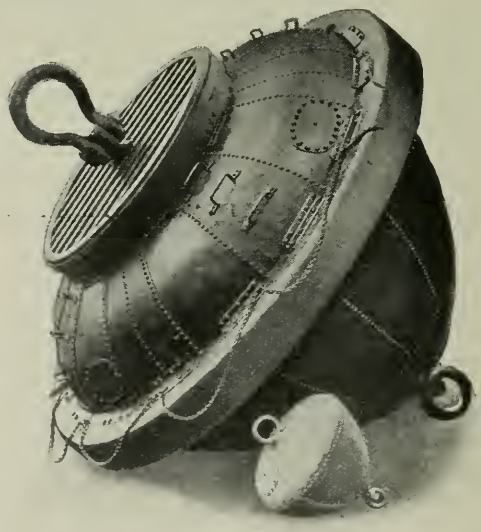
The accompanying illustration contrasts this modern, sanitary feeding equipment with the poorly-ventilated bag, that has to be tossed about by the horse if he wants to reach the last mouthful of oats at the bottom.

A Dreadnought's Buoy.

AS battleships have grown in size so have the mooring buoys to which these floating forts are made fast. The one shown in the photograph was recently turned out by a British firm. The buoy measures eighteen feet in diameter, and has a depth of thirteen feet. It is made of steel plates three-eighths of an inch thick, and has four water-tight compartments. A forged iron mooring bar passes through its center. It will withstand a breaking strain of 185 tons.

A wooden fender on the outside of the buoy protects it from collisions. This is made of elm and is one and one-half feet wide and about the same dimensions in depth. With mooring bar the buoy weighs fifteen tons. It carries a load of seven tons when one of the bulkheads is filled with water.

The smaller buoy seen in the photograph has a diameter of three feet and weighs two hundred pounds.



The buoy of a dreadnought has a platform all around on which the sailors can walk to attach the cables. The small buoy is of ordinary size—three feet in diameter

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Floating a Sunken Warship with a Bubble of Air

By M. G. Cary


Two great dangers faced the divers on the wrecked gunboat. The surf constantly beat over the ship and made it almost impossible for the divers to work, and numberless man-eating fish were attracted to the scene. The men had to work in large cages for protection

SALVING the Mexican gunboat *Progreso,* sunk by one of the factions opposed to Carranza at Progreso, Yucatan, was interesting because the vessel suffered an injury identical with that which would have been caused had she been torpedoed. What is more, she was converted by compressed air into a huge bubble, so that she was able to make a long voyage under her own steam. The repair, while provisional, was almost permanent. It was a steel patch applied while the ship was still submerged. The plates were of course bolted and not riveted, but the finished job compared favorably with one done in dry dock.

The story of how the gunboat was sunk has some of the amusing elements associated with Latin-American revolutions. When the *Progreso* was sent to Progreso by General Carranza to blockade that port, the wily Yucatecans hatched a plot. For several days the *Progreso* rolled about in big swells. Word was sent out to her captain that the Carranza sympathizers were going to communicate with him and try to send him fresh provisions. In the jail, a real Carranza sympathizer languished. He was made the unwilling tool of the plotters. Deceived into believing that he would be aided to escape, he was taken from jail, put in a boat with provisions, and sent out to the *Progreso.* As he

The ship had been sunk on a bar in the open roadstead, so that the upper works were awash. The surging of the rollers and the undertow made it difficult for the divers to work or to move about

In the first place the surf was heavy. The steamer sent down by the salvage company wallowed about seventeen days before it was possible to start work. The ship had been sunk in the open roadstead, but upon a bar so that the upper works were awash. Before the wreckers could start to raise her it was necessary to seal every opening; glass deadlights, hatches and bulkhead doors had been blown away. The surging of the rollers and the undertow made it hard for the divers to work or to maintain their footing. Even at low tide the obstacles were formidable, for the surf broke about their heads, and the heavy diving suits hampered them because they were not completely submerged.

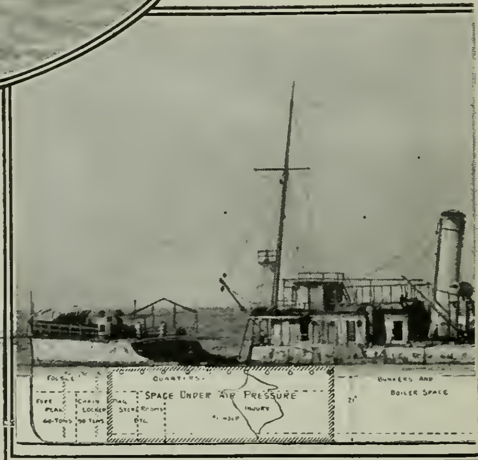


Diagram of the hold of the ship, showing the compartment which was filled with compressed air to make the steamer rise on what was practically a bubble

came alongside he was closely questioned. Some of the provisions were taken aboard, among them were a number of bottles of brandy. Perhaps the brandy allayed all suspicions. At all events it was decided to hoist on board a hogshead of lard. This was found to be already slung. Half way on its upward journey it exploded, killing about thirty men, wounding nearly the same number, and incidentally sinking the *Progreso*. The poor fool in the boat (if he really had known what he was doing, his courage would rank with that of Hobson), was taken on the deck of the sinking ship and shot with characteristic Mexican promptness. The *Auxiliar,* an ocean-going tug, happened to be near, and saved the crew from the sinking vessel.

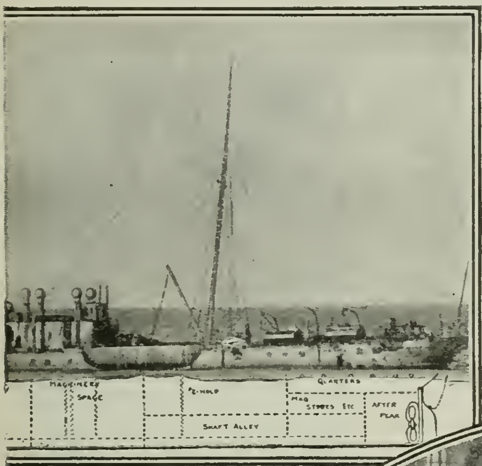
Five months later a New York salvage company was commissioned by the Mexican government to raise the ship. Ask the head of the wrecking expedition how the *Progreso* was salved, and he will answer: "By a board fence, a few lengths of barnyard netting, and a moving-picture screen." In spite of this airy description, the undertaking was fraught with many difficulties and real danger.

Cages Saved the Divers from Sharks

Man-eating sharks added to the hazards of the work; for they were attracted by the noise of hammering, and had to be fought off many times. Even more savage than the man-eating sharks was a peculiar fish with a cod-like head, called *tinteraro* by the natives. Finally the engineer hit upon the plan of caging his men. Uprights were placed on the four corners of the weighted scaffolds upon which the divers stood, and wire netting was run around the three sides. The *tinteraros* would make a rush for the men, but stubbed their noses against the netting. Men were always on duty with pikes to assist if the cage should give way. After nightfall the fish were attracted by hundreds, and it was feared that the combined weight of many of them would break the netting. Fortunately, it held until the operations were completed. cofferdam was erected on deck to bring the space to the same height and to facilitate draining the sunken body of the ship. The cofferdam is the above-mentioned "board fence," and the motion-picture screen was an eighteen by eighteen-foot canvas used inside the hull to close the wound. When all the hatches and deck were thoroughly sealed compressed air was turned into the hold, and the water receded as the canvas was put in place. After only four days of work the craft was towed toward the shore and beached. There the job was completed.

The steel patches were put on when the rent was still below the surface of the water, but where the surf could not harm her. A template was made to lay out the plating, i. e., a full-size pattern to show the exact size and shape of the hole and the location of any existing rivet-holes in the plating which might still serve to attach the new plates. The plating required was then laid out and drilled on deck.

Meanwhile the sand hogs, working in the compressed air, had driven out the rivets in the plating of the ship, where the holes would serve for the new plates. At certain points they drilled new holes, putting a wooden plug in each. The steel patch was then lowered section by section, by a derrick. Starting at the top, these sections were bolted in place over the rent. One by one the bolts were



Before the wreckers could start to raise the sunken steamer it was necessary to seal every opening

Lowering the plate into position so as to cover the vent in the side of the ship, made by the explosion. This was done under the direction of the divers by the derrick on the ship's deck. The divers placed it in position and set the bolts, which were fastened on the inside with nuts put in from the outside by the divers. As the sand-hogs on the inside removed the wooden plugs from the rivet holes, they also put in the nuts and bolts. In the vicinity of the injury, the frames of the ship were entirely destroyed, and they were supplanted by a new structure of heavy timbers. To make all this bolting tight, gaskets of red lead and lamp wick were used. Also, due to irregular contour of the hull plating, in many places it was necessary to fill in with concrete. Once before this method had been utilized, and by the same man, Mr. W. W. Wotherspoon, and that was when the *Royal George* went down in the St. Lawrence River.

Thus patched and plugged, the *Progreso* was finally pumped dry. She was then able to make a sea voyage to Vera Cruz under her own steam. After an examination it was decided that the patches would be allowed to remain as they had been placed, until a slight amount of work could be done to put her into excellent condition while in a New York drydock.

The *Progreso* is a vessel of fifteen hundred and sixty-five tons displacement, measures two hundred and thirty feet in length by thirty-four foot beam, has engines of 1,380 horsepower, and mounts four-inch guns.

The method by which the *Progreso* was raised is substantially the same in principle as that used in driving tunnels under the bed of a river. When the tunnels under the Hudson River were constructed, a "shield" was driven forward by hydraulic jacks. The men who dug and blasted the earth and rock encountered by the shield passed through air-locks; in other words, chambers in which air was forced at such high pressure that the river water was held back and prevented from inundating the workmen. Some conception of this air pressure may be obtained when it is considered that during the construction of the Pennsylvania railway tunnel under the East River a man was actually blown up through the mud of the river, arriving at the surface none the worse for his experience.

It is evident that a kind of air-lock was created in the forward hold of the *Progreso* and air at such high pressure was forced in that the sea water could not push its way in.

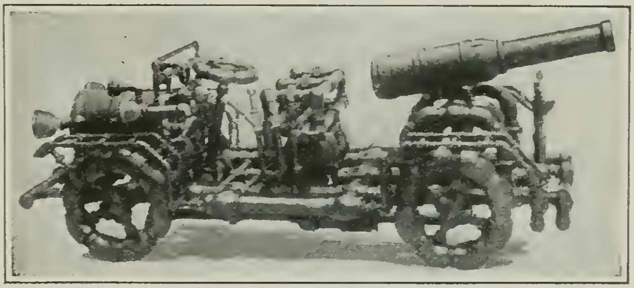
After the holes in the hull of the steamer had been patched with sheets of steel, and the forward compartments filled with compressed air, the powerful salvage pumps were started, and the vessel was quickly pumped dry

When the "Progreso" was pumped dry, she was able to steam to Vera Cruz, where she was dry-docked and thoroughly examined

A Military Automobile From Fittings

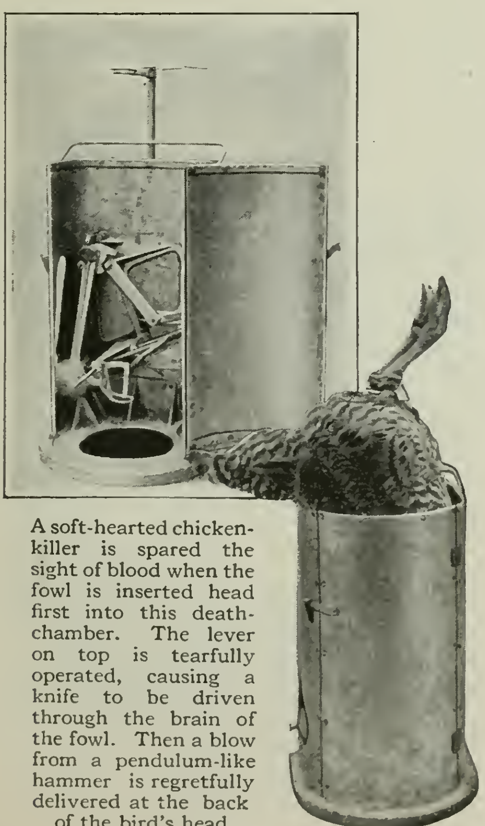
ONE of the most painstaking pieces of pipe-fitting work ever exhibited in this country is a model military automobile built entirely from malleable and cast iron fittings and so admirably put together that the wheels are almost perfectly round. The detail, even to the smallest parts, is very perfect and well proportioned.

The model contains one thousand one hundred and twenty-nine separate pieces and weighs seven hundred pounds. It is six feet long and two feet and four inches wide. It was built by Julius Genor of Bridgeport, Conn.



This model military automobile is built entirely of malleable and cast iron fittings

Although the material of which it is composed was cheap and easily obtainable, the model represents an immense amount of fine machine work.



A soft-hearted chicken-killer is spared the sight of blood when the fowl is inserted head first into this death-chamber. The lever on top is tearfully operated, causing a knife to be driven through the brain of the fowl. Then a blow from a pendulum-like hammer is regretfully delivered at the back of the bird's head

For Squeamish Fowl-Killers

A NEW and ladylike way to kill fowls has been devised by which the free flowing and spattering of a chicken's blood after lancing is prevented and the unpleasantness of viewing the whole sanguinary affair is removed.

What to the squeamish is the most distressing feature of the poultry business—killing fowls by hand—is eliminated by a machine, which does the work with accuracy and with a delicacy that must appeal to the aesthetic. The fowl is considerately suspended by the legs from yoke-like leg clamps, with its body and head within a tubular casing. In the lower portion of this casing is a dainty head-holder with a ring, in which the bill is inserted. A V-shaped collar is pushed into position and tenderly locked in place over the front portion of the neck of the fowl. The door to the casing is then decently closed, shutting the fowl from the horrified view. Next a lever extending out from the casing is boldly operated, causing a knife or lance to be driven through the brain of the fowl. To relieve any doubts that still linger a blow from the pendulum-like hammer is immediately thereafter delivered at the back of the head of the fowl. To relieve any doubts that still blood, which is caught in a small pan below the head, so that not even the machine is soiled. Could respect for one's feelings be carried farther? No undertaker can be more considerate. But, somehow, the old axe and the chopping block seem simpler and just as effective to our brutal mind. The fowl is certainly rather more tortured before the last quick death-blow is delivered.

This Automobile Signal Takes the Place of Your Hand When Rounding a Corner

THROUGHOUT the country it is the practice of motorists, when they are about to turn a corner, to extend the arm out of the car at the side toward which they intend turning. Drivers have learned to look ahead for this notice. The unusual signal here shown comes nearer to the extended arm than anything that has thus far made its appearance.

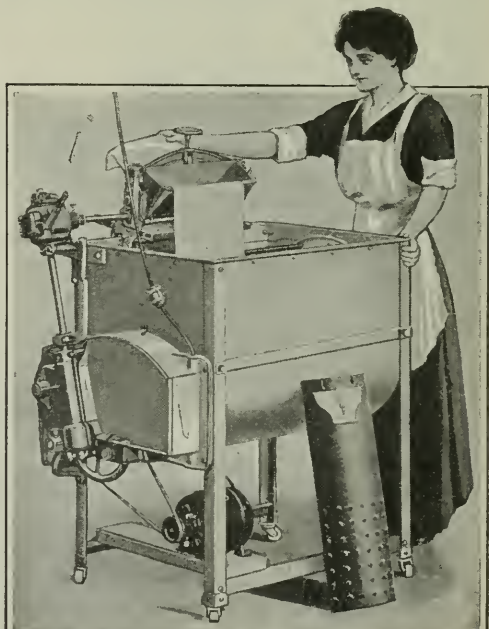
A red disk, raised by pressing a button, takes the place of the motorist's extended hand in making a turn

Upon approaching the corner the driver of the car, which is equipped with a pair of these signals, simply presses a button which is located at the top of the body near the side of the seat. As this button is pressed it operates a mechanism, which in turn swings this arm-signal outward from the side of the car so that it may be plainly seen by the driver of the machine that is following. When the corner has been turned, the button is again pressed, this action permitting the signal to drop down against the side of the car. This signal is equipped with a red disk for use during the hours of the day and a tiny electric lamp for night driving.

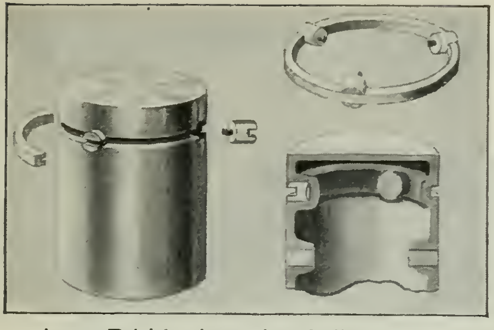
We are told by experts that seventy-five per cent of the driver's steering efficiency is lost the moment the arm is extended outward from the side of the car. By the use of this device the hands of the driver are upon the wheel when the corner is actually being rounded. The arm of this signal is about fourteen inches in length, twice the thickness of the ordinary lead pencil, and the disk is about six inches in diameter. With the exception of the disk and the globe, the contrivance is painted black, and everything except the small lamp is mechanically operated. The device is the invention of W. F. Irwin of Los Angeles, Cal.

A Safety Wringer-Guard

AS wringer rolls revolve very rapidly when operated by an electric motor the element of safety to the hands of the laundress is important. A new wringer-guard has appeared, the inventor of which has kept this in mind. In feeding the clothes into the wringer the hands are kept at a safe distance by this guard, the opening of which is large enough for bulky pieces, like blankets. The guard may be attached to either side of a reversible wringer.



The need of a guard to prevent injury to the fingers in an electric wringer has been met by this device



A new British piston ring, built on a new principle, for use on motorcycles and light automobiles

A Novel British Piston Ring

A BRITISH piston ring, especially adapted to motorcycles and light motor cars, has been constructed along entirely new lines, shown clearly in the accompanying picture. Nothing heretofore has appeared on the market, which even resembles the Gaskell ring, as it is called after its inventor.

The ring is made up from three segments, held in place by three plungers, inserted in recesses spaced equally round the circumference of the piston and slotted to receive the ring. They are held up to their work by small helical springs, which tend to press the rings against the inside of the cylinder walls. One of the plungers is fitted at the center with a small stud, which engages small recesses cut in the ends of two ring segments. This pin, shown on the left-hand side, prevents the ring from turning as a whole. The groove in the piston is deep, and only one ring is required, which is not distorted by being forced over the larger head of the cylinder piston into the slots. This is an advantage which cannot be gainsaid. Compression is good and frictional losses small in this type of ring.

ACCORDING to the report of the Police Commissioner of New York the policemen of that city are healthier than those of London and healthier than the soldiers of the United States Army. The average percentage off duty because of physical disability was 2.24 for New York policemen as against 2.43 per cent for enlisted men in our army, and 2.35 for the London police.

This Factory Burns "Sauerkraut" for Fuel

A WESTERN paper mill uses "sauerkraut" as a fuel for firing its boilers. Lovers of this Teutonic delicacy need not be alarmed, however, for the "sauerkraut" used in this reckless manner is not to be bought at the corner grocery store. This "sauerkraut" is a by-product of their pulp mill and looks so much like the vegetable that it was given that name in the mill.

The "sauerkraut" of the pulp mill is in reality the coarse material that is not completely ground up in reducing the logs to pulp. It is caught in screens, when the ground pulp is floated away from the machines, and is dried and delivered to the boiler rooms, where it is used for fuel.

A handful of "Sauerkraut," not the real thing, but the kind used for fuel. It is really wood pulp, the rejected portion of a paper mill's product

Why Cotton Is Contraband of War

By Hudson Maxim

Cotton: It will make a shirt to hide your nakedness or blast a subway to make transportation easier

COTTON happens to be the best combustible element to combine chemically with nitric acid so as to produce a high explosive, and also to serve as the principal ingredient for the manufacture of smokeless powder.

A bale of cotton may, therefore, be considered a bale of guncotton in embryo.

There are many kinds of nitrocellulose, depending upon the so-called degree or character of nitration, that is to say, upon the way in which it is treated with nitric acid and the strength of the nitric acid.

When ordinary cotton is immersed in nitric acid, the cotton absorbs oxygen from the nitric acid, but not as free oxygen, because the oxygen is taken up in combination with nitrogen. But the weight of the oxygen absorbed is much in excess of the weight of nitrogen, the nitrogen acting merely as a carrier of the oxygen. The appearance of the cotton is not changed to any appreciable extent, but the weight of the cotton is considerably increased.

The oxygen which the cotton absorbs from the nitric acid is sufficient to consume all of the cotton without atmospheric air, so that when guncotton is put in a confined space and set on fire it explodes with great violence, producing what are called carbon dioxide and carbon monoxide, with free nitrogen and steam.

When the cotton is immersed in the nitric acid the acid takes water out of the cotton, which dilutes the acid. But the cotton gets the best of the bargain, because the weight of oxygen and nitrogen which the cotton receives is in excess of the weight given up by the cotton.

In order to keep the nitric acid bath strong enough to act on the cotton, and to minimize the acid, it is necessary to add sulphuric acid to absorb the water, and it takes about three parts sulphuric acid to one part of nitric acid to make a proper mixture for this purpose. The sulphuric acid, however, has no effect whatsoever upon the cotton. It merely acts to absorb the water liberated from the cotton.

There are several ways in which the cotton is treated with the acid mixture. The oldest and simplest was merely to immerse the cotton in the acid, and when it was thoroughly nitrated to place it in a centrifugal machine and wring out the acid and throw it into an excess of water to wash out the remainder.

From the portrait by S. J. Woolf.

If you want to know how to write poetry or blast a subway, lay out a garden or design a battleship, ask Hudson Maxim. It is no off-hand slap dash opinion that he will give, but a well reasoned statement. For Maxim believes that everything could be reduced to a science, whether it is writing sonnets to your lady's eyebrow or defending the country against foreign invasion.

But Maxim is above all an authority on explosives. That is why we asked him to write this article for the POPULAR SCIENCE MONTHLY. *He invented the process of making the multi-perforated smokeless powder used by the United States. His Maximite, adopted by the United States Government, was the first high explosive which could be sent through armor plate and burst inside of a ship. That achievement in itself was enough to make any man famous. But then he is also the inventor of Stabilite, a powder which we have every reason to regard as important because it can be made quickly in an emergency. A torpedo invention of his, intended to do away with compressed air, has also been bought by the Government. Mr. Maxim is a member of the Naval Consulting Board.*

The way that is employed principally by the United States Navy is to do the nitrating in a centrifugal machine and when the nitrating is complete to set the centrifugal machine in motion, which extracts the acid from the nitrocellulose. Thereupon the nitrocellulose is quickly and thoroughly washed.

After the washing process is completed there is a quantity of acid remaining, and also there are contained in the nitrocellulose certain unstable compounds. These are removed by thoroughly boiling the nitrocellulose in a large excess of water.

After this is done the nitrocellulose is pulped in an ordinary pulping machine, like that used in making paper pulp. When this is thoroughly done the finely pulped nitrocellulose is gathered and pressed into cylinders. It still contains a considerable percentage of water, which must be removed in order to dissolve or gelatinate it as a step in converting it into smokeless powder.

This is done by forcing alcohol under pressure through the mass of pulped guncotton cake from the top, the water beig forced down ahead of the alcohol until it is driven entirely out at the bottom, and alcohol takes the place of the water.

This is called the replacement process, and was discovered by Francis G. du Pont. It is very important.

Making cotton contraband of war does not prevent the Germans from making guncotton from other materials. When wood fiber or fiber obtained from grass is treated with nitric acid it also becomes a kind of guncotton. The German chemists are very well able to make their guncotton, and consequently their gunpowder and high explosives, from the trees of the forest.

Cotton nitrated and ready to be transformed into smokeless powder (nitrocellulose). Grains of smokeless powder (nitrocellulose) are perforated so that they can burn inside as well as outside, thus controlling the rate of gas production

But nitric acid also is contraband of war. How then are the Germans to get their nitric acid?

Before the outbreak of the European War the Germans had anticipated the present blockade and prepared for it. The German chemists and scientists had developed a very practical, very efficient and cheap method of producing nitro compounds from the air, nitric acid among them, by means of the electric current.

I understand that today the Germans are not only able to make all the nitro compounds they need for the purposes of explosives, both high explosives and smokeless powder, but also what they require for fertilizers for the farmers.

With a nation of scientists, chemists and inventors like the Germans, it is entirely impossible to stop them from producing explosives in any quantity they may desire, entirely independent of any class of imported materials, because although the English may blockade the seas they cannot establish a blockade between the genius of the German scientists and the German government.

It is very curious how the trials of war often result in the most beneficial effects upon a nation.

When the English established their famous blockade under their Continental system in Napoleon's time, the French were compelled to resort to some other means than importation to get their sugar. Consequently, they developed the sugar beet, and planted it in enormous quantities, with the result that France introduced the sugar beet industry, which has been of vast importance to that nation ever since.

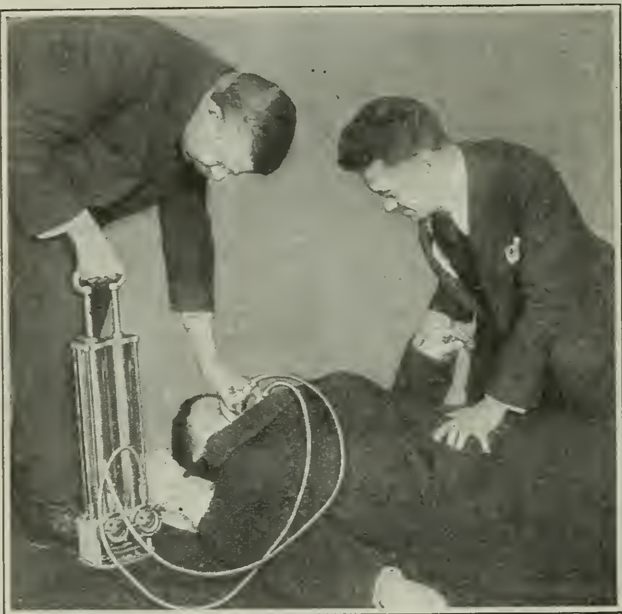
Likewise, the English blockade against Germany today is compelling the Germans to develop their internal industries in a most phenomenal way. They have solved the nitric acid problem, and very likely they will continue, after the war is over, to make their nitric acid and other nitro compounds from air. What is more, they will probably compete successfully with the natural nitrate of Chile.

If you want to know why cotton is contraband of war this picture will tell you. It shows a Russian mine which ran ashore on the Baltic Sea and which the Germans exploded. As in all modern mines the charge was composed of a high explosive made by the proper chemical treatment of cotton. The war is actually being fought with cotton—cotton grown upon the peaceful southern plantations of the United States. So long as cotton is obtainable these high explosives can be manufactured in great quantities. Naturally, the warring countries who can secure unlimited control of the cotton supply make themselves just that much more formidable to their enemies. Great Britain watches with never-closed eyes every shipload of cotton leaving the United States

You read of "craters" in the newspapers—great holes produced either by the explosion of some huge shell or of some subterranean mine. This is a photograph of a type of crater produced by a mine. Surely the men in this war live on the crests of volcanoes—not figuratively, but literally. At any moment the soldiers in the trenches may be blown to atoms by mines charged with high explosives made from guncotton. The tremendous expansive power of guncotton when exploded, will lift many million times its own weight of matter, with a suddenness that prevents any possibility of escape for those who are within its range

Saving the Asphyxiated with a New Air-Pump

THE man pictured in the photograph is being revived by a lungmotor, which is a resuscitating machine invented by two Chicago men. It competes with the pulmotor in the life-saving work of the United States Bureau of Mines, and is being adopted by hospitals, fire companies and life-saving stations. Its usefulness extends to cases of poisoning by gases and fumes, mining accidents, electric shock, the rescue of persons apparently drowned or overcome by the smoke of fires, cases of collapse through excessive anesthesia and the rescue of infants asphyxiated at birth.



A new resuscitating machine has been invented which so nicely meets any requirements that it can be operated in a rocking boat or a swaying ambulance

The device has two independent air cylinders, the pistons of both of which are attached to and operated by one handle. Air is drawn into the inspiration cylinder on the upstroke. On the down stroke it is compressed and forced through an outlet-valve into the metal inspiration-tube and thence through the face mask into the mouth and to the lung. When the lung has been expanded until full, its natural resilience will assert itself, and expel the air into the expiration cylinder of the lungmotor. Suction action is avoided.

The lungmotor introduces a small volume of air at a time, and keeps a full volume of air in the lung. The natural resilience of the lung comes into operation as a safety-valve in forcing out excessive air and obviating the dangers that attend the introduction of too great a volume of air, which would cause obstruction to the flow of blood to the lung and prove disastrous to the patient.

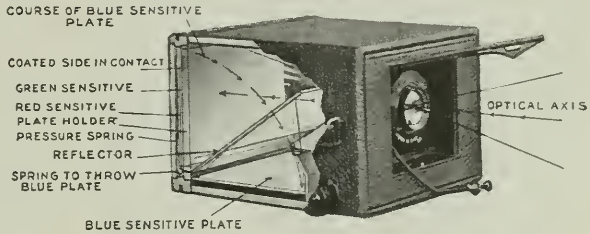
The appliance has a very delicate pump-regulating mechanism. A device for limiting the degrees of pressure within the lungs of the patient is combined with mechanism for controlling the supply of air—or of oxygen if oxygen is employed, as it may be. This minimizes the possibility of injury to the delicate structure of the lungs through abnormal pressures. A number of stops are located at different positions on the piston-rod. These serve to limit movement of the piston to be reciprocated. It is, of course, necessary to regulate the operation of the device so as to force much more air into the lungs of an adult person than would be used in the case of a child.

A limiting valve is interposed in a tube that leads from the inspiration cylinder or pump to the mouthpiece applied to the patient. This limiting valve regulates the amount of air or oxygen delivered to the mouthpiece and thus protects the patient's lungs against pressure of the air from the machine. This feature of the device is important because of the hurry and confusion that is likely to exist where a patient has collapsed. It may be noted in concluding that the device can be operated in a rocking boat, a swaying ambulance, or while the patient is being carried on a stretcher. An oxygen generator can be connected with the machine when needed.

Is This Actual Color Photography at Last?

SINCE the discovery of the wonders of the camera a hundred years ago, the instrument has done some marvelous work, but it has always been regarded as incomplete in that it was not capable of producing a print in which the colors of nature would appear. Some few years ago the greatest step in this direction was made by Frederick E. Ives, of Philadelphia, who succeeded in getting three impressions on glass and, when superposed and backed by a light, these three, each of a different color, blended together so that all the tints of nature were reproduced accurately. This trio could be placed in a lantern and the picture projected in all its glory of color on the screen. Utilizing the same principle it was found possible to make excellent press prints in color, but a photographic print in color was not achieved until recently, when Mr. Ives succeeded in devising a new camera by which it is possible to deliver a picture, entirely the product of the camera, in which are shown all the tints and colors of the original object or model.

The invention consists primarily of an arrangement by which three plates are exposed in the camera at the same instant and each one under a screen which sifts out all the rays except those desired. For instance, one plate takes a record of all the yellow rays, another the red rays and the third the blue rays. These plates are developed in the same manner as the usual photographic plates (differing only in the fact that they are extremely sensitive to color); then a print is made from each negative, a special printing frame being resorted to by which the three prints are made simultaneously. One of these prints is made on a piece of blue print paper, and the other two are made on film which has been sensitized with bichromate of potash, which makes an image slightly in relief. The film which was made under a red screen is dyed red and that which was made under the yellow screen is dyed yellow and then the three are held together, with the blue print on the bottom. When they are properly registered the colors are blended together and a perfect picture in real color is presented. After being secured at one edge, these sheets are given a chemical bath and then pressed together so that they form one piece. The process is no more complex than that of making an ordinary photograph. There are a few more operations which are more than compensated for by the beautiful results obtained.



The principles of construction of a camera which exposes three plates simultaneously. From them a photograph in natural colors can be made

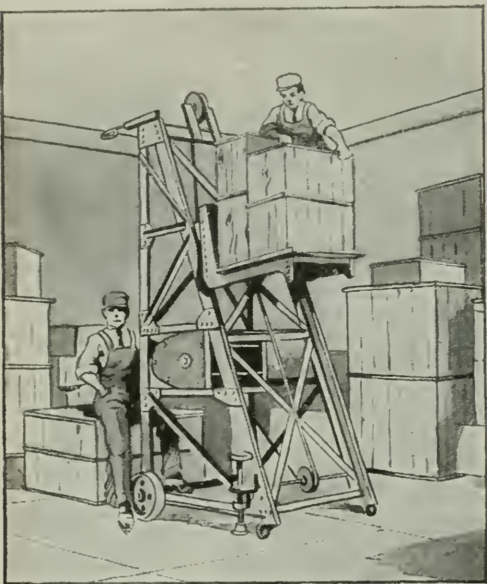
A Brazilian Snake Farm

ONE of the queerest farms in the world is the snake farm at Butantan, in the State of Sao Paulo, Brazil, where thousands of poisonous snakes of all varieties are kept in captivity. The venom is removed from these reptiles and injected into the veins of a number of young horses kept for that purpose. Thousands of tubes of serum are distributed from this institution every year, and much has been done to reduce the high mortality rate resulting from snakebites.

If you want further information about the subjects which are taken up in the Popular Science Monthly, write to our Readers' Service Department. We will gladly furnish, free of charge, names of manufacturers of devices described and illustrated.

A Movable Storehouse Elevator

IN many industries which require the storage and removal of heavy bales, boxes or casks the employment of stationary elevators is impracticable. This is the case in tobacco warehouses, in chemical factories and in storehouses for various raw materials, contained in packages half a ton in weight and a cubic yard in bulk, must be handled. As the bales are usually piled up four deep, the work of storage, if done by hand labor, is very fatiguing.



Boxes and bales for storage are easily handled by two men with this simple movable elevator

The *Zeitschrift des Vereins deutscher Ingenieure* says that a movable elevator has been devised by W. Dahlheim, which has given satisfaction in the establishments that have already adopted it. The apparatus consists of a wrought-iron skeleton tower having an inclined front, which forms the runway for the platform on which the load is placed. The loaded platform is hoisted by means of a hand-winch, so constructed that the platform remains stationary when the handle is released and descends gently with uniform speed when the handle is pressed backward. There are no separate brakes or catches to operate and everything is done with the winch handle. The work is so light that one man can raise an average load of 500 pounds to a height of twelve feet in one minute.

The elevator is mounted on two large wheels, at the back, and two small steering wheels in front. When it is to be moved to a distant part of the establishment, it is tipped backward on its large wheels and moved like a hand truck. The loaded elevator can be tipped without disturbing the load and can be moved through low doorways, while its small width (about thirty inches), allows it to traverse narrow passages. The vertical back of the elevator may be constructed in the form of a ladder, by which the pile of goods can be climbed. The floor of the platform is composed of a smooth iron plate, for bales, or a number of small rollers, for boxes. It can be loaded and unloaded either from the front or the side.

The field of this device is not restricted to storehouses. It may be utilized in the erection of buildings, for loading heavy articles on trucks or railway cars, and in various other ways. Its economy in operation is evident from the fact that for average loads it requires the service of only three men—one to load, one to unload, and one to hoist.

Why Do We Have Two Eyes?

BECAUSE we have two eyes the things we see seem solid and not flat, with the result that we can judge their distance from us with fair correctness. Look through a window at a house across the street with one eye closed and then with the other eye closed. The bars of the window frame will cut across the opposite house in different places. The two fields seen with the eyes separately although in the main alike, differ. When you look at the house with both eyes open the two fields seen by the two eyes are combined and the house across the street assumes depth and relief. Although we see a house with each eye we see only one house with both eyes. This makes the stereoscope possible—an instrument so designed that the two eyes are made to converge on a single point and yet to see two different pictures. If these two pictures represent a chair as it would appear to the right and left eyes respectively, they are perceived as one solid object.

Why Is the Sky Blue?

Sunlight, which we call white, is composed of light rays of different colors—red, orange, yellow, green, blue, indigo and violet. It can be broken up into its constituent colors in various ways. If it passes through a transparent prism (like the crystals that hang from a chandelier) or if it falls on a surface which has almost invisibly minute irregularities (like mother-of-pearl or the wing of a butterfly) we see the rays into which sunlight has been separated. These phenomena are observed when light is not absorbed.

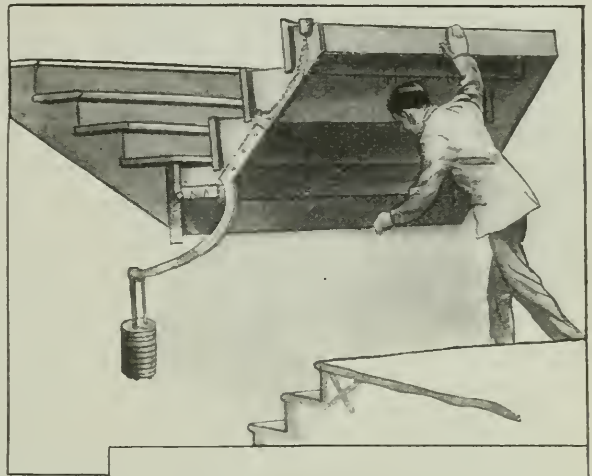
Hold a piece of red glass in front of a flame and we see only red. Rays of all other colors have been absorbed. The natural colors of the objects we see about us, leaves, flowers, books and chairs, depend upon absorption. A green leaf throws back chiefly green rays; the rest are absorbed. So, the natural color of everything in nature is the unabsorbed residue from full white light. There is no such thing as color by itself.

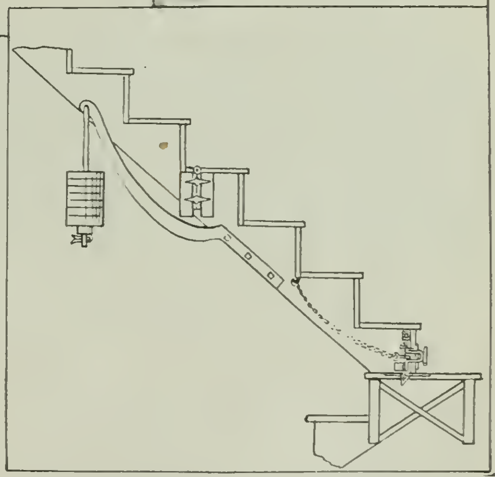
A swarm of minute particles, scattered in the path of white light, will break it up, like the surface of mother-of-pearl. If the particles happen to be of just the right size and the spaces between them just the right distance, they will absorb rays of one color only and throw off the rest. The atmosphere is filled with countless dust particles, and their size and spacing is such that they scatter rays which we call sky blue. Nearer the horizon, larger particles turn the blue into white; this happens above a dusty town and when mists or clouds hang above us. All that is left of white sunlight, after passing through many miles of blue-scattering air, appears in the hues of sunset. The size and spacing of dust particles as well as the angle at which sunlight strikes them, determines the color of the sky.

On the moon where there is no atmosphere and no dust, the sky is jet black at noon. The sun appears as a vividly glowing disk in an inky canopy. That is also true of the vast space which exists between the stars.

A Stairway Which Is Also a Door

IN order to construct a stairway between floors in a limited space, a swinging stairway has been developed which does away with the usual double-width landing. The stairs are built with a hinge half way between the upper floor and the landing, the landing being half way between floors. The stairs from the landing to the floor are built directly beneath the others. A person descending, stops at the landing to disengage a small catch. The released catch allows the lower portion of the hinged stairs to fold upwards, so that the person passes underneath them to the lower staircase. A heavy weight makes it easy to lift the stairs when the catch is released.





A stairway which has a hinged door section, by which the cellar or the upper floor can be reached with equal facility

The tea-wagon has now been adapted to the kitchen. The dinner dishes are all handled at the same time

A Folding Service-Wagon

A REAL labor-saver for the housekeeper is a wheeled service-wagon. A helpful new one has two oblong trays with raised rims to prevent dishes from sliding off. The upper one is approximately table height, the lower forms a supplementary shelf beneath. In one trip, breakfast or luncheon for the family can be taken to the dining-room.

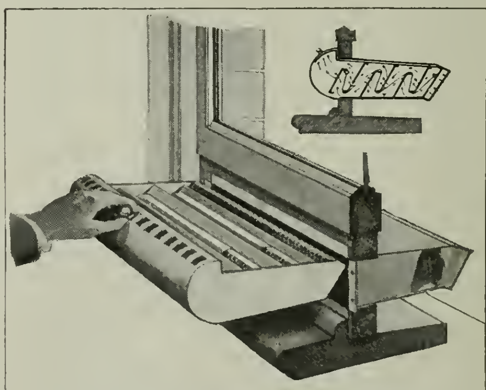
The wagon is mounted upon two large rubber-tired wheels with two small nickel-plated ones in the rear. Placed beside the wife at the dining table, it can be used without rising to exchange the soiled dishes of the first course for the fresh food of the second. After the meal the soiled dishes are wheeled in one trip to the kitchen. Rolled close to the sink, the wagon receives the clean dishes as dried and returns them to the china-closet. When not in use it folds up compactly and can be stored in a closet or pantry. It is equally serviceable to receive clean ironed clothes and to distribute them over the house, or to serve as a sewing and mending table.

A Dust-Collecting Window-Ventilator

IN order that the air brought into a room for ventilating purposes shall be as free as possible from dust, a filtering box has been developed, which, attached to the window frame, allows only cleansed air to enter. The box projects some distance beyond the outside wall, so that the air currents will be sufficiently strong to force their way through the layers of filtering material, into the room.

Sheet metal walls are arranged in the box in a zig-zag fashion, half of them attached to the top and half to the bottom; the air must pass repeatedly up and down. The walls are perforated at their outer edges. A strip of cloth is passed between the projecting edges of the plates. Because of the staggered arrangement of the plates, this ventilator acts in the incidental capacity of a sound muffler. When in position it occupies a very small space; and the amount of air admitted can be controlled by a small sliding shutter.

OF the two hundred and four cities in the United States of over thirty thousand inhabitants, one hundred and fifty-five have municipally owned water-supply systems, the total value of which is one billion, seventy-one million dollars.



A window ventilator which eliminates dust as well as drafts

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An Elevated Road Which Tried to Outstrip a Town

INTERESTING bits of history sometimes lie behind big projects—the motives that inspired the undertakings, the difficulties that were encountered in the promotion of the work and various other things that either record success or failure.

In Sioux City in 1890 was built the third elevated railway in the United States. Also Sioux City is said by many to have had the first electrical elevated railroad in the United States.

It was not necessity that prompted the building of an elevated railway in Sioux City; it was the desire to develop farm land into a suburb of what was destined some day to be the great commercial center of the west. The company collapsed a few years later, but endured long enough to accomplish its one aim—to convert a strip of farm land into a suburb.

In reality Sioux City grew during the years of 1880 and 1893 to a size far out of proportion to the development of its trade territory. The slogan appeared to be: "Build the city first!" instead of permitting the city to expand as the industries of agriculture and cattle-raising expanded.

Sioux City was in the midst of a "boom" between the years of 1880 and 1893. Buildings sprang up within a night. The elevated railroad was one of the "boom" products. Like other projects it fell during the panic of 1893. But unlike numerous other undertakings of magnitude it was not abandoned after the crash, which blighted the dreams of hundreds of men, although at that time it went into the hands of a receiver.

The men who built it believed, of course, that it would be used permanently. The suburb could have been reached as well by surface lines as now—but the purpose was to shorten the distance by building an elevated line which would obviate all railroad crossings.

What remains in Sioux City, Iowa, of the elevated railroad that cost more to build than the suburb it served was worth. The railroad actually ran during the "boom" days of the 80's, but Sioux City, with thirty thousand inhabitants, finally decided she did not need it

The elevated road, proper, was about two miles in length. To this was added about three miles of surface lines. The cost of construction for the five miles of railway was $586,000.

On December 7, 1889, the contract for construction work was awarded. Finished within a period of six months, it was used as a steam road until May 5, 1893, when one of the builders and incorporators was appointed receiver. No reverses of importance were experienced by those who financed the work or the construction company. In the rush everything apparently was forgotten. When the panic was precipitated the bonding companies realized their mistake. There had been no demand for such a road in a city that contained only about thirty thousand inhabitants.

Delia the Motor Duck

THOUSANDS of bathers at a famous beach near San Francisco were recently astonished to see a rakish-looking automobile drive down the beach and into the water. Instead of immediately disappearing beneath the waves, the automobile rode high over the swells, and still moving rapidly, took a short cruise around the harbor, after which it came ashore and disappeared as suddenly as it had appeared.

If you owned "Delia" and you came to a stream you would plunge boldly in and swim with the aid of the propeller to the opposite shore. Then you would climb the bank and ride on wheels over roads again

A closer inspection of this remarkable machine reveals the fact that it has a boat body, through which project the automobile wheels. When used as a boat the power is transferred from the driving wheels to a propeller in the stern, and the steering wheel actuates the rudder instead of the front wheels.

Water is prevented from entering the body at the points where the axles project through the sides by the same method of packing that is ordinarily used at the propeller shaft. The hull, or body, is hung on large steel springs, similar to those used on stock automobile bodies. These springs, as may be seen in the illustrations, are not exposed, but are contained within the hull with the rest of the mechanism, and are protected from all dust, grit and water. The sides of the boat-automobile are high enough to prevent the shipping of water, but the machine is not designed to be operated in rough weather.

The hydro-motor car rides well in the water, and is able to attain a speed of about ten miles an hour.

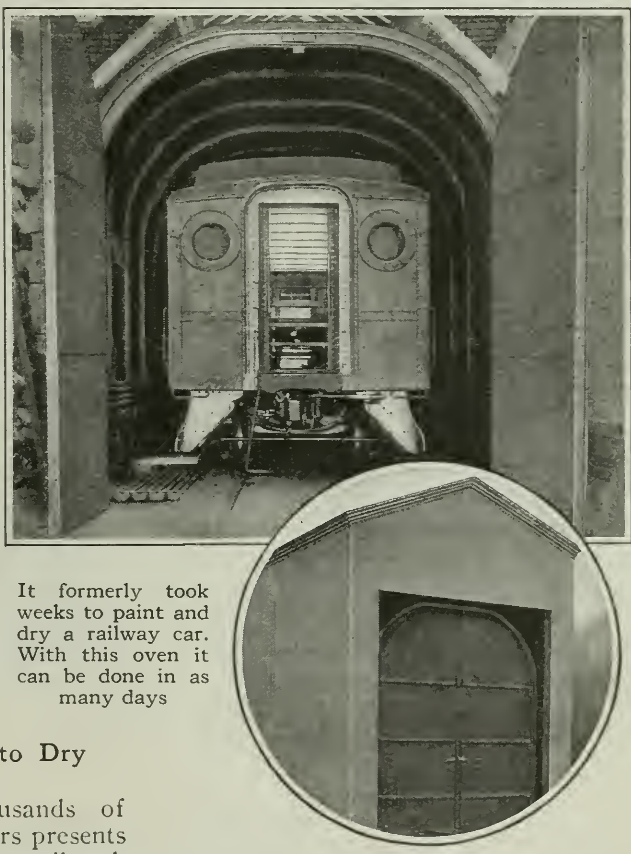
This hydro-motor has proved so successful that its inventor, Michael de Cosmo, of San Francisco, is designing a new model which he expects to exhibit in the near future. Several improvements suggested during the experiments with Delia," will be made soon.

Baking a Railroad Car to Dry the Paint

THE repainting of thousands of passenger and freight cars presents a big problem for the average railroad. It also represents a large expense, which the roads are trying to cut down by increasing the durability of the paints and shortening the time that cars must be kept out of service during the process. It is the aim of practically every road to keep its cars in continual use, whereever possible.

Very recently the Pennsylvania Railroad established a test department, for the purpose of speeding up the work of inspection and repairs and thereby reducing the loss due to idle cars. One problem that had engaged the attention of the railroad officials was that of reducing the time required for drying a car after painting. Their experience, however, with quick-drying paints had not been satisfactory, as they proved less durable than those requiring two days or more to dry.

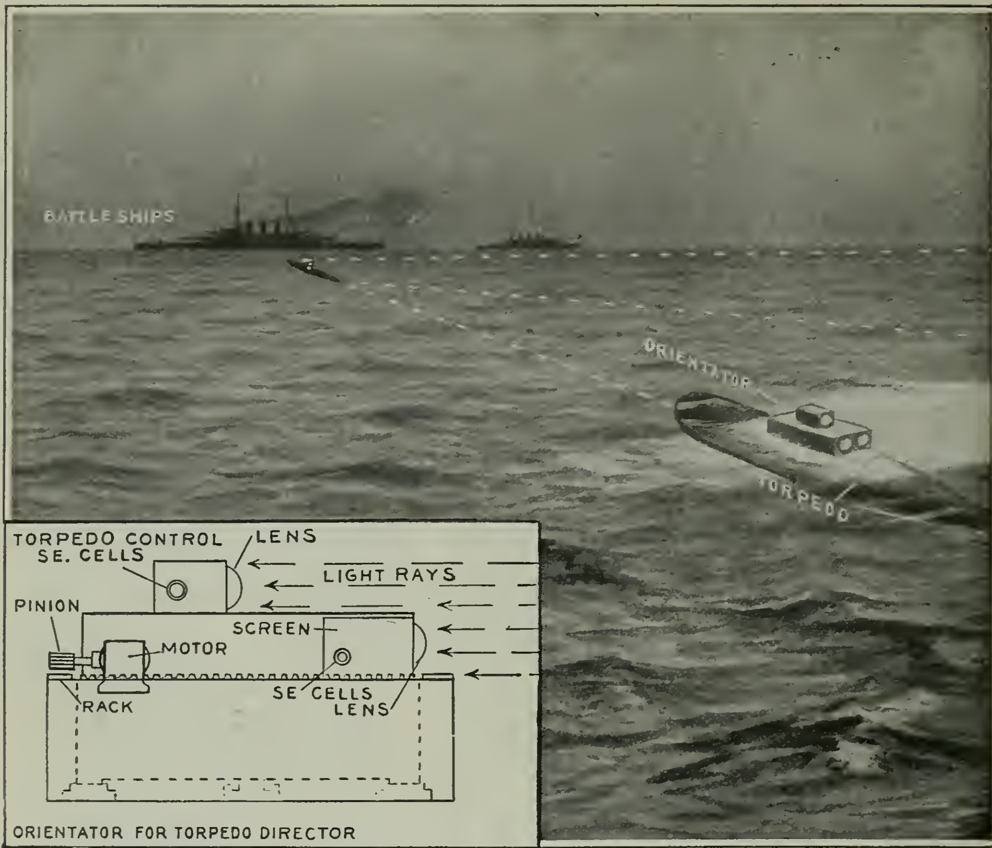
This led to experiments in baking the slow-drying paints, and for that purpose



It formerly took weeks to paint and dry a railway car. With this oven it can be done in as many days

the railroad recently constructed a mammoth baking oven at Altoona, Pa. It is large enough to accommodate cars of almost any length. With the car well inside, the doors are closed and the temperature is raised above the boiling point of water. The paint is completely dry and hard and the car ready for service in about three hours.

The saving of time by this process has been very marked. It has reduced by ninety-five per cent. the time usually required for drying cars by the old method and has cut in half the time a car is held out of service during repainting. Besides, the artifically dried paint is claimed to be much more durable than that dried in the open air.



As a human being, you have the power of running toward the thing that you see. You have eyes —organs sensitive to light. Suppose a torpedo had eyes. Suppose that it were given the power

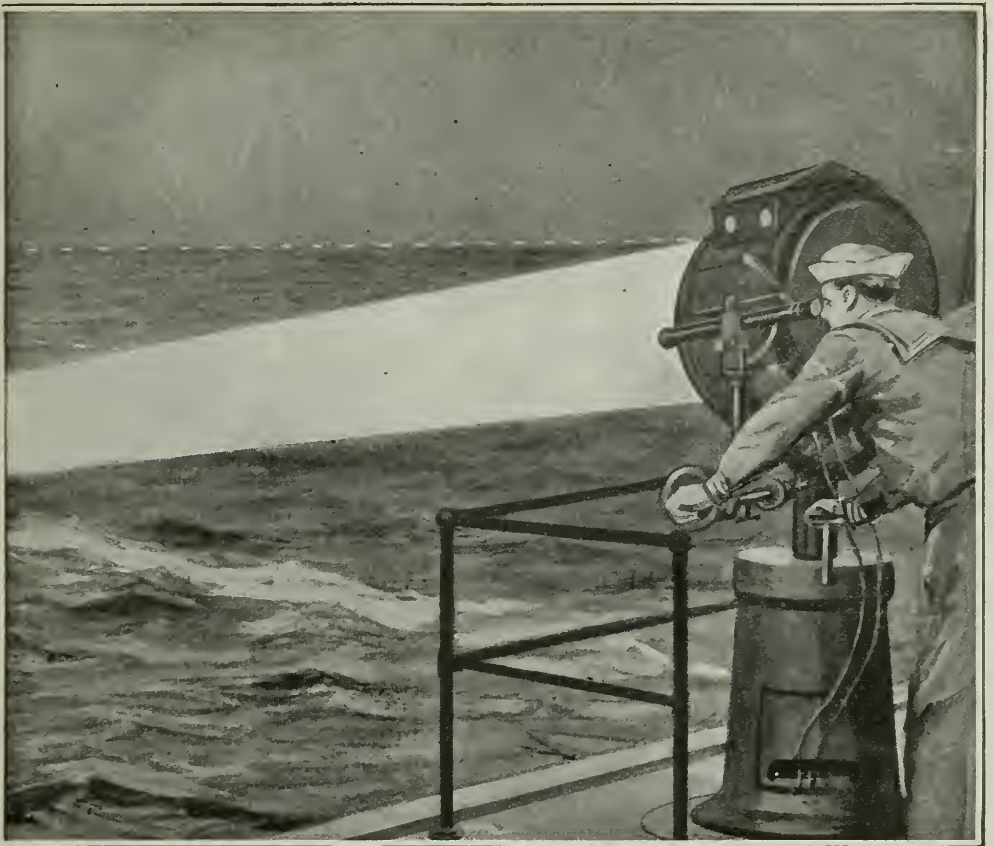
A Torpedo with Eyes

By Walter Bannard

SUPPOSE we have at our command torpedoes that obey the orders of a single master; torpedoes that heed faithfully the wish of an operator expressed through a simple directing apparatus; torpedoes that can be projected six or eight miles through the water, being constantly under the control of the man and his machine on shore; in a word, torpedoes which carry out the intention of one man to destroy an oncoming vessel of the enemy. This torpedo would simply be the projection mechanically, of this man's will to destroy that vessel.

Theoretically, we have the materials at hand to render this achievement possible. In fact, the "light-directed torpedo," as it is called, is virtually on the threshold of reality, but it has not yet crossed the threshold. This delay is caused by the present unreliability of a chemical substance, selenium, and it is upon selenium that the eventual success of the light-directed torpedo depends. In an article on the Hammond electric dog, appearing elsewhere in this issue, will be found an explanation of the way in which selenium does the work.

A boat has been directed wirelessly from shore—most all of us have read of that—and a boat can be directed by wire-



either of running toward the thing it sees, or of fleeing from it. That is the basic idea of the weapon here pictured. Its movements are absolutely controlled by the beam that comes from a searchlight

less from shore now; can be made to stop, start, stop and swerve to right and left. Nevertheless, the secret of a reliable, light-controlled torpedo — for light-rays are more desirable than wireless—has not yet been entirely solved.

John Hayes Hammond, Jr., who has been widely heralded for his wireless experiments, joined hands not long ago with B. F. Meissner, an electrical engineering student of Purdue University, and together they designed and constructed an ingenious mechanism on wheels that would trail after a pocket lamp held before its selenium eyes in a most uncanny way. Using this same principle, a torpedo with selenium eyes that will follow the directions of light rays from shore, will eventually be developed; soon, it is to be hoped.

There have been two big obstacles to prevent the evolution of a controllable torpedo:

One is the lack of a suitable apparatus for transmitting sufficient light to control the mechanism at useful distances; the other is to accomplish the directing without interference from the enemy's ship. The solution of the problem demands a more scientific knowledge of selenium and its chemical properties.

Suppose that day had come and a hostile ship was booming into the harbor of New York, grimly determined to scatter our fair buildings to the four winds.

"Sic!" says the man on shore.

Almost with human intelligence, the glistening steel cylinder darts out towards the enemy, at a forty-mile-an-hour clip. Though at present such an occurrence is only a fancy, it may become a reality.

The Electric Dog and How He Obeys His Flashlamp Master

By B. F. Meissner

The electric dog and its master. A pocket flashlight is the magic wand which it obeys

THE electrical dog, which Mr. John Hays Hammond, Jr., and I designed, and which has received much publicity, has no tail to wag and no voice to bark with, but he can follow a person about in a most surprising way.

Like the sunflower that follows the sun in its path across the heavens, my first apparatus was capable of turning itself only to face the object that stimulated it. But a great difficulty had to be overcome. The stimulant was light, and sometimes the dog saw too much light, so that he behaved occasionally in an astonishingly erratic manner.

Just how grave a difficulty this disobedience really is, was illustrated by an amusing incident during a demonstration at a Chicago theater.

The dog was ready to spring into action, but when the stage was lighted, instead of obeying the flashlight held in my hands, the dog insisted on paying attention to a very alluring but not thickly clothed young woman painted on the scenery near by. It seems that the reflected light from the painting was sufficiently brilliant to compete with the flashlight and to cause the dog to creep to this fairer attraction with a directness which was almost uncanny.

To all practical intents and purposes, the electrical dog is a dead dog until excited by an external light ray—usually a pocket flashlight, held in the hand. Fastened to the front of a squat, oblong box on three roller-like wheels, are two great lenses, much out of proportion to the rest of the dog's make-up. These are the eyes through which the dog receives his intelligence. Behind the lenses are two extremely sensitive cells containing the black, wax-like selenium. Because of the importance of this substance in the dog's behavior, the mechanical animal has received its nick-name, "Seleno." A peculiarity of selenium is that it is sensitive only to light rays; or, to put the facts a little more technically, selenium is a non-conductor of electric currents until it is struck by light, when it becomes a conductor. Located behind the selenium eyes is an arrangement of relays, batteries, magnets and a motor. When a beam of light strikes one of the selenium cells, it causes a relay to be operated which, in turn, causes current to flow through one of the magnets controlling the steering wheel. The driving motor starts, and the dog is under way. Shift the light so that it strikes the other selenium eye and the dog moves in the other direction. In other words, in whichever direction the light travels, there, also, will the dog go. By reversing a switch on the outside of the box, the dog can be made to back away from the light. Illuminating both cells equally causes the dog to move in a straight line.

The electrical dog will never become a common household toy. It has taken years of scientific study and endeavor to perfect, and it requires ripe technical knowledge to understand clearly. However, for the benefit of the reader who possesses more than an average amount of scientific and technical knowledge, a detailed description of the electrial dog is given in the following lines:

The mechanism involved in the successful performance of the electrical dog is so complicated and delicate in its nature that it is doubtful if many experimentors will care to attempt its construction. Few dimensions are given, because the materials naturally convenient to the builder have an important bearing upon even the most detailed parts of the apparatus. The dimensions, together with the construction in general, are largely a matter to be determined by the builder's individual ingenuity. The general construction details supplied here were embodied in the electrical dog, or orientation mechanism, that Mr. John Hays Hammond, Jr., and I constructed, and which I have employed in lectures and demonstrations before various engineering societies and gatherings of all kinds.

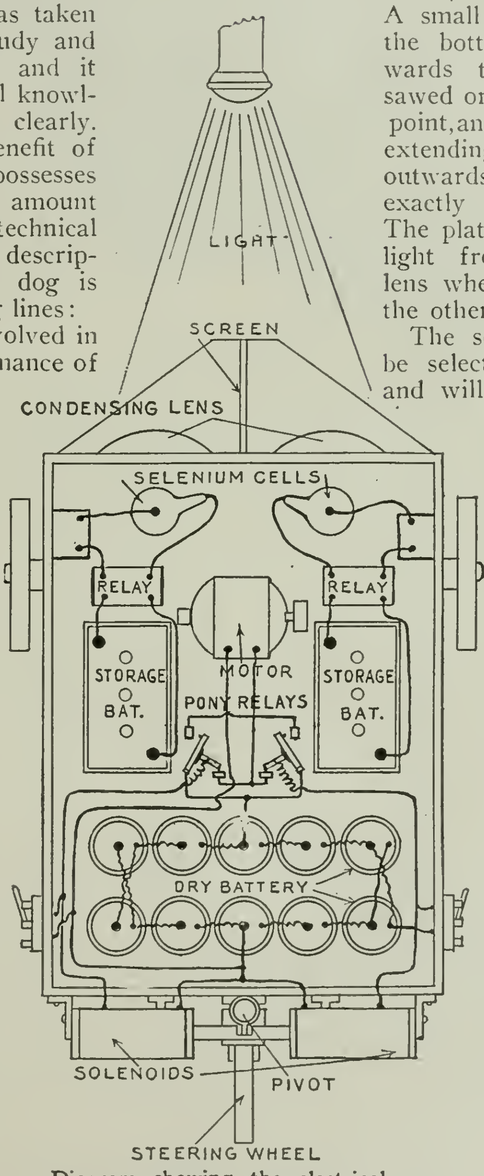


Diagram showing the electrical apparatus used in the construction of the Hammond Meissner Orientation Mechanism, or Electric Dog. Rays of light striking the selenium cells cause the motor and steering magnets to be operated. The light in the position here shown causes the dog to go in a straight line

Beginning outwardly, the electrical dog has these three dimensions: Length, three feet; height, one foot; width, one and one-half feet. A small shelf projects from the bottom of the box towards the front. This is sawed or whittled almost to a point, and a metal plate erected extending four or five inches outwards from a line drawn exactly between the lenses. The plate is there to prevent light from going into one lens when it is intended for the other.

The selenium cells should be selected with great care, and will cost from five dollars apiece, upwards. The cells are of as low a resistance as possible, this resistance being at the same time consistent with a high resistance ratio between light and darkness. Putting this thought into concrete figures, cells with a resistance of from one thousand to one hundred thousand ohms normal or "dark" resistance are the best. The resistance of the cell in the dark should be at least three times as great as its resistance in sunlight. I have used cells of sixty thousand ohms resistance, and they gave good results with batteries of fifteen or twenty dry cells. Since the current amounts to only a few thousandths of an ampere, small flashlight batteries may be employed. The selenium cells should be capable of carrying at least two or three milli-amperes without heating.

The next and probably the most delicate step in the entire construction is the ultra-sensitive relay that is placed in circuit with each selenium cell. These should operate reliably on a change in current strength of as little as twenty-five millionths of one ampere.

The finest of polarized relays, such as those devised for use with coherers in the early stages of wireless telegraphy, require an operating current of at least five hundred microamperes, or one-half a milli-ampere; the most sensitive galvanometer relay with solid contacts requires about two hundred microamperes. These values are for conditions of jar and vibration such as those which naturally exist in the electrical dog. The relays that I use are the most sensitive of the pivoted, galvanometer type; but instead of having two solid contacts of platinum, one is made of platinum with a needle point, and the other is a globule of mercury, an arrangement which requires a very small contact pressure for reliable operation under vibration.

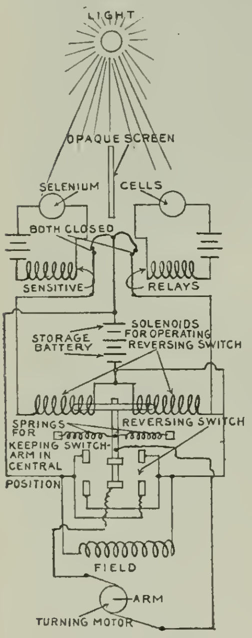


Diagram of the electrical connections

A drop of light oil over the mercury prevents oxidation. This contact, however, cannot break currents in excess of a few milliamperes and should therefore be used in conjunction with relays of the telegraph type, which are capable of handling the currents required in the motor and solenoid circuits. Less sensitive instruments cannot be used unless the source of light be very powerful. The sensitiveness of this arrangement is so high that a dog can be operated with ease from a distance of twenty feet with a pocket flashlight.

The pony relays indicated in the diagram are ordinary telegraph relays of twenty ohms resistance, provided with a special pair of back contacts, which are always closed when the relay is not energized.

The motor is a ten-volt battery motor of the largest size obtainable (about fifty watts). Its source of power should be a storage battery, which also supplies the solenoids. In my apparatus this battery was composed of four four-volt, thirty-ampere-hour cells. They should be as small and as light in weight as possible.

The solenoids are approximately five inches long and three inches in diameter, with cores three-fourths of an inch in diameter. Of the iron-clad type, they are wound with number sixteen magnet wire, and have cone-shaped pole faces, the air gap being inside the coil near the middle; the stroke is about one-half inch from the central position. Their purpose is to turn the steering wheel.

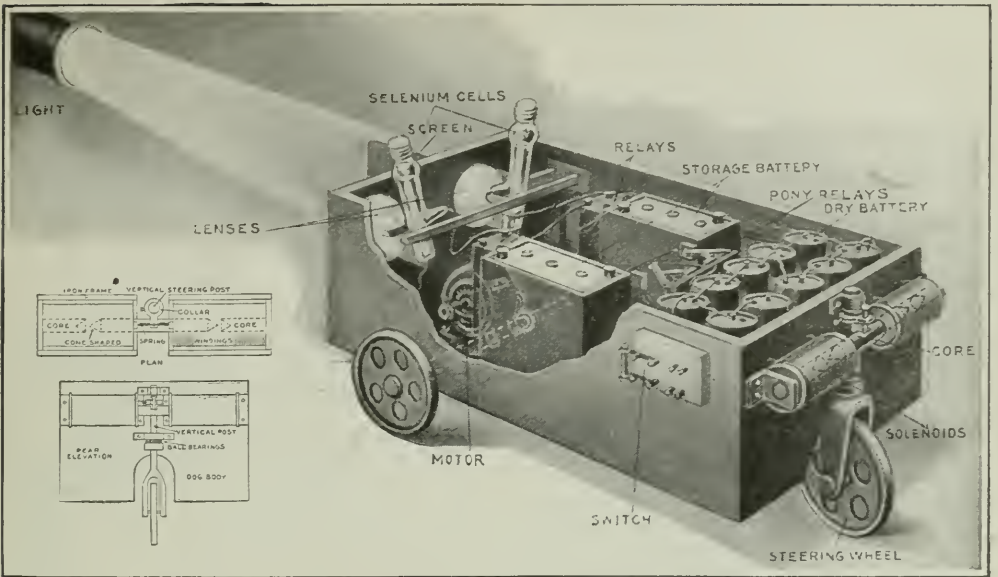
The core, which extends from one solenoid to the other, is maintained in the central position when both the solenoids are energized.

The single rear wheel is mounted on ball bearings in the horizontal plane to facilitate turning by the steering magnets.

The reversing switches, by means of which the dog can be made to back away from the light, instead of being attracted to it, are not shown in the diagrams as they would introduce an unnecessary amount of complication. Their purpose is to reverse the connections of the two solenoids.

The driving motor is connected to the shaft of the two forward wheels through a worm-wheel reduction, and a differential gear box, such as those on automobiles.

The adjustment of the parts of the dog is sometimes a rather difficult task, particularly when other sources of illumination besides the flashlight are encountered. If used in a room with windows through which daylight passes it

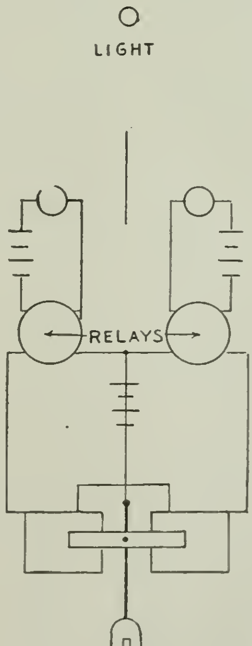


A perspective view of the dog showing his internal mechanism. In the insert, a diagram showing the construction of the steering solenoids

may suddenly refuse all the inducements offered by the master with his pocket fiashlight and turn his entire attention to the pursuit of the window.

The principal adjustment is that of equal sensitiveness of both selenium-cell-relay units. It is practically impossible to obtain two selenium cells having equal resistances and equal sensitiveness, and therefore different applied voltages and different tensions in the back springs of the relays are necessary, in order that both will operate at the same instant when influenced by the attracting light, and that both will release at the same instant when the light is extinguished, or when it becomes too weak to effect operation.

With selenium cells made sensitive only to definite colors or wavelengths of light, it is possible to make the dog back away with one light and be attracted by another. Cells can be given a certain amount of inherent color sensitiveness, but this is best secured by means of ray filters which allow only definite wavelengths to pass. Another means of making the dog sensitive to only one source of light is to cause that light to be interrupted by means of some form of shutter, in conjunction with selective elements on the dog which will not allow the sensitive relays to be closed unless the fluctuations in the transmitted light correspond exactly with the frequency of the selective element.



A simplified diagram illustrating the principle of the dog's construction

It is obvious that if we make the dog a boat instead of a wheeled vehicle, and if we provide the boat with a forward compartment filled with gun cotton, we would have a torpedo of the kind described and pictured elsewhere in this issue. A searchlight on board a ship would serve to guide the torpedo on its course of destruction through the water.

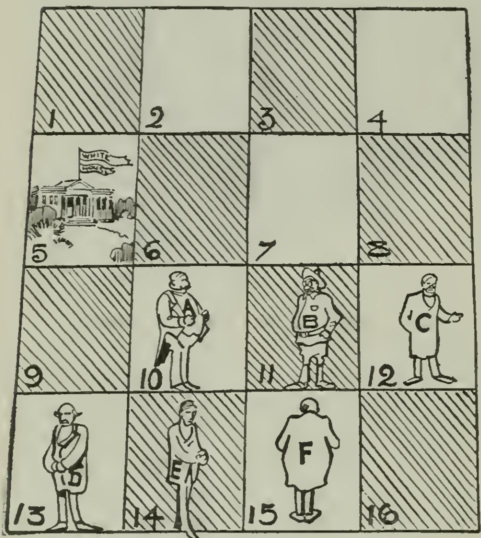
A Medley of Puzzles

By Sam Loyd

We asked the puzzle man to prepare for our readers a variety of his popular problems—mechanical, mathematical and otherwise.

Here we have his first offering.

Let us put on our thinking caps and see who can unravel his interesting posers.—Editor.



The problem of the presidential dark horse

Puzzling Kugelspiel (see page 431)

The Presidential Puzzle

A political prophet says that only six of the presidential possibilities are to be considered in "the running," and that, eventually a "dark horse" will come in the winner.

In the illustration we see his idea presented in checker-board puzzle form, with the six likely candidates deployed for the contest and the "dark horse" standing on square No. 15. The puzzle is to show how the candidate F may, in a series of jumps, make his way to the White House on Square 5, his opponents being eliminated in the process. Here are the conditions:

Jump the men in any order you wish, a jump meaning that a candidate hops over another on an adjoining square to the square beyond.

A candidate hopped over is at once removed from the field.

The jumps may be diagonal or otherwise. That part does not matter.

Start with anyone you like and continue the jumps until the survivor F in the final jump lands on Square 5, the president's future home.

The candidates and squares are numbered and lettered to facilitate a description of the jumps.

Now see if you can clear up the political situation.

Prizes for the Clever Ones

If you can solve one or more of the problems write out your answers and send by post not later than March tenth to SAM LOYD, care of the Popular Science Monthly, 239 Fourth Ave., New York City.

To each of the ten persons who send the best answers to the puzzles will be awarded a copy of Sam Loyd's Cyclopedia of 5000 Puzzles, Games, Tricks and Conundrums," published at Five dollars.

Answers and prize awards will appear in May issue

Puzzling Kugelspiel

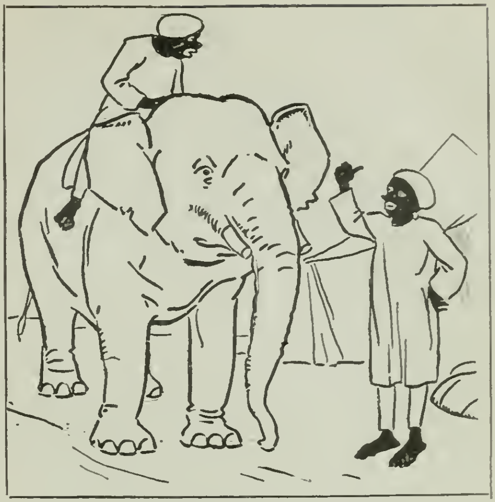
An old Dutch sportsman informs me that our modern ten-pin game is derived from the Dutch pastime of Kugelspiel, played on the greens of Holland for many centuries. He says that while our modern game has resolved itself into mere expertness in knocking down the pins many variations of old Kugelspiel involved mathematical features as well.

The most scientific of these old-time "set-ups" employed 15 pins which were arranged, as shown on page 430, in three groups of 3, 4 and 8 pins respectively, and the contest between two players consisted in turn-about plays to see which would be compelled to roll his ball at the final pin.

It is an interesting puzzle to work out just what should be the first player's shot to assure his leaving a final pin for his opponent, assuming that both players were so skilful that at every shot they could knock down any or all of the pins in one of the separate groups. At a single shot a bowler is permitted to strike a pin or pins from only one of the groups.

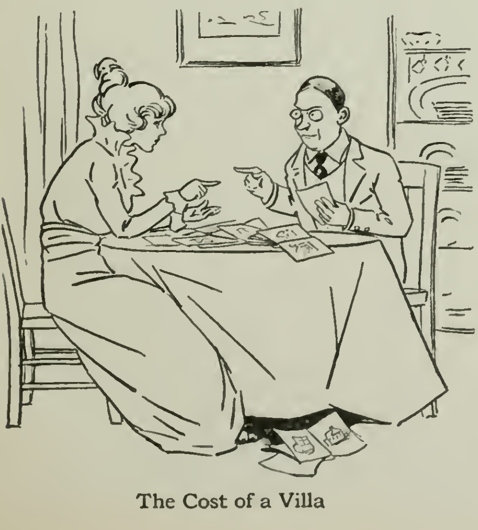
Here is a specimen game:

Player A knocks down 5 of the pins from the group of 8; player B wipes out the entire group of 4, leaving two groups of 3 each for his opponent. A then takes one pin from one of the groups; B takes a pin from the other group and the situation is now two groups of 2 each. A takes one pin then B removes the 2 and wins by leaving a single pin.



An elephant on his hands

If you were bowling a game with the old Dutchman what would be your opening shot in order to assure the leaving of a final pin for him?



The Cost of a Villa

The Cost of a Villa

When the Smith's suburban villa was completed and they counted costs, it appeared that the painter's bill was $82 in excess of the paperhanger's charges; the plumber charged $30 more than the painter; the mason received $160 more than the plumber and the carpenter, who charged $24 more than the mason, rendered a bill three times as large as that of the paperhanger. The lot cost half as much as the house, so who can tell how much the Smith's new home cost?

An Elephant on His Hands

An overly-ambitious Hindu who had acquired the proverbial elephant that "ate all night and ate all day," sought to rid himself of the voracious beast by unloading him on a fellow native. The prospective buyer was willing to do business on the basis of 8 rupees less than the asking price; the would-be seller would knock off only 20 per cent. There remained a difference of 7 rupees between their terms, and the pachyderm failed to change owners.

Can you tell how much the native was offered for his animal?

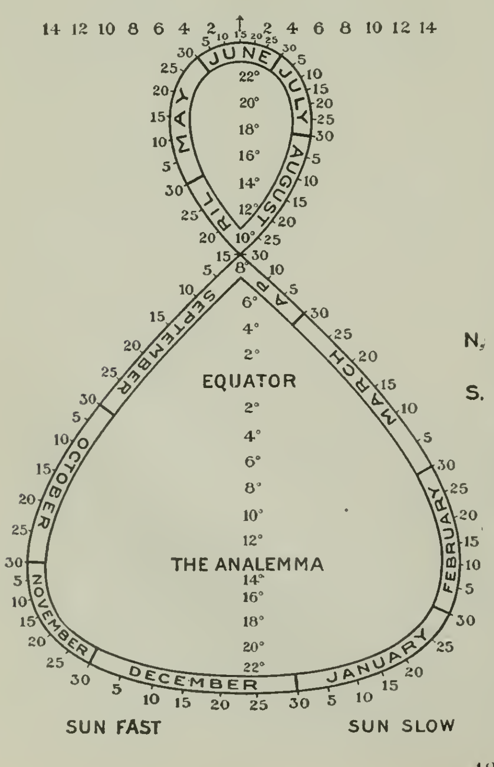
How to Ascertain Your Latitude and Longitude

By Hereward Carrington

THERE is a very simple way by means of which the novice, untrained in astronomical observation, can determine his latitude, without the aid of complicated and expensive apparatus.

If you were situated on the equator, the north star would be directly north of you. This star must be learned and identified, so that it can be picked out anywhere, at a moment's notice. This is all the astronomy you need know—as the location of this star will give the latitude.

When half-way to the north pole the north star is midway between the zenith and the northern horizon. At the pole it is directly overhead. In all other places its "angle" varies, being for example, 30° at New Orleans, 40° in Philadelphia, and so on. The altitude of the north star is the latitude of a place north of the equator. All that is necessary then, to determine the latitude, is to measure the angle of the north star and thus determine the altitude of the celestial pole. This will give the latitude.



Take a pair of ordinary compasses. Open them, and place one point in a level window sill, holding the arm upright. Now point the other arm of the compass at the north polar star. The angle thus formed by the pair of compasses will be fairly accurate, provided the pointing has been done carefully and the other arm is held at right angles to the sill.

When the compasses have been adjusted, as explained, proceed to measure the angle formed by the arms of the compass. This will indicate your latitude. For every degree of curvature of the earth, the north star rises one degree from the horizon. It is thus an easy matter to see your latitude, from the number of degrees made by the angle of your compass.

Another way to discover the latitude of any given place—and a method much more often used—is by means of the sun. Observations of the sun are depended upon by vessels at sea.

The first thing to do is to ascertain what is known as your true north-south line. To do this you must know your longitude and have the correct time. Next, measure the altitude of the sun at apparent noon—that is, when its shadow is north. Place a curved piece of cardboard in the window, as shown in the diagram, with the blind drawn down to the wood of the upper window. The angle made by the shadow will then indicate the altitude of the sun with sufficient accuracy.

Next, consult what is known as the "Analemma" (see diagram). If you live in the northern hemisphere, you must subtract from the declination of the sun (which the analemma gives you) the sun's declination. Subtract this result from 90°, and the remainder is your latitude.

For example, you wish to ascertain the latitude of San Francisco, and make your observation on October 23.

1. Ascertain your north-south line. (The sun's shadow will cross it on that date at 11 h. 54 m. 33 s. A. M., Pacific time.)

2. The sun's altitude, when the shadow is north, would be found to be 41°.

3. The declination is 11° S. Adding, we get 52°, the altitude of the celestial equator.

4. Subtract: 90° — 52° equals 38°, the latitude of the place of the observer.

The "analemma" employed is a carefully worked-out diagram, giving the position of the apparent sun and its declination for every day in the year. It must be remembered that, each year, this will vary slightly, but for all ordinary calculations, the diagram here given will answer every purpose.

The vertical lines represent the number of minutes the apparent sun is slow or fast—as compared with the mean sun. Since the analemma shows how fast or slow the sun is each day, it is obvious that, knowing one's longitude, one can set his watch by the sun, by reference to this diagram; or, having correct clock time, one can ascertain his longitude.

To ascertain longitude, one must have a true north-south line; also the correct standard time. Now—

1. Note when the sun's shadow is due north. Refer to your analemma and see how far the sun is fast or slow.

2. If fast, add the amount to the time by your watch; if slow, subtract. This gives you mean local time.

3. Divide the number of minutes and seconds past or before 12 by 4. This will give you the number of degrees and minutes you are from the standard time meridian. If the right time is before 12, you are east of it; if after, you are west of it.

4. Subtract (or add) the number of degrees you are east (or west) of the standard time meridian, and this gives you your longitude.

To set your watch you must have a correct north-south line and know your longitude.

1. Find the difference between your longitude and that of the standard time meridian by which you wish to set your watch—Eastern time, Central time, etc.—as the case may be.

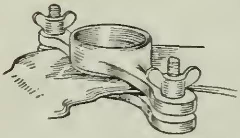
2. Multiply the number of degrees and seconds of the difference by 4. This gives you the number of minutes and seconds your watch is faster or slower than local time. If you are east of the standard meridian, your watch must be set slower than local time; if west, faster.

3. Observe the position of the sun—whether fast or slow—according to your analemma. If fast, subtract that time from the time obtained in step two; if slow, add. This gives you the time before or after 12 when the shadow will be north; before 12 if you are east of the standard time meridian; after 12 if you are west.

4. Set your watch at the time indicated by step 3, when the sun's shadow crosses the north-south line.

To strike a north-south line you must know your longitude and have correct time. Steps, 1, 2 and 3 are just the same as before (in the last example). At the moment of making step 3, you know the shadow is north; then draw the line of the shadow. If out of doors, stakes will indicate this line.

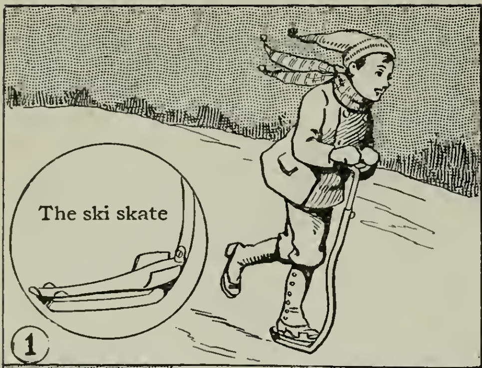
A Vulcanizer for Tire Repairs



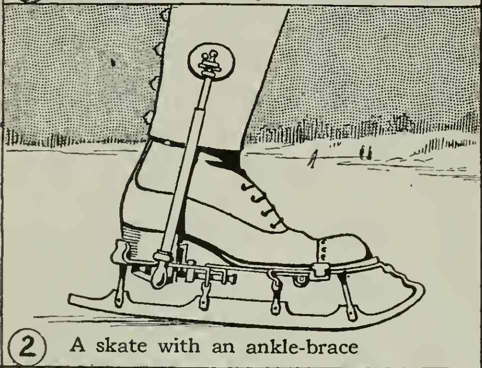
SEVERAL new types of vulcanizing devices have recently been placed on the market for the motorist who desires to make his own quick tire repair on the road. They all naturally strive to utilize some material or part of the car. Among those of more than passing interest is one which can be used without special instructions. It is nothing more than a clamp, in which the inner tube is held. On the upper half of this clamp is a hollow, to be filled with gasoline. A one-ounce measure goes with the device, and the ounce of gasoline will burn about seven minutes, which is just enough to effect a complete repair of a puncture.

Another device consists of a plain metal plate which is held by any sort of clamp to the exhaust pipe of the muffler. Putting the inner tube on this metal plate and holding it down on it for about five minutes is sufficient for vulcanizing.

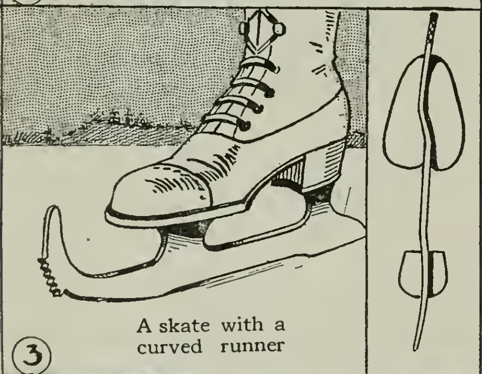
Improving the Old



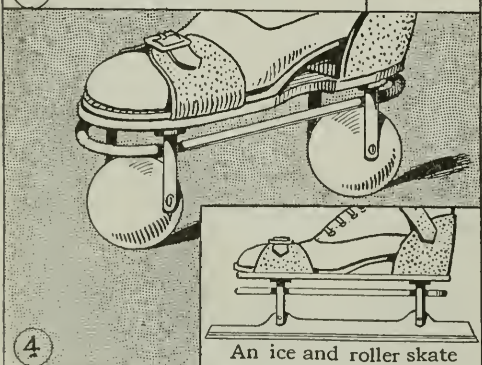
1 The ski skate



2 A skate with an ankle-brace



3 A skate with a curved runner



4 An ice and roller skate

DURING this winter, when society's revival of ice skating has caused many dance hall managers to turn their polished hardwood floors into ice rinks, manufacturers have studied the patent office files in search of novelties in skates which might be offered to the public.

It is a surprising fact, that a large proportion of patents which have been awarded to inventors have described skates which are capable of being transformed from ice to roller skates at a moment's notice. Many and weird are the skates described in the patents, and hardy indeed would be the skater who would offer to experiment with them on hard and unyielding ice.

A skate which may be used as a ski is shown in Fig. 1. It may be used singly or in pairs, and is designed to be used on a thick crust of snow. The runner projects over the front of the skate, and forms an adjustable handle by which the skees may be steered. A turn of the handles guides the runners in any desired direction.

In Fig. 2 is shown a skate which is claimed by the inventor to have most unusual advantages. The lever which extends upwards from the skate contains a mechanism for clamping it tightly to the shoe. By turning the top, the position of the clamps is changed, and when the lever is swung to an upright position, as illustrated, the clamps are drawn tightly to the shoe. A gaiter is furnished with the skate, and when the lever has served its other purposes, it is fastened to the gaiter, and forms an ankle brace.

When one thinks of the blade of a skate, it is natural to believe that it must be absolutely straight. Should we see a blade that had several kinks in it, we would be tempted to take it to a blacksmith and have him hammer it until it became straight. To do this, however, would be to defeat the purpose of a German inventor, who has patented in this country a skate which has several curves in the blade. Each of these curves is designed to correspond with the natural movements of the skate in use, or with the curve or figure which is described

Fashioned Ice-Skate

by that part of the runner which becomes active. The inventor believes that a steady forward movement is never given during a single stroke of the skate. A glance at Fig. 3 shows this.

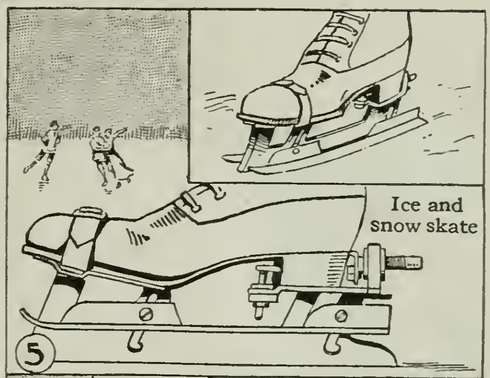
Another German invention is the combined ice and roller skate illustrated in Fig. 4. The inventor has attempted to reduce the friction common to roller skates by employing balls or spheres, instead of wheels. These are attached to the skate by means of bolts, which may be removed to adjust the ice blade.

A skate which may be used with equal facility on ice or snow is shown in Fig. 5. Runners are secured to each side of the blade by means of a bolt, which permits of the runners being lowered flush with the blade when it is desired to travel over snow through which the single blade would sink. This skate has the advantage of being equipped with clamps which will permit the skate being secured to any type shoe.

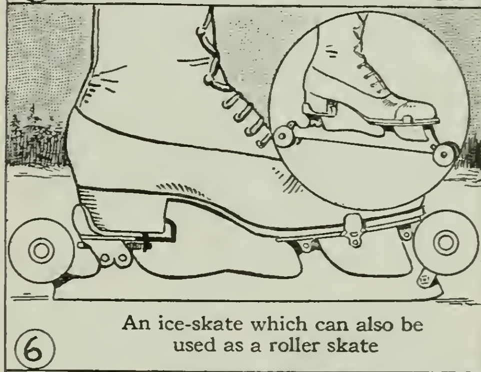
An ingenious invention patented several years ago is an ice skate which has two rollers mounted on each side of the blade. These are so affixed that when it is desired to skate upon the ice, the rollers are fastened out of the way of the blade, and are ready at any moment to be swung down so that they will lift the ice blade from the ground (Fig. 6).

Another combination ice and roller skate is illustrated in Fig. 7. This skate is unusual in having five rollers attached to the blades when the skate is to be used away from the ice. The ice blade is made in two parts, and the rollers are held between the sections by means of a bolt, which is also used to draw the blades tightly together when the skate is to be used on the ice. Both sections of the blade are slightly beveled, and when drawn together, form a "hollow ground" blade, which is said to be very desirable.

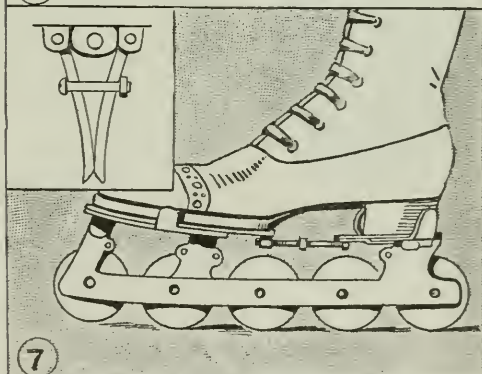
Roller or ice skates which may be equipped with brakes is the subject of the patent shown in Fig. 8. Braces are projected from each side of the skate and fastened to a leather band which is adjusted to fit the limbs. By means of a ratchet, the brakes are operated by swinging the braces forward or back.

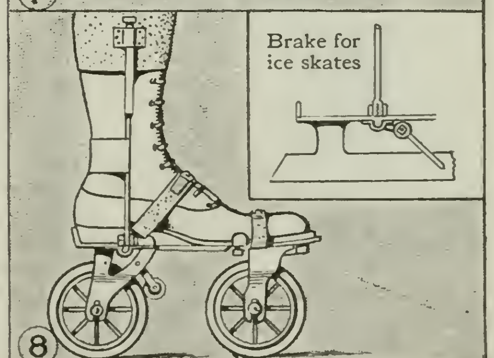


Ice and snow skate



An ice-skate which can also be used as a roller skate



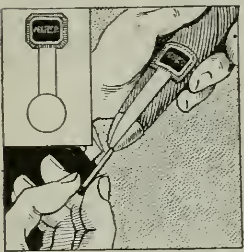


Brake for ice skates

Little Inventions to Make Life Easy

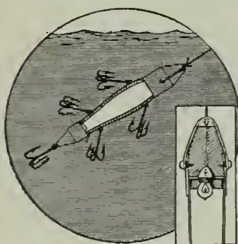
Why Weren't They Thought of Before?

Cigar Tip Protector of Many Uses



A CONE-SHAPED cap to protect the tip of a cigar is made with a projecting piece extending half the length of the cigar. This projecting piece is a label, as well as a surface upon which a match can be struck. In the center of the conical top is a small hole through which a match can be inserted into the cigar, to make a draft opening without cutting the end of the cigar.

Tricking Fish with Electric Minnows

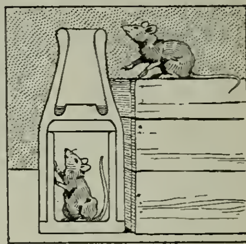


AN artificial minnow for angling is provided with a transparent body, within which is placed a small electric light. The invention is to illuminate the minnow in order to attract the attention of the fish. Of course, a number of hooks are attached to the sides of the device to catch the too inquisitive fish.

Head-Guard for Alley-Boys

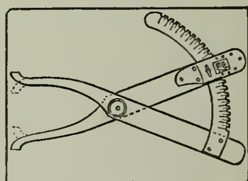
A SPHERICAL wire cage, made in hinged sections, is provided for the protection of alley-boys against flying bowling balls and pins. The cage completely surrounds the boy's head and face, and pads are provided to hold it in place. A hinged section is also provided for each shoulder.

Trapping Mice in a Milk Bottle



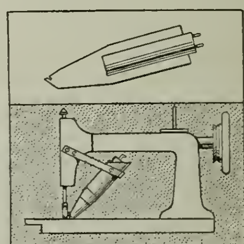
THE trap is composed of top and bottom sections which are placed in an old milk bottle. The mouse enters at the mouth of the bottle and finds himself in the upper section of the trap. Surrounding this section is a trough filled with liquid bait. When the mouse attempts to climb out, his wet feet slip on the glass walls of the bottle and he falls through the central hole in the trough down into the lower section of the trap. The two sections of the trap may be separated in order to remove the entrapped animal.

More Accurate Calipers



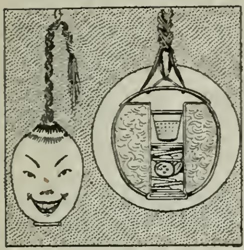
ATTACHED to one leg of a pair of calipers is a rack upon which teeth are cut to fit a worm gear which is affixed to the other leg. The width of the jaws of the calipers is regulated by means of the worm gear, and it is claimed that great accuracy may be obtained.

Burnishing With the Sewing-Machine



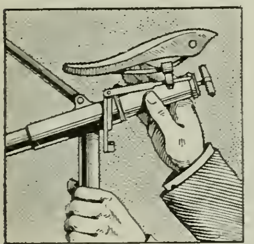
THE burnishing tool is made of a tapered, cylindrical tube of metal, in which is inserted an electrical device for heating the tool. At the lower extremity is a slot through which the margin of the material to be burnished may be placed. The device may be easily attached to a sewing-machine.

A New Kind of Pin-Cushion



THIS pin-cushion represents a Chinese face, the lower portion of the pigtail being composed of threads which can be withdrawn. Through the center of the cushion a box penetrates, which may be used to hold buttons, thimbles and other useful implements. The bottom of the box is designed to hold needles, thus acting as a needle case. The entire device hangs from the wall by the pigtail.

Bicycle Frame Holds a Tire Pump

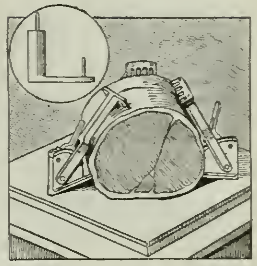


THE steel frame of a bicycle or a motor-cycle is made hollow immediately beneath the rider's seat. Into this hollow space is slipped a tubular tire pump. When the pump is needed, the seat is swung out of the way on a swivel, the cap which closes the open end of the frame is unscrewed, and the pump may be removed.

Collapsible Millinery for Traveling

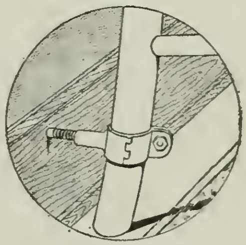
TO provide a fashionable hat which may be folded up and placed in a travelers' trunk or suitcase, a dressmaker has created a design which is composed of two stiffened sides and a soft collapsible middle on the principle of the paper hats made for carnival time. When the hat is placed on the head, the stiff sides are bent to open the hat in its proper position. When it is taken off, the hat flattens so that it can be stored away in a small space.

Holding Meat While Carving



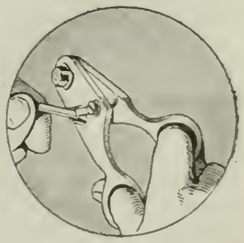
UPON a suitable base is fixed a casting consisting of three equidistant arms, each terminating in a toothed quadrant. Actuating on these quadrants are arms to which are affixed claws for holding the meat. In the center of the device is a small plate, to which are attached two metal points of different lengths, designed to pierce the meat and to hold it in the center of the device. This plate may be clamped in any desired position by means of a bolt which is equipped with a thumb-nut. Either large or small pieces of meat may thus be accommodated.

Preventing Furniture from Chipping Walls



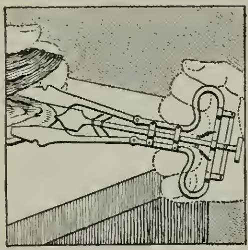
FITTED into the threaded interior of a boss which is attached to the resilient clamping-ring of the furniture buffer, is a wooden or metal screw, equipped with a rubber button at the end. When the clamp is applied to the leg of a chair or bedstead, the rubber tip on the adjustable screw acts as a buffer to prevent the marring of the wall.

A Cutter for Fiber Phonograph Needles



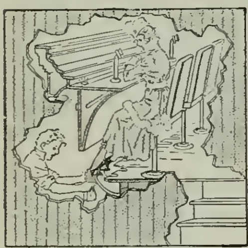
A DEVICE for trimming or cutting fiber phonograph-needles is modeled closely after a pair of ordinary scissors. The top element of the device is equipped with a holder for the needle, while the lower element has a sharp blade for trimming the needle.

Conquering the Obstinate Oyster



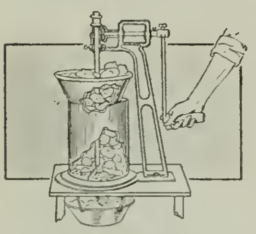
A PAIR of jaws are hinged to a T-shaped handle. Between the jaws is placed a sliding cam, terminating in a button protruding from the handle of the device. By pushing the button, the cam is pushed down between the jaws, thus spreading them, and opening the oyster.

Can Maidenly Modesty Ask for More?



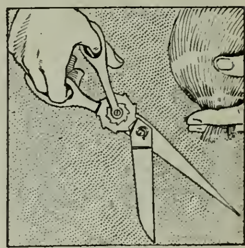
A SHELF is provided for the seats of the patrons, the seats being placed considerably above the workmen's floor. In front of the seats is placed a desk, the lower part of which forms a curtain, leaving just enough space above the floor to allow the workman to reach the shoes of the patron. A speaking tube is placed before the patron on the desk so that she may give instructions to the workman, and by means of an electric light signal, the completion of the process is announced.

A Muscle-Saving Potato Masher



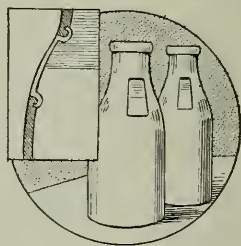
A SPINDLE, running vertically through the center of a hopper, is rotated by a suitably geared handle. A set of rotating arms at the bottom are actuated by the spindle to force the mashed vegetables through a perforated plate or sieve. The chief improvement consists in the rotating arms, which are toothed on the upper edge, thus serving to grate the potatoes before they are forced through the sieve, obviating any possibility of the potatoes' remaining lumpy or hard.

One Motion of the Handles Works These Scissors' Blades Twice



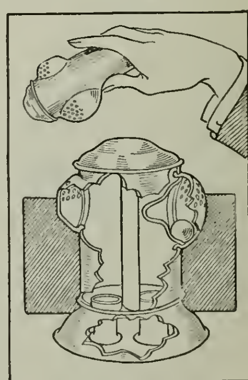
THE shorter blade of the scissors is actuated by means of a ratchet, which, as the handles are spread apart, opens the scissors. A spring closes the blades when the plunger has passed the tooth of the ratchet. The device may be made to close the blades twice for every movement of the handles by spreading the handles wide. By so doing two teeth actuate the plunger.

A Paper Milk-Bottle with a Window



A RECTANGULAR opening is cut in the side of a bottle made of paper, pulp, or other opaque material. Into this opening is inserted a section of transparent material, such as celluloid. A flange on the inside of the bottle prevents the window from being pushed out by interior pressure, and when the process is finished, the joints are covered with transparent cement.

A Salt and Pepper Shaker

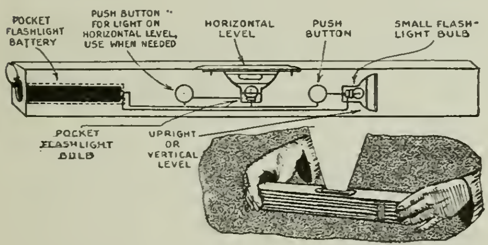


A RECEPTACLE is divided equally in two parts, to serve as a combined salt and pepper shaker. A screen is fitted on opposite sides of the device, so that either seasoning may be poured out singly. A ball is held near the screen in the salt compartment to break the lumps of salt to a fine consistency.

For Practical Workers

A Spirit-Level for Use in Dark Places

A MILLWRIGHT must often set up machinery and benches before a tenant has moved into a building. As the gas and electric lights are not turned on before the tenant takes possession, it is hard to level shafting, foundations, benches, etc., in dark places, especially on dark, rainy days. Candles are often employed, but both hands are required. With the level to be described, one hand is always free.



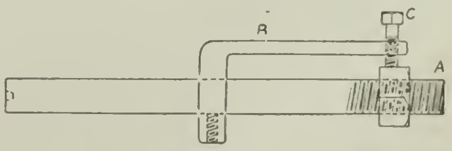
A spirit level equipped with a small flashlight will be found very useful for use in dark buildings

Use a small, round flashlight battery and drill a hole in one end of the level, large enough to hold it. With a ruler as a guide, make grooves with a thick-set penknife on the outside of the level to hold a fine wire. Push the wire in with a screwdriver, fill in the top with rosin or wax and finish smooth. Drill holes under each level, just deep enough to hold a flashlight bulb. Solder wires on them, and fill in with rosin or wax and finish smooth. The rosin or wax filling will hold the wires and bulb securely.

Drill holes for the smallest size buttons obtainable, and push the buttons in with a block of wood. A three-wire system is employed. The buttons are so located that the hand which places the level, lights the level with the thumb of that hand, thus leaving the other hand free to work with. A sliding cover is put on the end and screwed in to keep the battery in position.—T. F. Busch.

To Face Left-Hand Nuts

IN facing left-hand nuts, damage is often done to the facing tool or nut arbor, by the nut's starting to unscrew, and pushing the tool to one side or breaking it. The nut arbor or mandrel shown, will prevent the nut from coming loose, holding the nut in place until one side has been faced. It consists of the threaded piece *A* on which the arm *B* is held by the set screw. When the nut has been screwed up tight, the shaft arm *B* is set so that the cap screw *C* can be tightened up against one of the flat sides of the nut. The set screw should have a copper end if it is used on nuts that have had their sides finished. When many nuts are to be faced, it will pay to make a small cam that pivots on the end of the arm *B* to take the place of the screw *C*. The arbor can be held between lathe-centers or made to fit the mandrel of any lathe.—C. Anderson.

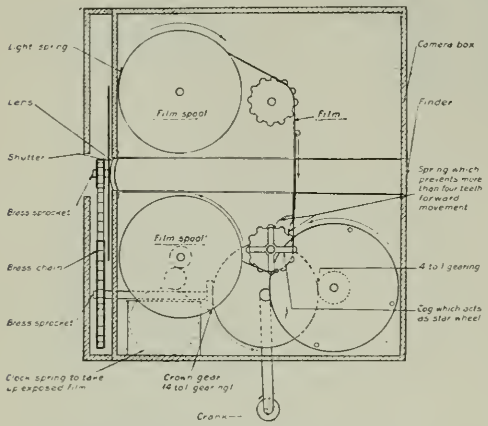


This nut arbor or mandrel holds the nut in place until one side has been faced

Home-Made Motion Picture Camera

THE motion picture camera shown in the drawing is very simple in construction and operation. It holds standard film rolls and is about 5″ by 7″ by 8″ in dimensions.

The film passes from the upper magazine over the toothed spool, down



The working mechanism of a home-made motion picture camera

through the slot where the exposure is made (size of exposure ¾″ high by 1″ wide) and then over the lower toothed spool on to the take-up reel, which is keyed to the shaft on which it rests. The shaft in turn is connected through gears to a clock-spring. This gives the reel the power to take up the exposed film as used.

It will be noticed that the lower toothed spool has a four-toothed gear fastened to its shaft. The action of the large wheel, which contains the four pegs, on the four-toothed gear is similar to the Geneva movement on most motion picture projectors. This large wheel is driven from the crank by four to one gearing, and as each of the pegs turns over four teeth of the little spool, the height of one exposure or ¾″, sixteen exposures are made to one revolution of the crank. Two little springs rub on the toothed spool to prevent slipping of the film in either direction, which action should take approximately one second.

A universal-focus lens is shown in the drawing, but a focusing lens may be used, in which case the shutter must be placed behind. The shutter is of the semicircular revolving type, driven through the chain and gears from the crank at a ratio of sixteen to one, or sixteen revolutions of the shutter to one of the crank. This will make a revolution of the shutter to each exposure. By shifting the chain forward or backward, the shutter can be made to uncover at the proper moment; that is, just after the fresh section of film has come to rest.

Before using the camera the spring must be wound. A cover should be kept over the lens.—E. G. GETTINS.

The Flap-Lock Envelope

THE ordinary envelope when sealed can very easily be opened and resealed, and the chances of detection are rather slight, especially if care be taken when resealing to see that the flap is put back in the exact position it first occupied. The attached drawings illustrate a distinct improvement on the old style flap. Instead of rounding off into a point, it is extended into a narrow strip, the length of this strip being the exact difference between the rounded point of the old-fashioned flap, when sealed, and the bottom of the envelope. A slit is cut in the back of the envelope, a little wider (1/16″) than the width of this strip, half way between where the rounded point would come and the bottom of the envelope. The flap is gummed in the

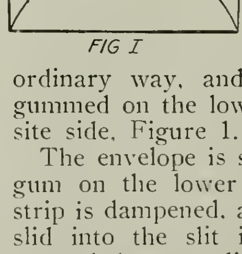


FIG I

This envelope cannot be secretly opened without certain detection

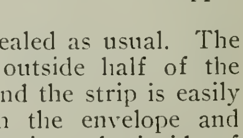


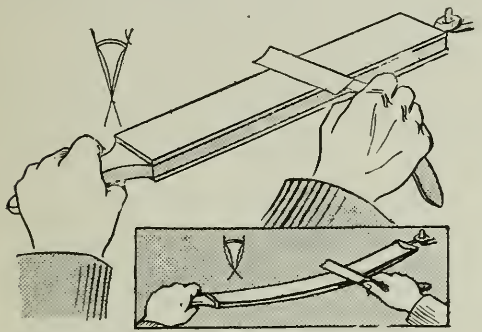
FIG.II

ordinary way, and the extra strip is gummed on the lower half of the opposite side, Figure 1.

The envelope is sealed as usual. The gum on the lower outside half of the strip is dampened, and the strip is easily slid into the slit in the envelope and pressed down, sealing it to the inside of the envelope, Figure 2. Opening and resealing this envelope, undetected, is practically impossible.—J. A. McMANUS.

How to Make a Self-Honing Razor Strop

MANY men do not know how to hone a razor. Twice a year they give their good razor to a barber or a tool grinder to hone, and it is often returned with the temper so far gone that it will not hold an edge. The red side



The proper and improper method of stropping a razor, showing why a flexible strop ruins the blade

of every strop, which is used for sharpening, is a strip of leather soaked in a mixture of crocus and kerosene. The black side (finishing side) is soaped, black, tanned leather. To retain a sharp, straight edge on a razor for life without honing, a straight flat strop must be used. You cannot hold a flexible strop tight and straight enough to prevent the formation of a blunt or rounded edge on a razor. That is why a razor must be honed every six months; it will not shave if the edge is too thick. The thin, concave edge that cuts can be retained only by using a flat and straight, nonbending strop, like the one illustrated.

Get a piece of hard wood 14 in. long, $1\frac{1}{2}$ in. wide and $\frac{1}{4}$ in. thick. Plane and sandpaper it to a smooth surface. Cut a handle at one end. Get two strips of smooth-finished horsehide (or cowhide, if you cannot get the other) 10 in. long, $1\frac{1}{2}$ in. wide and about $\frac{1}{8}$ in. thick. Coil one strip of leather to fit into a tomato can. This will save space and material. Get 25 cents worth of crocus (accept nothing but dry, bar crocus) from a machine shop supply store or a polishing concern. Mix this with enough kerosene to make a thin paste. Pour this on the strop until it is covered above the strop level and allow it to soak seven days. Clean off with cloth, and cement both leather strips on the wooden strip, using a good tire or leather cement, and allow it to dry, using several flat-irons as weights.

Crocus is the finest emery there is. It is used for polishing nickel and brass and does not scratch. The finishing side of the strop should be lathered with soap and rubbed in until dry.

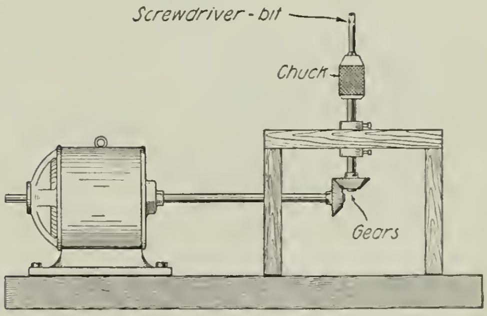
Do not throw the crocus mixture away. Bottle it, and use it for polishing purposes. Also apply it to your strop once a year to keep it effective.

Strop your razor flat. The lower diagram shows how a flexible strop wears down the edge of your razor to a rounded edge.—F. T. Busch.

An Electrically-Operated Screwdriver

A HANDY and practical screwdriver, operated by electricity, will more than pay for itself in a very short time.

An electric motor is fastened at the left side of a base of wood. A small wooden structure, as depicted, is built of posts, and a small hole is drilled at the top cross post to admit and allow the



This electrically driven screwdriver may be conveniently held in the hands

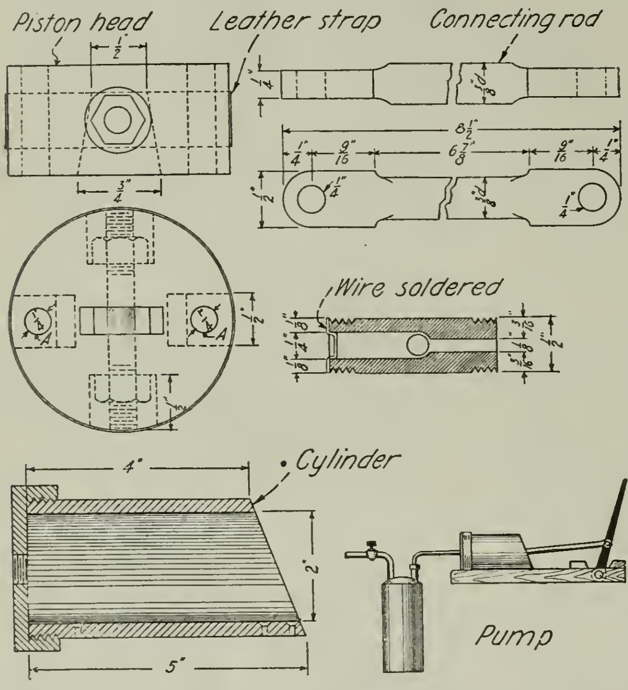
free movement of the steel shaft with the chuck. An arrangement by which the motor rotates the steel shaft (with chuck) is clearly shown. This device consists of two threaded pieces one on the end of the steel shaft of the motor, and the other on the end of the shaft with chuck. A chuck is threaded on to the upright shaft, and with a set of bits, drills, and so forth, including taps, very good and quick work can be done with this apparatus. The base being rested against the body and the current switched on, the apparatus does the rest.

A Simple Air-Pump

In order to obtain great heat or a high temperature, with a blow torch, it is necessary to have a tank supplying compressed air.

Obtain an iron-pipe, 2″ inside diameter, and having one end closed up with a pipe-end which may be removed at will by unscrewing. In the center of this end drill a ½″ hole and thread with a standard thread. The pipe should be cut 5″ long. Now from the plain end measure in 1″ and cut the pipe diagonally across, as shown in diagram, ⅛″ holes should then be drilled at either end and in the same line of the pipe. These holes are for the screws, which are to hold the cylinder in place on the base, and therefore they should be sunk rather deep so as not to interfere with the working of the piston. It will be a good idea to smooth the inner sides of the pipe with some emery cloth.

The piston is the most important part of the pump and ought to receive most attention. It is made of a wood disk 2″ diameter and 1″ thick. In the middle on the disk a hole is chiseled out measuring ½″ x ¼″ at the bottom and ¾″ x ¼″ at the top and is ⅜″ deep. Through the middle of the side and passing through the center of the circle of the disk, a ¼″ hole is drilled right through from one side to the other. At either end of the hole and with the same center a ½″ hole is now drilled. This is to admit the piston pin and the ½″ holes admit the nuts at either end. This part may be seen in the diagram.



Construction diagram of a simple air-pump which will supply a blow torch with compressed air

A and *A1* are the inlet valves and are ¼″ diameter, and the center of each hole is ¼″ from the edge of the disk. Leather is placed in these holes measuring ½″ x ⅝″ and is glued to the disk by a section about 3/16″ from the farthest edge of the leather hinge. The drawing shows this by dotted line across the rectangle. In order that there will be little or no leakage, a ½″ leather strap is wound around the disk ¼″ from top and bottom. This is done by making a ridge 1/16″ deep and ½″ wide in the middle of the side of disk when it is turned out. The leather should be glued in with the rough side out.

The connecting rod is made of ⅜″ iron rod. The length when finished should measure 8½″. This length is not at first needed because we flatten the ends out to the shape and dimensions given in drawing. The holes are for the bearings of piston and arm pins. It is very easy to forge the ends in a fire made for heating the house and to hammer them on a small piece of iron.

The air is kept from returning to the pump by a valve set on top of the tank. The drawing gives all the information necessary. The ball bearing used is a little smaller than ¼″ (perhaps 3/16″). The wire at the top prevents the ball bearing from escaping.

The pressure arm is 1″ x ½″ x 10″ over all. Holes are drilled ⅜″ and 3″ from one end. One serves as the pivot pin and the other as the connecting rod pin. The end should be rounded off to give the arm play in the bottom of the base. Stop pieces prevent the arm from being pushed or drawn too far. A slot 1″ x ¼″ x 1″, which is through the arm, allows the arm to move freely on the connecting rod pin. The pin is nothing but a ¼″ bolt, 1½″ long.

The receving tank used is made from an old hot water boiler usually found in homes where the hot water is not supplied by the house.

If a pump is made in this way it will surely give great satisfaction.

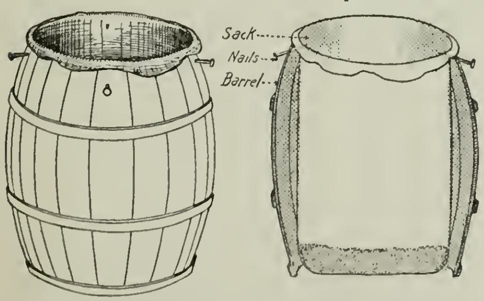
Gage for Duplicate Hole Drilling

DRILL the hole to the required depth and measure the distance exposed on the auger bit. This distance is taken from the face of the work to the end of the jaw protruding from the chuck of the brace.

Secure a block, say 1¾″ or 2″ square, which is as long as the distance previously measured. Drill through this block and allow it to fit over the auger bit, acting as a sleeve. The only exposed part of the auger bit will then be equal to the depth of the required hole.

A Barrel for Filling Sacks

THE clumsy performance of holding a sack and filling it at the same time can be simplified if the sack is hung in a barrel. Four curved nails are placed at equal distances in the rim, and the sack is suspended from these. When it is filled, the sack can be easily removed.

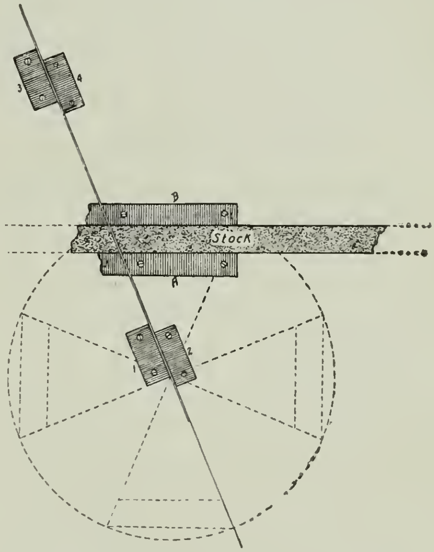


A few curved nails in the rim solve the problem of keeping a sack open while it is being filled

By the use of this device, one man can do the work of two and in less time, with practically no outlay.

How to Saw Difficult Angles on Small Stock

IN making a craftsman lamp, a very rigid miter is needed to cut unusual angles on small stock. If no miter box is at hand, the following device may be substituted. Use a smooth board about 1 in. thick and 18 in. sq. as a drawing-board and lay out the work directly on this board. Nail on cleats as indicated and the miter is ready for use. It is possible to secure very great accuracy and rigidity with very little trouble. In the case of one lamp, 44 pieces ½ in. by ½ in. by 3 in. were cut with bevels to form an eight-sided box, built up of these pieces as a child builds up dominoes. The pieces were so accurately cut that they went together perfectly.



The cleats and the drawing take the place of a very rigid miter-box

The drawing is first made very accurately, then blocks No. 1, 2, 3, 4, are nailed on the board along the diagonal. Enough room for the saw kerf was left holding the saw in position against Nos. 2 and 4 before nailing on Nos. 1 and 3. *A* and *B* are now nailed on, allowing just enough room for the stock. The first cut trims the first end on the stock, at the same time removing the surplus ends of *A* and *B*. Care must be taken that blocks 1, 2, 3, 4 are right-angled on the sides.—E. A. Hodgson.

How to Build an Aero Ice-Racer

By R. U. Clark

A small and simple ice-racer, which should attain speeds of from sixty to one hundred miles an hour, according to the power of the engine used

ILLUSTRATED accounts of several motor-driven ice-boats have appeared for some time past in different publications. The machines depicted have been more or less alike, and practically all have born a close resemblance to an ordinary sled fitted with a motor. In many cases these vehicles have been greatly overpowered, for although some of them have attained to speeds as high as eighty miles an hour, they have accomplished this with considerable waste of power, principally because of their faulty design, both as regards body shape and propelling mechanism.

In designing any high speed vehicle the body and all the external parts should approximate a pure streamline form as nearly as possible. This fact has been thoroughly demonstrated during the past few years in the case of the aeroplane, and during the past season has been forcibly illustrated at the auto races. In the case of the motor-driven ice-boat, the necessity of a streamline body is far more apparent when it is considered that more than 95% of the tractile power is consumed in overcoming the resistance of the wind where traction is secured by direct aerial drive.

In addition to being essential to high speed, a closed-in ice-boat body affords a very necessary protection from the cold and wind, which alone would be reason enough for constructing such a vehicle along these lines. It therefore seems strange that, in spite of these facts, people should think a wooden cross equipped with runners and a motor, a fit apology for a motor ice-boat, but this is probably due to the fact that the advantages of closed-in construction are not fully realized, and consequently the builder does not care to take the time to build a decent body.

A motor ice-boat to be worth while should combine the following features: Strength, lightness, cheapness, proper streamline form, complete protection from the wind, and above all ease of construction. Fortunately it is a very simple matter to design and build such a body, as will be at once apparent after a glance at the illustrations submitted herewith. As will be noticed from these sketches there are two possible seating arrangements which allow of simple streamline body construction. The machine depicted in Fig. 1, with the motor at the rear, is designed primarily for use as a single passenger machine, in which case the body need not be over five feet long, by about twenty inches wide. By enlarging the body as regards length and width, from three to four passengers could be carried, provided the body was strengthened accordingly, the occupants sitting in the same manner as they would on a double runner sled. This requires a few inches additional width to the body.

Fig. 2 shows a different motor and seating arrangement from that submitted in Fig. 1. On the machine in

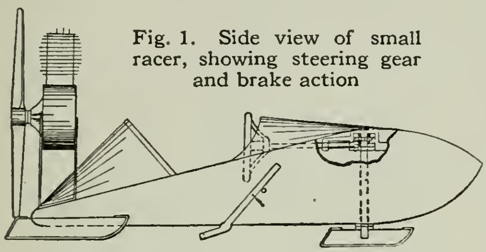


Fig. 1. Side view of small racer, showing steering gear and brake action

Fig. 2 the motor is placed in front, driving the propeller, through a long shaft, at the rear. This shaft runs between the passengers along the middle of the vehicle, as can be seen from the top view plan in Fig. 2. Note that the shaft is enclosed where it passes through the cockpit. From this sketch it is apparent that sociable seating is employed. This requires a wider body which tends also to cut down the speed, but at the same time allows of several passengers being carried, and the use of more power.

The body construction is practically the same in either machine illustrated in this article, but, of course, due allowance should always be made for the weight carried. A one or two passanger machine may be constructed so as to weigh little over 100 pounds complete, but in all cases it is advisable to build a light frame to lay the planks on, although in the case of a small machine it is perfectly possible to obtain sufficient strength from a body constructed of four boards of the proper shape fastened edge to edge, in which case the side boards should be fairly thick, or else have their edges re-enforced with moulding inside.

As has already been stated when tandem seating is utilized the motor should be situated at the rear, in which case the aerial propeller can be directly connected to the crank shaft of the motor, thus constituting the complete power transmission.

The runners for both of the models described in this article are constructed in the usual manner of wood, shod with steel or iron edges, these being formed of square rods set in the wood edgewise so as to present a sharp running edge to the ice. They are held in this position by their extremities, which are flattened and secured to the wooden runners.

Both machines can be made with only three runners, one in front by which the boat is steered, and two at the rear. The size of these runners depends to some extent upon the load to be carried, but for ordinary use runners from twelve to eighteen inches long should prove entirely satisfactory. When it is the intention of the builder to carry many passengers, the spread of the rear runners should be widened considerably, or else the machine should be fitted with four runners.

The steering of the motor ice-craft here described is accomplished by means of two beveled gears and shafts as illustrated. This fixture can be rigged up by using the gear mechanism found on an old ice cream freezer. This changes the plane of rotation as desired and

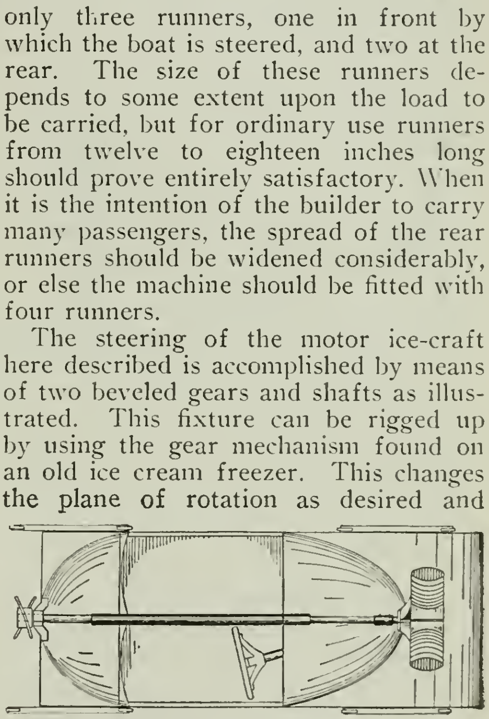
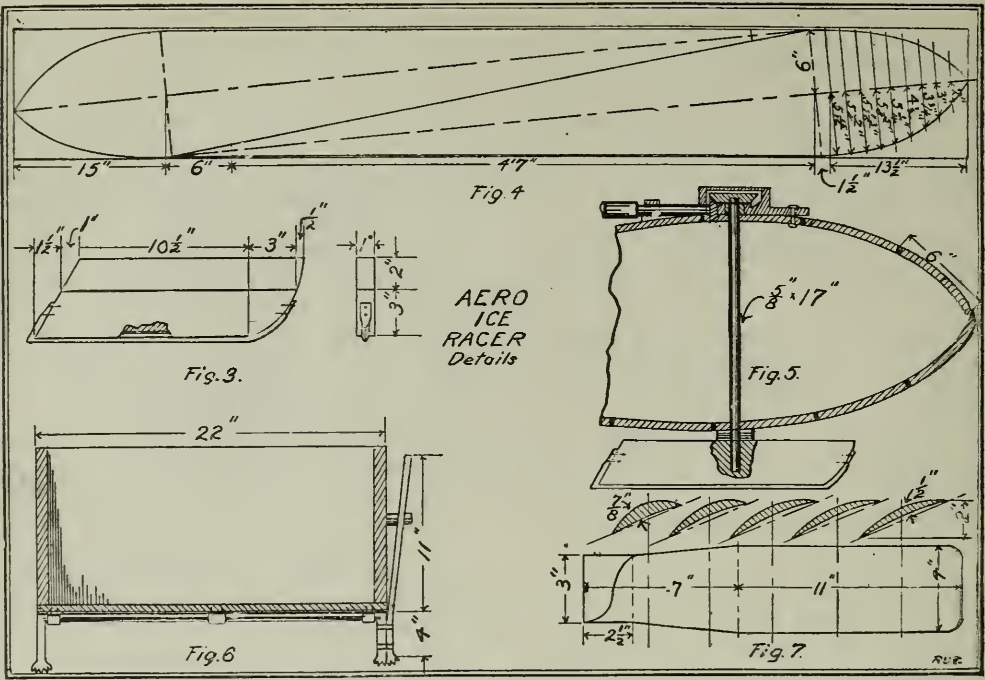


Fig. 2. Top view of another form of racer, in which the motor is in front, and the propellor at the rear. This form of machine holds two passengers

saves the cost of a regular steering mechanism. In case the former device is employed, a large steering wheel should be provided, as the ratio of the gears utilized is rather high.

Braking the speed of the aero ice-boat is accomplished by means of the lever drag brake shown in the drawing. The complete brake is constructed of two pieces of iron or soft steel riveted together and forged to the shape illustrated. The brake is held in the proper position when not in use by means of a



Working drawing showing details of a simple aero ice-racer. This entire machine may be built for less than twenty dollars, if good judgment is used in buying materials

spring and a small wooden block, as can be seen by referring to the drawings. The bottom edge of the brake should present several rough teeth to the ice. This prevents any sudden catching due to lumps or ridges in the ice.

The small shields on the top of the body are intended to cut down the resistance caused by the bodies of the passengers, and can be constructed of metal or fiber. They are semi-conical in shape as shown, and afford considerable protection from the cold.

A motorcycle motor is very well suited for use on a motor ice-racer. These motors can be bought second hand in running condition at most any price from $8.00 up, and ranging in horse power from 3 to 20. The smallest of these weigh only about 40 lbs. complete, and are capable of driving a small ice-racer at considerable speed.

The speeds possible with the aero-driven ice-boat range very high when the craft in question is properly designed and constructed, and if sufficient power is used. Even the smallest craft should be capable of a speed of a mile a minute when well made, and with a powerful motor a good machine should attain a speed of nearly 100 miles an hour; a great deal, however, depends on how well the body is designed and constructed, and how well the motor runs.

Having described the aero ice-racer in a general manner, it is next in order to furnish detailed instructions for the construction of a simple craft of this type which will give the most satisfactory service, and at the same time require the least effort in the making. A machine of this type is therefore described following the design in Fig. 1.

To begin at the bottom and work up. Three wooden runners should be made of clear stock at least 1″ in thickness. One of these is represented by the lower portion of the runner shown in Fig. 3. The other two should be similar in shape to the entire runner illustrated in the same figure. The dimensions for these are given in the drawing. The shape can be laid out from the sketch by marking off the chief dimensions as indicated and drawing in the curves free hand.

A V-shaped groove 3/8″ wide by 3/16″ deep is cut along the middle of the bottom of these three runners with a miter-box saw, and is continued part way up both ends as shown in Fig. 3.

Three 18″ pieces of 3/8″ square iron or soft steel should be procured and the ends flattened, by hammering two opposite edges, for a distance of about 1½″, and two 3/16″ holes bored in each end so that the iron runners can be attached to the wood, after being bent while cold to the approximate shape, in the exact manner shown in Fig. 3. These iron runners are held in place by 3/16″ brass screws countersunk. The screws should not be less than 1″ long and should have flat heads.

If the wooden runners are over 1″ thick they can be made of soft wood, and it will be possible to run the craft over the snow even if it is only packed to a small degree.

The small runner mentioned above is for the rudder, and is placed in the front of the machine. A 5/8″ round steel rod 17″ long is sunk into the center of this runner to a depth of about 2″, and is held in place by two 3/16″ steel bolts which pass through the rod and runner, as in Figs. 1 and 5. Four or five 5/8″ washers are slipped on the rod.

Fig. 4 shows plainly how to lay out the sides of the boat body. Both sides can be cut from 7½′ board ¾″ thick by 12″ wide. The dimensions are taken from the sketch and are laid out on the boards in the exact manner shown. The proper curve for the bow is obtained by marking off various points at different distances from the center lines, as shown, and connecting these points until a fair curve is obtained. Spruce is one of the best materials, as well as the cheapest, for making the body, but should be free from splits.

Nineteen pieces of ½″ by 6″ stock exactly 22″ long are now required. These should be of selected spruce and are used for the bottom and deck of the boat body. They are laid on crosswise. The side boards should be held the proper distance apart temporally by several short sticks nailed at various points along their edges, and the entire bottom nailed in place with 2″ nails. The bottom board should overlap about ¾″ at the front of the body.

The rear edge consists of a piece of spruce 20½″ long by 1″ thick by 2″ wide. This is nailed in place between the sides before the first rear deck board has been laid on, and properly beveled at the same slant as the sides. The rear deck board is then nailed on, the nails along the back being set in ¾″ from the edge. The rear edges are then rounded off to decrease the wind resistance, and give the body a finished appearance. Two more 6″ boards are then laid on, thus completing the rear deck, which is composed of three boards in all.

The deck board nearest the bow is now laid on in such a manner that its lower edge meets the front bottom board. First, however, it should be beveled to the proper angle to allow of a perfect fit. The top edge of the bottom board is then rounded over to a blunt point. These details are illustrated in Fig. 5. Three more top deck boards are then put into place. The front boards should be steamed before bending.

In the third boards back from the front, on the top and bottom of the body, 5/8″ holes should be bored midway between the side planks, and 2″ in from the rear edge of the boards in question. The hole in the bottom board is re-enforced by a 1/8″ iron plate, 2″ square, drilled in the center to correspond with the hole in the bottom plank. This plate is placed on the outside as shown in Fig. 5.

It is now in order to insert the upright shaft, affixed to the small runner, in the two half-inch holes bored for this purpose. The top of the shaft is then filed square in such a manner that it makes a good fit with the hole in the bevel gear, of the rotating device of an old ice cream freezer, which turns the dasher. This mechanism is seen in place in Fig. 5. It will be noticed that in this figure the housing for the gears is bolted direct to the upper deck on the outside, while in Fig. 1 it is placed under the deck. The former method of outside mounting is by far the simplest, and probably the best. The crank shaft of the freezer mechanism is slipped into an 8″ piece of heavy brass tube, which should fit snugly over it, and should be secured to prevent movement in any direction by two 1/8″ pins passing through the tube and shaft. These pins should be made of steel, and should be riveted in place. On the end of the brass tube is mounted the steering wheel. A good idea of the complete device can be gained from Fig. 5.

The two rear runners should now be bolted to the body of the craft with 1/4″ bolts. These runners should overlap the rear of the body by 3″, leaving about 11″ of surface to bear against the body. The bottom edges of the runners should be 3″ below the body. In other words the clearance of the body at the rear should be 3″. At least 3 bolts should be put through each runner.

Figure 6 gives a good view of the brake. This is constructed of two pieces of iron, or soft steel. One piece 30″ long by 1/2″ in diameter has its extremities bent at right angles making legs 4″ long. These are flattened as shown, and saw teeth filed to engage with the ice. To one of these legs is affixed the 1″ x 1/4″ iron lever by means of rivets. This is brought to the bottom of the leg and affords additional surface to engage with. The upper end of this is rounded to fit the hand. This brake is attached to the bottom of the body 20″ from the rear by means of three stout brass straps. The lever is bent out to clear the side by about 3″ and when not in use is held against a small block by means of a spring as shown in Fig. 1, so as not to drag on the ice.

The next step is to select a good second-hand motorcycle motor of from 3 to 4 h.p. A motor in good running condition can be bought for $10.00 with battery ignition, and for about $15.00 with a magneto. This motor is mounted at the extreme rear of the sled, and is held firmly in position by two U-shaped iron supports, one of which is shown in Fig. 1. These supports should be about 1/4″ thick by 1 1/2″ wide, and should be high enough to elevate the motor so that the distance between the top rear edge of the body and the main crankshaft bearing is about 18″. This will require about 44″ of strap iron for each support, as these pieces must extend high enough up on each side of the crankcase to permit of two crankcase bolts on each side being passed through the supports, provided the engine in question has two bolts to a side, which is generally the case.

The controls on most second-hand motors are so different that it is practically impossible to give any method for rigging them up on the motor ice-boat. The simplest method, is to use flexible controls for the spark and gas, mounting the levers on the side of the boat near the brake handle, in such a manner that they do not come in the way when actuating the brake.

The next consideration in equipping the craft is to provide an aerial propeller of the proper diameter and pitch. So many things must be taken into consideration in designing a propeller for an ice-boat that it is practically impossible to submit any one design which will work at high efficiency on any motor ice-boat. In order to obtain the very highest efficiency exhaustive experiments with propellers of different dimensions would be necessary. However, for ordinary work an aerial screw having an over-all length of 3′ will be found entirely satisfactory. in Fig. 7, a design is submitted which will give good results with a motor of from 3 to 4 h. p. The greatest pitch of this propeller is 4′. This means that at every revolution the propeller theoretically advances 4′ and in practice somewhat less than 3′ if we figure the efficiency at about 70 per cent.

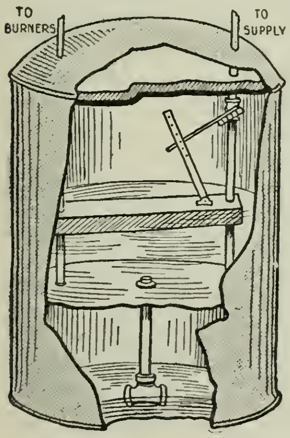
The exact dimensions for the propeller are indicated in the sketch. The cross-sections of the blades given show the size and angle every 3″ from the center to the tip. It will be noted that the under-surface of the blade is slightly concave, most of the cross-sections being semi-streamline in form. This propeller can be constructed of a 2″ by 6″ spruce plank slightly over 3′ long. Spruce is one of the best materials for this purpose and also the cheapest. Most of the work in turning out this propeller can be done with a small hatchet or a draw-shave, and finished up with a spoke-shave. The blades should be well sand-papered and given several coats of shellac. This propeller is bolted directly to the pulley or sprocket as the case may be, on the end of the motor crankshaft, with two 3/8″ bolts, the ends of which should be secured to prevent their loosening.

The machine which has been described will carry two passengers.

A Simple Gas-Pressure Regulator

A STEADY gas pressure is often desirable but seldom obtainable direct from the main. The writer, desiring to use gas as fuel for six small incubators, found the regulator shown in the accompanying diagram very simple to construct and extremely effective.

The tank used was a five-gallon, galvanized iron oil tank. The division shown is cut from a piece of galvanized iron and the pipes are fastened into place with locknuts and leather washers, before it is soldered into place, which should be about one-third the way up the bottom. The center pipe is 1¼′ standard and extends to the bottom, forming a conductor for the oil and a brace for the dividing diaphragm. The gas pipes are ½″ standard, and are fastened firmly to the wood brace at the top of the tank. The regulating valve is an ordinary gas cut-off with an extended arm riveted to its "T" lever. The arm which connects the valve lever with the float, is bored in a number of places, which allows for setting. This adjustment is necessary only once. The wood float has two 1″ holes bored through it as shown, and so uses the two gas pipes as guides. The weight of the float must, of course, be sufcient to operate the valve, which may be suppled up a little with laundry soap.

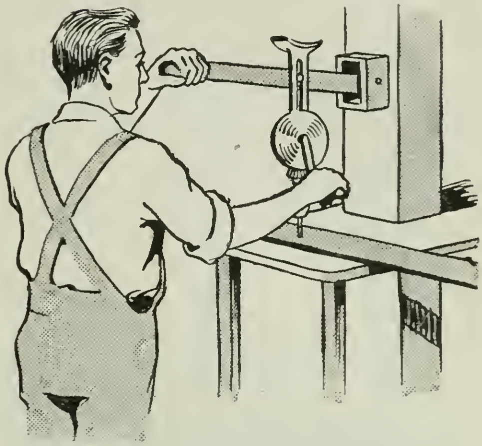


This simple device will regulate an uneven gas pressure from the main

Pour in enough thin, cheap machine oil to fill the bottom compartment and raise the float about an inch, set the valve about two-thirds open and turn on the gas. With no burners going, the float should rise so that the valve is nearly closed. With all burners going it should be an inch above where it stood before the gas was first turned into the regulator.—E. C. GRAVES.

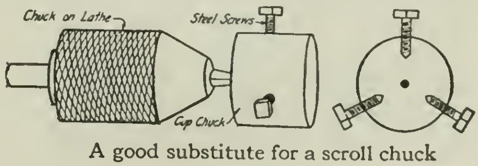
An Emergency Drill Press

A DRILL press for emergency jobs can be made in a few minutes provided a breast drill is available. A wooden arm between two and three feet in length should be pivoted at one end to a wooden support that is fastened by nails or screws to a stout base. A few inches from the pivot, a bolt should be inserted through the arm and the handle of the drill. Place the lever under the left arm; manipulate the drill with the hands.—N. S. McEWEN.


This emergency drill press is simple to rig up, and will be found very useful

A Handy Chuck for a Small Lathe

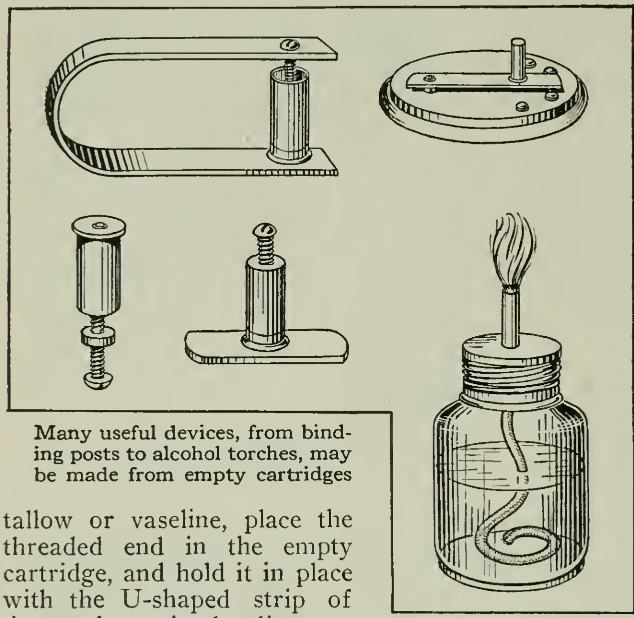
A CHEAP and useful chuck for a polishing lathe, can be made as follows: Cut from a 1½″ brass tube, a piece about 1″ long. File the edges true and solder at one end a fairly thick disk of brass. In the centre of this, drill a hole and insert and solder a short length of steel shafting, which will serve as a grip for the drill chuck when mounted on the lathe. At equidistant points around the circumference of the cup, drill and tap to fit three steel screws. The article to be turned is held securely by the screws.—H. VINCENT.



A good substitute for a scroll chuck

Utilizing Empty Cartridges

VERY good binding posts can be made from empty .32, .38 and .44 caliber cartridges and stove bolts in the following manner: Grease the stove bolts with



Many useful devices, from binding posts to alcohol torches, may be made from empty cartridges

tallow or vaseline, place the threaded end in the empty cartridge, and hold it in place with the U-shaped strip of tin, as shown in the diagram. Now fill the space between the bolt and the cartridge with melted lead or babbitt metal. When the lead has hardened, remove the strip of tin, and unscrew the bolt from the lead. By drilling a small hole through the cartridge, and soldering a small strip of brass to the bottom to permit its being fastened to the desired base, an inexpensive and handsome binding post is ready for use.

A good alcohol torch can be made from a vaseline bottle and a rim-fire cartridge as follows: Make a hole through the screw cap of the bottle large enough to admit the cartridge. File off the closed end of the cartridge, so as to produce a short tube with a flange at one end. Insert this through the cap, to which it should be soldered. The wick is led through the tube from the bottle, and the entire outfit forms a serviceable torch.

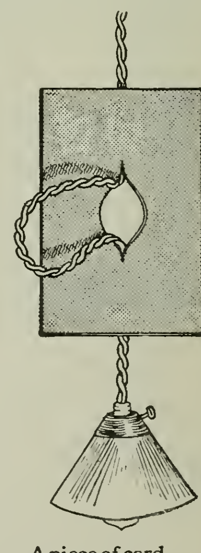
The Thermos Bottle as a Stove

IT is perhaps not generally known that the smallest fireless cook-stove is any one of the numerous vacuum bottles which have been on the market so long. In most families these are regarded as a convenience or luxury for picnic purposes. They really make a very useful fireless stove.

Heat soup, beans, peas, or any other vegetable that will go through the rather small opening of the bottle, leave them there for several hours, and they will come out completely cooked. The many uses of vacuum bottles are by no means exhausted by the one just mentioned.

To Adjust a Light-Cord

IT is often difficult to adjust the electric drop-wire quickly and at the right height by tying knots in the cord, and worse still to untie these knots and put new ones in, when the light is to be moved. The wires also become dirty after they have been up some time, and if one undertakes to change the light the result is a pair of soiled hands.



A piece of cardboard and a knife make tying knots unnecessary

A piece of good stiff cardboard, about the size of a calling card, and a sharp pen knife complete the list of necessaries to make a cure for this evil. Cut a diamond-shaped hole in the cardboard and draw the wire through the middle of the hole. When you have the light at the proper place, push the twisted wire towards the bottom and top of the slit, and the weight of the fixture and globe will prevent further slipping. There is no knot here and if it is desirable to move the light again you can do so, without any trouble, and in a minimum time.

Experimental Electricity

Practical Electrical Hints for the Amateur
Wireless Communication

Safeguarding Vessels by Radio

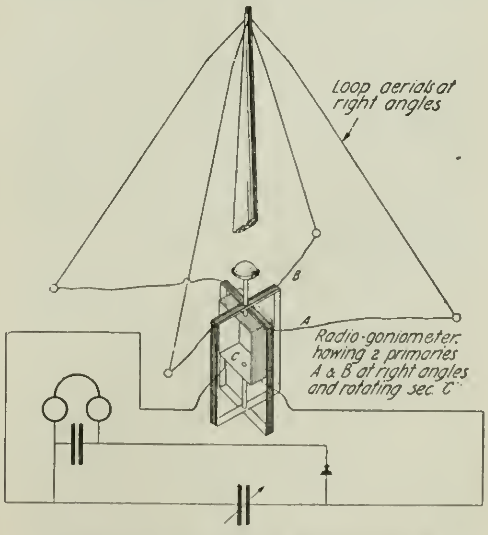
By Annis Salsbury

ONE wreck a day is said to be the average on the fog-visited Pacific Coast. Commerce on the Great Lakes, while possible during only half the year, is exposed to dangers inherent in waters visited by dense and persistent fog. Likewise, the Atlantic Coast is not without this menace to navigation, for it runs a close second to the Pacific in the number of its sea tragedies; the Gulf of Mexico is also frequently blanketed with mist, and there the dangers of collision or grounding on coral reef or sand bank are much increased.

The United States lighthouse service has greatly lessened the death toll of treacherous points, but even a beacon of a million candlepower or the shrillest fog whistle is powerless to combat fog. Sound, unreliable under even the best atmospheric conditions, is refracted and reflected to a marked degree by fog-banks, fog-waves and fog-billows. Fog blots out the bright rays from a lighthouse as completely as if it were swathed in thickest wool, and the mariner who is unfortunate enough to find himself on the sea under these conditions, unable to sight a warning beacon, and not trusting fog-siren or booming rocket, flounders about as helplessly as a blind man on a busy street. Fog is without doubt the greatest menace to safety known to navigation, and any means of enabling a mariner to keep his course in fog and to receive timely warning of the proximity of other vessels will relieve ocean travel of its chief danger.

Scientists in the United States, thoroughly cognizant of this fact, have for some time been on the trail of devices calculated to overcome this peril of the sea, but not until recently have practical suggestions been put forward for the relief of this age-old menace.

The "radio compass," which promises to add much to the safety of navigation, has been in use in Europe for several years. It is said that ships have found their way up the river to Hamburg in the densest fog, and that Zeppelins depend entirely on stations fitted with this special apparatus during darkness or when the earth and its familiar land-



Wiring diagram of the Bellini-Tosi directional receiver

marks are blotted from view by mists or fogs. The French government, as well, has made it possible for ships, fitted with the compass, to determine their positions through wireless signals from the stations along the coast.

The United States Radio Service is now experimenting with the Bellini-Tosi type of radio compass at Cape Cod and the Telefunken compass at Fire Island. The purpose of each is to enable the navigating officer of a vessel to take bearings of wireless telegraph stations, in order to find the position of his ship or to avoid collision with other craft. It is not asserted that the bearings taken exceed, or even equal in accuracy, those taken with an accurate optical instrument under favorable conditions, but reliable bearings may be obtained by radio, when direct optical bearings may not be taken because of unsettled weather, etc., and in making harbors, in keeping to difficult channels, and in avoiding collisions with other vessels, when fog obliterates surrounding objects from view.

Transmitting Distributors of the Telefunken Compass

Both compasses are modifications of the same principle. The Bellini-Tosi type provides that the moving station, whose position requires determination, shall send signals to a fixed station. The direction of receipt is determined at the fixed station, and then transmitted by wireless to the moving station. In the Telefunken system, the fixed station sends out signals and the moving station determines from what direction they are coming. In both arrangements it is necessary that one of the stations should be directive.

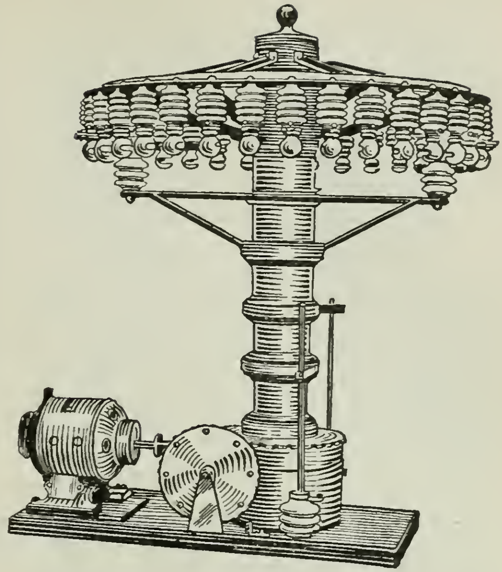
Directive sending is accomplished by special antennas, which are considerably more complicated than those of the ordinary undirective type, require greater space, and are difficult to install on movable stations, such as ships or aeroplanes. The system in which fixed stations send out directive signals, therefore, appeared most feasible to German inventors. In this case the movable receiver need only be equipped with an ordinary antenna. The Telefunken compass is so worked out, then, that it may be installed only on shore. Some thirty-two transmitting antennas are disposed at equal distances around a circumference of a circle 200 meters in diameter. Each pair is joined up successively with the transmitting apparatus by a rotary distributor, and at each position a signal corresponding to a point of the compass is sent out. An operator on board ship thus hears a succession of signals, increasing gradually in strength to a maximum and then dying away. The loudest signal occurs at the moment the shore operator is sending on the antennas pointed in the direction of the receiver. All that is necessary for the ship operator to do, then, to obtain the bearing of the land station, is to note the signal that is strongest.

On the other hand, the Bellini-Tosi arrangement is contrived so that it may be installed on shipboard. The ship thus fitted is enabled to get its bearing from any wireless station on the coast or inland, if within range of the ship's wireless. The salient features of the Bellini-Tosi system are two aerial loops of equal size, suspended in vertical planes crossing each other at right angles, and a "radiogometer" or special receiving transformer, having two primary coils of equal size and crossing each other at right angles in vertical planes. When a signal is received, currents are induced in both aerials, their relative strength depending on the direction of the sending station with reference to the planes of the two aerial loops. The signal is loudest when the plane of the aerial loop is the same as that of the sending station, weakest when the planes are at right angles. The induced currents pass through the corresponding crossed coils in the instrument and produce, in the space enclosed by them, two magnetic fields at right angles to each other. The two fields have relative strengths depending on the relative strengths, depending on the relative aerials, and they combine to form a resultant field at right angles to the direction from which signals are coming. The pivoted secondary coil will consequently receive the strongest signals when its plane is in the direction from which signals are coming. A pointer attached to this secondary or "exploring" coil indicates its position and consequently the direction of the sending station.

A useful application of the direction finder is the determination of whether the ship is on a course which will take it inside or outside a lightship or isolated lighthouse. A few signals from the fixed station will settle the question as certainly as if the light were visible. Similarly, when making a harbor, a few signals from a station within will show immediately whether the ship has drifted to one side of the entrance. When trying to locate another vessel in a fog, the indication of the direction finder may show, by a steadily increasing strength of signal, that the other ship is approaching, but, since only the direction and not the sense is given, it might leave doubt as to whether it was approaching on the port bow or the starboard quarter. A wireless query as to her course, addressed to the other ship, would remove the doubt at once.

Following out the German idea and installing the compass on shore, relieves the ship of a special aerial, but the point against it is that there must be numerous coast stations fitted out with the transmitting apparatus. The Telefunken device is used along the German coast, however, and at the outbreak of the war, comprehensive schemes for installation at intervals of every 25 miles along the northern and western coasts were about to be carried out.

United States Government engineers, working from a slightly different angle, have suggested a plan which they believe will greatly reduce the fog peril and yet require minimum investment in men and money. It is merely a wireless transmitter, fitted with an automatic sending device, and calibrated to send only a limited distance. This radio fog-signal may be installed with equal facility on shipboard or at a land station. The antennas are of the simplest type, and the automatic transmitter makes it possible for any person to operate it. A ship making its way along the coast in a fog may hear some lighthouse in his vicinity, equipped with the radio fog-signal, sending out a pre-arranged series of signals, characteristic of that particu-



The transmitting distributor of the Telefunken compass

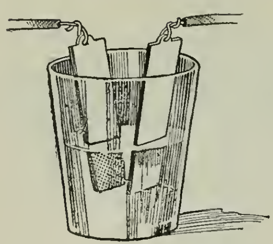
lar lighthouse. The captain then knows that he is within ten or twelve miles of that particular point. His position is further fixed as the ship proceeds, from the change in intensity of the signals, since, if the signals increase in strength, the captain knows that he is getting nearer the source of transmission.

A bad coast may be fitted with the radio signals at intervals close enough so that the coast-wise vessel will pass directly from the jurisdiction of one to that of the next. In this way there will be continuous protection for the ship. Installed on shipboard it may prove a valuable means of keeping vessels from crowding on to one another. The radio fog-signal is not a direction finder, but is to be merely a warning to ships passing along a dangerous coast, or an inexpensive addition to ship's equipment which way be used in time of fog.

The Earth's Conductivity

THE resistance of sea-water is only about one-hundredth that of fresh water. Damp earth often offers less resistance to electric current than does fresh water, but dry earth measures over ten times as many ohms between opposite sides of a cubic section.

Finding the Positive Wire



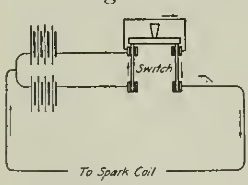
AN easy and simple way to find out which wire from a storage battery is positive and which is negative is the following:

Take a glass tumbler and draw some of the electrolyte from the battery, filling the tumbler about half full. Take two strips of clean lead and attach them to the two wires. Drop the leads into the solution, suspending them free in it, and switch on the current. After two or three minutes turn off the current and examine the pieces of lead. The one attached to the positive wire will be covered with a fine brownish deposit, while the negative end will be clean. The illustration herewith shows the arrangement.

How to Prolong the Life of Battery Cells

BATTERIES used for gas engine ignition are usually connected in series parallel, or, in opposition. This is the best method of connecting them, since a larger current can be obtained.

One disadvantage in this method of connecting cells is that, if the cells are left in opposition when not in use, they very quickly "die." The accompanying diagram shows a handy method of connecting cells so they will be in parallel only when the switch is closed. When the switch is opened the parallel connection, as well as the external circuit, will be broken. The arrows indicate the direction of the current when the switch is closed.

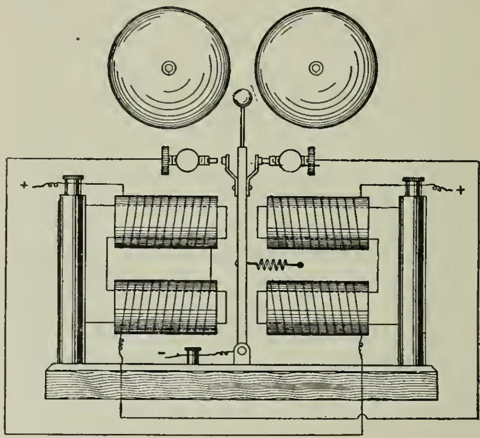


The Obligation to Secrecy.

ALTHOUGH the United States Government does not require experimental radio receiving stations or their operators to hold Federal licenses, the law as to secrecy of received messages is enforced upon them. This law states in effect that no persons shall divulge or publish the contents of any radio messages received or known by them, and provides a fine of $250 and three months imprisonment for violations.

Springless Electric Bell

AN electric bell can be made which will operate without springs, by installing the armature between two opposed sets of magnets. The resistance of opposing sets of magnet coils should be equal, about 150 ohms when the bell is operated on low voltage, and 200 ohms when a higher voltage is used. The diagram of necessary connections is shown in the accompanying illustration.



The action of the magnets makes the use of springs unnecessary

Photographic Records Still Impracticable

HIGH speed automatic wireless telegraphy in which a photographic recorder is used for the receipt of messages has often been attempted. Under favorable conditions signals of a moderate strength can be recorded at 80 or 100 words per minute, but presence of the slightest "static" makes great trouble. Even normal static, as it is heard during the summer in Northern latitudes, is sufficiently troublesome to make practical working impossibile. Other methods, such as those using phonographs or telegraphones, for recording the incoming signals, have proved successful over moderate distances. The large number of messages which can be sent in a short time by automatic working makes the problem attractive to radio companies.

A Simple But Powerful Arc-Light

THE arc-light shown can be made from odds and ends at a very small cost and can be used for many different purposes.

A piece of wood for the base, some strips of brass, a few battery binding posts, screws, drop cord and plug, and two battery carbons in a fruit-jar, with a small piece of fiber insulation, are all the articles needed to construct the light.

The fruit-jar resistance is the novel feature. Two ordinary battery carbons are held at a fixed distance from each other by two strips of fibre, the bottoms being about 1/8-inch and the tops 3/8-inch apart.

Rubber insulation cut from an old baby buggy tire may be used for handles at the ends of the strips holding the arc carbons. By moving these handles the arc may be raised or lowered and fed together.

After the wiring is completed, fill the jar 3/4 full of water and connect the plug with a regular 110 volt house light socket. This will make it necessary to put heavier fuses in the fuse block.

This arc will melt any substance placed between the carbons, as it will give from 1/4 to 1 inch flame.

If a housing is placed over the base,

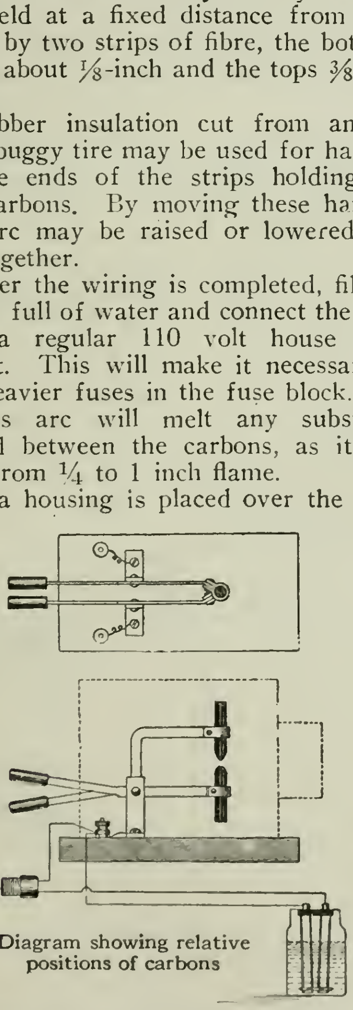


Diagram showing relative positions of carbons

as shown in dotted lines, and a reflector used with a common reading glass in the sleeve, the arc will cast a light the distance of a mile.

An Electric Heater in the Garage Makes Cranking Easy

THE problem of cranking an engine on cold mornings is one of the irksome tasks that still confronts the owner of automobiles. Radiators filled with

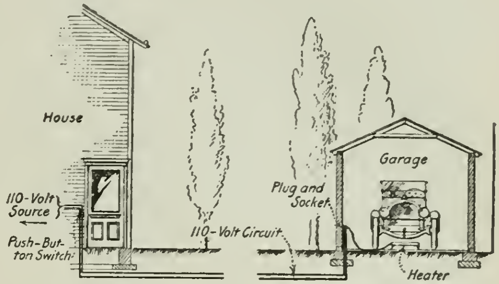


Diagram of wire connection with heater

an anti-freezing mixture will resist very low temperature without congealing, but if an engine is idle over night, all the working parts become so cold that a great deal of energy must be expended at the crankshaft before even a sputter of encouragement comes from the exhaust muffler. This can be avoided by the use of a 500 watt electric air-heater. The circuits to feed the heaters can be wired, as shown in the diagram.

About half an hour before the owner is ready to use his car in the morning, he turns the switch, which is located inside the house, and the heater in the garage begins to warm up the engine and the fluid in the radiator. As he leaves the house he disconnects the heater from the line; but by this time the engine, radiator and carburetor are warm, and at the first turn, a liberal charge of gas is exploded in the engine cylinder and the car is ready for work.

The Wireless Idea Is More Than Seventy Years Old

NEARLY eighty years ago the first patents on wire telegraph systems were issued, in England and America. The first suggestion that wires might be eliminated came only a few years after the beginning of line telegraphy, and although "wireless" telegraphy by conduction was practiced experimentally in 1842, it was not until 1895 that radio telegraphy was first accomplished.

Recent Radio Inventions

Microphonic Relays; An Unusual Quenched Spark-Gap; a Slipping-Contact Detector

By A. F. Jackson

FOR a number of years inventors struggled to produce microphonic relays, but their work was practically without substantial success. It was not found possible to build an instrument which would magnetically modulate the current through a microphone contact in such a way that all the vibrations of the human voice could be reproduced and magnified. This, nevertheless, did not prevent the development of microphonic relays that would augment the energy of current having a single definite frequency. Instruments of this sort are shown in 1915 U. S. patent No. 1.163,180, issued to W. Schloemilch and A. Leib.

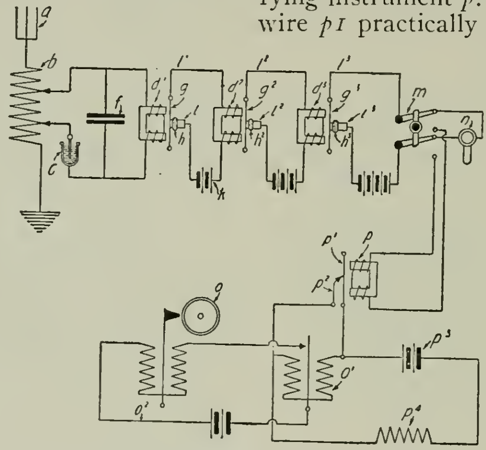


Fig. 1. With a microphonic relay of this sort, tremendous magnifications may be obtained

One arrangement of this patent is shown in Fig. 1. The antenna, tuning and rectifying system *a, b, c, f,* leads the converted, pulsating energy of the received waves to the first amplifier *d1*. This consists of a wire vibrating system *g1* connected mechanically to a microphone *h1*. The tension of the vibrating wire is variable, and is to be adjusted so that its mechanical period is the same as the sound period of the incoming wave groups. Thus the wire is made to vibrate, through resonance, and a great effect is produced upon the microphone. The current from battery *k1* is varied by the first relay and led through the magnets and the second-step relay, which controls the current from a second battery. The second step of amplification is carried into the third relay and its output through switch *m* either into the loud-speaking telephone *n* or into the delicate contact relay *p,* the final relay *o1,* and the Morse printer *o*. The relay *p* is not of the microphonic type, like those of the first three steps, but has a tuned wire *p1* in contact with a sluggish spring *p2*.

When signals are received of the group frequency to which all these relays are attuned, the third-step relay sends a strong current into the intensifying instrument *p*. The vibrations of the wire *p1* practically open the local circuit of this last named apparatus and so permit the final relay to close and the Morse printer to register. This same microphonic amplifying apparatus may be applied to sustained-wave reception, if an interrupter is inserted at either the sender or receiver; in this case, the vibrating wires are tuned to the interrupter frequency.

In the same way, beats or heterodyne receivers may be used, and the relays tuned to the resulting signal frequency. With apparatus of this kind, tremendous magnifications of signals may be obtained; the microphonic relays must, however, be protected from vibration and kept in accurate adjustment. In place of the intensifying relay *p*, a transformer and rectifier may be used to make the amplified alternating currents operate a direct-current relay.

By the combination of large amplification from the microphone relays, connected in cascade, with exceedingly sharp resonance to tone frequency, some extremely interesting results have been secured. Using a single receiving antenna, tuner and detector, it has been found possible to record, on separate Morse tapes, messages from three different transmitters, sent simultaneously on the same wavelength. Each sender used a different spark frequency, and three banks of relays, such as those described, were connected in the telephone circuit of the receiver. Each of the relay-groups was mechanically tuned to the tone-frequency of one of the senders, and therefore responded to signals from that station only.

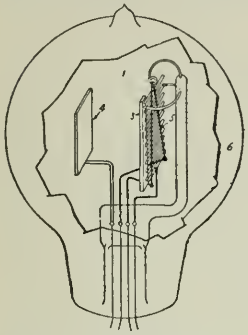


Fig. 2. An audion bulb of high voltage

The use of group-frequency tuning, in addition to the ordinary wavelength tuning, gives a vast number of combinations for the reduction and prevention of interference. The practical difficulty is that "static" is amplified along with the messages, and, what is most unfortunate, produces a ringing, musical sound. This of course makes it all the harder to read the signals.

Patent No. 1,129,942, 1915, issued to H. D. Arnold, shows a form of audion tube of increased efficiency. It is found possible, by varying the location of the plate with respect to the grid and filament, and by altering the form of the grid, to build audion amplifiers in which the magnified energy is characterized either by high voltage or high current. A bulb of the high voltage type is shown in Fig. 2, in which the grid 3 consists of fine wire and is placed close to the filament 5. The plate 4 is set at some distance from the grid-filament system and the whole is enclosed in the usual evacuated bulb 6. The patent referred to deals especially with various combinations of these high and low voltage amplifiers for line telephony; nevertheless, the use of similar instruments for both radio transmitters, amplifiers and receivers makes the design of interest.

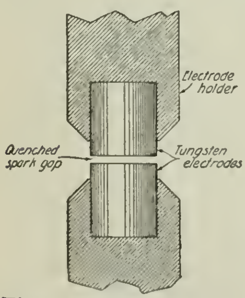


Fig. 3. A quenched spark gap of unusual construction

A quenched spark-gap of unusual construction appears in Fig. 3. Small tungsten buttons, having parallel faces, are set into brass or copper electrode-holders, and set with their parallel faces very close together. A number of these gaps, each operating in open-air, are connected in series to make up the complete quenched-gap system. With gaps of this type, on account of the very high melting point of tungsten, the two electrodes can be adjusted very close together without any great likelihood of short-circuiting through oxidation. Also, since tungsten is practically unburnable, the diameter of the electrodes may be made very much less than in the ordinary quenched gaps. The inventor states that little difficulty is experienced in getting pure spark-tones when the tungsten electrodes are used, because of their constancy in operation; it is pointed out that even with incorrect coupling values, the spark tone remains good. Oscillation circuit couplings of as high as 45 per cent, giving extremely high quenching, may be used. The drawing is taken from 1915 U. S. patent No. 1,152,272, issued to H. Boas.

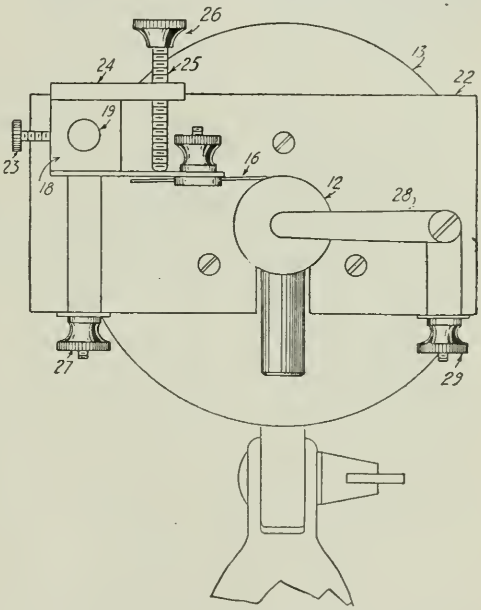


Fig. 4. Diagram of the slipping-contact detector for radio telegraphy

A United States patent issued to C. V. Logwood, in 1915, No. 1,161,142, describes what has come to be known as the "slipping-contact" detector for radio telegraphy. This is shown in Fig. 4, and consists of a grooved conducting cylinder 12, which is rotated by a smaller motor 13 and has bearing upon its surface a delicately fine contacting wire, 16. This apparatus forms a resistance-varying device, which is connected into the receiving circuit as shown in Fig. 5. Rapid irregular changes of resistance, or in some cases actual breaking of the circuit, result in permitting the large condenser 8 to draw an irregular charge from the condenser 6 in the oscillating circuit. The condenser 8 discharges through the telephone 7, and gives the hissing response to sustained or feebly damped waves that is characteristic of this form of receiver. The device has been found to be very sensitive as compared with a rectifier and interrupter for receiving sustained waves, and in addition has the advantage of drawing energy from the receiving secondary circuit at so small a rate that very sharp tuning may be obtained.

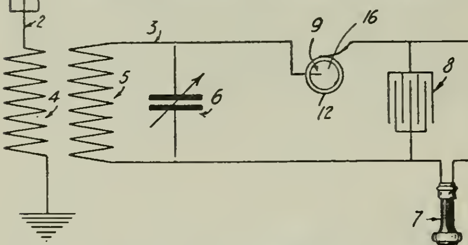


Fig. 5. A resistance-varying device connected into the receiving circuit

Patent No. 1,144,969, issued to G. W. Pickard, shows an interesting receiver for radio telegraphy and telephony. The circuit arrangement is shown in Fig. 6, where the antenna *A* is connected through an inductance $L1$ to ground G. Coupled to this primary coil, which is tuned to the frequency of the incoming waves, is a secondary $L3$, shunted by tuning condenser $C2$ and having associated with it the detector D, condenser $C3$, and telephone T. These elements form the usual receiver, which is tuned to the waves it is desired to receive; the present invention adds to this a closed oscillating circuit formed of coil $L2$ and condenser $C1$. This third inductance coil $L2$ has a variable coupling to the primary $L1$, and is used to create electrical beats in the receiving circuits by the peculiar coupling reactions which occur when the mutual inductance of the system is given the correct value. The inventor states, in effect, that when sustained waves are received, the primary and the closed circuits may be so related that the inducing and induced currents will react upon each other in such a way as to produce electrical beats or amplitude variations and at such frequency that they may be picked up by the coil $L3$. The receiver is of nearly equal value if the received waves are not completely sustained, but are only feebly damped; for highly damped, incoming energy, however, the device is practically inoperative. From the patent specification, it appears that this is a new type of receiver which will give variable musical responses to signals transmitted by spark or sustained-wave alternator-senders. The tighter the coupling between $L2$ and $L1$, the higher the frequency of the beat-tones produced. The coil $L3$ should not be very tightly coupled to the primary $L1$.

A modified form of quenched-gap sender is shown in Fig. 7, from U. S. patent 1,162,830, issued to G. Von Arco and A. Meissner. The invention is intended to permit heterodyne or beats reception from spark-senders, without destroying the musical character of the signal note. As is well known, when a heterodyne receiver is used for producing sustained-wave signals, the tones produced are clear and perfectly musical; the same receiver, when translating signals from spark-senders, almost invariably gives a hissing sound instead

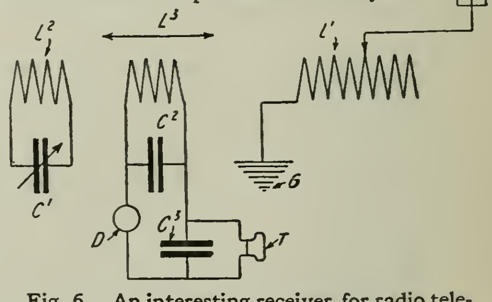


Fig. 6. An interesting receiver for radio telephony as well as telegraphy

of the ringing musical tone which is so desirable. At one time it was thought that the increase in damping of spark signals, as compared to those of sustained-wave transmitters, was responsible for this change of note, but more recently it has been found that the difficulty arose through the constant changes of phase from group to group. If the train of waves produced by a single spark discharge continued until the next spark passed, and if the second spark occurred at just the right instant and in the right direction to keep its waves in exact phase (or so to speak, hand in hand) with those which were dying away, the beats-receiver would produce a musical tone instead of a hiss. The method of the present patent is directed toward producing this result.

Referring to the figure, the closed primary circuit *I*, including the condenser *1* and quenched spark-gap *2*, coupled to the antenna circuit *II*, is charged by power from the alternator *12* through lead wires *4* and *5*. A portion of the spark-gap is shunted by the closed circuit *III*, which comprises the secondary of transformer *8*, condenser *7*, and spark-gap *9*, with shunting-switch *13*. Transformer *8* serves to couple the controlling circuit *IV* with the ignition circuit *III*; *IV* includes one coil of transformer *15*, coupling it to the antenna. Primary and secondary of *15* may be short-circuited by switches *16* and *17*. Associated with the antenna is a closed pick-up circuit *VI*, which has coupled to it a rectifying-detector combination *VIII* and a local high-frequency-generator circuit *VII*.

The operation of circuits *I* and *II* is in accordance with the ordinary quenched spark-gap practice. Controlling circuit *IV*, however, acting through ignition circuit *III*, (and being of high persistence compared to the antenna), tends to regulate the recurrence of spark in the main gap *2*. With transformer *15* in operation, by opening switches *16* and *17*, the antenna *II* reacts upon and governs the controlling circuit *IV*; the conjoint operation of these various systems keeps the successive wave groups of the same phase and therefore, by continual reinforcement of the oscillations in the persistent receiver-circuit, results in a pure signal note in the heterodyne telephone. Thus it becomes possible to take advantage of the musical note for reading through static, in addition to the amplifying properties of the beats-receiver and the comparative simplicity of quenched-gap operation. The circuits *VI*, *VII*, *VIII*, form a beats-receiver used as a tone-tester at the transmitting station; when the outgoing wave-trains are held exactly in step by the controlling circuits, the telephone of *VIII* gives off a musical tone of the sort heard at the distant receiving station.

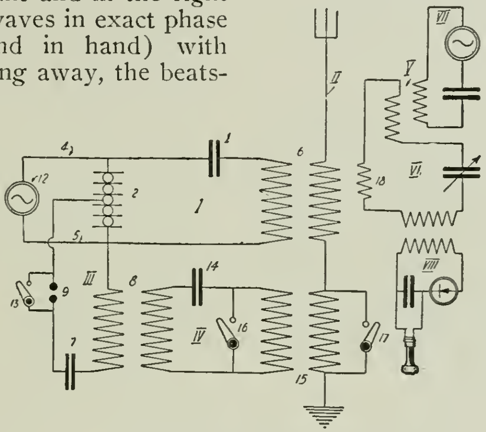


Fig. 7. A modified form of quenched-gap sender

ANNOUNCEMENT

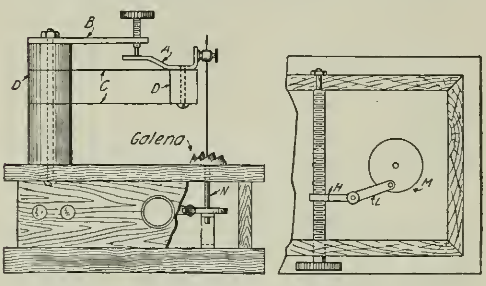
The time which must necessarily elapse before the publication in a monthly magazine of news of any sort has forced us to discontinue the department of "Radio Club News." The editor will, however, be interested to receive communications from Radio Club secretaries, and suggestions from them concerning the magazine and future articles.

An Improved Crystal Detector Stand

After many years of scientific experimentation with various kinds of detector stands and contacts, the crystal detector stand described below was found satisfactory.

The detector is of the ferro type, mounted on a small box containing an arrangement for moving the crystal. The chief merit of the instrument lies in the use of a direct differential screw which insures perfect alinement.

This differential screw consists of a combination of an 8-32 screw and a 2-56 screw. It is made by drilling in the end of the 8-32 screw a hole to be tapped out with a 2-56 thread. A little patience is required, for if the builder does not center the hole perfectly the first time, he must try again. This is where the success of the instrument lies. A 2-56 screw is to be screwed tightly into this hole.



Elevation and plan of a simple crystal detector stand

A hole should then be drilled in the piece *A*, directly below the one in the piece *B*, and tapped out for a 2-56 thread. When the differential screw is screwed in place and turned one complete revolution, it will lower 1-32″, but at the same time the piece *A* will be raised 1-56″ by the other screw, or in other words, the piece *A* will be lowered 3/224″.

The rest of the standard is easily made, as may be seen from the diagram, the pieces *A* and *B* being of 1/16″ brass, ½″ wide and of a suitable length. The pieces *C* are of thin phosphor bronze or brass ½″ wide and of suitable length, and the pillars *D* of round or hexagonal brass of any size to please the maker. The parts are held together with 8-32 machine screws.

A box of ¼″ oak about 5½″ by 3″ by 1¼″ should then be made, the detector being mounted centrally on the cover. Two binding posts are put on the front as well as the knob for the adjusting arrangement. As will be observed the adjusting arrangement includes a screw with adjusting knob, the screw running through the box, and the far end having the thread filed off and resting in a small hole bored in the back of the box. Jam nuts are used in back of the front piece to prevent the screw from coming out.

A small guide rod guides the piece *H*, which is moved by turning the screw. The rest of the arrangement can be seen from the diagram. The disk cup should be mounted eccentrically on the shaft *N* so as to obtain a greater range and contact for the mineral. The hole in the top of the box should be small enough so that the mineral will be held firmly. The standard and mineral adjusting device are connected respectively to the two binding posts.

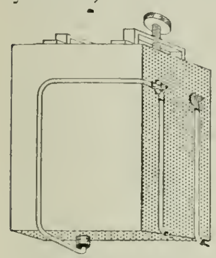
For a contact wire, a piece of very stiff German silver or other resistance wire (not iron) should be used, and heavy or light contact can be made with the point. No. 30 B. & S. is all right.

Loose-Coupler Switch Arrangement

Amateurs often wonder how they can reduce the number of taps on their loose-coupler and still tune accurately. The following scheme has been used successfully and it is found that it not only saves money but the instrument works more easily. Instead of tapping every wire in the first ten and then every tenth wire, a tap is taken from every *second* wire in the first *twenty* and after that every *twentieth* wire. Thus half of the taps are done away with on the second switch. This, of course, only tunes in steps of two. To remedy this a separate single turn is added at one end of the primary and arranged with an extra two-point switch, so that this turn can be used whenever needed. With this arrangement, any possible number of turns may be used and the trouble and expense of making several extra taps are saved. Another advantage is that rough tuning can be accomplished much more quickly and, after a station is located, the more accurate tuning can be done.

Making a Master Vibrator for Automobiles

THE ignition of any motor car equipped with a vibrating coil may be greatly improved by the insertion of a device known as a "master vibrator" in the circuit. It is very difficult to adjust the separate vibrators for each cylinder, so that sparks of the same intensity are produced in each of the cylinders; but by substituting one vibrator for the several originally used, this difficulty is overcome.


The master vibrator as completed

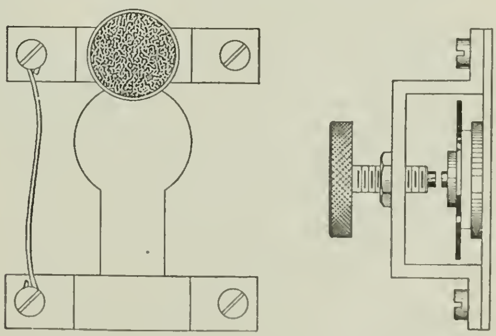
A discarded unit coil may be secured from any garage or second-hand parts house, the only requirement being that the vibrator on the end of the coil shall "buzz" when current is passed through the terminals. It is not necessary for this coil to deliver a spark. Hence the condition of the secondary winding is unimportant. A single coil which has been removed from a set of two or more, will prove very satisfactory, the box not being required.

This coil will have three terminals, two for the battery current and one that led to the spark plug. Connect four or five dry cells, as shown, and touch the two wires to any two of the three terminals until a pair is found which causes the vibrator to operate. Connect either one of the two terminals just found to the third (the one that did not cause vibration). This short-circuits the secondary winding of the coil, and makes it inoperative. The two terminals which did cause vibration are to be used. If this coil has no protecting box, it will be best to make one of a size that just takes the coil, with a cover hinged or screwed on over the vibrator end. The two terminals to be used should be brought to the outside of this box, preferably through the end opposite the cover, and the box containing the coil should then be mounted solidly on the dashboard by the side of the two, four or six-unit coil-box already there.

It will now be necessary to prepare the coils on the car which have been in use for ignition purposes. A permanent electrical connection must be made between the two platinum points on each vibrator. This may be done in either of two ways. The best method is to run a short piece of copper wire from the metal piece carrying the vibrator-spring to the metal piece on which the other platinum contact is carried. This allows the current that formerly flowed from one contact to the other, to pass through the copper wire, and the spring will no longer tremble when current flows. A quicker, although not as satisfactory a method, is to turn the adjusting screw on each coil until the two contacts are held tightly together, making the circuit complete at all times and preventing vibration of the spring.

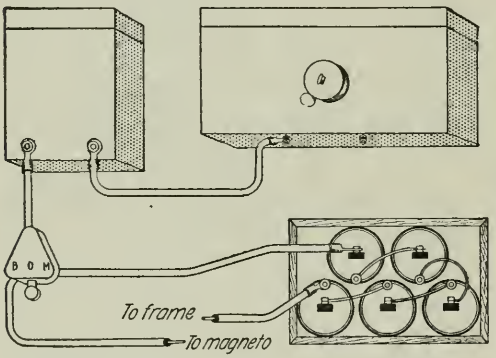
The wires running from the coil originally used to the timer on the engine and to the spark plugs, are to remain, but all other wires to battery, magneto and switches are to be removed from the coil terminals. This completes the preparation of the coil formerly used.

If the car is equipped with two sets of batteries, or a set of batteries and a magneto (such as the Ford magneto),


When the contacts are properly adjusted, the addition of this master vibrator greatly improves the ignition circuit

it will be necessary to fit a switch having three terminals, one for the batteries, one for the magneto or reserve set of batteries and the other for the coil connection. This switch will have three positions, one being "off," one for battery and the other for the magneto or second set of batteries. If but one set of batteries was used, or if the magneto was used without batteries, it will be necessary only to use a switch having two terminals, one "on" and one "off." The switch selected should be fastened to the dash or to the box containing the master coil, previously described.

The system is then ready for wiring. A good grade of primary wire should be used, and the connections should be made with regular brass or copper wire terminals soldered on. The switch originally used on the coil case should be placed in one of the positions formerly used for running and allowed to remain there permanently.



Wiring diagram showing connections for master vibrator

If the position selected is on the "magneto" side, the following connection will be made to the terminal which formerly ran to the magneto; if on the "battery" side, to the connection which ran to the battery. This terminal, either battery or magneto, should now be connected to either terminal on the master coil.

If a switch having but two terminals was used, the remaining connection from the master coil should be connected to either switch terminal. If a switch having three terminals was used, this connection from the master coil will be made to the common terminal on the switch. This common terminal is the one that completes a circuit through either of the other switch terminals, depending on which way the switch is thrown.

If the switch having but two terminals is in use, connect the unused terminal to the battery or magneto through the wire which formerly ran to the coil on the car. If the three-terminal switch is used, run a wire from the terminal that completes a circuit when in the "battery" position to the battery, and run another wire from the terminal that completes the circuit when in the "magneto" position to the magneto. This can be accomplished by attaching the wires that formerly ran to the car-coil terminals to the new switch terminals.

Provided the connections have been made as directed and other wires have not been disturbed, the system is ready to operate when the master vibrator has been properly adjusted. This is done by turning the adjusting screw until the contacts are seen to separate. The screw is then turned in the opposite direction until the contacts just come together. Turn the starting crank or flywheel with the new switch in the "battery" position until the vibrator is heard to buzz; then turn the switch off without moving the flywheel out of this position. The vibrator may be adjusted by removing a spark plug wire about 1/4" from the plug and again turning on the switch. Turn the adjusting screw one way or the other until a good strong spark is secured, replace the spark plug wire and start the engine as usual.

Cutting Brass

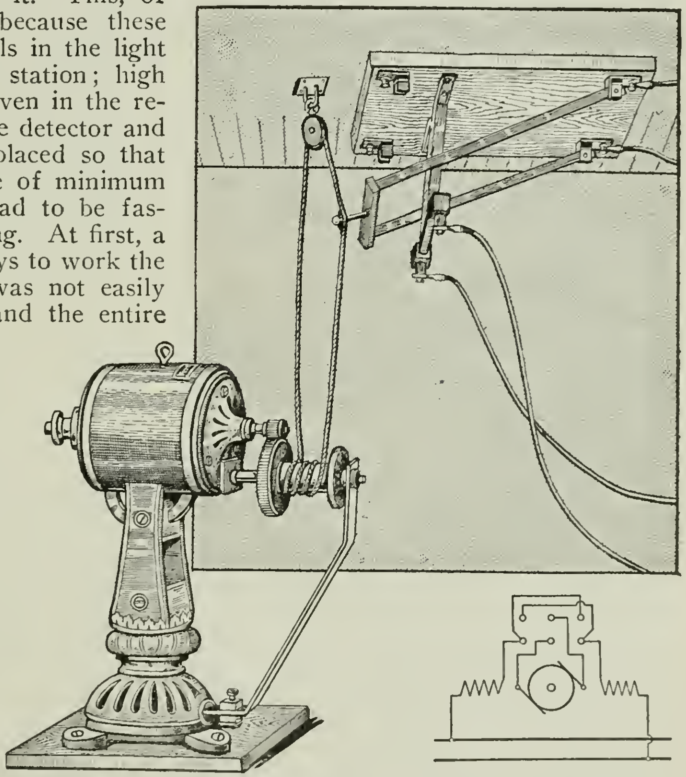
WITH a quill pin dipped in a strong solution of alcoholic corrosive sublimate, draw a line on the brass. Set it dry and then go over it with the pen dipped in nitric acid. The metal may then be broken like glass cut with a diamond.—JOHN SCHMELZEIS.

If you want further information about the subjects which are taken up in the Popular Science Monthly, write to our Readers' Service Department. We will gladly furnish free of charge names of manufacturers of devices described and illustrated.

A Motor-Operated Aerial Switch

IN the DeForest sending equipment of a certain station, no anchor gaps are used, since the switching system for the aerial consists of a large D. P. D. T. switch with one side for sending and the other for receiving. The operators could not place the switch near the operating table, since then the aerial and ground leads for the sending set would have to run a long way to reach it. This, of course, is objectionable because these leads induce high potentials in the light and power wires in the station; high voltages may be induced even in the receiving set, burning out the detector and so on. The switch was placed so that the sending-set leads were of minimum lengths, even though it had to be fastened high up on the ceiling. At first, a system of ropes over pulleys to work the switch was used, but it was not easily operated from the table and the entire arrangement did not look good.

After having tried several ideas, one was found which is a working success, and the switch is now worked by a small, reversible series motor. A miniature electric hoist, with the motor, pulls a cord so as to throw the switch from one set of jaws to the other. The accompanying cut shows the systems installed. The winding apparatus consists of a drum driven from the motor shaft by a reduction gear. The drum is a wire spool having a 1½″ core and 3½″ heads and made 2½″ long by sawing some of the core off. The cog wheels for the reduction gear were taken from a telephone magneto. The little cog was soldered on the motor shaft and the big one screwed on one end of the winding drum. The bearings and shafts of the magneto drive were also utilized. The shaft of the winding drum is supported on the motor frame by a bent piece of scrap iron and fastens on the motor base.



By means of this system all the large switches may be controlled directly from the radio table

A series-wound motor, which drove a ten-inch fan, is used. It draws about one ampere from the 110-volt A. C. circuit. It is reversed with a small D. P. D. T. battery switch.

The cord is kept from slipping by tying a knot around a screw. The cord is then wound a couple of turns in each direction. One end goes to the switch handle, where it is tied fast, and then continues over a small awning pulley and back to the other end, where the two ends are tied together.

Besides the duty of reversing the motor, the control switch must disconnect the motor from service as soon as the aerial switch has been thrown. This was easily arranged by placing a bent spring of No. 16 or No. 18 brass between each pair of jaws of the control switch. Thus the switch handle kicks open and leaves the motor out of circuit, as soon as you release pressure, on either side.

Free and Forced Oscillations in Radio Telegraphy

By John Vincent

THE February article of this series pointed out how closely all oscillation circuits resembled each other, whether or not they contained spark-gaps and whether they were open antennas or closed condenser-circuits. Not all of the similarities were brought out, however, and it is interesting to note that for all practical purposes the rule last given, for finding the time period of an oscillating spark-circuit, is the same as that for determining the resonant wavelength of an antenna. The simplest way to work this out is to compute the period and wavelength of an aerial, such as shown in Fig. 1, accordin, to each of the rules, and then to compare the results.

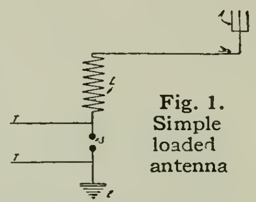


Fig. 1. Simple loaded antenna

Suppose the antenna system of this diagram has the constants given in the fourth example of the November article. The aerial itself will then be of 0.0012 microfarad capacity and 0.023 millihenry inductance, and the loading-coil will have 0.35 millihenry inductance. This last named figure is the sum of the inductances of secondary and loading-coil in the earlier example; the total is taken because in Fig. 1 only a single coil is shown.

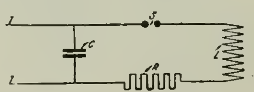


Fig. 2, Spark-gap circuit

Applying the rule for finding resonant wavelength, when capacity and inductance are known, the steps are: (1) multiply the total inductance by the total capacity (0.0012 microfarad times 0.373 millihenry=0.000447), (2) take the square root of this number, which equals 0.0213, (3) multiply this result by 60,000 (0.0213 times 60,000 = 1,270 meters) and thus obtain the answer required. Thus the tuned wavelength of the antenna with loading-coil is found to be 1,270 meters. From the January article it appeared that this corresponded to the length of the ether-wave that would be set up when currents of a definite frequency surged back and forth in the antenna, and that the frequency could be found by dividing the wavelength in meters into the number 300,000,000 (which is the velocity of electromagnetic waves in meters per second). By performing this operation, it is found that the frequency of the 1,270-meter wave is 300,000,000 /1,270 =236,000 cycles per second. This is the resonant frequency of a circuit having the inductance and capacity above stated, or, in other words, the frequency of exciting alternating voltage which will produce the largest current in that circuit. At that frequency the current will be the greatest possible for any given voltage, because the circuit has minimum impedance when the capacity and inductance neutralize each other's reactive effects, as was also explained in January.

Now, taking the same antenna circuit of Fig. 1, and assuming the same values of inductance and capacity, the time period of natural oscillation may be found by applying the rule stated last month. This time period is the number of seconds which it takes for the alternating current in the circuit to pass through a complete cycle, i. e., to start from zero, reach a maximum in one direction, reverse, pass through zero and reach a maximum in the other direction, reverse again, and reach zero. The number of times this cycle is performed in one second is the frequency of the current, and is the numerical reciprocal of the time period. Since one millihenry is one-thousandth of a henry, the value of inductance may be given in either unit. Since for this antenna it is 0.373 millihenry, in henrys it is one-thousandth of this, or 0.000373 henry. One microfarad is one-millionth of a farad; hence the capacity in farads is one-millionth of 0.0012 microfarad, or 0.0000000012 farad. Taking up the rule for computing the time period, the first step is to multiply the capacity in farads by the inductance in henrys (0.0000000012 times 0.000373 = 0.000000000000447). The second step is to take the square root of this number, which is found to be 0.000000669. The third step is to multiply this by 6.28, which gives 0.0000042 second as the time period. Thus it appears that the alternating current passes through a complete cycle in only 42 ten-millionths of one second, and that the frequency (which is the reciprocal of this) is a little over 236,000 cycles per second. This agrees with the result secured from the first calculation above.

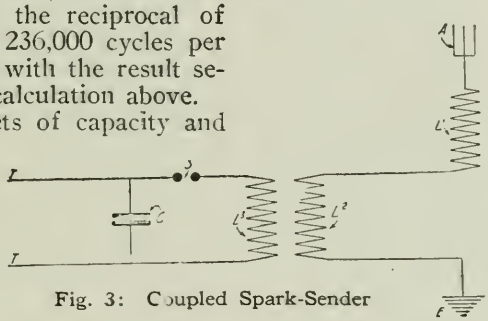


Fig. 3: Coupled Spark-Sender

If several other sets of capacity and inductance values are worked out by both the above rules, the same agreement will be found. It thus becomes clear that the resonant frequency at which any condenser-circuit will oscillate most strongly, is practically identical with the frequency of the free alternating current which will be produced if that circuit is set into vibration by a sudden discharge within itself. Referring to Fig. 1, if the capacity of the antenna is charged by a gradually rising voltage supplied from the secondary of a transformer through terminals *T, T,* a point will be reached beyond which no energy can be forced in, because the air between the spark-balls at *S* will break down. The spark which then occurs completes the oscillating circuit from the earth *E* through the inductance *L* to the antenna *A,* and the stored electrical energy rushes to the ground. By the overshooting action which always takes place, if the circuit resistance is not too great, the current surges back and forth. The frequency of the alternations thus produced is that which may be computed as in the paragraph above. This frequency is practically the same as that which would produce the greatest current in the antenna, if the transformer were disconnected and the spark-gap replaced by a high-frequency alternator in such a way that the total inductance and capacity remained the same.

An entirely similar condition exists for the closed circuit of Fig. 2. Here a condenser *C,* a spark-gap *S,* an inductance *L* and a resistance *R* are connected in series. The terminals of a high voltage transformer, to charge the condenser, are connected at *T, T.* If the potential applied across the condenser is gradually increased, a charge will be stored in it by virtue of its electrical capacity. When the voltage becomes so high that the spark-gap breaks down and a spark passes, the condenser discharges through the inductance and resistance. If the resistance is not too high, the discharge will be oscillatory, and the frequency of the oscillations (and their time-period) can be calculated according to the three steps of the same rule given for antennas. Thus the number of cycles per second of the free alternating-current discharge in the circuit can be found, if its inductance and capacity are known. The wavelength which would be set up by currents of this frequency may also be determined easily, as has been shown.

If the transformer is disconnected and a high-frequency alternator substituted for the spark-gap, the circuit will have in it forced alternating currents of the frequency at which the alternator generates. As was shown in January, the greatest current will flow when the frequency of minimum impedance (or zero reactance) is reached. This is the resonant frequency and has practically the same numerical value as that of the free oscillations discussed in the paragraph immediately preceding.

The foregoing descriptions should give a clear indication of the difference between free and forced alternating currents in oscillation-circuits. If a sustained, alternating voltage is applied to of any circuit, either from the outside (by magnetic induction, for instance) or internally by a high frequency alternator or other apparatus, a *forced alternating current* of the generating frequency will flow. The frequency of this forced current cannot be changed by varying the constants of the circuit, for it is determined by the generating source. The amount of current which is set up for a certain voltage, however, is governed very largely by the circuit constants. As was shown in the January article, the greatest current flows when the applied alternating frequency is of the value for which the capacity and inductance of the driven circuit neutralize each other, or that for which the impedance (alternating current resistance) is therefore the smallest. The other type of alternating current, called "free," occurs when a condenser is charged and then allowed to discharge through an inductance and resistance (which must not be of too high value). The frequency of this *free alternating current* so produced is dependent entirely upon the constants of the circuit, and, for the same values of capacity and inductance, is practically identical with the resonant or minimum impedance frequency.

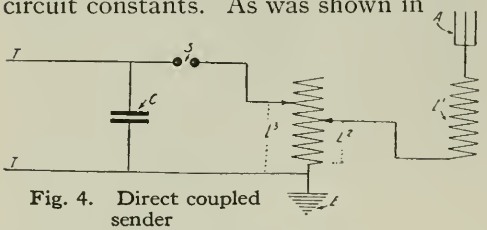


Fig. 4. Direct coupled sender

The critical value at which resistance becomes too high for free oscillations to exist in a condenser-and-inductance circuit, is almost never encountered in radio transmitters. It may be computed from a simple rule, as follows: (1) Divide the total circuit inductance, in henrys, by the total capacity in farads, (2) take the square root of this ratio, and (3) multiply the result by 2. The result is the "critical resistance" in ohms. For the antenna circuit of Fig. 1, this is found to be (1) 0.000373 henry divided by 0.0000000012 farad=310,000; (2) the square root of this is 556; (3) 2 times 556=1112 ohms. Thus if the resistance is less than 1112 ohms, the result of the condenser discharge will be oscillations at the rate of 236,000 per second; of course no ordinary sending circuit ever reaches so high a resistance value, so oscillations are always to be expected. In receivers, however, when detectors may be placed directly in series within the circuit, the direct-current resistance is often several thousand ohms. Free oscillations cannot exist in such circuits, but a definite tuning effect for forced oscillations is present, since, by adjusting the capacity and inductance reactances to neutralize, the greatest alternating current can be made to flow.

Referring to Fig. 2, it is obvious that for a given charge in the condenser, the greatest current will flow when the resistance R is of the smallest value. It is also true that the oscillations will persist for the longest time when this resistance is smallest. The actual resistance in circuit may be made only that of the wires and spark-gap, so that the free oscillations may be made to vibrate back and forth hundreds of times for each spark. In an antenna like Fig. 1, however, the effective resistance cannot be reduced indefinitely, because in addition to the spark-gap and wires forming the inductance and leads, the radiation of energy in electromagnetic waves adds a few more ohms. Because of this, and also because the capacity of an antenna cannot be increased indefinitely without great expense, the two circuits of Figs. 1 and 2, are often combined in the arrangement of Fig. 3. Here the coil in the closed circuit, $L3$, forms the primary of a transformer whose secondary is coil $L2$ in the open or antenna circuit.

When condenser C is charged and allowed to discharge through the closed circuit, free oscillations are produced of the frequency determined by the effective capacity and inductance of the circuit. In passing through the primary $L3$, these free oscillations induce alternating voltages of their own frequency in the secondary coil $L2$ and the connected antenna circuit $A\ L1\ L2\ E$. By adjusting the inductance of the secondary and loading-coils, so as to neutralize the capacity reactance of the antenna for the frequency of the closed circuit, forced alternating currents of the same frequency and largest amplitude will be induced in the antenna circuit. These large currents surging in the aerial will produce electromagnetic waves of the same frequency and corresponding length. Thus the discharge of a condenser in a closed circuit may be used to generate waves for radio telegraphy; for the best effect, the antenna circuit must be adjusted so that its natural frequency is the same as that of the closed circuit, or, in other words, both must be tuned to the wave frequency.

This principle may be applied to a case corresponding to the circuits of the average inductively-coupled amateur transmitter. Since the present laws limit amateurs to wavelengths below 200 meters, it is necessary to use such inductance and capacity in the primary as will give waves below this value. Practice has shown that it is not feasible to use a condenser larger than 0.01 microfarad in size; this, with an inductance $L3$ equal to 0.0011 millihenry (including lead wires), will produce free alternating currents of 1,500,000 per second frequency, which corresponds to 200 meters wavelength. Since, for this size of condenser, the total permissible inductance is so small, it will often be better to use smaller condensers and more inductance; for instance, 0.005 microfarad capacity and 0.0022 millihenry inductance or even 0.001 microfarad capacity and 0.011 millihenry inductance (both of which combinations tune to 200 meters) will give better results in many stations. The average small antenna, such as may be used for 200 meters sending, will have a capacity of about 0.0004 microfarad. The sum of inductances in coils $L1$ and $L2$ will therefore be 0.027 millihenry for 200 meters. The secondary may be made identical with the primary, and the balance of the inductance needed placed in the load coil $L1$.

The values quoted are not absolutely accurate, of course, for every station will have small variations in length of lead wires, closeness of coupling, regularity of gap action, etc., which may modify slightly the amounts required.

The best way to get true tuning-adjustment is to set the closed circuit at the desired wavelength, by calculation or wavemeter, and then to alter the coupling between $L3$ and $L2$ and the amount of inductance in $L1$, until a hot-wire ammeter in the antenna circuit shows the greatest possible current to be flowing. For good results, the coupling must not be too tight. When very small primary inductances are used in inductively coupled transmitters, it is not likely that the coupling will be tight enough.

The circuit of Fig. 4 is the equivalent of Fig. 3, except that the closed oscillation-circuit is directly coupled to the antenna circuit. Part of the primary coil is used as the secondary, as indicated by the portion between the right-hand clip and the earth, marked $L2$. The computations given above apply to this circuit as well as to that of Fig. 3, but, with the direct coupling here shown, it is sometimes possible to get satisfactory operation with larger primary condensers than when the inductive coupling is used. Since larger condensers make it possible to use more transmitting power for the same voltage and spark frequency, the direct coupling may be preferred in some senders. Contrary to the widely accepted idea, it is possible to get just as sharp waves with the direct as with the inductive coupling. It is necessary to tune the circuits with care, however, and to have the greater part of the total antenna inductance in the loading coil $L1$.

The above stated principles of tuning and adjusting various open and closed circuits for maximum effect, with both free and forced oscillations, include the fundamental laws of radio telegraphy and telephony. The simple rules which have been given in the five articles of this series may be applied to all types of transmitting and receiving circuits, and permit selection of apparatus which will operate successfully in various circumstances. The computation of receiving-circuit constants will be discussed next month; and after power in transmitters is treated, designs will be given for coils, condensers and other instruments which may be combined according to these rules.

Making a Simple Alternating Current Rectifier

A RECTIFIER is very convenient if audion storage batteries are to be charged and only alternating current is available. The ones on the market are rather expensive, but a simple apparatus can be made by anyone at small cost.

Thoroughly clean worn-out Sampson sal-ammoniac cells. Cut some sheet aluminum 1/32″ thick, the same size as the

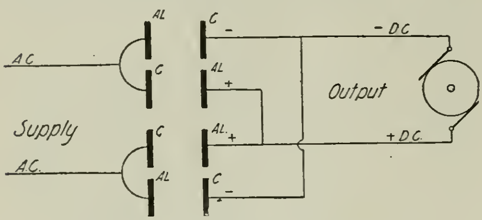
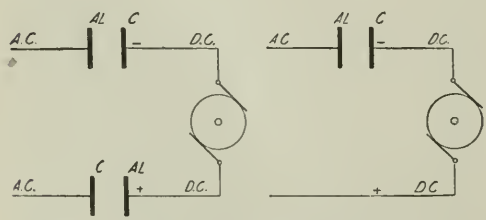


Fig. 1. How the jars are connected

zinc plates which belonged to the cells. These aluminum plates should be fitted into the old slots occupied by the zinc, and wires carried from them up through the holes in the jar covers, to serve as binding posts; or the old binding posts may be aluminum-soldered to the aluminum sheets. Insulate the aluminum by wrapping a few rubber bands around the carbon terminals.

Prepare an electrolyte by dissolving aluminum sulphate in cold tap water to the point of saturation. Fill the cells with this solution to the water level, indicated by a line about 1½″ from the top; the two poles are then completely immersed. Connect the jars as shown in Fig. 1.

The operation of the rectifier is based on the principle that for every half-wave a film of oxide is formed on the surface of the aluminum, preventing the flow of negative current. A rectifier of 1, 2 or 4



Figs. 2 and 3. Wiring for one and two-jar types of rectifiers

jars can be used, but neither the one nor the two-jar type will have 80 per cent efficiency. The one-jar type rectifies only one side of the wave. These types are shown in Figs. 2 and 3.

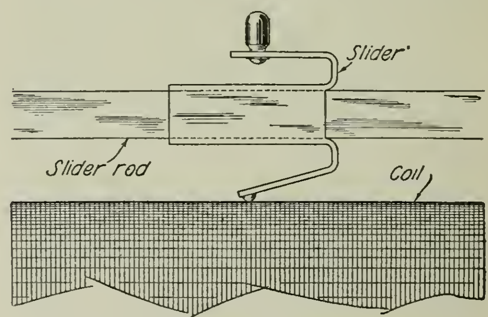
A Tuning-Coil Slider

THERE are many kinds of home-made tuning-coil sliders, but most of them have faults.

The most troublesome part is usually making the contact strip and fastening the handle. Since this requires almost constant use, it must be reliable and capable of working easily.

A good plan is to take a piece of square brass tubing, about 3″ long, and with a sharp hack-saw, slit down 1½″ on both sides. Then bend both parts, one up, the other down, and cut out the remaining piece inside, leaving two curved arms.

Now drill a 11/64″ hole at the end



A simple and efficient tuning-coil slider

of the upper arm, and with a sharp-pointed center-punch, make a small dent at the end of the lower arm, to form an excellent contact point, being much better than a drop of solder, since that is always liable to chip off. An 8-32 screw passes through the upper bent piece and serves as a fastening for the handle.

Radio's First Rescue

THE sinking of the S. S. *Republic,* which struck the *Florida* during a heavy fog, occurred in January, 1909. This was the first ship whose passengers and crew were saved by radio from what would have been almost certain death.

Reconstructing a Dry Battery

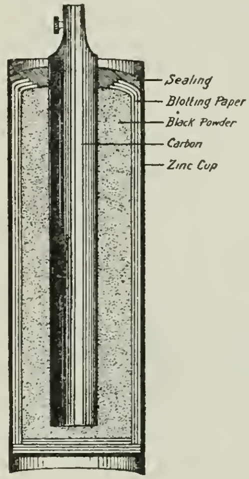
CONSTRUCTING or reconstructing a dry battery, if it is done carefully and with pure materials, will prevent the unfortunate experience of the amateur experimenter, who upon buying dry cells in an electrical store, finds they are old and that a generous portion of their strength has seeped out while lying on the shelves. So far as the cost of construction is concerned, a home-made dry battery is about as expensive as a standard ready-made cell. The only gain is in the life and consistent ability of the battery.

The foundation of the home-made dry cell consists of the zinc cylinder, carefully cleaned, from a worn-out battery. The cup should be boiled in clean water for several minutes. When the inner zinc surface is washed, it is lined with three or four layers of white blotting paper. This paper should be laid in firmly and held with clips but not glued. Two disks of blotting paper are placed in the bottom of the cup. Care should be taken that none of the inner surface of the zinc is exposed to the chemicals that are afterwards put in, or the life of the cell will be considerably shortened.

After blotting paper is in place, it should be soaked for several minutes in a solution of zinc chloride and sal ammoniac in distilled water. To arrive at the correct proportion of chemicals will take a little time unless a hydrometer is handy. The zinc chloride should be dissolved first. Crystals should be dissolved in the water until the hydrometer reading is 32 degrees. If a hydrometer is not available, a saturated solution of zinc chloride should be made; that is to say, a solution that has dissolved as much of the chemical as it is able. Add half again as much water as was originally used. This brings the solution to an approximate 32 degrees.

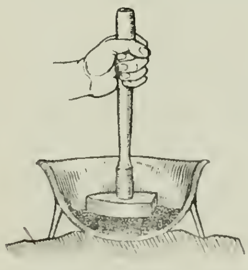
Powdered sal ammoniac should now be added until the solution is again saturated, when it is ready for soaking the blotter lining of the zinc. The soaking process should continue until the blotter can absorb no more of the solution.

Chemicals with which the battery is filled consist of a thorough mixture of two parts of manganese powder and three parts of powdered carbon or graphite. Carbon is cheaper. Coke is still cheaper, although it does not answer the purpose quite so effectively. Retort carbon, or arc carbon, pulverized in an iron retort, can be used. The two powders can be thoroughly mixed if they are placed in a covered jar of some sort, and the jar rolled and shaken carefully. Pains should be taken in mixing the powders, as a generous proportion of the battery's future performance depends upon this operation. When the manganese and carbon powders are thoroughly intermingled, they are moistened with the zinc chloride-sal ammoniac solution. Moistening the powder does not mean bringing it to a pasty state. It should have a damp, lumpy appearance.



Section through an ordinary dry cell

Tamping the mixture into the zinc shell is the next step, and it is the most important part of the process. After the carbon rod is placed in the center, the powder should be dropped in, a little at a time, and tamped down forcibly with a blunt stick and a hammer. It is a painstaking process, but the results are worth the effort. When the container is filled within about one-half inch from the top, the blotting paper layers are folded inward and the rest of the space filled with sealing wax or a mixture of paraffin and resin.

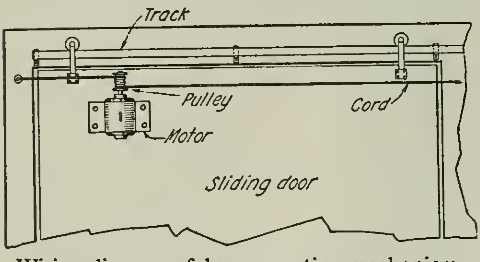


Method of mixing materials in a mortar

When the battery is finished, if the directions are carefully followed, it should give excellent results.

Electric Door-Opener for a Garage

THE unpleasant climax to a motoring trip on a wet evening is the necessity of climbing out of the machine when the garage is reached, walking through the downpour and opening the door. This undesirable experience can be averted entirely if the garage door can be made to open by an electric motor, started by the closing of a contact in the roadbed, by the weight of one of the wheels.



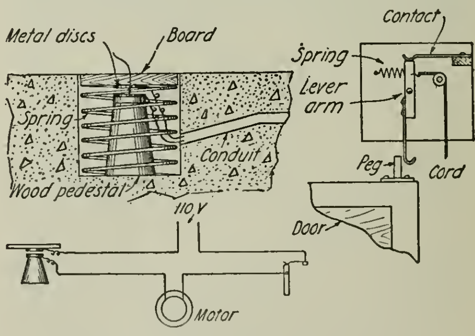
Wiring diagram of door-operating mechanism

A small pit should be cut in the concrete path at the entrance of the garage. The pit should measure 1′ across and 1′ in depth. A stout wood post should be erected from the floor of the pit and capped with a thick disk of copper or brass to which is attached a well-insulated wire. A well-seasoned board about 1″ thick, which will fit loosely in the mouth of the pit, should be cut and on the bottom of it screwed a heavy plate to which another wire is attached. The two wires should lead through a conduit, placed at an angle so that water will not leak into it, and terminating in the garage. The board should be supported, flush with the roadbed, by a heavy spiral spring. To drain the pit, a pipe of sufficient size should lead from one corner to a sewer connection. A white post, or a signal mark of some kind, should be put in the path close to the pit, for the purpose of marking its location when the automobile is driven upon the contact.

The door of the garage must be of the sliding type, and the rollers which run along the suspension track above should be oiled thoroughly, so that the friction is reduced to a minimum.

A motor, ¼ or ½ h.p., should be secured, by screws or lugs, to the door as near to the top as possible and very close to the edge which opens. The shaft, which should point upwards, should be fitted with a large friction pulley with wide flanges at both ends. A stout, non-stretching, braided rope should be attached to a screweye in the door jamb, at the same level from the floor as the pulley of the motor, three or four turns wrapped smoothly about the pulley, and fastened taut to a screweye in the opposite jamb. When the motor is operated, it is obvious that the rope will wind and unwind on the pulley, and the door will be pulled open.

A circuit breaker should be installed above the door at the back, so that when the door is wide open, the current will be shut off from the motor. Some pains must be taken in the construction of this circuit breaker, as it is a most important part of the apparatus. A short wooden peg projecting upward should be fastened to the top of the door. When the door slides open, this peg strikes a lever arm, and the circuit is broken. The lever arm should consist of a 4″ length of brass, ½″ wide and ¼″ thick. A small hole should be bored through its center to serve for pivoting purposes. At the lower end, a "trigger" of somewhat lighter and more springy metal should be soldered. When the peg strikes this trigger, the breaker will not be thrown out so suddenly as to derange the rest of the apparatus. The contact arm



Wiring diagrams of important parts

should be screwed to the center of some sort of wooden base upon a thick washer. The washer will act as a bearing. A light spiral spring, to insure a quick break, should be attached to the upper part of the arm and its other end held by a screweye set in the base. The contact spring should be cut from rather heavy spring brass sheet. It should be bent, as shown in the drawing, and held securely at one end by a small wood block and screws. A stout, flexible cord should be fastened to the upper end of the lever arm and led out to a small pulley, from which it should hang within reaching distance of the floor. When the opening door causes the peg to strike the trigger and open the circuit, the circuit breaker should be re-set by pulling the string Although not entirely advisable, the helical spring may be omitted, and a weight suspended from the lower end of the string so that when the door is closed, the breaker will be re-set automatically.

Connections of the various pieces of apparatus should be made as indicated in the accompanying diagram.

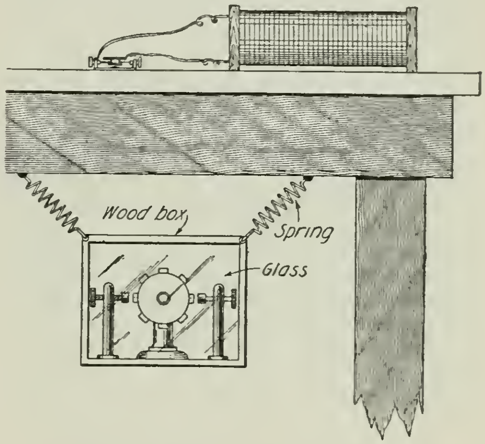
Briefly, the operation of the electric garage door-opener, is this: When the wheel of the automobile runs upon the board in the pit, the car should be stopped. The current from the line flows through the contacts and into the motor; the pulley revolves and draws itself, almost literally, along the rope, thus opening the door. When the door is opened, the peg strikes the trigger and the current flow is shut off.

There are various other ways of installing the motor and driving mechanism upon the garage door, but the one described is undoubtedly the cheapest. However, in case the clearance of the automobile roof is very small—too small to allow even for the small space that the rope occupies—the motor may be installed on the door jamb, and a bicycle cog mounted on the end of the shaft. A long bicycle chain should pass from this cog to another on the opposite jamb, and one of the door pulleys attached to the chain. Another method which would be simpler, perhaps, than either of the foregoing would necessitate only the installation of a magnetic release and a heavy weight operating through pulleys. If electricity were not convenient, a water motor could be used, or a water or compressed-air plunger, working on the principle of the plunger elevators, would give fairly satisfactory results. It is quite evident that much originality in construction is left to the builder.

Mounting Spark-Gaps to Eliminate Unnecessary Noise

A NOVEL and very good method of eliminating most of the noise made by a rotary spark-gap in operation, is shown quite clearly in the illustration. The rotary gap, with its motor, is mounted in a substantial wooden cabinet, with a glass door. This cabinet is then suspended on four strong spiral springs, from the underside of the operating table.

It is advisable to have the glass door on the cabinet closed tightly, so as to confine all possible noises and vibrations to the wireless room.



The springs eliminate most of the noise made by a rotary spark-gap in operation

Winding Tuning-Coils

A METHOD of winding tuning-coils so as to increase their durability and quality should be of interest to wireless amateurs. Most of those who wind their tuning coils and loose couplers with enameled wire find that it is hard to keep them from rubbing when the slider passes over the turn. This occurred with a coil which one correspondent has been using and which is wound with enameled wire on a hard rubber tube.

To prevent this loosening of the turns, one should, before winding the coil, wind an even layer of tire tape over the tube, and thereafter wind the wire over it tightly. This scheme will also prevent the wire from loosening much on a coil, wound on a wooden core, which may shrink. Soaking in paraffin also prevents shrinking of wooden tubes.

What Radio Readers Want to Know

Range of Station

S. D., Glendale, Cal., inquires:

Q. 1. With a four-wire aerial, 100 feet in length by 55 feet in height at one end and 70 feet at the other, connected with a "1500-meter" tuning coil, galena detector, 1000-ohm receivers, 43-plate variable condenser and a fixed condenser, how far should I be able to receive?

A. 1. The daylight receiving range of this apparatus is perhaps 250 miles, while the night range may be 1000 miles, depending largely upon the power of the transmitting station from which it is desired to receive.

Q. 2. With the foregoing aerial, ¼ K. W. transformer connected to the proper condenser and oscillation transformer, how far can I transmit and approximately what will be the wavelength emitted?

A. 2. The natural wavelength of the antenna system is about 300 meters, and radiated, it wlll be above that value by an amount depending on the number of turns and the general over-all dimensions of the secondary winding. If your station is located so that the Government Authorities will allow it to be operated at a wavelength of 300 meters, the daylight range will be approximately 50 miles. At a wavelength of 200 meters its probable range will be from 20 to 30 miles.

Condenser for Transmitter

LeR. D., Milwaukee, Wis., inquires:

Q. 1. How many plates of glass, 8 inches by 10 inches covered with tinfoil 6 inches by 8 inches, are required to make a suitable condenser or a ¾ K. W. Thordarson transformer?

A. 1. Assuming that this condenser is to be operated at a wavelength of 200 meters, its maximum capacity in any case cannot exceed 0.01 Mfds. With the dimensions given, the capacity of each plate is approximately 0.0006 Mfds. For a value of 0.01 Mfds. approximately 16 plates should be connected in parallel. If the potential of the transformer is 20,000 volts, the condenser should be split into two banks. You then require 32 plates connected in parallel in each bank and two such banks connected in series.

Q. 2. Please give the construction of a 0.5 Microfarad condenser.

A. 2. We infer that this condenser is to be somewhat similar in construction to the type used in telephone work and operated at low potentials. If so, two strips of foil, 6 inches in width by about 90 feet in length, are separated by a similar thin strip of paraffin paper. A second sheet of paraffin paper is then placed over one of the tinfoil strips and the entire unit wound up in circular form. The connections from each strip may be brought out to a binding post.

Q. 3. How many electrodes should be employed in connection with a rotary spark-gap having a disk 6 inches in diameter? The motor has a no-load speed of 6000 R. P. M. This gap is to be used with a ¾ K. W. transmitting set.

A. 3. With the transformer operated from a 60-cycle source of current supply, it is not advisable to produce more than 300 to 400 spark discharges a second. Assuming the load speed of the motor to be about 4000 R. P. M., it is recommended that the disk be fitted with 6 discharge electrodes equally spaced about the circumference. Excessive speeds are undesirable and unnecessary. The average commercial, non-synchronous, rotary spark discharger operates at a speed of 2400 R. P. M. and has 10 discharge electrodes mounted on the disk.

Q. 4. What are the names of the cities corresponding to the abbreviations sent out from Arlington in the weather forecasts, such as M, C, U?

A. 4. These abbreviations refer to important weather observation points. An interpretation follows: T, Nantucket; S, Sidney; A, Atlantic City; H, Hatteras; C, Charleston; K, Key West; P, Pensacola; B, Bermuda. For the Great Lakes the designations are as follows: DU, Duluth; M, Marquette; U, Saulte St. Marie; G, Green Bay; CH, Chicago; L, Alpina; D, Detroit; V, Cleveland; F, Buffalo.

Inductively Coupled Tuner

W. M. K., Windsor, Ontario, writes:

Q. 1. I have an inductively-coupled receiving tuner with a primary winding 4½ inches in diameter by 6 inches in length. It is covered for 5 inches with No. 18 enamel wire. The secondary is 6 inches in length by 3½ inches in diameter covered for 5 inches with No. 24 single cotton wire. Kindly advise the range of wavelength.

A. 1. The range of wavelength to which this apparatus is responsive depends upon the size of the variable condenser employed in shunt to the secondary winding, but with one of very small capacity it should be adjustable to about 2500 meters. The present winding does not represent the best design for an efficient tuner, since No. 24 wire is preferred for the primary winding and No. 30 or 32 for the secondary winding.

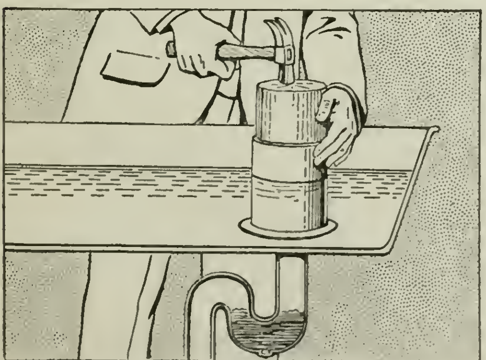
The Home Workbench

A Simple Method of Clearing a Clogged Waste Pipe

REMOVE the top and bottom from a discarded tomato or other can and place it over the outlet from the sink, as illustrated. Procure a block of wood that will easily fit into the tin, as shown.

With a hammer hit a sharp, strong blow on the wooden block, and away goes the stoppage. The tin cylinder prevents the force of the blow from spreading sideways and upwards. It is a fact that a stoppage seldom occurs in the trap, but usually at some bend or joint below it.

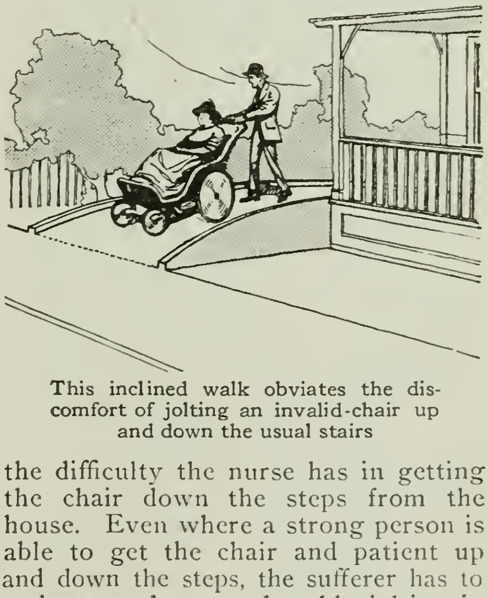
This scheme has been used before, but the addition of the can is a new idea, and is a big improvement over the old method of laying a board on top of the water and striking a blow, most of the energy being expended sideways. Of course the sink must be partly filled with water to use this idea, and the can must be held down firmly.



By striking the plug a sharp blow, the clogged waste pipe is cleared for the free passage of water

Inclined Sidewalk for a Wheeled Invalid Chair

IN homes where there is a wheel-chair invalid, the patient could have more frequent outings, were it not for



This inclined walk obviates the discomfort of jolting an invalid-chair up and down the usual stairs

the difficulty the nurse has in getting the chair down the steps from the house. Even where a strong person is able to get the chair and patient up and down the steps, the sufferer has to endure much uncomfortable jolting in the process.

This difficulty was solved in one home by removing the railing at one end of the veranda and building a new side walk, an inclined plane sloping down to the street walk, to take the place of the usual stairs.

While relatively few homes have invalids, the average home does have a succession of babies, and the slight cost of such a walk would be more than repaid by serving the convenience of the mother with the baby carriage, both in leaving and entering the home.

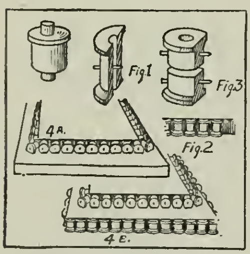
A Music Stand

A VERY pretty and useful music stand can be easily constructed with inexpensive material. Anyone who can use a hammer, saw, auger, varnish-brush and glue-pot, can make this stand at an astonishingly low cost. The material necessary can be obtained in almost any village. The use of the stand is not restricted to music, as the one the author constructed had various uses. The lowest shelf held a set of Shakespeare's works. The next was used for music books, the second for sheet music and the top for holding a lamp, a metronome and a match-holder.

The materials will mostly depend upon the advantages: Four boards (dressed to required thickness), 15″ x 24″; one board (dressed to required thickness), 9″ x 18″; four iron rods, 4′ x ¼″.

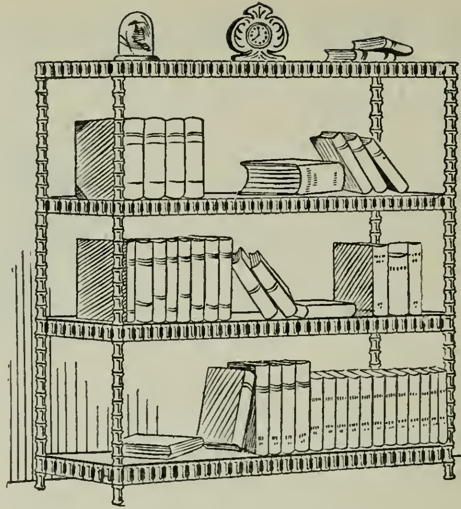
Tacks and putty are required, as well as spools of different sizes and shapes, nails, and glue. The boards will be dressed for a few cents at a planing mill; the rods can be obtained at a blacksmith's and the spools at a dressmaker's, tailor's or milliner's. Thumb tacks may be procured at a book store.

If possible, obtain spools that have had Nos. 36, 40 or 60 cotton thread, and dress the boards, of the first size, to a thickness equal to the length of the hole in the spool. This will vary with the size of the spool. Find points on the four similar boards, four inches from the corner, on the diagonal. This may be done by drawing the diagonals and marking on them points x inches from each corner. With a ¼″-bit, bore holes at these points in the four boards (x depends on the radius of the spool in Fig. 3).



Method of cutting and placing spools

Place the spools in a vise and saw each in two, making the cut parallel to the hole in the spool. Then drive the finishing nails, one in each half-spool, as shown in Fig. 1. Commencing at one corner, nail these half spools to each of the boards, the hole in the spool running at right angles to the top of the board. Some difficulty will be found in driving the nails into the spools, to avoid splitting the wood. The boards, when completed thus, will appear as in Fig. 2.


Music stand easily constructed at small expense and with few tools

Take the board whose larger dimensions are 9″ x 18″ and complete it. It must be dressed. The spools required for it are common spools that have held silk thread. These must be sawn into halves, the cut made this time at right angles to the hole (Fig. 3). Next, with a good, sharp knife pare off the side, as shown in Fig. 3, just enough to prevent rolling. Then into some, drive nails, from one side to the pared side, as shown in Fig. 3. Dress the board to a thickness equal to the smallest diameter of the spool, and place this board centrally on one of the other boards. To do this, draw the diagonals on the under side of the smaller board, and measure one diagonal. Then from the middle of the other board (where its diagonals intersect) mark off on its diāgonal lines equal to one-half the diagonal of the small board. The corner of the smaller board will coincide with the four points just marked. Lay the spools on the larger, around the smaller board, which has been nailed firmly to the larger board (nails being driven from underneath the larger board). The larger part of the spool is on the outside.

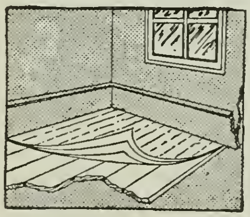
and the hole of the spool forms a right angle with the edge of the board next it. Having each spool touching the next, drive in the finishing nails. The spools will be arranged as in Fig. 4A and the board complete will appear as in 4B. In 4A the dotted lines represent the holes in the spools. The lower board has previously been covered with a light coat of glue, from the center to the line of the end of the spools.

Cut more spools like those used in Fig. 3, only do not drive in nails or pare. Then find the radius of the end of the spool (the smaller end). Suppose it to be x inches. Then mark off four points which are x inches from the four sides. That is, each point is somewhere on the diagonals, and perpendiculars from those points to the 2 nearest sides are x inches. Join these points together and then mark off, on the lines thus formed, points 2x inches apart. Count the points, and whittle that number of sticks which will fit snugly into the holes of the spools and are 3/8″ longer than the holes. With a gimlet drill holes at the points marked on the board, a little over 3/8″ deep. The gimlet should be exactly the same size as the pegs. Drive in each peg and before doing so, put some glue in each hole. Pour in enough to fll the hole. When the peg is driven in the glue will partly run out. Smear the upper part of the pegs with glue and put on the spools, with the saw-cut next the board. The glue on the peg and on the board will hold it. Push a thumb tack, which is also smeared (the point and underside only) with glue, into the top of the peg. These thumb tacks should be of brass, and are only for ornament. The corner spools, of course, are not put on, neither was there a peg driven in, the hole there being drilled with the auger. Varnish the four shelves, or stain to match furniture.

For the remainder, more spools are necessary. These spools must be in sets of 4, the spools in one set being all equal. The sets range from those containing spools of cotton basting variety to the small cotton thread, the sets getting smaller as they reach the top, though there should be a far greater number of small spools than large ones. One end of each rod is threaded and has a nut. Run these spools to the rods and varnish. When all is dry, assemble. Commence by putting the unthreaded ends of the rods through the upper shelf, extending above to half the depth of the spool. Glue the four spools, similar to those in Fig. 3, on the ends of the rods and board.

Then slip on the spools, in sets, smallest first, gluing the ends of the spools to make them stick. When 12½″ have been covered, put on the next shelf and 12½″ more spools and so on till the last shelf is on; then fill up with the largest spools and put on the nuts, cutting off any rod left over, though it depends on the size of the spools whether any will be over or not. Then set up the stand, and, filling in the holes of the four corner spools with putty, push in a thumb tack in each, and varnish the stand again. The author using this as a model, though varying a little in design, constructed a flower stand, though much smaller.

A Cheap Substitute for Linoleum



THREE sheets of strong, brown paper, pasted together, with a top covering of ordinary wall-paper, make an excellent, inexpensive, sanitary substitute for linoleum. After cleaning the floor, a sheet of good, strong, brown paper is pasted down and allowed to dry. Then a second sheet is laid and allowed to dry thoroughly before laying a third sheet.

If a pattern floor covering is desired, ordinary wall-paper serves the purpose admirably. It is pasted to the top sheet of brown paper already laid. The whole, being thoroughly dry, a coat of sizing is applied and left to set, after which a coat of good varnish completes the process. This floor covering has all the advantages of real linoleum and may be washed and polished in the usual way.

Lengthening the Life of a Worn-out Clock

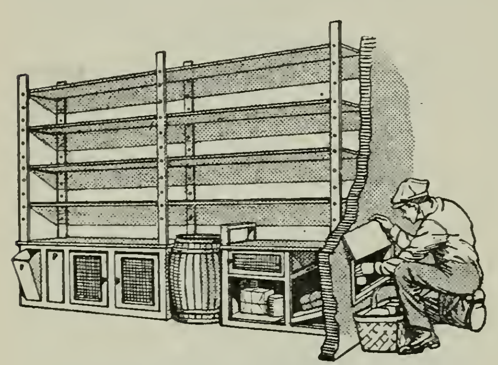
AN old clock can be rejuvinated and used for many years by increasing the distance of the escapement, or in other words, by prying apart the jaws just a mite.

An Extension to a Kitchen

By George E. Walsh

IN many houses, there is no room for little devices, especially when these are for the kitchen. The old house has been remodeled and extensions added, but the kitchen has not kept pace with the growth of the rest.

There is a great deal of work to do in too small a space. There are not shelves enough. What ordinarily can be stored on the first floor must be carried down into the cellar.



This well-planned extension can be fitted to almost any house

This condition ends in a serious consideration of building an extension to the kitchen. A carpenter is probably consulted, and an estimate given, but nine chances out of ten this extension will be only an increase in floor area.

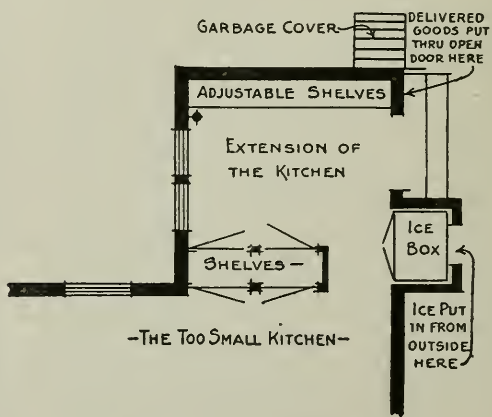
This would not be the case if the owner realized how many extra advantages he could obtain by making this change more thoughtfully. There are a great many devices which could be planned for. If foresight is used, many of the little conveniences can be built by the householder, after the carpenter has finished his job.

The first illustration shows a well-planned extension which can be fitted to almost any house. Arrangement has been made in it for various little contrivances. The storage of the food that is desired to be kept handy, such as crackers, cakes, bread and unopened groceries, can be put in the cupboard which opens both into the extension and into the kitchen. This saves many steps, because the supplies may be reached from either side. As all the doors are glass, quite a little light comes through into the kitchen from the extension.

At the further end of the extension, along the entire wall, are adjustable shelves for canned goods, preserves, vegetables, etc. These shelves are easily made, as shown in the diagram. They consist of six uprights with holes for pegs in them at intervals, upon which pegs the shelves rest.

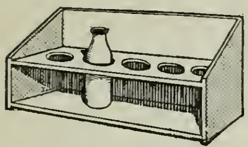
At the bottom, are lockers with screens and places for boxes and barrels of flour. In one end are deep drawers which work on hinges, and swing out and down, forming a trough in which loose sugar and flour can be kept. It is easy to scoop out the contents from them and save the extra labor of uncovering and covering barrels and tins.

A handy device for the delivery is installed at one side of the entrance. It consists of a small opening with a swinging door, something like a letter box. The goods, pushed through by the delivery boy, slide along an inclined plane out of reach. A small bell can be arranged at the side to give notice of delivered goods. This saves many a weary chase down stairs to open the door for the tradesmen.



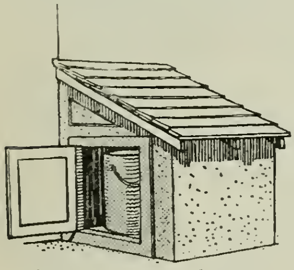
Plan of the extension to the kitchen

Ice is also put into the ice-box through a door from the outside. A small shed-like extension, just large enough for the ice-box, is built nearest the kitchen proper. The doors of the ice-box open on the inside, but a smaller one opens on the outside to permit the iceman to insert the ice from without. Because this ice-box extension stands out from the rest of the house, it is very cold in winter, so that no ice is then needed.



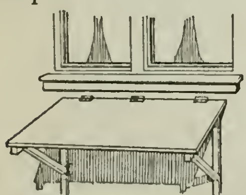
This bottle rack prevents upset milk

Another feature of the kitchen extension is the large window opposite the door. In hot weather this can be thrown wide open and netting put in. This makes a very cool place for ironing. A gas jet should be placed near for use with a gas iron, making the work even cooler.



This garbage-house keeps flies out and bad odors in

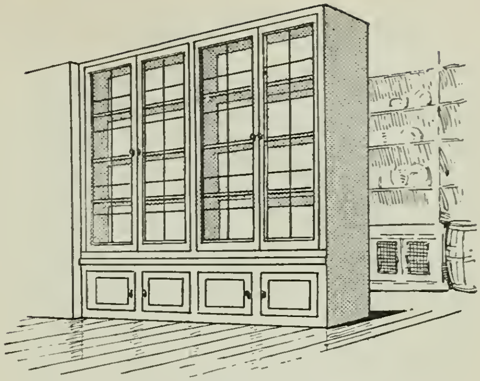
Around the corner of the entrance-stairs is built a cement garbage-holder. This consists of a small house with a roof over it, large enough to enclose the garbage pail. It can be slipped in or out by means of a door at the side. In the summer, this keeps the flies out and the odors in.



This collapsible table will be found most useful

Other small contrivances can be constructed in this extension. For instance, a rack with holes large enough to contain the milk bottles, can be fastened just outside of the door. This will do away with the nuisance of upset milk bottles.

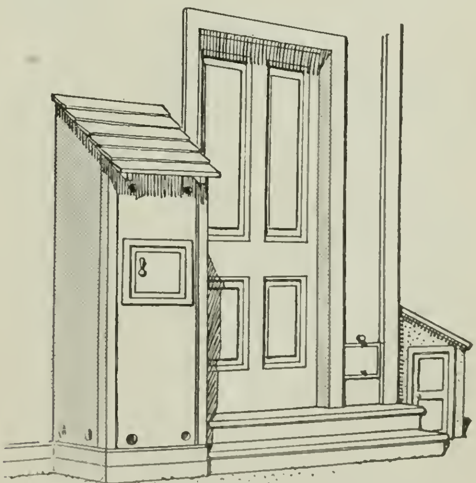
A collapsible table can be hinged under the window, or even a kneading board. A pair of heavy wooden brackets can be built near the ceiling out of reach of the head, for the purpose of holding a step ladder or clothes pole.



This cabinet will save the housewife many unnecessary steps

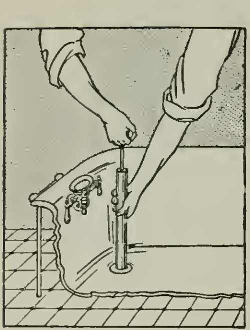
Indeed, many little devices can be built into an extension such as this, if arrangements are made for them in the beginning. They are all simple and can be home-built, after the main structure has been completed.

An extension with all these aids will be more than welcomed by the housekeeper. Even those houses which have kitchens of ample size would be helped by such an addition, for it divides up the work, leaving one part for cooking and washing dishes, and the other for storage, food preparation and laundry finishing.



A door on the outside of this ice-box allows the ice to be inserted from without

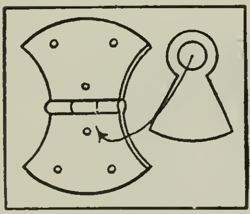
Using a Suction Pump to Clear a Clogged Drain



THE head-pump of an ordinary tin garden-sprayer may be used effectively for freeing a waste pipe from obstruction. Being unable to empty the bath tub, even by running wires down the drain, one experimenter prepared to bail it out, anticipating afterward a plumber's bill of $2 or $3. For bailing, he had, besides a basin, a tin suction pump detached from the reservoir usually included in the hand-sprayer.

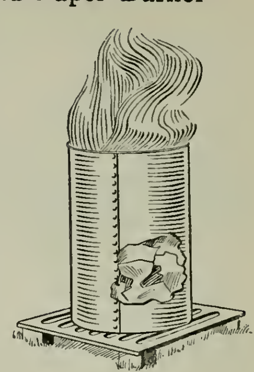
Taking up this pump, it occurred to him to try its effect over the vent of the tub. Pressing down the piston, he was astonished at the resistance, and on taking two or three strokes, found that the water was rapidly lowering in the tub. The suction pump, pressed down upon the drain, had given an opportunity for exciting its not inconsiderable force and, as a result, had dislodged the obstruction without further difficulty.—E. R. Chadbourn.

A Door Retainer



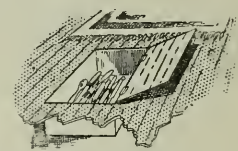
NOT wishing the horizontal top door of an ice-box or cabinet to fall clear back when opened, the device here shown may be used. From 1/16″ steel or brass, fashion a piece as in the illustration. The angle of the sides is equal to 180° minus the angle at which the door is to stand. The hole in the piece is equal to the diameter of the pin of the hinge on the door. Take the pin out of the hinge and file one of the pin-holders off, to allow the device just made to fit on the pin and in the inner portion of the hinge. Re-assemble the hinge and screw it on the door. When the door is opened this device will hold it up at the desired angle.—Noble Landis.

A Garbage and Paper Burner



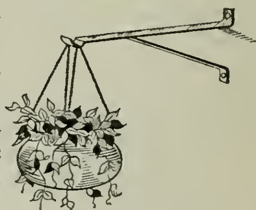
A SATISFACTORY garbage and paper incinerator can be made from a cylinder of galvanized iron 14″ in diameter and 28″ in height. A cylinder of this sort can be made at the local tinsmith's for about seventy-five cents. In use, it is placed on an iron grate and the refuse ignited by placing it on a pile of dry paper in the bottom.—C. L. Vestal.

Concealing the Spare Silver



IN building their home, a family provided a storage place for the "company" silver, which holds the entire supply when the family leaves home in the summer. In the clothes closet of an upstairs bedroom is a shirt-waist box on casters. This seems natural and attracts no attention. Beneath it is the hiding place in the floor. A section of flooring is hinged and below is a box for the silver.—Avis G. Vestal.

A Flower-Pot Hanger



WITH the coming of winter, it becomes necessary to bring in the flowers. The handy device shown can be made by any blacksmith. It consists of a frame for holding the flower-pot and a wall bracket for holding the frame. Both are made from ¼″ round iron, fashioned to the illustrated shape and welded together. The size of the iron hoop that encircles the pot is determined by the diameter of the pot just below the top flange. The size of the bracket is determined by the weight of the pot and its size. Good judgment only is needed to make either of these parts.—Noble Landis.

A Modern Sanitary Hog House

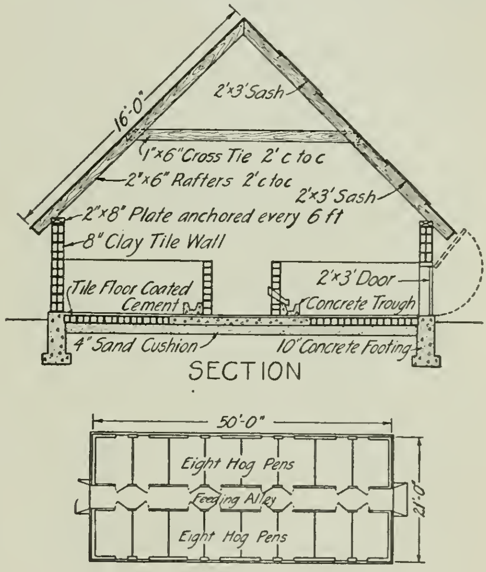
IN Iowa, where the hog is given the first place on many a farm, hundreds of new hog houses have been built. They are very practical, easy to build, and make the most of the materials. Houses built after this plan harness the sunlight most effectively. The windows are in the roof, that is on the south slope of the roof, which is at half pitch. Any farmer who has only ordinary skill can put together such a structure during the nothing-to-do period on the farm or at the end of the rush season.

The foundations for the walls are made of concrete and go down below the frost line, so that the tile-walls will not crack. The pen-floors are of hollow clay, tile laid, on a sand cushion. This makes a warm and dry bed for the old mother sow and her litter. The pen partitions and the walls of the house are made of clay tile 8″ thick, and a stanchion is bolted to the wall every 6′. The rafters are 2″x6″ and are 16′ long and spaced 2′ apart.

The house is solidly put together, if the plan here shown is followed out by the builder. It will need but little repairing. The materials that will be needed for the farmer who will want to build such a house have been listed below. For a sixteen pen house, that is with eight pens on both sides of the center feed-alley, and with pens 6′x8′ in size, the materials will cost at the rate of about $20 per pen in many sections. For a house that has outside ground dimensions 21′ x 50′ the following materials will be needed:

- 25 barrels cement for foundation and feed-alley floor.
- 2,500 hollow, clay blocks for floor and walls, 5″x8″x12″.
- 10 pcs. 2′x8′—10′ for plates.
- 52 pcs. 2′x6′—16′ rafters for roof.
- 26 pcs. 1′x6′—12′ cross ties for rafters.
- 1,600′ roof-sheathing.
- 15,000 cedar shingles for roof.
- 16 skylight sashes for roof.
- 16 pen doors, 2′x3′.
- 2 doors, 3′x7′.
- 1 metal cupola, 18″.

Stake out the building site, 21′x50′, and inside the lines dig the foundation trenches. These are 10″ wide and 2½′ deep. If the ground is solid, wood forms will not be needed, but always use care and do not jar loose any of the trench walls when pouring concrete into them. Make the concrete with one sack of cement, three cubic feet of sand and five of gravel. Mix



Floor and section plan of sanitary hog house

the sand and cement thoroughly before adding the gravel and the water. Slush the mixture into the trench at once and be sure that the top is leveled off properly.

The tile walls (8″ thick) of the house are laid directly upon the concrete foundation, as the diagram illustrates. The common size blocks are 5″ x 8″ x 12″ in size. Lay them flatwise in the wall. Use a lime and cement mortar, but only a small amount of lime will be allowed, not to exceed one tenth part by volume. The lime makes the mortar plastic, so that the mortar will stick to the ends of the blocks when they are being laid up in the walls of the hog house. The tile walls of the house are 5′ in height. When the last course of tile is being laid, do not forget to insert the anchor bolts in the mortar joints every 6′. Let the threaded end of the bolt project at least 2½″ so that the 2″ x 8″ wood plate can be securely bolted to the tile wall. It is then possible to spike the roof rafters of the house to this wood plate. As the tile walls are going up, set in place the door frames for the pen doors and also the end doors. These are only made of 2″ x 8″ planks, with spikes driven into them so that they will be well bonded to the tile walls.

The roof building is the next step. Make it at half pitch with the 2″x6″ rafters, 2′ center to center. Use 16′ lumber and tie every set of rafters with a 6″ board 12′ long. This makes a stiff frame and a solid foundation for the roof. Any cheap lumber can be used for sheathing. Space the boards 1½″ apart. The cedar shingles should be applied with galvanized three-penny nails and laid with not over 4½″ exposed to the weather. The roof sash or the skylights have a metal flashing so that they will not leak. These sash frames are set in place as the roof is being shingled. The roofing will run up over the metal flashing. The glass in the roof sash is covered with hardware cloth to prevent hail damage. That completes the shell of the house.

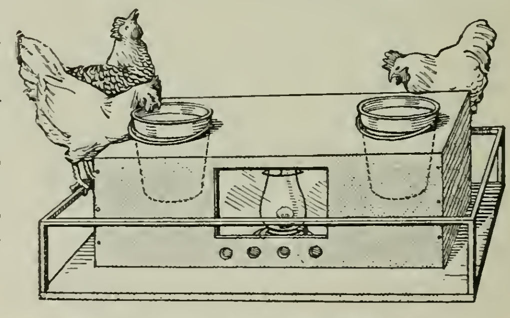
The floors are the next step in the process of erecting a modern hog house. The tile for the floors may be seconds. Lay them on a well-tamped sand and gravel cushion and cover the tile and the joints with a rich mixture of sand and cement, mixed one to two. A floor so made, with an air space under it, is warm, dry and healthy. The feed-alley floor is all concrete, 5′ thick, and the hog-troughs are made of the same material. The pen partitions can be made of either tile or wood planks. Make the pens size 6′ x 8′. This is the generally accepted standard-size farrowing pen.

The recent cholera epidemics and other swine troubles have in a large measure been traced back to the old filthy, germ-ridden, dark hog pens on most corn-belt farms. This great loss from disease has taken millions of dollars from hog growers' bank accounts. It has driven home a lesson, nevertheless. It has, in a way, revolutionized the management of swine and has brought about a general cleaning-up policy, better sanitation and better health for the porker, so that he will be in a prime condition to fight disease when it appears.

A Hen-House Water Supply Which Will Not Freeze

TO make a non-freezable drinking fountain for the hen house the following material will be needed: One soap or cracker box; a lantern; two galvanized iron pails, about two-quart capacity; and enough heavy asbestos paper to line box with a double thickness to keep in the heat generated by the lantern and for fire prevention.

The box must be large enough to hold



The deflected heat from the lantern keeps the fountain from freezing

the lantern and two pails. Two holes are cut in the top of box, one at each end, allowing the pails to sink into the box with only about 3″ protruding; inside the box, between the pails, the lantern should be placed. The heat will be deflected by the lantern top and the box around the water pails, thus keeping the water a few degrees above freezing even in coldest weather.

The box is placed on a platform. This, in addition to being a support for perches on which the fowls stand while drinking, is also the bottom of the heat box upon which the lantern rests. When filling or cleaning the lantern, the box and pails are lifted from the platform, but when filling the pails, they are simply removed from the holes.

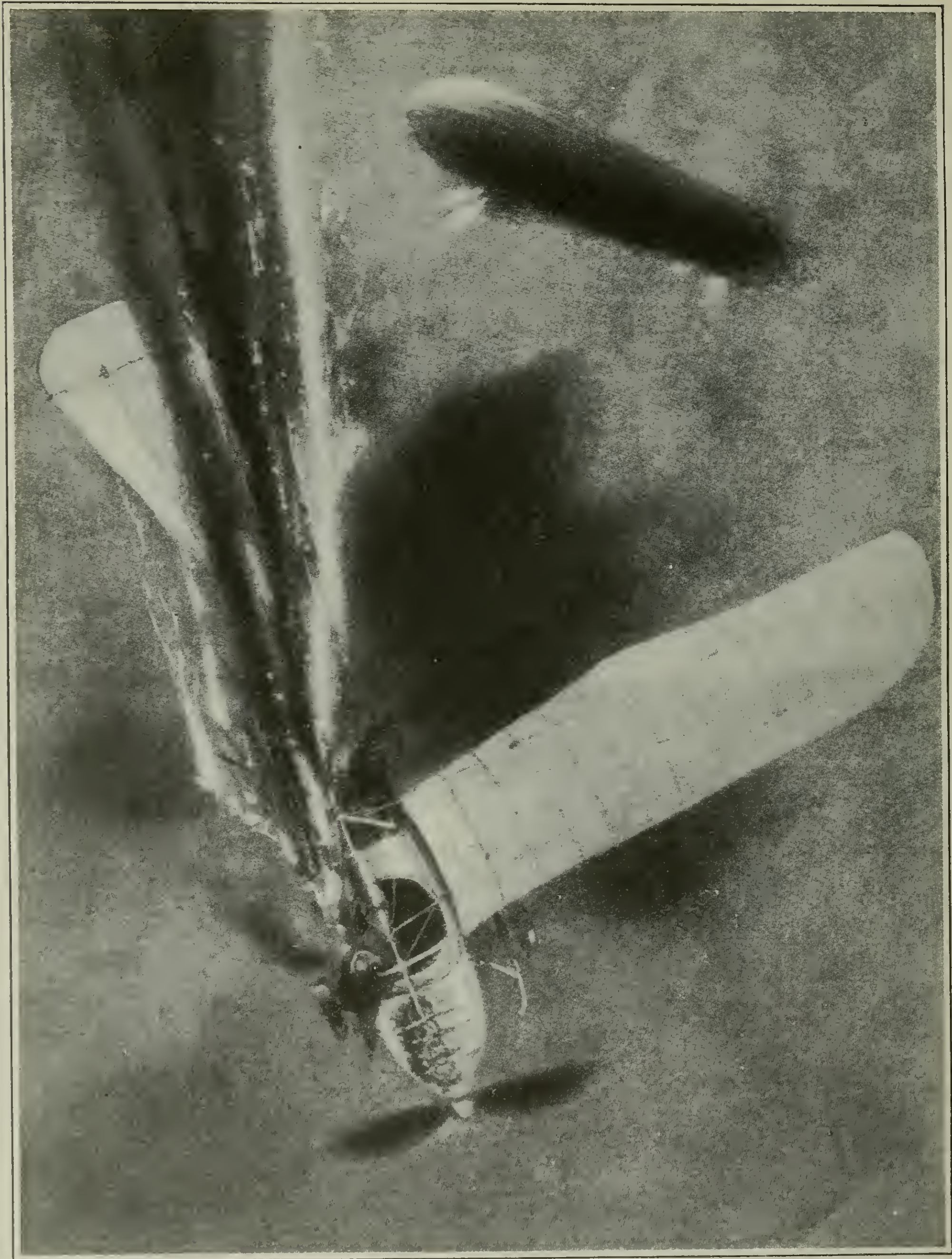
Money Prizes for Radio Articles

We want you to tell our readers how you have overcome your wireless troubles. Every radio operator, commercial or experimental, has encountered difficulties in building or using his apparatus. Many different people are bothered by the very same problems day after day, and it will help you to learn how others worked to get successful results. It will help others to learn how you succeeded.

For the two best articles describing how you overcame troubles in building, operating, adjusting or repairing any radio instrument or group of instruments, we offer first and second prizes of $25.00 *and* $15.00 *respectively. The Judges of the Contest, who will be the Editors of the* Popular Science Monthly, *will select the prize-winning manuscripts from those which conform with the following conditions. The prizes will be awarded to the two writers whose articles, in the opinion of the Editors, will prove most helpful to the readers of the magazine.*

Conditions of Prize Contest

1. *Manuscripts must be typewritten, on one side of the paper only.*
2. *Illustrations must be on sheets separate from the manuscripts.*
3. *Articles must be addressed to the Radio Prize Contest,* Popular Science Monthly, 239 *Fourth Avenue, New York, and must reach that address before June* 15, 1916, *in order to be considered.*
4. *Manuscripts which do not win prizes may be purchased for publication, at the option of the Editors and at the usual rates.*
5. *The decision of the Judges, which will be announced in the August,* 1916, *issue, is to be final.*
6. *Each manuscript must be accompanied by a letter containing criticisms and suggestions as to the wireless section of the* Popular Science Monthly. *The merit of these letters will not be considered in awarding the prizes, but their suggestions will be taken as indications of what types of articles are of the most value to our readers.*
7. *If contestants wish to have their manuscripts returned, they should send postage for that purpose.*
8. *Articles should not exceed* 2,000 *words in length. If you cannot compose your information in that length, write more than one article on different phases of the subject, each article to be independent.*



The End of a Battle in the Air

A few years ago military experts considered fighting in the air an improbability and declared that the aeroplane and the Zeppelin would be useful only for scouting and bomb dropping. Now, battles between aeroplanes are so common that they are seldom mentioned in the dispatches. Aeroplanes as yet have been able to accomplish little against raiding Zeppelins. The anti-aircraft guns are the Zeppelin's greatest enemies, and these Paris and London dare not use lest the projectiles fall back in the streets

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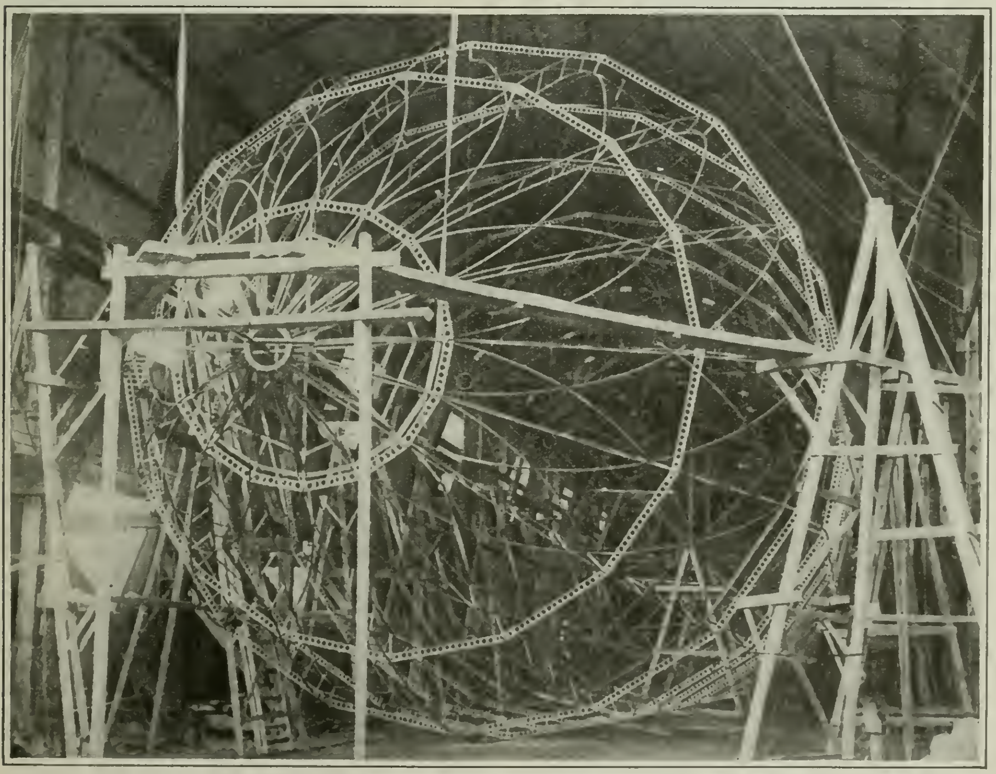
A Pigmy Zeppelin

A PIGMY Zeppelin (pigmy as Zeppelins go) with a basket-work frame of layered wood has been recently built for the British Government by a number of American constructors, including T. Rutherford MacMechen, president of the Aeronautical Society of America, and Walter Kamp, a prominent American aeronautical designer.

One of the chief efforts of the designer has been to reduce the weight of the hull and car without sacrificing strength, and this has been accomplished, he believes, by the substitution of laminated wood for the aluminum which composes the framework of the Zeppelin. The rings which are used to keep the hull in cylindrical form are made of thirty-nine thin layers of mahogany, carefully glued together, and covered by a steel collar. Thirty-two wooden ropes, hardly as thick as a man's thumb, wind again and again around the hull, weaving the whole



A pigmy Zeppelin which is being built for the British Government by a company of American constructors. The framework of this novel airship is made of ropes and laminated wood, so closely woven together as to resemble a huge mesh of wood and wire into a great mesh of basket-work. Sixteen slender members form the longitudinals, running from bow to stern, and intersecting the spirals of wooden rope where they cross each other. The function of the spirals and longitudinals acting together is to distribute the gas lift and strains evenly to all points of the hull.

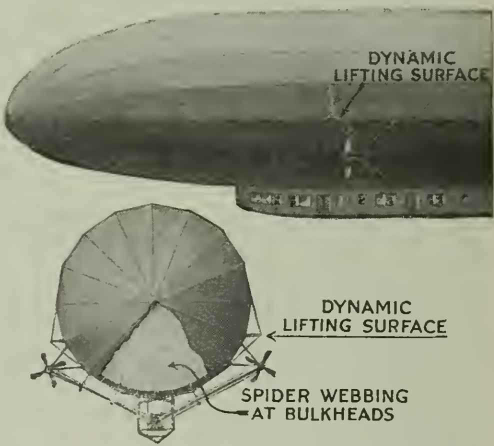
There are, in reality, two hulls, the inner enclosing thirteen balloonets or gas bags and the outer supporting a waterproof and airtight envelope or skin. Twenty-nine ribs, or transverse girders, encircle the inner hull, and a spider web of wire cables stiffens the alternate ribs and forms the bulkheads between the balloonets.

Two eight-cylinder, sixty-horsepower motors have been installed, and by means of cable drives transmit the power to four propellers mounted high above the car, two being placed on each side of the slender torpedo-like hull.

In hot weather, or when the airship passes through a heated stratum of air, the gas expands, exerting more lifting power, and causing the airship to rise. To control this tendency, the gas has to be artificially cooled, or it will be necessary to release some of the valuable hydrogen to allow the ship to retake its proper altitude. On the contrary, if a sudden wave of cold air strikes the gas bag, the gas immediately contracts, and part of its lifting power is lost. If there is no means for heating the gas and expanding it, ballast will have to be dropped from the car, thus compensating the decreased lifting power of the gas by a lighter weight which it has to carry.

The control of the lifting power of the gas in the MacMechen dirigible is in the heating and cooling process. To keep the hydrogen from cooling and losing its lifting power, hot vapor from the engine is blown into the foot-wide space between the balloonets and the outer skin of airtight cloth. To cool and condense the gas for descent, or to prevent its expansion to an extent that causes an undue inflation of the gas bags, cold air is introduced into the same space by means of a luminum disks with revolving shutters at the bow and stern.

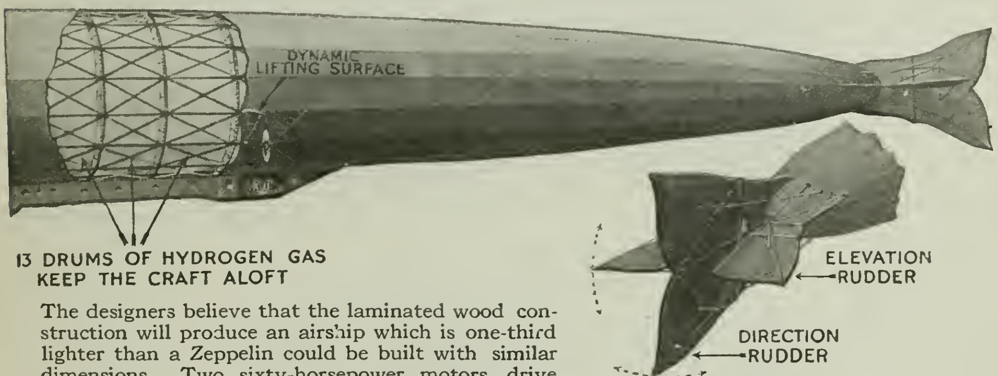
It is claimed that by this method of construction a rigid airship has been built which is one-third lighter than it is possible to build a Zeppelin of the same relative size. The hull and car weigh 2,190 pounds, and the gas capacity is 108,000 cubic feet, or about one-tenth that of the latest Zeppelin monster. As hydrogen is usually rated by aeronauts, this quantity will lift about three and one-half tons, or seven thousand pounds. With engine equipment and crew, the airship weighs about 5,300 pounds, leaving a margin of 1,800 pounds for ballast, explosives and additional fuel. The length of the hull is 236 feet over all. The designers claim that their airship



will make about seventy miles an hour, or about ten miles an hour faster than the speed of a Zeppelin.

The Popular Science Monthly believes that this airship will prove disappointing to its builders and to the British Government. Previous experiments with wooden frames in dirigibles have proved costly failures. The Zeppelin's first rival, the Schütte-Lanz dirigible, was built with wooden framework, and proved much heavier than a Zeppelin of the same dimensions. Laminated wood was used in the experiment and this was found faulty and discarded. The Zeppelin of to-day is the product of practical experience, as is the second, and successful, Schütte-Lanz, which discarded the weblike wooden frame for the lighter metal ribs and strakes of the Zeppelin. Such a solid frame as that of the pigmy airship would not do for a larger dirigible, for it loses the greater lightness for the same strength of a small structure. In a small dirigible resistance against propulsion is so much greater than the lift available for engine power in the large craft, that it completely discounts the small craft's structural advantages. Any improvements in lightness and strength will, therefore, never make this pigmy Zeppelin a superior in speed to its larger and more powerful rival.

The whole idea of a small and speedy "aerial destroyer" is mistaken, since in a dirigible everything has to take second place to speed; otherwise Zeppelins, which cannot seek safety in landing, would be at the mercy of the wind.



The designers believe that the laminated wood construction will produce an airship which is one-third lighter than a Zeppelin could be built with similar dimensions. Two sixty-horsepower motors drive four propellers, and the airship will be expected to make more than seventy miles an hour at full speed

The rope drive to the propellers has been proved greatly inferior to bevel gearing, chains and belts. The cable drive was tested on the first Gross-Basenach, but was quickly discarded.

The most meritorious feature of the design of the pigmy Zeppelin is in the alternate heating and cooling of the gases by hot vapor from the engine and cool air sucked in by blowers. This certainly should prove of valuable assistance to the dynamic lift-control without entailing much additional weight.

In conclusion, it seems that the idea of a wooden frame has been tried, approximately in its present form, and found lacking. The rope drive has been succeeded by more efficient means of power transmission, and the entire trend of dirigible construction has been to increase the lifting power, and consequently the size, in order to achieve greater power and speed. Whether the Zeppelin has been a success or not is a mooted point, but the Zeppelin has been the only dirigible that has accomplished anything of note in this war, and the smaller dirigibles have been permanently relegated to their hangars.

A Barbed-Wire-Proof Fabric

ONE of the most trying tasks incident to trench fighting has been considerably lightened by the appearance in the British trenches of gloves made of a fabric which is said to be impervious to barbed-wire points. The fabric is made up into mittens, with the first finger and thumb separate. The fabric is waterproof, and in addition the gloves are insulated for gripping electrically-charged wires.

The same material is applied to the manufacture of sleeping-bags, which, when opened, may be thrown over a barbed-wire entanglement to allow a soldier to climb over the sharp points without injury. When made up into vests or tunics, the fabric is strong enough to turn shrapnel splinters, or even a bullet when it has lost part of its momentum. The interlining is antisepticized, so that if a bullet goes through, it takes into the wound enough antiseptic wool to prevent poisoning.

The materials used in the manufacture of this remarkable fabric have been sedulously kept secret this far.

Preserving Indian Speech

WE are already beginning to regret that no phonographic records could have been made of the voices of great singers of the last generation, while we shall be handing down our Carusos and Melbas to those who come long after us. Not long ago the Department of the Interior in Washington awoke to the fact that there was something else to be preserved for the future, namely the speech and war songs of our native Indians. The new generation of Carlisle-bred chiefs do not take the ancient rituals very seriously, and it is probable that after the oldest of the living warriors have died, the Indian war songs will be practically forgotten.

A chief of the Blackfeet singing his war songs into a Government phonograph for preservation

It was this feeling which prompted the Government to make the phonographic records of the voices of the greatest of the living chiefs for the files of the nation. For some time past, now, these warriors on their periodic visits to Washington have recorded on the phonograph their songs and their legends for the files of the nation.

A Rowing-Bath

THE rowing-bath has been perfected in a western sanitarium for the purpose of adding zest to the morning plunge. It is valuable as a curative measure, but it may also be used with enjoyment and benefit by any one.

The rowing-bath consists of a metal container which is attached to the nozzle of an ordinary tub by means of a rubber cord sufficiently strong to give the element of exercise. Entering the tub, the bather attaches the rowing device and turns on the cold water. As it pours into the tub he scoops up the water and, pulling the container toward him with a rowing motion, empties it full upon his breast, thus securing the zest which accompanies the pleasant pastime of buffeting surf. This bath is a diversion from the ordinary "shower" on a hot summer day.

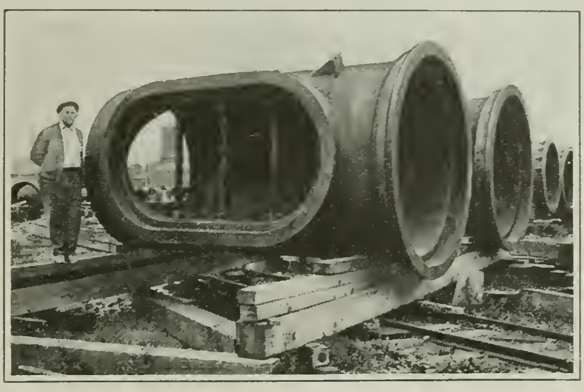
The rowboat bath is the newest contribution to the physical enjoyment of living

Biggest Cast-iron Pipes in the World

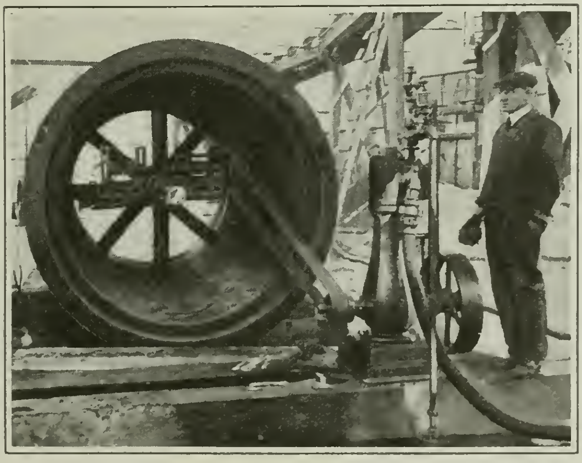
THE big gas-mains in the Astoria-Bronx Tunnel at New York are probably the largest cast-iron pipes ever made. The internal diameter is six feet; the thickness of metal is two and three-quarter inches; and the length twelve feet. The one end has the ordinary bell form; the other the spigot. The weight of one length is about twenty-six thousand pounds.

These mains are laid parallel and run down a shaft at Astoria on Long Island, along a tunnel two hundred and twenty-five feet below the surface, under East River, and then up a second shaft at One Hundred and Thirty-second Street and East River. They are to carry gas into the Bronx, the most rapidly growing borough of New York city.

It is not an impossibility that the tunnel may sometime be flooded with water. Under such circumstances it would not be desirable to have the long lines of iron tubes begin to float. While the pipes are heavy enough to prevent their floating, the margin is not great. The weight of water displaced by a cylinder twelve feet long and seventy-seven and one-half inches in diameter is between twenty-four thousand and twenty-five thousand pounds. The overlap where bell-end encompasses spigot-end complicates the matter a little, but after all allowances are made, there would probably be a good solid weight to the pipe lines if the tunnel were full of water.

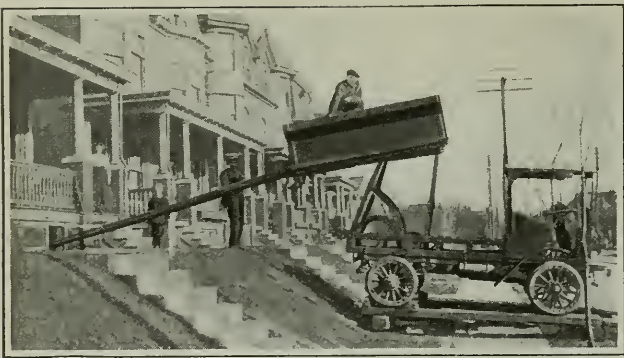


A row of seventy-two-inch pipes for the Astoria line, New York city. In the foreground is a spigot joint with tee cut-off



The small motor is driving eight steel knives which are cutting the pipe from the inside

The amount of lead used to calk the joints is about two hundred and twenty-five pounds per joint. The mains rest on concrete saddles set six feet apart.



In order to reduce his unloading time and also to run coal into cellars as awkwardly placed as this, a coal-merchant had a special truck body designed like that shown here

Small Motor Trucks Deliver Coal Cheaply

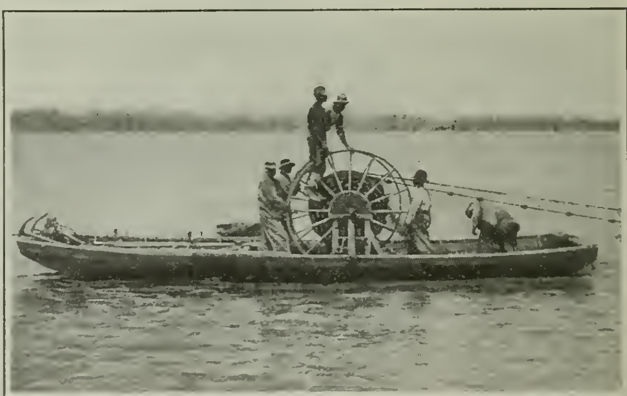
SAVING time by means of a dumping body elevated by power from its own motor and skids laid over the sidewalk, the small two-ton truck shown in the accompanying illustration delivered an average on thirty tons per day for a period of several months and in doing so covered between fifty and sixty miles daily. At two tons per load this means fifteen trips per ten-hour day with an average length of trip of three to four miles.

In large cities, where streets are well paved, the coal delivered in large quantities and the hauls more than five miles, five- to ten-ton trucks have proved very successful. But for country and suburban work, where the roads are poorer, the coal delivered in five-ton loads or less and the hauls less than five miles, trucks of two-tons capacity or thereabouts have proved best.

For work in residence sections where the streets are soft, small-capacity trucks can maneuver more quickly than larger ones, run less chance of getting mired, and because of their greater speed, can often deliver a greater tonnage.

A Man-Power Reel for Hauling in a Long Seine

AN ingenious device for hauling in a long seine has been introduced by a fisherman who operates on a large scale in Mississippi. The seine he uses is over a mile in length, and it would require a large crew to haul it in. The contrivance he has invented consists of two wheels about eight feet in diameter, mounted on the ends of an axle, thus forming a huge reel. This is mounted on a scow so that it can re-revolve. The seine is wound up on the big reel.



The fisherman winds up his mile-long seine on a big windlass which a small crew can operate by hand in a moderate-sized boat

When it is to be laid, the scow is rowed out to the desired spot, the end of the seine is fastened to a stake, which is driven to the bottom, and the seine is paid out from the reel as the scow is rowed away from the stake. A man at each wheel tends the seine to keep it from tangling. To haul it in, two of the crew tread up the spokes of the wheels so that the reel revolves and slowly rolls up the seine on the axle, the scow meanwhile being backed over the course of the laid seine. Negro labor is cheap in the far South, so that this device has proved both economical and efficient.

THIRTY-FOUR dollars a minute is the cost of maintaining New York's police force of nearly eleven thousand men.

Saves Work of the Book Gatherer

The center of the table revolves and the girls pick off the printed units they are gathering for binding

THE gathering or assembling of a book in the book bindery is generally done by girls who walk around a large room taking the signatures from one pile after another as they move along. The work is hard and the capacity of the gatherer is limited by her walking ability. Where the character of the work is always the same, special machinery has been made which will do the work, but where there is a variety of work the human gatherer is necessarily resorted to.

An electric table driven by a two-horse-power motor has recently been designed and built by the manager of a Louisville printing establishment which enables the girls to sit at their work, taking the desired sheets from the piles placed on the table as they move by in an endless procession. The table will accommodate ten or twelve girls. It was successfully used in the assembling of a two-thousand-nine-hundred-page legal work, and it is claimed by the inventor that by making the table a double-decker, an unabridged dictionary could be handled upon it, so efficient is the rotating arrangement.

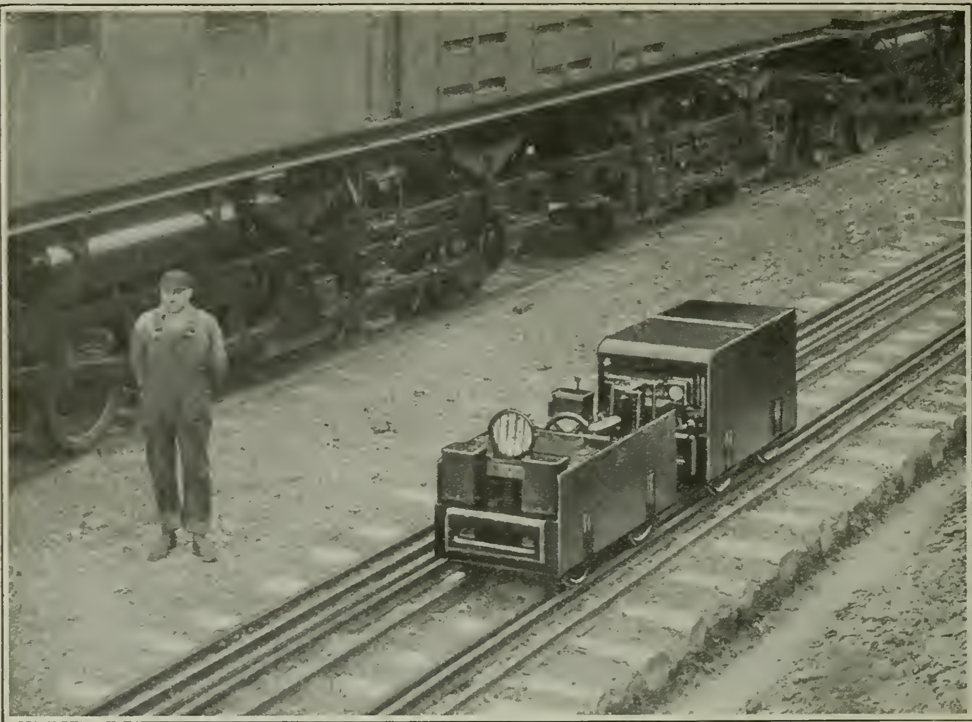
A California fireplace where everyone can sit in front of the blaze, but which has no inglenooks

A "Center-of-the-Room" Fireplace

A BUILDER of Long Beach, California, has constructed a novel fireplace in his home, the very lines of which have the effect of making this dwelling "different." This is a "middle-of-the-room" fireplace and is known as a brazier. It is possible for a family and its friends to sit entirely around the fire, so that a dozen or more persons may toast their toes at the same time.

The brazier consists of a hood, a basin, a spark-guard and a grate. With the exception of the grate, the parts are made of hammered copper. The basin, the sides of which serve as a foot-rest, is five feet square, six inches deep and four inches from the floor, and is supported by four legs, located at the corners. Within this basin an iron grate has been placed, on which the fire is made, only the ashes falling to the basin. A copper-wire spark-screen, three feet in height, has been made to fit within the basin at the foot of the sloping sides. This guard has brass posts, top and bottom. It may be instantly removed when it is desired to clean the basin.

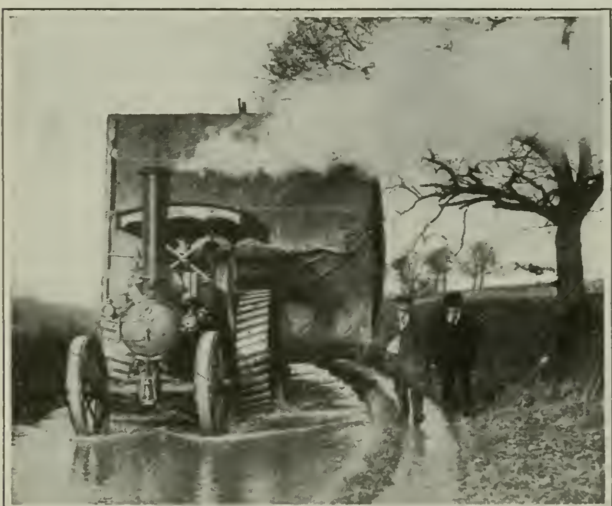
This home has walls nine feet in height and it is of such a length so that when lowered its upper end extends a foot or so above the ceiling. The neck of this hood is twelve inches wide. At its lower end it flares out to four feet.



The tiny electric locomotive on the small track is as mighty, weight for weight, as the giant which fills the background

Not a Toy—A Real Locomotive

THE engineer is standing next to the largest electric locomotive in the world. But the youngster in the foreground is not a top by any means; it is a lusty, able, mining locomotive weighing five thousand pounds. Pound for pound and volt for volt, it can draw just as heavy a load as its big brother behind, which weighs five hundred and sixty thousand pounds. The big motor is driven by a current of three thousand volts, while the "toy" which runs on a twenty-inch gage track, is driven by a self-contained storage-battery, delivering eighty-five volts.



A British army tractor which crossed England despite many difficulties

A Difficult Journey for an Army Tractor

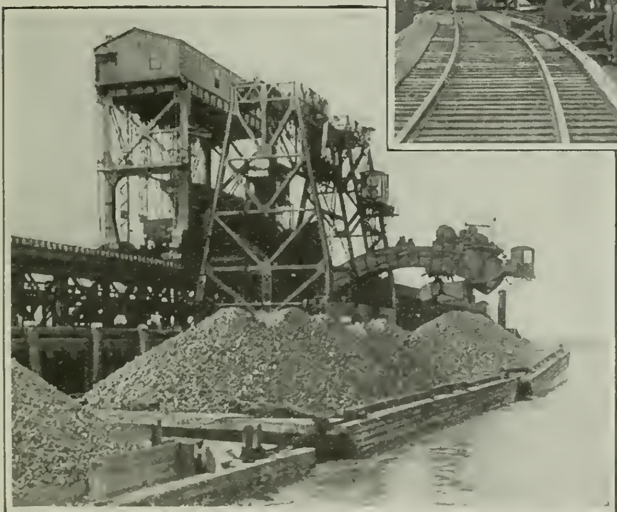
WAR certainly gives rise to strange exigencies. In the illustration may be seen a big tractor transporting a large, awkward load through a flooded road in Berkshire, England. Difficulties were encountered every mile. Telegraph wires were always in the way, tree branches seemed surprisingly numerous, and arches reared themselves in the path of the vehicle.

Dumping a Whole Carload of Coal at a Time

THE speediest way of loading coal from a freight-car into a steamer is embodied in a mechanical loading plant installed on a wharf at Charleston, South Carolina.

Instead of unloading the coal from the cars and stacking it to await the steamer, then retransporting it to the steamer's hold, the car, filled with coal, is merely lifted bodily from the track by a powerful elevating mechanism and its contents poured into a great chute, from which it streams into the hold.

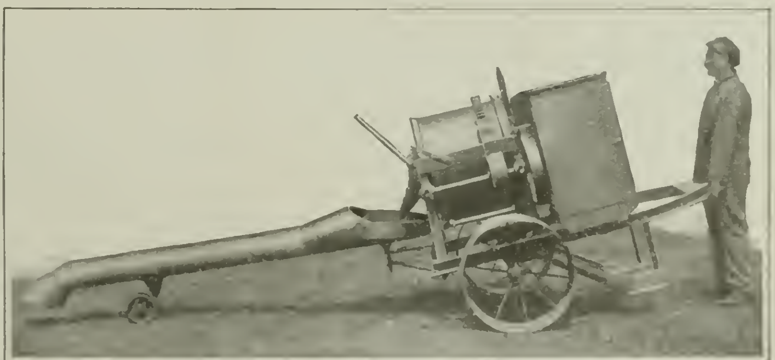
Thirty coal-cars, each with a load of one hundred tons, can be handled in an hour. The entire plant is electrically operated. In action, the electrical loader is spectacular. The loaded cars roll down an incline upon the elevator. A motor is started, the car swings upward until it is turned bottom-side-up, the coal pouring into the hopper, thence to the ship.



This giant coals steamers and loads barges by picking up railway cars and turning them upside down over the hopper

Machine Fills Cracks in Pavement

FILLING in the cracks between paving-stones is a process known as "grouting," and proper grouting, when done by hand with the aid of a wheelbarrow and a trowel or a spade, is a slow and time-consuming task. A compact grouting-machine has been brought out, which, while operated by only one man, is able to do the work better and in less time than a small gang of laborers. A concrete-mixing machine is mounted on wheels with a long spout protruding in front. As the concrete is needed, it is poured through the spout and out upon the pavement, whence the cement finds its way into the cracks.



A machine which fills in the cracks between paving stones

The "Cascadas" is the largest all-steel dredge in the world. It scoops up fifteen wagon-loads of material at a time, and has disposed of as many as seventeen thousand wagon-loads of earth and rocks in a single day

Digging Away the Slides at Panama

THE whole Panama Canal zone may be imagined as an aggregation of slopes of hard material upon which softer materials rest. In cutting the canal the equilibrium maintained between the upper and the lower strata was disturbed. As a result the overlying material tobogganed down into the cut which constitutes the canal, upon the inclined under material. Nothing can stop the movement now in progress until the angle of repose is attained, and this can be reached only by removing the excess amount of material. Col. Goethals states that seven million cubic yards must be removed before the slides are entirely stopped, and that this is at best only a guess. "It must not be inferred," says Col. Goethals, "that the canal will be closed until this amount is dredged; on the contrary, it is the intention to pass ships as soon as a channel is secured through the remaining six hundred feet, and there are reasonable grounds for as-

The thousands of tons of earth and rock precipitated into the Panama Canal had to be removed before shipping could pass through the canal. Two dredges and the ship "Newton" were caught at this point. It took seventy-nine days to dig the "Newton" out

suming that a channel through the obstructed area can be maintained."

Seven dredges have been more or less steadily working at the bases of the Culebra slides for the last few months. Three of these are fifteen-yard dipper-dredges, one is a five-yard dipper-dredge, one a ladder-dredge and the others are sea-going suction and pipeline suction-dredges.

The two photographs appearing on these pages show the fifteen-yard dipper-dredge *Cascadas* at work. This is the largest all-steel dredge in the world. It was made in Germany especially for use in the canal and was shipped in parts to the Zone. The dredge is one hundred and forty-four feet long. The bucket shown in the picture lifts fifteen wagon-loads of material at a time. In a single day fourteen thousand cubic yards—in other words as many wagon-loads—can be removed, although a record of seventeen thousand cubic yards has been made.

The May Popular Science Monthly will be on sale Saturday, April fifteenth (West of the Rockies, Saturday, April twenty-second).

Roller-skates have been found successful in Baltimore as a means of speeding up the message boys in telegraph offices where a great volume of messages is relayed

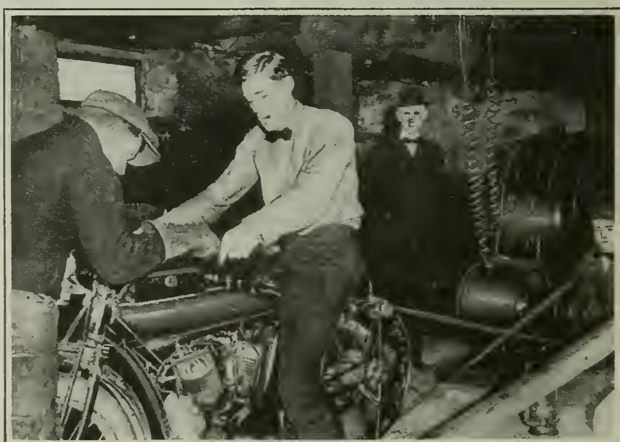
Roller-Skates in Business

DURING the rush hours, when telegraph operators are busiest, Western Union boys glide on roller-skates from desk to desk, snatching the messages from the hooks without even stopping, and scarcely slackening their speed. The boys and operators co-operate in the ratio of about one to twenty-two. That is, with one boy for every twenty-two operators, the messages are not allowed to stay on their hooks more than one second before being snapped up.

The skates are fitted with rubber rollers, so that another feature of modern business efficiency—silence—has been considered. Every second is scored down in black and white on the telegrams, and efficiency experts study these figures in an attempt to cut down the seconds to fractions of seconds. The use of skates reduces the time according to the space which has to be covered. The main office in Baltimore has five boys who work in shifts, two being able to handle the work of forty-five of the swiftest operators. The room is sixty feet long and accomodates many operators.

Best of all, the boys enjoy their work.

Motor-cycle Helps Light a Town



A motor-cycle attached to an electric light plant helped to light a town

WHEN the town of St. Charles, Mo., was left in darkness recently by the breaking of the high-powered transmission cable from the Keokuk dam on the Mississippi, a motor-cycle helped save the situation and keep the town lighted. The town formerly was lighted by a steam-power plant which drove a 150 k.w. generator. When the engineers looked up the abandoned steam plant they found it possible to get up steam and run the generator, but discovered that an important auxiliary, the little exciter-generator which is run in conjunction with the big one was out of commission. The exciter at the sub-station was available and E. F. Wayee, trouble man for the Electric Company of Missouri, harnessed his motor-cycle to the plant by removing the rear tire and belting the wheel to the exciter. For an hour, the motor-cycle supplied light to the city.

Suspension Bridges of Wire Fencing

SUSPENSION footbridges have been built by a wire agency in Southern Oregon, to the number of twenty in Jackson County alone, which goes to show their practicability.

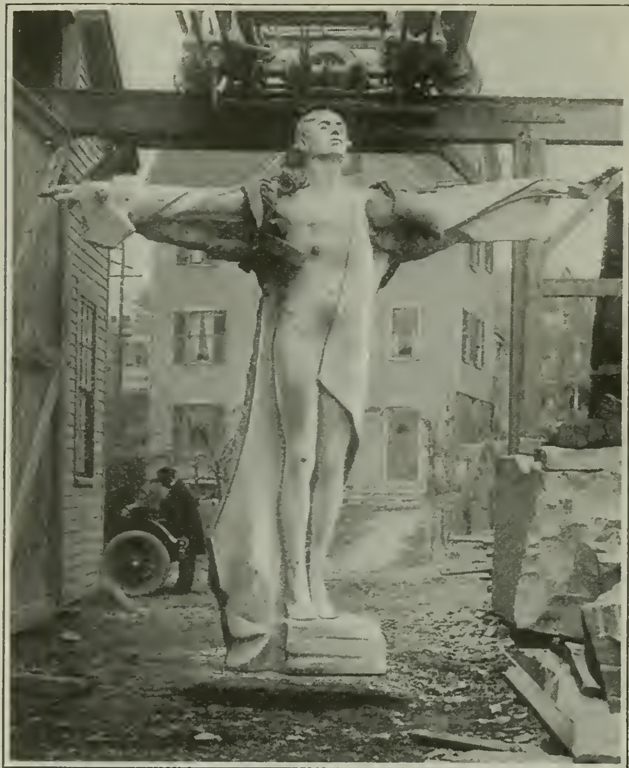
The method of construction is simple. Three lengths of fence are used. Two are stretched for the sides and one horizontal length serves for the bottom. After having been wired together and planked, the bridge is safe even for small children. The anchor posts must be well braced and put deep in concrete with long cross-pieces on the bottoms. The ends of the wires are wrapped around the posts and spliced to the wires again, so that there is no danger of their slipping, even though the staples may give way.

The bridge shown in the photograph is three hundred and ninety-six feet long; the longest span being two hundred and fifty-six feet. At the highest point it is forty-five feet from the water. The total tensile strength of the wires is seventy-five thousand eight hundred and eighty pounds, so that it will safely hold a load of a hundred people. The agency plans to build a one-hundred-foot wagon bridge in the near future along the same lines of construction.

Suspension bridge built of fence wire

A Cheap Way of Preserving Eggs

EGGS may be successfully preserved for many months in a solution of water-glass. One quart of water-glass, which may be purchased from any druggist for twenty-five cents, is enough to preserve twenty dozen eggs. Heat ten quarts of water to the boiling point and allow it to cool. Pour the water into a five-gallon earthenware crock, add one quart of water-glass and mix the two. Place the eggs in this solution as soon as laid, but do not wash them. When the crock is filled to within two inches of the top of the liquid, cover and store in a cool, dry place.



A gigantic granite statue is to stand in Washington—a monument to the heroes of the "Titanic"

The Lively Bird on Our Cover

KANSAS CITY was recently treated to the unusual sight of a spirited race between a young ostrich and a motor-cycle, when a policeman attached to the motor-cycle squad of the city police force paced the bird nearly a mile and a half on Cliff Drive, one of the fashionable thoroughfares of the city.

The bird is seven months old. Specially trained for such work, it has appeared in numerous state fairs in races with automobiles and motor-cycles. The policeman, although he could have easily made a speed of seventy miles an hour with his high-powered machine, paced the ostrich. His speed indicator showed that the bird made forty miles an hour. When near the finish line, the policeman brought cheers from the crowd which had gathered to witness the race by opening the throttle of his engine and finishing well in advance of nature's fastest bird at a whirlwind speed of over a mile a minute, to the dismay of the ostrich.

To the "Titanic" Heroes

A COLOSSAL statue to the men who died on the "Titanic" that women and children might be saved first, is soon to be unveiled in Potomac Park, Washington. The statue, fifteen feet high, is the work of Mrs. Harry Payne Whitney, and is carved in granite. It was put in the stone at Quincy, Mass., and shipped from there to Washington for the unveiling.

The stark simplicity of the whole design, and the reach of the arms, which the artist consciously exaggerated, make the statue one which will be seen and remembered. Mrs. Whitney recently gave an exhibit of her work, the original design of this statue being the center of attraction.

For part of the race, the motor-cycle kept just ahead of the ostrich, both bird and machine making a speed of forty miles an hour

The new safety hair-cutter by means of which you can trim your own locks

Every Man His Own Hair Cutter

CONSIDERING the success that has accompanied the wide use of the safety razor in its various forms, the advent of a new honed barber tool, the safety hair-cutter, leaves no reason now why every man should not become his own barber. The new safety hair-cutter is operated on practically the same principle as the safety razor, the main difference being that a comb takes the place of the steel guard. Holding the comb close to the head results in a close cut; holding it at a wider angle, in a longer cut. It is possible, if the comb is manipulated properly, to cut the hair nearly as close as if a razor were used, although the manufacturers advocate the use of a safety razor behind the ears and along the back of the neck.

Lawn Leveling

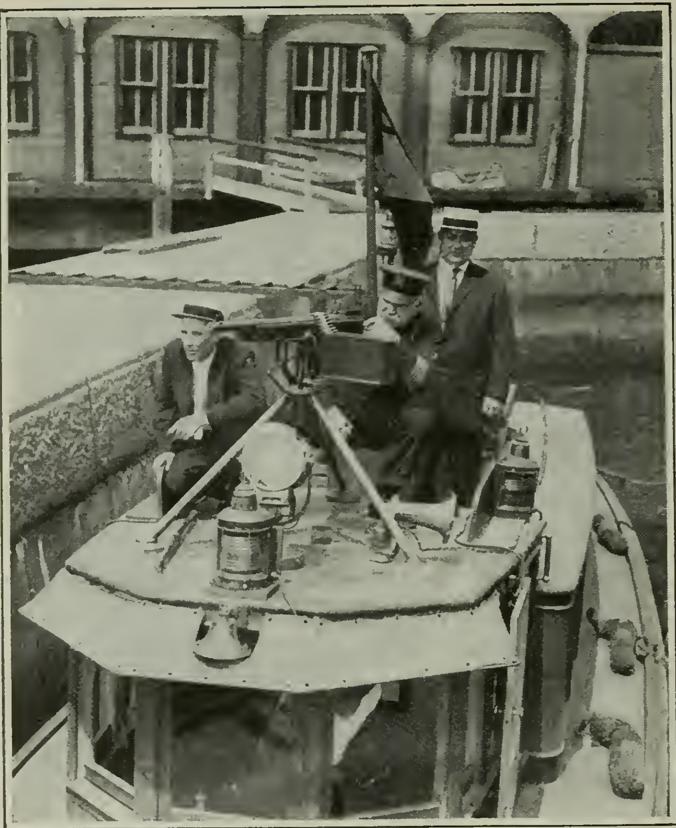
TO enable one man to level a lawn, set up in the center of the lawn a "plane table." Use a drawing board supported perfectly level on three stakes and about four feet from the ground. To test the height of the leveling pins as driven, tie a knot in a plumb line, so that when the knot is on a level with the board, the end of the bob is on a level with the required height of the lawn. It is then easy, no matter where the man is working, to sight along the level board and test the height of the stakes with the line. This method saves accumulating errors when carrying the levels out from one peg to another.

Making Throat Examination Behind a Glass Screen

ONE of the newest medical appliances to be placed at the disposal of physicians is an instrument which combines a device for holding down the tongue of a patient during an examination of the throat, and a circular glass shield, as shown in the illustration.

The device combines a spoon to hold down the tongue and a circular glass shield through which the physician looks at the patient's throat

The glass shield is interposed between the face of the doctor and the mouth of the patient, and allows the doctor to make a much closer examination of the mouth and throat, than is now convenient. It is often necessary to swab out the throat with a solution which irritates the delicate mucous membrane and nerves, causing the patient to cough suddenly and violently, right in the face of the physician. Every physician will welcome this apparatus, especially for the treatment of diphtheria.



Only Hong Kong surpasses New York in the number and activity of its harbor pirates. New York's police boats are therefore armed with machine guns

Taming Those Harbor Pirates

THE problem of the harbor pirate has perplexed the police of every great port of the world. Perhaps they have been more notorious in the cities of the Chinese coast than any other part of the world because of the wantonness and the dare-deviltry of their attacks. Even now in the port of Hong Kong which usually bristles with the warships of all nations, a dark, ghostly junk often slips quietly up out of the night. Throat-cutting and loot occur before the unsuspecting crew is hardly aware of the attack. Armored, shallow-draft gun-boats have done away to a large extent with these cut-throats in the south of China.

Next in prominence to the Chinese ports is the harbor of New York. It would be difficult indeed to estimate the number of cheap melodramas that have been based on New York harbor pirateering. Within the last few years, however, the vocation of pirate in New York waters has lost the greatest part of its profitableness. River pirates when caught are dealt with so harshly that the pirates have been discouraged, and the recent addition to the New York police boats of automatic rifles, or gattling guns has removed almost all of the remaining desire.

Mounted conveniently on the roof of the pilot houses of the New York police tugs are rapid-firing rifles which can be swept entirely around the compass. These guns will literally squirt bullets of the regulation army size at any desired target within a range of twenty-eight hundred yards, or considerably farther than a mile, with accuracy. They are not aimed. When the searchlight of the launch discovers a pirate craft, the gun is pointed in its general direction—and the trigger is pulled. The business of hitting the target is just as easy as squirting water from a hose on a man who is passing your front yard.

The crews of the eleven New York police boats were given daily practice all last summer in the Ambrose Channel off Staten Island.

Each launch carries five hundred rounds of ammunition. When pirates are pursued, one of the three men who comprise the crew, is stationed at the gun, another steers the boat and directs the searchlight, while the third takes care of the engine.

When the character of the enemy is believed to be more dangerous than usual, the patrol boat which is equipped with a Hotchkiss one-pounder, projecting a shell about two inches in diameter, is called into service. It will throw a projectile accurately more than two miles.

Our Helpless Coast Defenses

IN one hundred years of naval warfare the range of guns has increased twelve times, the weight of broadsides twenty times, the speed of firing twenty times and the weight of projectiles eighty times. The most powerful weapons at present mounted on a battleship are the fifteen-inch guns of the *Queen Elizabeth*, England's famous super-dreadnought. They can hurl sixteen-hundred-pound shells from one end of Manhattan Island to the other—a distance of fifteen miles.

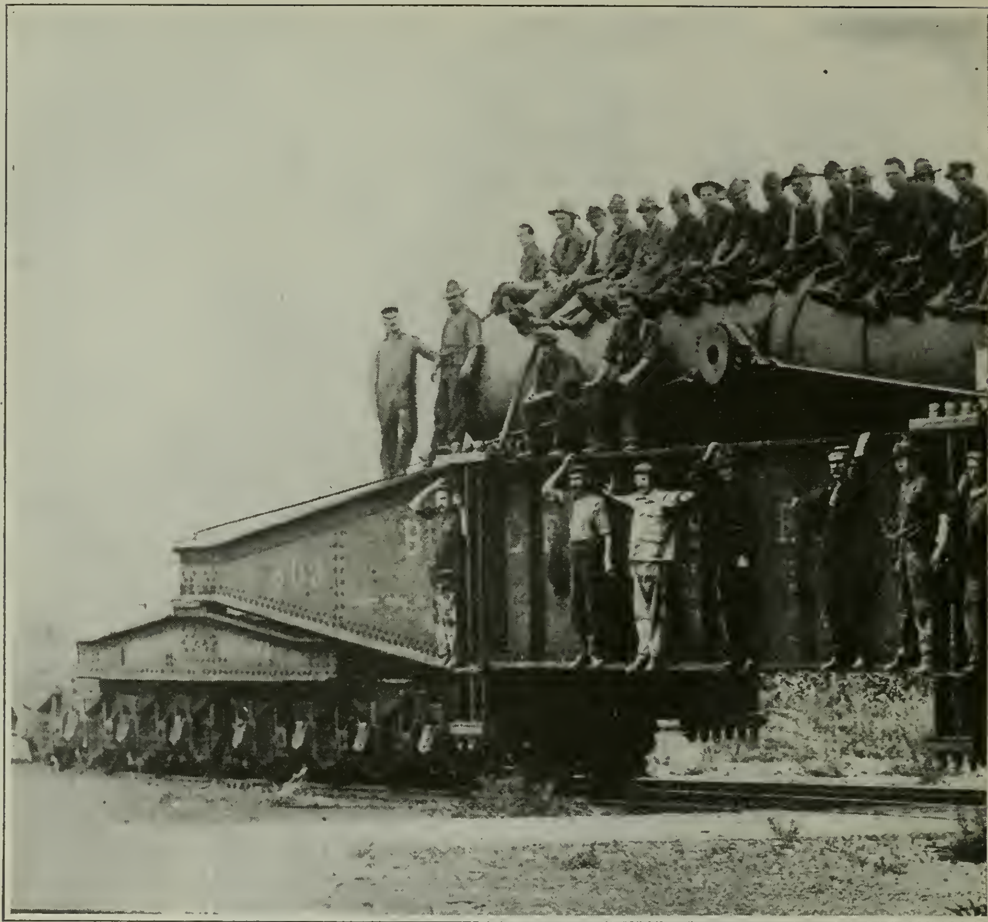
The *Queen Elizabeth* could stand off nearly two miles beyond the range of our largest twelve-inch coast defense rifles at Sandy Hook and destroy the fort. And we—we could do nothing. The splashes from our shells would be seen by the officers on shore—evidences of our inferiority.

© American Press Association

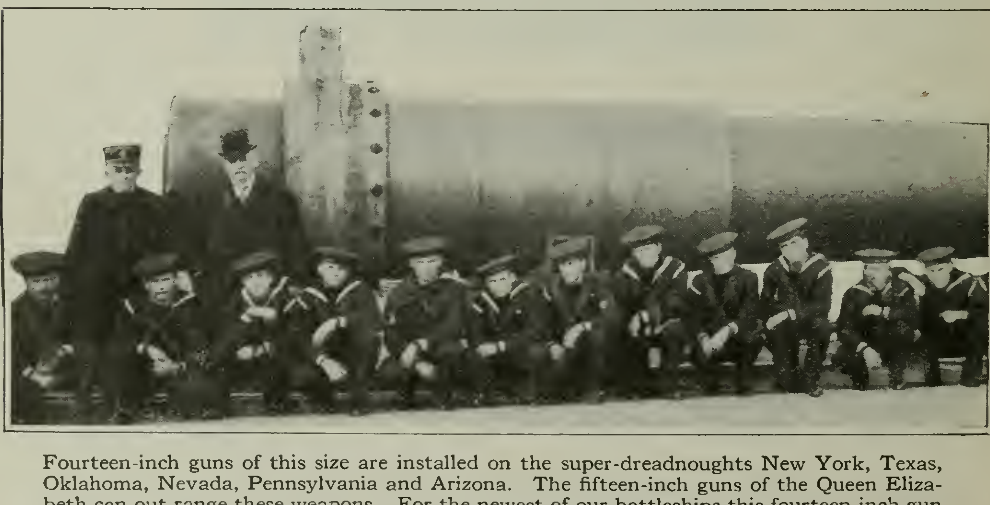
The gun crew of a twelve-inch mortar in one of our coast-guard forts. These squat guns fire a heavy projectile high in the air, and are able to do great damage during an engagement. The shell at long ranges rises three or even five miles in the air and drops almost perpendicularly on its target

Making a Fourteen-inch Gun Hit Harder

The performance of the fifteen-inch guns mounted on the latest English super-dreadnoughts have stirred the ingenuity of our naval ordnance experts. For our new battleships, the *California*, *Mississippi* and *Idaho*, fourteen-inch guns of forty-five-caliber were specified. The caliber of a gun is simply its muzzle diameter divided into the length; a six-inch gun of fifty caliber is twenty-five feet long. Obviously these fourteen-inch guns would be at a disadvantage if opposed by the fifteen-inch guns of a *Queen Elizabeth*. Accordingly, their length has been increased to fifty calibers. Because the gun is longer, the powder is able to give the shot an additional push, as it were. Rear-Admiral Joseph Strauss, Chief of Ordnance of the United States Navy, gives it as his opinion that "these guns, although of less caliber and weight than fifteen-inch guns now mounted abroad, are capable of penetrating the heaviest side armor at oblique impacts and at the greatest effective battle range, and give us the advantage of flatter trajectory with greater volume of fire due to



We have built exactly two sixteen-inch coast defense guns, one of which is shown in



Fourteen-inch guns of this size are installed on the super-dreadnoughts New York, Texas, Oklahoma, Nevada, Pennsylvania and Arizona. The fifteen-inch guns of the Queen Elizabeth can out-range these weapons. For the newest of our battleships this fourteen-inch gun

the picture. These guns are intended to be used at the two ends of the Panama Canal

will be lengthened so that the powder charges may exert a longer push on the projectile. It is claimed that this expedient will make our fourteen-inch gun of the future even more powerful than the fifteen-inch gun of the Queen Elizabeth, which at present is unequaled the increased number that we are permitted to mount on any ship of equal displacement."

But we have not rested here. In August, 1914, a type of sixteen-inch gun forty-five calibers in length was tested. This gun fulfilled the expectations of its designer. It is probably the most powerful gun in existence to-day. Some day it will be mounted on our battleships.

A Modern Fourteen-inch Gun Is Better Than Sixty Thousand Muskets

The projectile of the modern fourteen-inch naval gun starts at a velocity of about two thousand six hundred feet per second. Its weight is one thousand four hundred pounds. Compare this with the weight of a musket-bullet —one hundred and fifty grains—which starts with a velocity of two thousand seven hundred feet per second. Rear-Admiral Bradley A. Fiske has made a very interesting comparison of the striking energy of the two. "After the bullet has gone, say five thousand yards, its energy has fallen to zero, while the energy of the fourteen-inch projectile is nearly the same as when it started. While it would be truthful, therefore, to say that the energy of the fourteen-inch gun within five thousand yards is greater than that of sixty thousand muskets, it would also be truthful to say that outside of the five thousand yards millions of muskets would not be equal to one fourteen-inch gun."

The high-powered, long range fifteen-inch guns mounted on modern dreadnoughts of the *Queen Elizabeth* type have made it necessary for the United States of America to consider its coast defenses. Remember that the *Queen Elizabeth* can fire her great guns accurately at a range of twenty-five thousand yards, and that our best coast defense guns could not touch her, partly because they are mounted on obsolete disappearing carriages which do not permit an elevation of more than fifteen degrees, and partly because the guns on dreadnoughts of the *Queen Elizabeth* type represent the very latest advance in ordnance. Even our newest fourteen-inch coast-defense guns, of which five were completed last year, have a maximum range of only eighteen thousand yards, which has been increased to nineteen thousand three hundred by enlarging the powder chambers.

Some idea of the power of a modern fourteen-inch coast defense gun may be gained when it is stated that its sixteen hundred pound projectile gun will drill through nearly twenty-three inches of the best quality of armor at one thousand yards and through ten inches at one thousand nine hundred yards. The fourteen-inch coast defense gun made at Watervliet Arsenal, weighs when finished one hundred thirty-eight thousand pounds, costs fifty-five thousand dollars and is wound about with thirty-seven thousand pounds of wire.

Realizing that even this mighty weapon is too feeble an opponent for a *Queen Elizabeth*, we are beginning to build sixteen-inch coast defense guns. They are the largest and longest in the world. Unfortunately only two of them have been built, and these are intended for Panama, to protect the canal.

Shots That Cost One Thousand Dollars Each

At an elevation of forty-three degrees, such a gun will have a range of twenty-one miles. That is about the distance which many suburbanites have to travel in an hour in order to reach their offices in New York city. The piece alone weighs one hundred twenty-seven tons. The shell, two thousand four hundred pounds, can pierce twenty-one inches of armor 2.8 miles. The powder charge is four hundred pounds. The shell and powder alone cost one thousand dollars.

The most commendable feature of our fortifications are our mortars. They are first-class and their high angle fire is as good as there is anywhere. Our twelve-inch mortar fires a shell weighing one thousand and sixty-four pounds and has a maximum range of twenty thousand yards.

Our coast defenses are in reality harbor defenses. Of our five thousand miles of coast line not more than three hundred are under potential protection of fortifications. The greater part of our seaboards is absolutely undefended at the present time.

Ladder Tipped With Mule's Feet

This ladder has feet like a mule, and that is why it can be safely tilted in any position. Four cupped pieces of rubber, secured by means of stout pins, swing on the ends of the ladder. They have just enough play to fit any inequalities of the ground or surface against which the ladder is placed

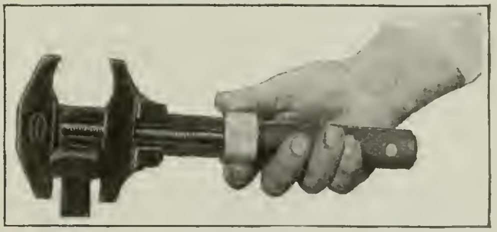
NOT every ladder will stand with perfect safety at almost any angle on rough and uneven ground or on a polished surface. The one shown in the illustrations will, because of the tips which are placed on either end.

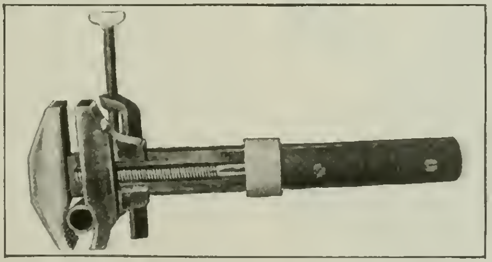
The mule is among the most sure-footed of animals. From his feet the inventor has taken his cue and made a ladder-tip like a mule's foot. The tip is metal and rubber; the rubber grips the surface on which the ladder rests.

A New Quick-Acting Wrench

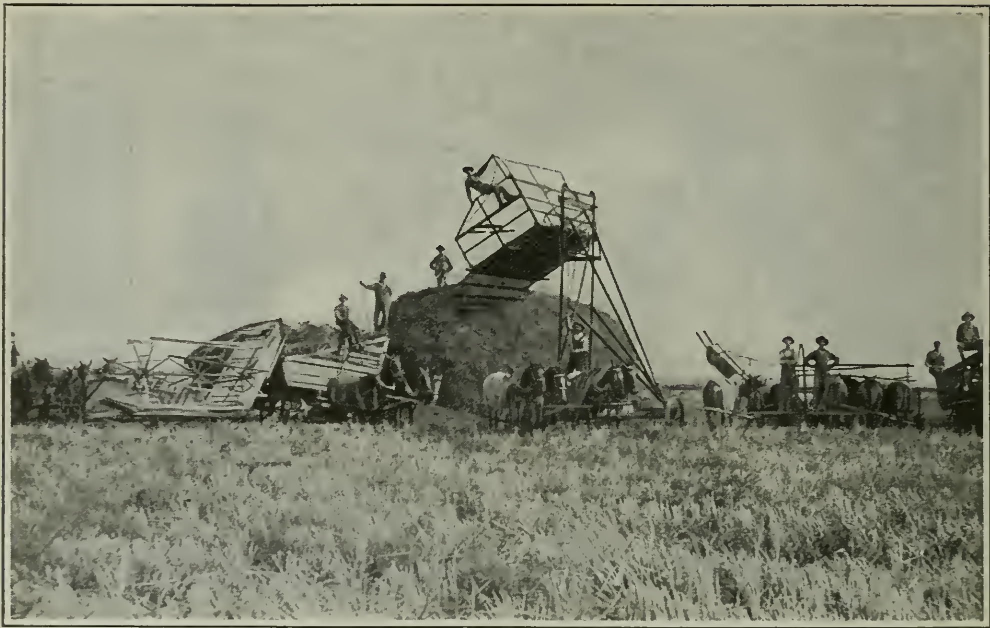
A QUICK-ACTING wrench invented by Fred G. Rockwood, Mendota, Wis., has a movable jaw which may be released with the screw-threads of the jaw-actuating shaft and quickly slid into engagement with the nut to be loosened. The actuating-shaft then engages with the threads of the movable jaw and tightens it with no loss of time.

The center bar is screw-threaded on two sides. To move the slidable jaw quickly, the screw-threads of the center bar are shifted so that they do not engage the slidable jaw. To lock the jaw, the operator gives the collar a turn.





Upper pictures show movable jaw, loose, and being locked. Lower picture shows the wrench used on piping

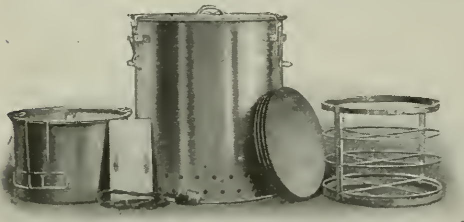


A rope drawn by horses lifts the load to the desired height. Then a clutch is released, the platform tilts, and the straw slides off

A Combined Electric Stove and Fireless Cooker

EVERYONE in this electric age knows the value of an electric stove in the kitchen, but unfortunately not everyone can afford to have one. For this reason the new electric fireless cooker will largely fill this want. Not only is the original cost less than that of the stove, but the cost of operation also is decidedly reasonable, considering that the current is on but a few minutes while the food is being brought to a certain temperature.

The electric fireless cook stove departs from the usual fireless cooker in that it has no soapstone radiators to clean, heat, or handle in any way. One permanent, stationary radiator is concealed in the bottom, and in this heat is stored and radiated. The kettle and pans are placed on the heavy wire rack, and the current turned on for a short time. A steam-escape valve warns of the danger of explosions. Though this stove has many advantages over the earlier types, the price is within the range of the average pocketbook. Many housewives will welcome its use, especially on hot summer days.



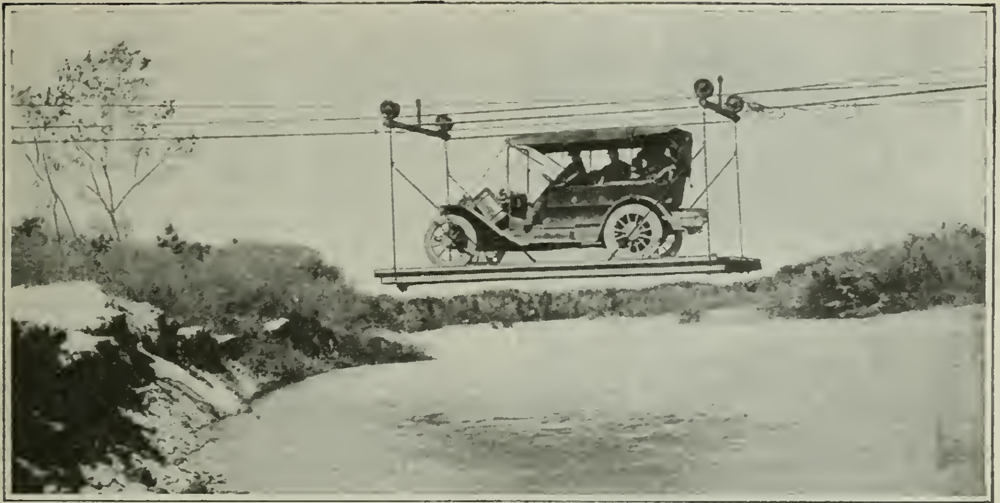
An electric fireless cooker which has no soapstone radiators to be cleaned, heated or handled in any way

Straw-Stacker Does Away With Man and Pitchfork

A MACHINE that does away with the laborious process of stacking straw with pitchforks has been put into use on some of the farms in Kansas.

The apparatus performs its task as an elevator, raising the straw from the ground and depositing it on the top of the stack. The elevator works on pulleys attached to a stiff frame on wheels.

A rope drawn by horses lifts the weight to the desired height, when a catch is released by the operator and the platform tilts and the straw slides off. By way of contrast, the old type of stacker is shown to the right in the accompanying illustration.



The Gila River is too deep to be forded. Hence this trolley ferry was constructed

Operating a Stage under Difficulties

OPERATING a stage line is not all that it's cracked up to be when the line happens to be in certain parts of New Mexico. The illustration shows one of the difficulties—and the picture was taken under very favorable circumstances.

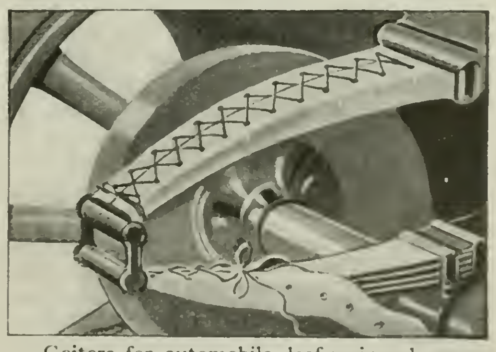
The route of the stage is between Silver City and Mogollon. As the Gila River generally is too deep to be forded, it was necessary to construct the "bridge" shown. The car is run on to the platform at one side and then pulled to the other side by a team of horses. Last winter the "bridge" washed out and the automobile was dragged across on the bottom of the stream with nothing showing but the top of the steering wheel. It took ten horses to do the trick.

A Calking Compound

A GOOD calking compound can be made by melting separately 1 lb. of beeswax and 2 oz. of rosin. When melted, mix them together. This amount is sufficient to calk a 16′ boat. The compound must be applied while hot, and can be poured into the seams or applied with a varnish brush, and the surplus scraped off with a putty knife. The hot compound will penetrate the wood, thus obtaining perfect water-tight seams. If the seams are very large, first calk tightly with cotton.

Gaiters to Protect the Spring-leaves of Automobiles

THE importance of keeping the spring-leaves on automobiles clean and thoroughly greased, cannot be overemphasized. Every motorist soon feels the effects of poor spring lubrication. A novel device which reduces the trouble to a minimum, by keeping the springs free from dust and grit and from the corroding influence of rain water, which somehow or other always manages to creep between the leaves, is shown in the accompanying illustration. It consists of plain leather or canvas gaiters, two for each spring, easily attached and detached. Additional grease can be injected at any time without the trouble of removing the gaiter, by means of a tube and screw-cap attached at the side.



Gaiters for automobile leaf-springs keep out dust and grit

By means of this new attachment, a shaper is converted into a power hack-saw machine

An Improved Hack-Saw Attachment

A NEW hack-saw attachment has recently been perfected which instantly converts a shaper into a power hack-saw machine. There are many advantages to be found in this improved arrangement, one of them being the saving of floor space and of the additional shafting space and extra pulleys that would otherwise be required.

The instant raising or lowering of the cutting edge of the hack-saw blade by elevating or depressing the tool-head of the ram, enables the operator to slit tool-steel, or any piece of work that will go in a shaper-vise, end up or lengthwise as desired. Since shaper-vises can be swiveled to any desired angle instantly, angle cuts at any degree can be made without loss of time, and the vise capacity is thus greatly increased.

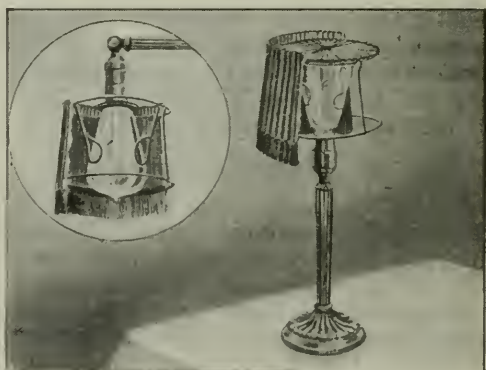
The vise-bed can be raised or lowered at will, or it can be shifted from side to side. The wide range of adjustment of the shaper-bed renders it possible to make cuts on large pieces of work which would otherwise require mounting on a milling-machine. Cuts can also be made at the same setting in dimensional relation to each other.

Perhaps the most important advantage of all is the privilege of changing the length of stroke of the blade. This can be operated by the ram-gage on the back of the shaper to drive the saw, from one-eighth of an inch up to and including the full length of the blade, whether it be twelve, fourteen or seventeen inches.

The connecting arm is simple in construction. It has a covered protector at its base which prevents the dropping of the frame itself at the completion of the cut. The lack of this feature in most hack-saw machines is of the greatest disadvantage, since the dropping of the frame causes the breaking of more blades than any other one thing.

This Lamp Shade Will Not Scorch

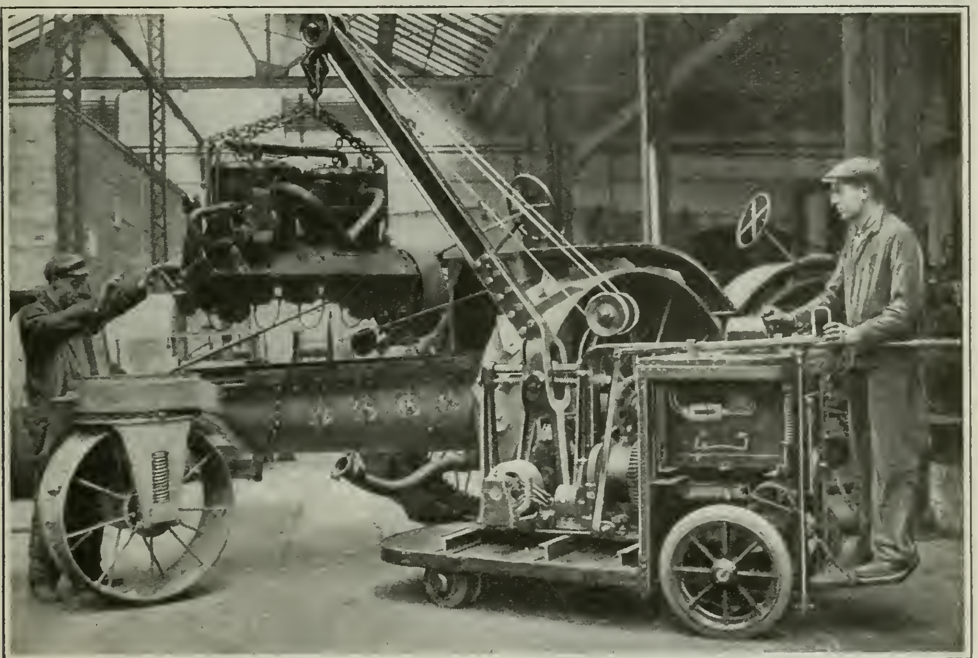
A DECORATIVE silk lamp-shade which can be slipped in place over electric-light bulbs of ordinary sizes has been put on the market by an electrical manufacturer, who claims that, unlike most shades of this sort, the silk will not be scorched. The silk is fastened about a light wire frame, which is slipped easily on to an incandescent bulb and held in place by spring clips. A disk of mica is put at the base of the bulb, so that in case the socket has not been properly grounded, anyone touching the wire frame can not receive a shock, because of the insulative qualities of the mica.



The electric bulb will not scorch the silk

Midget Crane Has Giant Ability

A TINY crane, so apparently helpless that it is difficult to imagine its doing actual work about a large factory, is in use on the assembling floor of a tractor plant in Cleveland. The crane, despite its appearance, has tremendous capacity. It can seize and lift a weighty automobile or tractor engine from the floor, swing it up into the air and into the chassis without so much as a grunt or a groan of protest.



The midget crane runs around the factory under its own power, on a body which looks like an electric baggage truck. It can lift weights apparently far out of proportion to its size, and it is controlled by one man

The crane with its operating mechanism is mounted on a rigid, four-wheeled truck. It travels about and performs its required lifting all under the guidance of one man.

Making a Hen Lay Self-Preserving Eggs

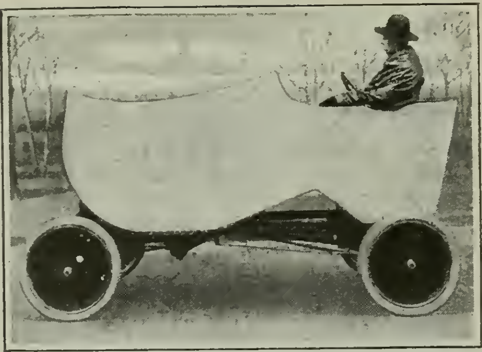
THE POPULAR SCIENCE MONTHLY for January gives an account of a Chinese method of preserving eggs by coating them in hard clay. It is an interesting process, but more or less laborious.

Four years ago, Dr. Oscar Riddle, now of the Carnegie Institution, undertook in a leisure moment to see if he could not make a hen lay an egg which should be self-preserving. He succeeded very well.

By his method the hen was fed urotropin, administered in capsules at the rate of less than a gram a day. Urotropin is deposited in the egg, where it changes into formalin, a well-known preservative.

Eggs laid within twenty-four hours after the first dosing, as well as those laid five days after, were sufficiently affected to be preserved. Dr. Riddle tested the keeping power of the eggs in comparison with those from untreated hens under particularly severe circumstances. Eggs of both varieties laid in the month of July were allowed to stand in a temperature varying from seventy-eight degrees above zero to twenty-five below. By the middle of September the difference between the two kinds of eggs could be easily detected; by the middle of November all the eggs from undosed hens were spoilt while those from urotropin-fed hens were still edible, although they had lost some of their bulk of water.

The drug does not injure the hens, and is obtainable at small cost.



The old Dutch wooden shoe as an advertising device on wheels

A Quaint Advertising Automobile

DESIGNED to resemble a wooden shoe, such as the peasants of Holland wear, the automobile pictured is curious enough. The lines of the sabot are correctly followed, and even the appearance of wood is secured by artistic graining. It is a most attention-compelling bit of advertising on wheels.

Gravity-Flow Gasoline Supply Station

THE owner of an automobile gasoline supply station installed a tank with a glass gage. The tank is much above the fuel tank of any automobile, so that the gasoline flows by gravity, the quantity being controlled by the purchaser at his machine. The tank has been accurately calibrated and checked by an official. This insures no shortage from leaky valves. This apparatus is less expensive and easier to operate than an ordinary pump.

Why not let gasoline run down into your fuel-tank instead of pumping it up by armpower?

A Portable Wrecking-Truck

A SMALL light-weight wrecking-truck, which can be carried with ease in a relief car, has been designed by a Danville (Ill.) man, and has been useful in his business. When called from his garage to tow in a wrecked car with a smashed wheel, he does not have to drag in the wreck on a four-by-four timber, set under the axle of the missing wheel, but slips the truck in place instead and tows the car home without difficulty. It fits under the front or rear axles with a few minutes' work, and the caster-like arrangement of the wheels makes it easy to steer.

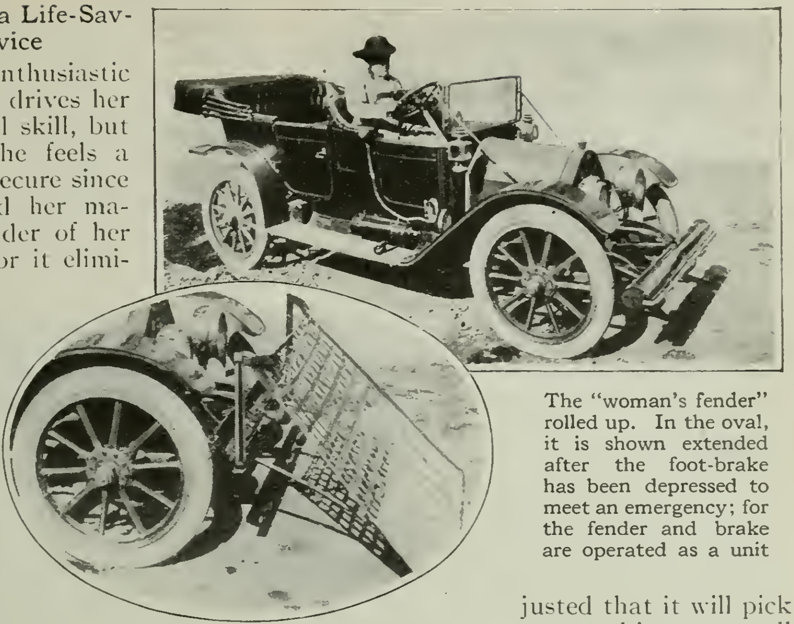
Is it not better to tow a wrecked automobile in this way than with the usual awkward timber drag?

An Oil-Proof Cement

A CEMENT which will not be affected by oil is made by mixing glycerine and litharge to the consistency of a thick paste. This will be found very handy in repairing cracked oil-reservoirs or in making an oil-tight joint between two metal plates. The cement should be applied as soon as it is mixed, since it hardens very quickly.

Woman Invents a Life-Saving Device

SHE is an enthusiastic motorist and drives her car with ease and skill, but just the same she feels a great deal more secure since she has equipped her machine with a fender of her own invention, for it eliminates the danger of injuring some unwary pedestrian. Who is she? Mrs. J. M. Wirt of Omaha. Her fender is enclosed in a small case extending across the front wheels. When not in use it is inconspicuous and does not disfigure the car. In an emergency it springs open like a flash, throwing out a net four feet in front of the wheels. The net is so accurately adjusted that it will pick up an object as small as a brick; yet it is strong enough to carry a weight of two hundred and fifty pounds.

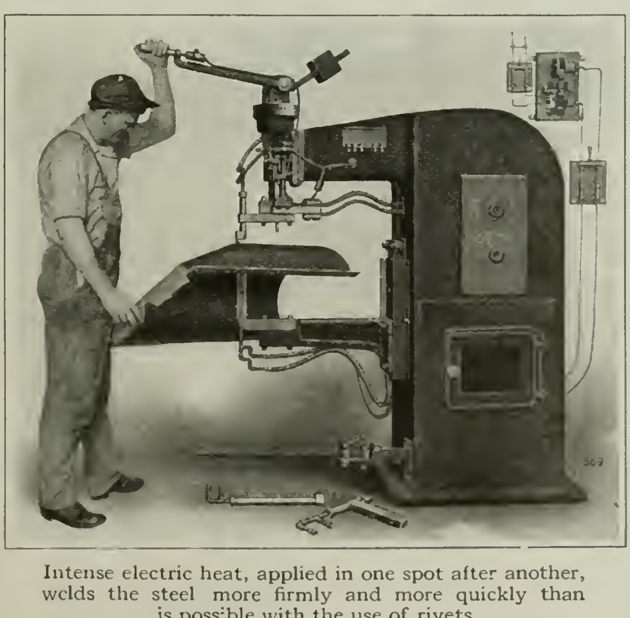


The "woman's fender" rolled up. In the oval, it is shown extended after the foot-brake has been depressed to meet an emergency; for the fender and brake are operated as a unit

The releasing-trip operates the brake and fender simultaneously.

Riveting Without Rivets

ELECTRIC current, reduced to an extremely low voltage but increased in volume to tremendous proportions by the use of huge transformers, finds an unusual and spectacular application in performing the work that rivets are intended to perform. The chief distinction between the ordinary rivet and the electric rivet is the difference in time that is required in the two operations. The results are equally successful. Electric riveting requires much less time. Riveting, however, is not the precise word, as welding is the operation that actually takes place. Two layers of metal to be joined are placed together between the jaws of a giant machine. A lever is pulled; electric sparks fly; a spot between the jaws quickly heats to brightness; the two surfaces melt and flow together. The result is a permanent but practically unnoticeable weld.



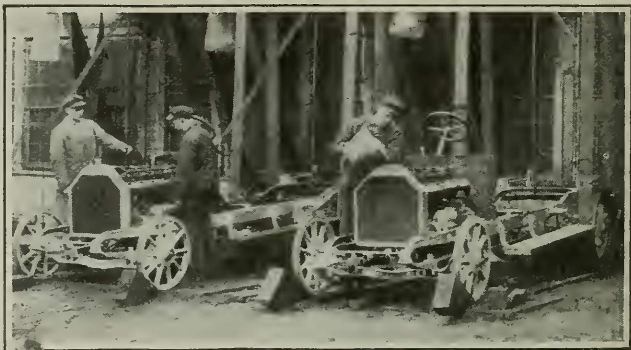
Intense electric heat, applied in one spot after another, welds the steel more firmly and more quickly than is possible with the use of rivets

Motor-Testing Up To Date

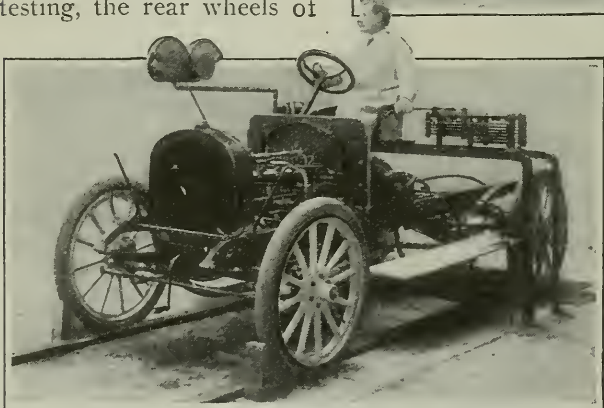
THE accompanying illustrations show two methods which are used in two motor-car factories for testing every chassis before it is turned over to the sales department for ultimate sale to the consumer.

In one method of scientific testing the semi-finished chassis with the motor in place is fastened beneath great air-fans. The rear wheels are belted to the fans which act as a brake. The motor is tested in this way. The power it develops is used to test the remainder of the chassis. Three frames at a time are tested. Following this test, tires are put on the cars and they are given a road trial.

In another method of testing, the rear wheels of the completed chassis are placed on large rollers set beneath the floor of the test house, and these rollers are geared to electric dynamometers which impose a load on both the motor and the transmission elements. With the aid of meters, set up on a standard in front of the operator, readings of the actual horsepower delivered to the rear wheels can be taken directly. Incidentally, it is interesting to note that the power developed is not wasted but is used to light the test house.



The testing plant of a modern automobile factory



Testing the horsepower of an automobile before leaving the shop. With the aid of meters set up on a support in front of the apparatus, the actual horsepower delivered to the rear wheels is read directly

The Dog as a Carrier of Disease

THE dog in the country is a useful and pleasant adjunct to the farm if he is properly controlled and cared for, but when neglected, may readily become a carrier of disease to stock, in addition to gaining opportunity to kill sheep and destroy gardens and other property. Dog ordinances, as a general rule, have been intended chiefly to curb the dog's power of doing harm by attacking, biting, killing or running sheep or stock. The part that he plays as a carrier of diseases to animals only recently has been recognized according to the zoölogists of the Department of Agriculture, who believe that when this is better understood, rural ordinances and laws which lessen this danger will gain the support of the community.

Of the diseases carried to stock by dogs, the foot-and-mouth disease is probably of the greatest interest at this time. In this case the dog acts as a mechanical carrier of infection. The dog which runs across an infected farm may easily carry in the dirt on his feet the virus of this most contagious of animal diseases to other farms, and thus spread the disease to the neighboring herds.

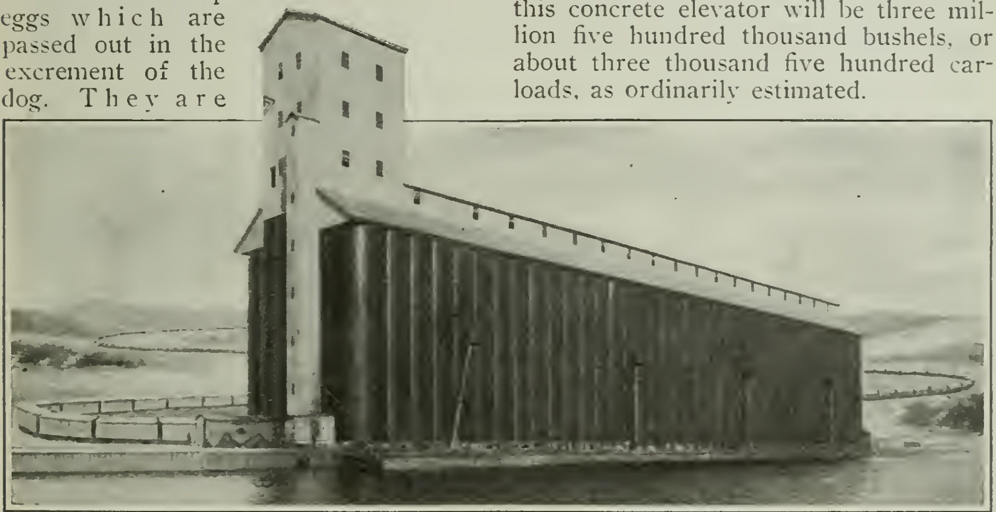
There are, however, many other maladies in the spread of which the dog takes an active part. Rabies, hydatid, ringworm, favus, double-pored tapeworm, roundworm, and tongueworm are often conveyed to human beings in this way. Occasionally the dog helps fleas and ticks in transmitting bubonic plague or the deadly spotted fever.

Hydatid disease is caused by the presence in the liver, kidneys, brain, lungs, and other organs, of a bladder worm or larval tapeworm. Bladder worms are often as large as an orange and may be larger. A dog which is allowed to feed on carrion may eat all or part of a bladder worm containing numerous tapeworm heads. These tapeworm heads develop into small segmented tapeworms in the intestines of the dog. The tapeworms in turn develop eggs which are passed out in the excrement of the dog. They are spread broadcast on grass and in drinking water where animals can very well eat them and thus become infected. The hog is particularly liable to this disease because of its rooting habits. The eggs may get into human food, and persons who allow dogs to lick their hands and face also run the risk of getting the eggs of the tapeworms in their systems.

The parasite which causes gid in sheep somewhat resembles the hydatid worm. A dog allowed to eat the brain of a giddy sheep may swallow this parasite and later distribute the eggs of the resulting tapeworm over the pasture. Sheep while grazing swallow the eggs with the grass which they eat. In the case of sheep dogs it is important to administer vermifuges often enough to keep them free of these worms. In the case of sheep measles, the bladder worm in the meat, typical of this disease, is swallowed by the dog and again the tapeworm eggs are passed by the dog to grass or water, and there are eaten by sheep.

A Grain Elevator Which Holds Three Thousand Five Hundred Carloads

ONE of the greatest of all elevators, is the concrete grain elevator which has just been completed in Fort Williams, Ont. The storage capacity of this concrete elevator will be three million five hundred thousand bushels, or about three thousand five hundred carloads, as ordinarily estimated.



Thirty-five hundred carloads, or nearly one hundred long trains, must carry the grain this elevator can hold at one time. It can load fifty thousand bushels in an hour and can empty itself, if the cars are available, in ten hours

The outstanding features of the concrete elevator are its marine unloading cars, which can empty any of the largest boats in less than ten hours. The marine unloading cars have a capacity of about fifty thousand bushels an hour and are capable of unloading a big boat in less than a working day.

It will be possible to load fifty thousand bushels of grain in freight cars every hour, which is tremendously fast. Canal boats can be loaded at the fast rate of thirty thousand bushels an hour. Aside from the great size and wonderful appliances for handling grain which have been incorporated in this elevator, the fact that it is constructed entirely of concrete reduces the liability of fire and with it the cost of insurance.

Decoy Targets for Zeppelins

By R. J. Bjierstedt

THERE is no doubt that more powerful guns are now available than those which made so ridiculous a showing during the September and October raids on London, but the problem of adequate range finding is so nearly prohibitive that few who are familiar with it pin much hope to a gun defense.

I am credibly informed, however, that what might be called "diversionary" protective measures have been employed with considerable success. These consist of various ingenious devices calculated to draw the fire of the Zeppelins away from the points where they could do the most harm. So far, these appear to have been employed principally in the important manufacturing districts between London and the North Sea rather than in the immediate environs of the metropolis. The idea is said to have originated in the mind of a Norfolk farmer after a pile of chaff which he had been burning on the night of a raid was made the target of several well-placed Zeppelin bombs.

"The Zepps thought my fire was the blast of the —— mills," he told an air service officer. "Why not have some ready to fool 'em the next time they come?"

Since factories and barracks were the main objects of attack, why not provide some that could be found without difficulty and the destruction of which would be of small moment. The first experiment was made by cutting "window-holes" in a row of bill-boards—"hoardings" the English call them—along a railway, and illuminating each orifice with a carbide lamp. When these came in for attention from the raiders, the present plan of using "stage scenery" factories and barracks as Zeppelin decoys was outlined.

These decoys consist simply of sections of imitation walls, pierced with windows, which, by means of guys and props, can be made to represent the side or sky-lighted roofs of a factory or barracks. Where practicable the illumination is furnished by running a cable from the nearest electric transmission line, and where this is too troublesome or expensive, carbide or kerosene lamps are employed. The sections hook or clamp together and are made small enough to allow of a stack of them being carried on one of the big war motor trucks.

An interesting light is thrown on this phase of protective work by a photograph that was published in England about three months ago, and probably also in the United States. It showed a huge war motor truck, with an enormous tarpaulin-covered load, stalled between the copings of an old stone bridge over which it had endeavored to pass. The caption merely explained that it was "Somewhere in England," and that the load itself was an "official secret." Most of the information which I have set down above came to me as a consequence of this photograph.

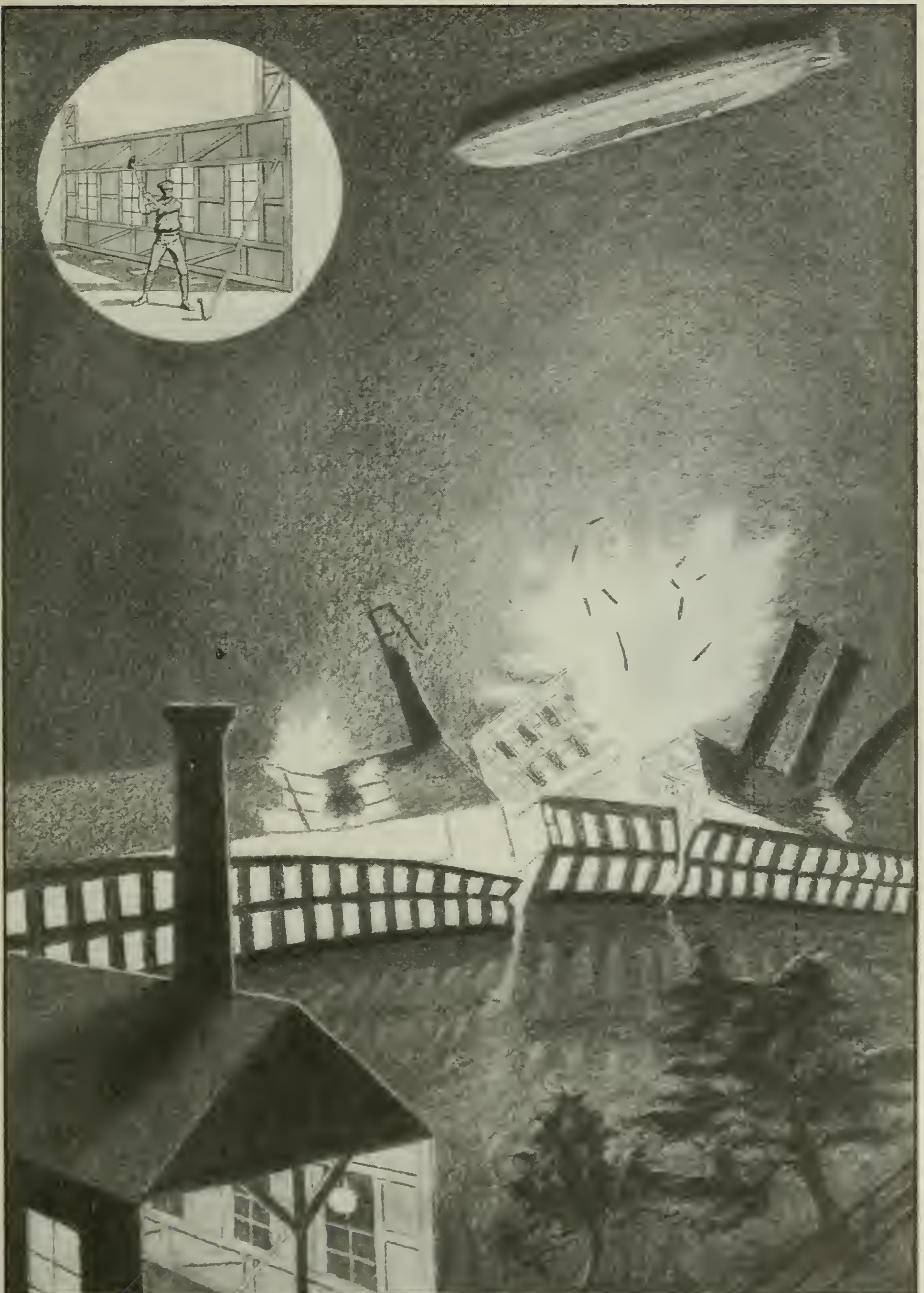
I chanced to be looking over the copy of the *Daily Mirror* on the cover of which the view in question appeared, when a garrulous and slightly inebriated "Tommy" who shared my third class apartment with me asked if I knew what the load was.

"Not beyond the fact that it is an 'official secret,' I replied. "Do you know anything about it?"

"Blime me if I don't," was the answer. "She wuz carryin' stage scen'ry; stage scen'ry fer the Zepps."

The man, it appeared, was a member of the Army Service Corps, and was just returning from the hospital where to use his own words, he had been to "git a hunk o' 'fact'ry' " picked out of him.

His injuries, he said, had been received when a "factory" which he had helped to erect was actually struck and demolished by a Zeppelin bomb. They had just switched the lights on from their dug-out, he said, when the Zeppelin hove in sight and headed up to pass right over the decoy. The "factory" was blown to pieces, but a couple of hours' repair work on the morrow left the shattered sections in as good shape as ever.



Decoys for Zeppelins

In order to deceive bomb-dropping Zeppelins, the English are building "stage" factories (mere painted scenes) which are illuminated at night

What the gun pointer sees through the loop-hole of a German gun shield

The armored Italian captain of one of the numerous wire-cutting "Death Companies"

© International Film Service

The Italians now possess heavy siege guns which compare very favorably with the German and Austrian guns which did such great execution at Liege and Namur at

Courtesy Illustrated War News

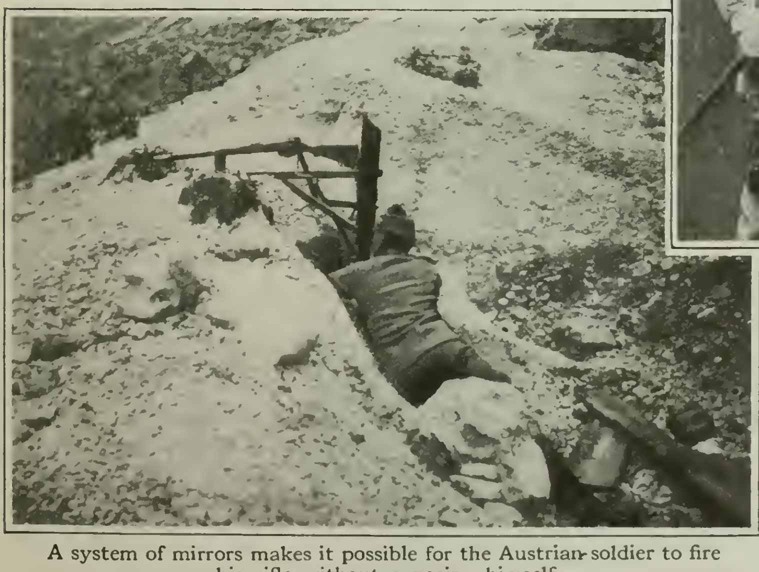
Through the barrel of the gun may be seen Italian soldiers who are hauling this heavy cannon

© American Press Association

One of the tragedies of the war. The sinking of the hospital ship "Anglia" with wounded on board, after striking a mine in the English Channel. The remarkable photograph was taken from one of the rescuing ships just as the "Anglia" plunged beneath the waves, carrying down many of the wounded and their nurses

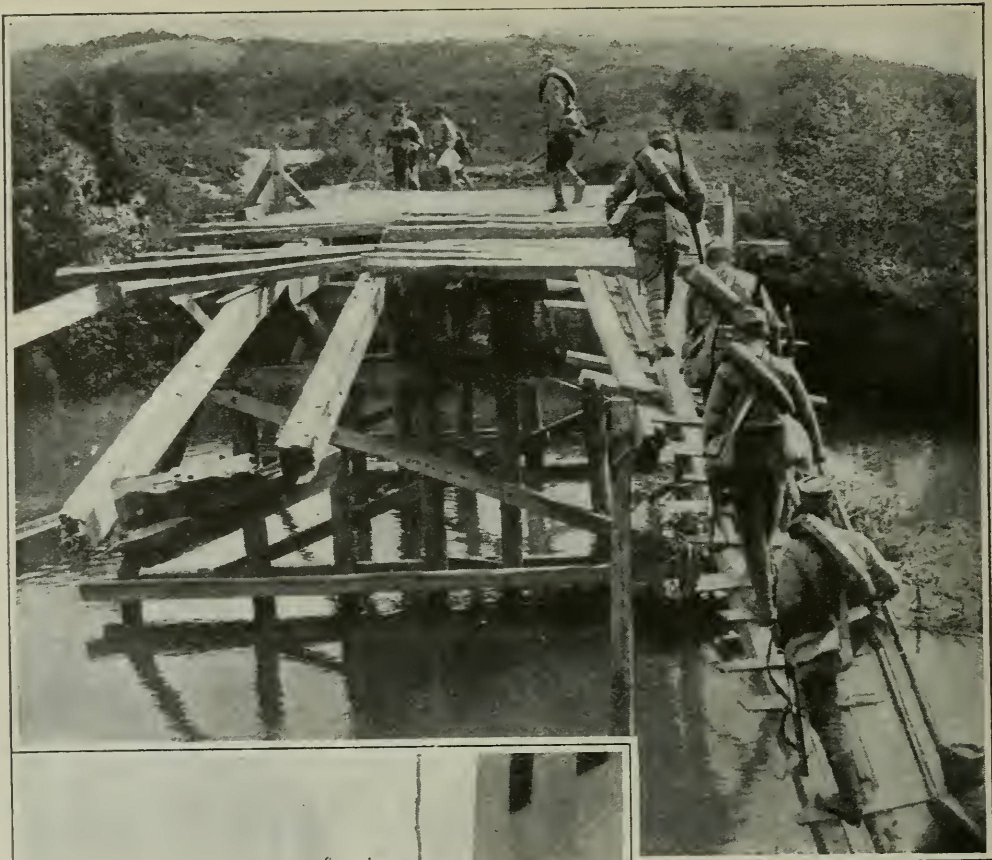
the opening of the war. The moving of these great guns to lofty positions in the Alps is no mean feat, as may be seen in the picture, showing thirty men at work

An Italian soldier wearing a steel helmet and suit of armor. His company is made up of picked men, whose perilous duty it is to cut the enemies' barbed wire entanglements before an infantry attack



A system of mirrors makes it possible for the Austrian soldier to fire his rifle without exposing himself

Soldiers Big and Little



Above may be seen a detachment of Serbians crossing the Koloubara River. This bridge has been the scene of many hard-fought engagements, having changed hands over and over again, each time being destroyed by the losers and repaired by the victors. Only enough timbers are used to permit soldiers to cross single file

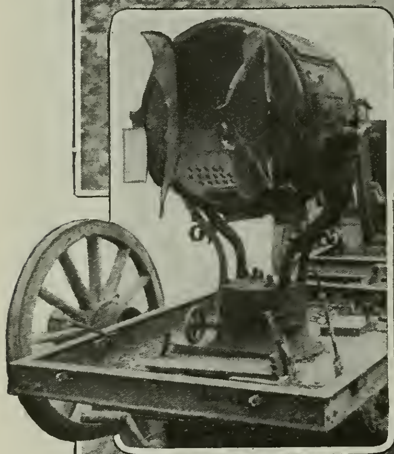
Probably the youngest soldier in the Serbian Army was recently captured by the Germans. Here he is, on the left, a six-year-old, clothed in odds and ends which he found on the battlefield. Nobody knew where he lived. He shared the fate of the other soldiers with whom he was captured. He is now in a prison camp, where we see a German soldier giving him a light for his cigarette—since he must smoke like a regular soldier

Two Queer Phases of the War

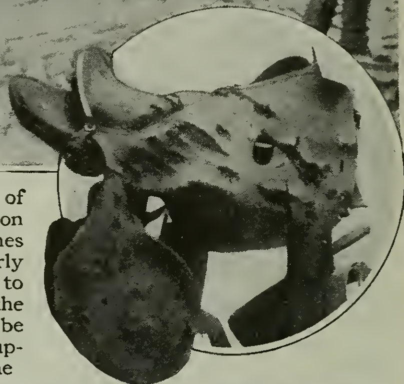
A French Red Cross dog returning from an examination of "No Man's Land" between the trenches, and bringing the helmet of a wounded soldier to the hospital corps behind the lines. These brave little animals are seldom wounded, for they seem to be the only living things respected by both armies. When dark comes, the hospital corps will venture into the dangerous territory and endeavor to collect the wounded who still live

On the right, a new use for women's finery in war. Hand muffs are, so far as we know, an innovation in the trenches. Last winter the troops received a great quantity of woolen mufflers, socks and mittens, but apparently fur muffs and ear laps are in style this winter on the German battle front

And They Call War Glorious!



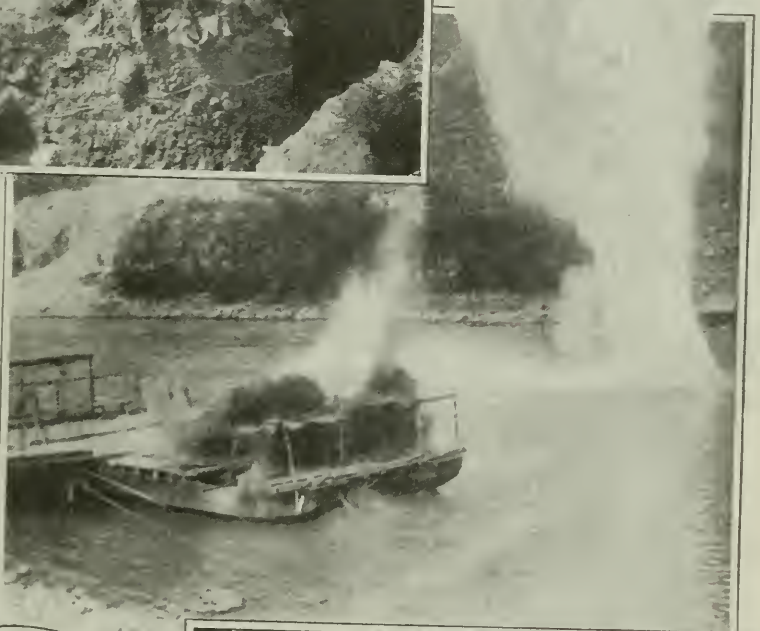
Rolling a field of mud for an aviation field. Aeroplanes must have a fairly smooth place to start from, and the ground must be hard enough to support the machine



An exhibition of war trophies was recently opened to the German public in Berlin. Great crowds have been in constant attendance, for the proceeds from the exhibition will go to the German Red Cross. In the center of the page are two of the exhibits. On the left, a searchlight which has been struck by a shell, and on the right a saddle which has been riddled with bullets and hacked by sabers. The lower picture shows the result of a rat hunt at the front. The trenches are infested with rats, and now and then a rat hunt constitutes a welcome diversion from the tiresome waiting for an attack by the enemies' forces

All in the Day's Work of a Soldier

In the lower right-hand corner of the picture on the left, is shown a French tunnel which leads to a mine under the German position. The wires which will blow up the mine may be seen coming from the mouth of the tunnel

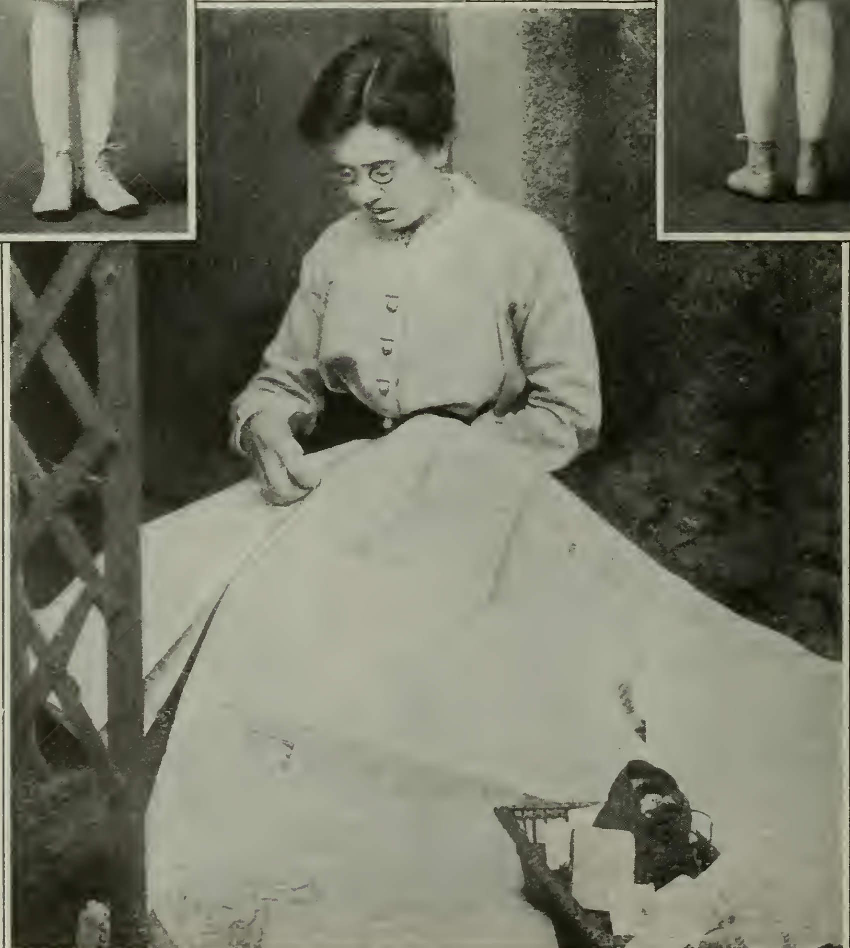


The destruction of a pontoon bridge on the Isonzo River. As is customary in modern warfare, all means of retreat and advance are destroyed whenever possible by the enemy. The illustration is a striking picture of the actual mining of a pontoon bridge which crossed the Isonzo

A piece of meat has been placed at the entrance to the rat's hole, and the French soldier is ready with his bayonet to strike. On the right, a hospital for injured rifles near the Austro-German lines in Russia. Expert gunsmiths repair rifles and small arms which have been put out of commission by the vicissitudes of hard campaigning

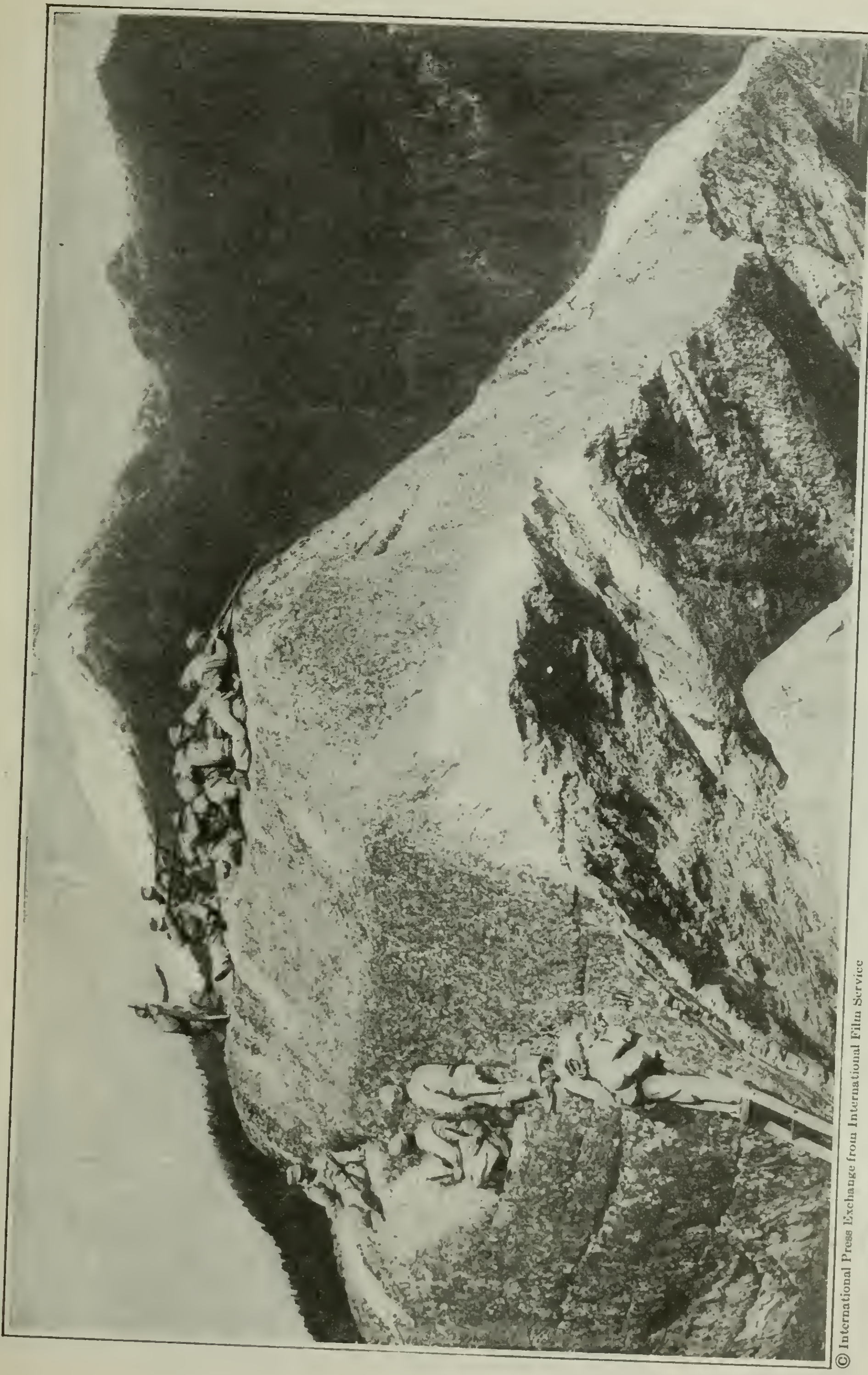
Clothes of Paper and Sacking for Belgians

Samples of clothing made by the women in the devastated districts of Belgium and Northern France. Empty flour sacks have been eagerly accepted by the women, and very serviceable garments for children have been made out of them. By clipping off the two bottom corners of the sacks for armholes and cutting a semicircle for the neck, the sacks have been converted into the shirts shown in the pictures



Another makeshift which is proving of great value in the war. Immense quantities of paper blankets have been made and forwarded to the men in the trenches. These blankets are made of a few sheets of newspaper, which are sewed together and sometimes covered with cloth

Natural Citadels in the Austrian Mountains



© International Press Exchange from International Film Service

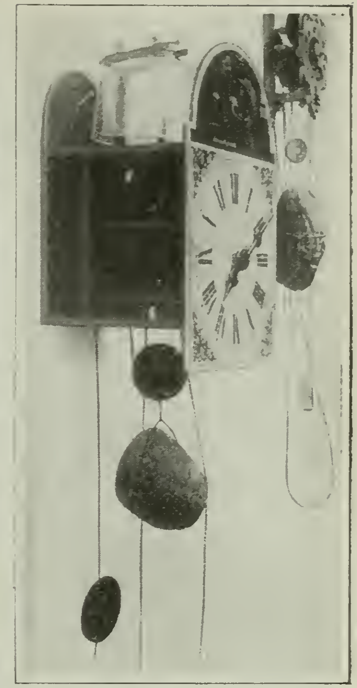
A glimpse of the Tyrolean Alps in war time. An Austrian patrol has secured, by means of ladders and alpenstocks, a position on a high rock commanding an important pass. The difficulty of dislodging even so small a number of armed men may well be imagined

In War As Well As In Peace

The fighting armies have large corps of men engaged in the trades and professions in which they were employed before the war. Shoemakers, tailors and barbers may be found in great numbers just behind the trenches. The photograph shows a German shoemaker hard at work near the front

Parisians no longer are able to make use of their favorite mode of transportation, the 'bus. Far from the busy streets of the great city, the 'busses trundle, painted an ominous war-gray, and filled with soldiers or provisions. When the battle lines move forward, the huts and shelters of the men are also brought up. The picture shows the dwelling of an Austrian commander put on skids and pushed to its new position

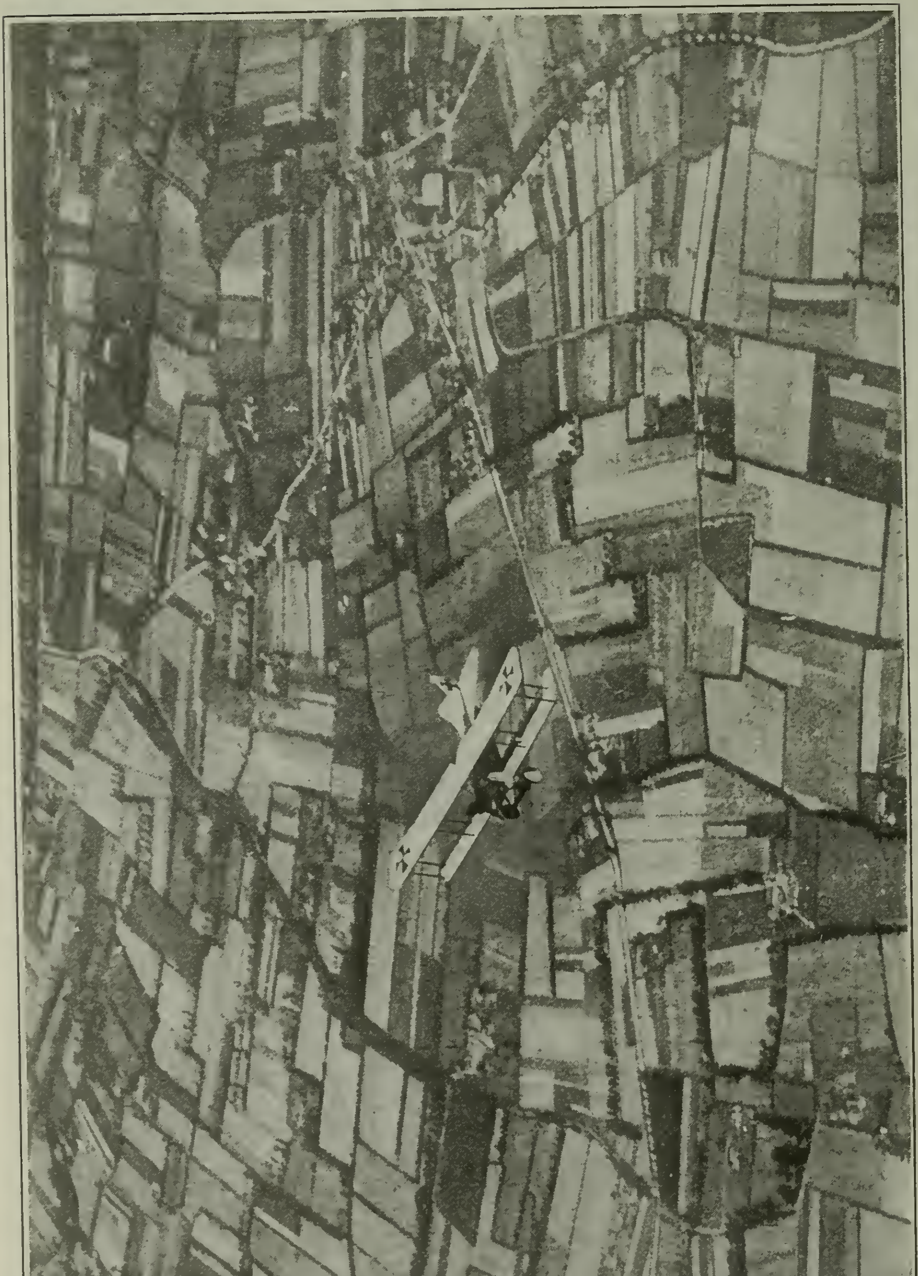
Necessity is the Mother of Invention



Even the copper weights on German clocks have been fired at the Allied troops! Stones have been substituted for the old copper weights

Another example of Germany's inventive genius turned to warlike purposes. The photograph shows the portable searchlight. This projector, small as it is, is remarkably powerful, and may be assembled for action in an exceedingly small space of time

He Is the Eye of His General—This Man in the Air



A German aeroplane flying above the battle front in Northern France. This remarkable photograph was taken by an officer who was flying above the aeroplane shown in another scout machine. The picture shows, with great distinctness, the squares and rectangles which indicate plowed and cultivated farm lands

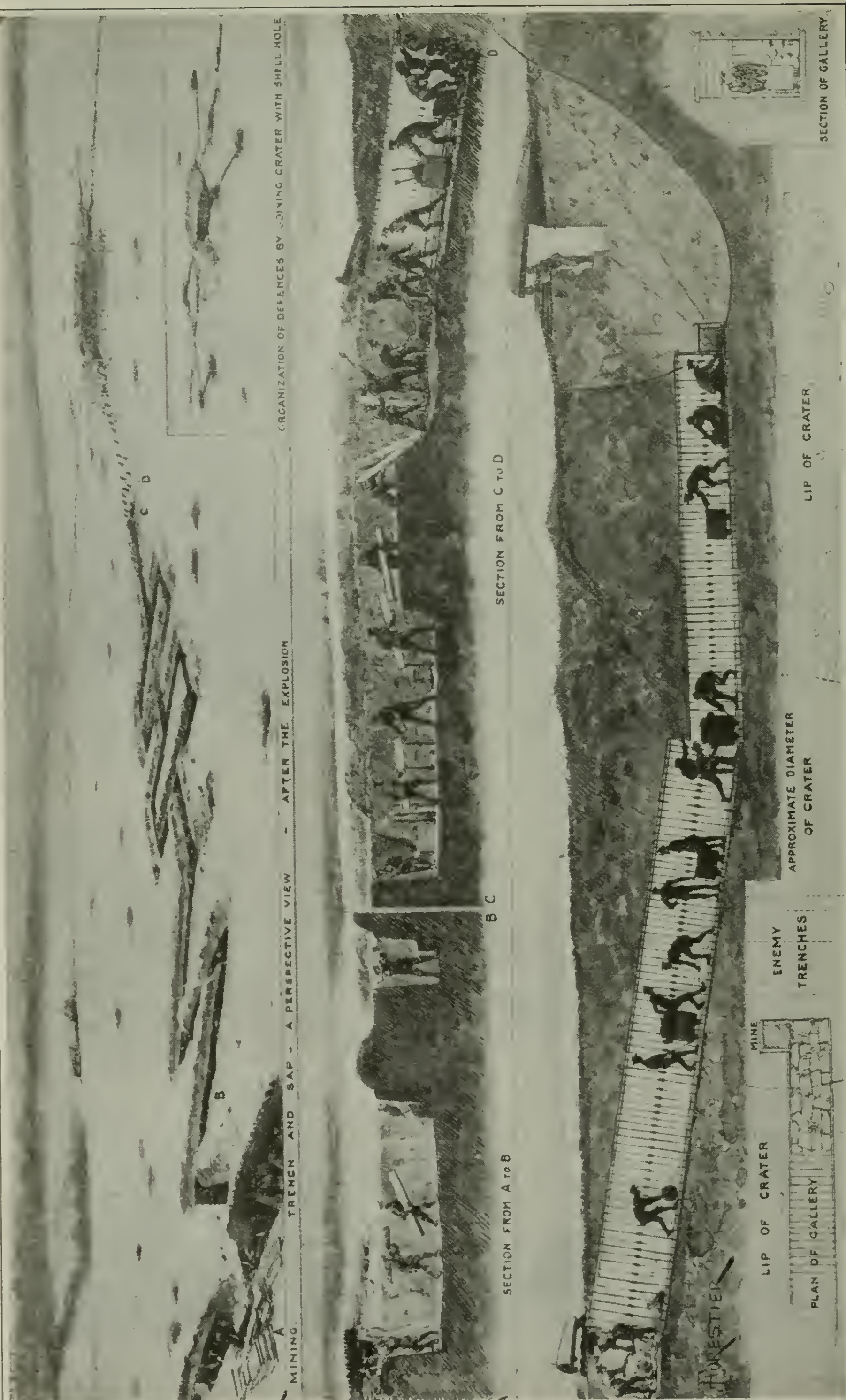
There is a Question About the Gun—Not About the Ovens

© International Film Service

Does this gun, mounted on the Italian liner "Verona," as a protection against submarines, transform the peaceful passenger ship into an auxiliary cruiser? This is the new question in international law which it has raised

Austrian ovens behind the lines in the Serbian war zone. These crude ovens are made of clay, and despite their strange appearance, they are said to suit their purpose admirably

How an Enemy Trench is Mined



Courtesy of the Illustrated London News

Mining is among the oldest phases of warfare. It was developed to a high point of efficiency during the siege and trench warfare around Richmond during our Civil War, and during the present European conflict has been used successfully and continually by both sides. This detailed picture of its construction gives an accurate idea of the method followed and of the system of attack which follows the successful explosion of a mine

A Tragedy of the Skies

© American Press Association

This remarkable photograph was taken from the German trenches during Lieutenant R. C. Ferrick's fall from the skies. While he was making an observation flight over the German lines in the Champagne district, his fragile machine was struck by a shell from an anti-aircraft gun and burst into flames, diving thousands of feet to the earth. The daring photographer who took this picture was forced to climb out of the trenches and stand fully exposed to the fire from the opposite trenches, but the British were watching with horrified eyes the fall of their comrade, and the photographer escaped with his wonderful picture without even being fired upon. The Germans have recently made great improvements in their anti-aircraft artillery, and as a result, Allied airmen have been forced to fly at great heights or run serious risk of being shot down

This blanket protects the man, the horse and the vegetables

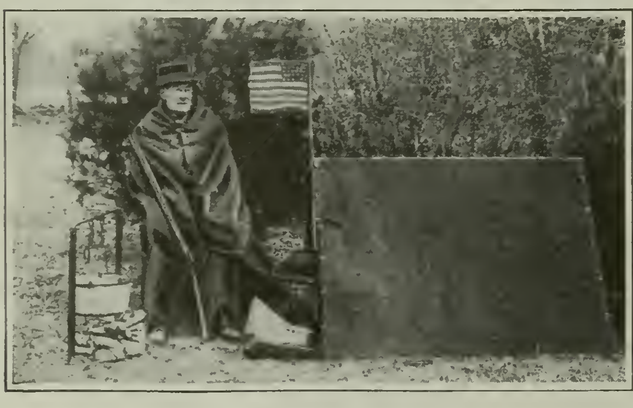
A Blanket with Many Uses

WHAT is believed to be the most ingenious and practical camping blanket devised to date is the invention of J. L. Wright, of Revere, Mass. As a warm, rain-proof traveling-coat, or storm-cape, it cannot be equaled. It is long and fits snugly about the neck. Owing to its size and rectangular shape, it can be readily converted into a tent-covering. As a sleeping-bag, it is closed at the side and bottom.

Sleep in the open, warm and dry

No chance for rain to enter

The uses of this handy accessory are not confined to camping. It is a better horse-cover than an ordinary blanket, since it has all the blanket's good points, but is not so heavy on the horse's back. It does good service as a wagon-cover, fitting neatly over the sides and buckling at the corners.



Two blankets make a shelter tent

Why Legs Are Called "Cork"

THE first artificial leg, other than the ordinary wooden pegs, is said to have been made in London by a man named Cork in the early part of the nineteenth century. Hence the name "Cork leg," no matter what the material.

Fun With Pictures of Your Friends

IF you would like to have a little fun with your friends, try enlarging a group negative or single figure after this fashion: First place the negative in the enlarging frame in the usual manner. After the desired size of print has been decided upon and focus made for size, tip the frame or sliding-board (on which sensitized paper is placed) gradually backward, until the persons or scenes assume fantastic shapes. The best angle of the board will probably be around forty-five degrees, although some negatives require a greater angle to change them.

A print from the negative of your thin friend will reveal him as a very stout person, but without losing the facial likeness in the process. By tipping the board backward, everything seen in the negative, is lengthened, so that the fat man becomes a tall, thin person and a stubby tower becomes a factory chimney.

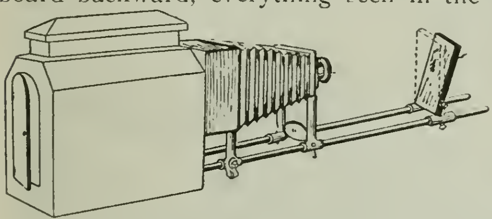


Diagram showing the arrangement of the sliding - board for making trick pictures

The length of exposure needed will be found to be about the same as when the board is in the normal position. Duration of exposure depends on the size of the stop used. It is not necessary to own an expensive enlarging outfit, since the trick can be done on anything from a "Brownie" to the professional apparatus. Try it on your friends.

If the tilt of the board is the length of the picture, thinness becomes an attribute of all

Tip your sliding - board at forty-five degrees sidewise and you make the whole world rotund and happy

A Metal-Vapor Light That Is White

A NEW vapor lamp employing the vapor from metals has been patented by a German scientist. Zinc chloride and zinc bromide have been used and give the best results at atmospheric pressure. As in the mercury-vapor arc, the inclusion of air or other foreign gases in the tube is prejudicial. On the other hand, an arc in an atmosphere of aluminium chloride or titanium chloride is more stable, and an admixture of nitrogen is harmless. Oxygen, however, must be excluded. It is stated that the color of the light is white, and that the efficiency is in the neighborhood of that of the mercury-vapor lamp.

The fact that the light is white will greatly add to the importance of the lamp, since there are many uses which demand such illumination.

What Wind and Rain Can Do

How Nature's Chisels Work Through Millions of Years

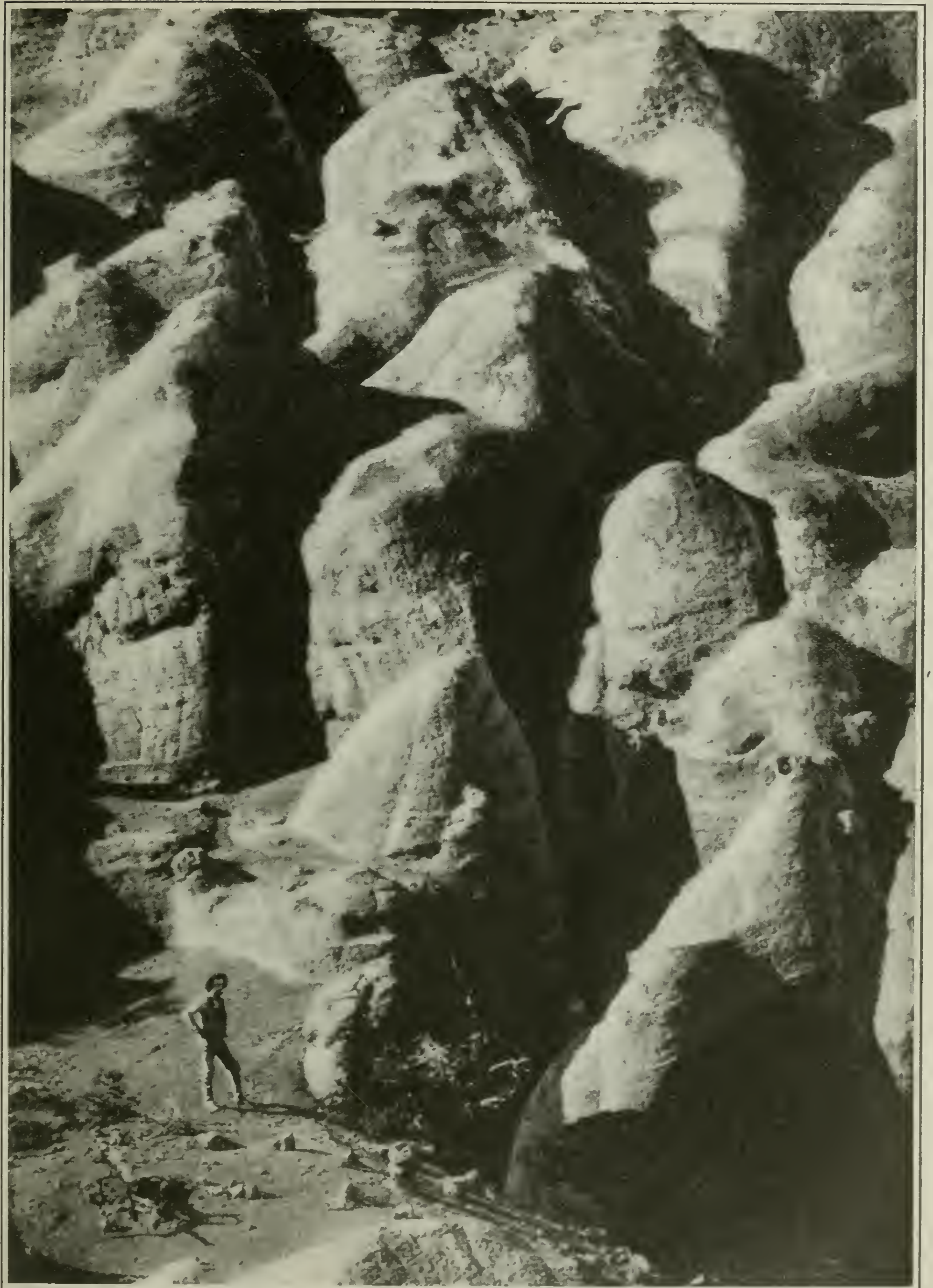
ON the sloping "shores" of the great salt-incrusted playa at the bottom of Death Valley, California, which is the bed of an ancient lake, there is a large volcanic rock which, it is stated, has appeared to grow out of the ground several feet within the memory of the pioneers. When first observed, this was simply a large irregularly-shaped rock resting on the ground. Since then it appears to have been pushed upward. It is supported on a fragile, wedge-shaped neck not over a couple of feet broad. The apparent instability of the thin neck with its top-heavy burden is accentuated by a good-sized hole in its middle, so that in traveling the trail which passes directly under the rock, the tenderfoot is apt to feel relieved when the formation has been left behind.

Contrary to supposition, there has been no growth or uplift of this rock. The earth at its base has been washed and blown away by the winds and the cloud-bursts, which, on rare occasions occur even in this intensely desert region, sweeping everything before their great volume of water.

On the opposite page is pictured another product of wind and rain, probably one of the most singular collections of rock figures in existence. Acres and acres in extent, from a distance they resemble, as much as anything, a vast family or colony of gigantic prairie dogs sitting on their haunches, and covering the entire slopes of Red Mountain, Arizona. The figure of the man in the left center of the photograph indicates the size of these "prairie dogs."

This mountain is a cinder cone of the San Francisco plateau, and the village of rock forms has been caused by the cutting and sculpturing of the soft lava by the wind and rain. The cinder cone of a volcano is the last upheaval, the result of the dying gasp of eruption. So stupendous, however, has been the dynamic energy attending many of the earlier volcanic disturbances of the West that there are cinder cones several thousand feet in height.

Mushroom Rock—one of Death Valley's curiosities



Sculptured by the Elements

Many acres are covered with these giant ninepins of soft lava. Of colossal size, as shown in contrast to the human figure, they resemble, from a distance, a vast colony of prairie dogs sitting on their haunches

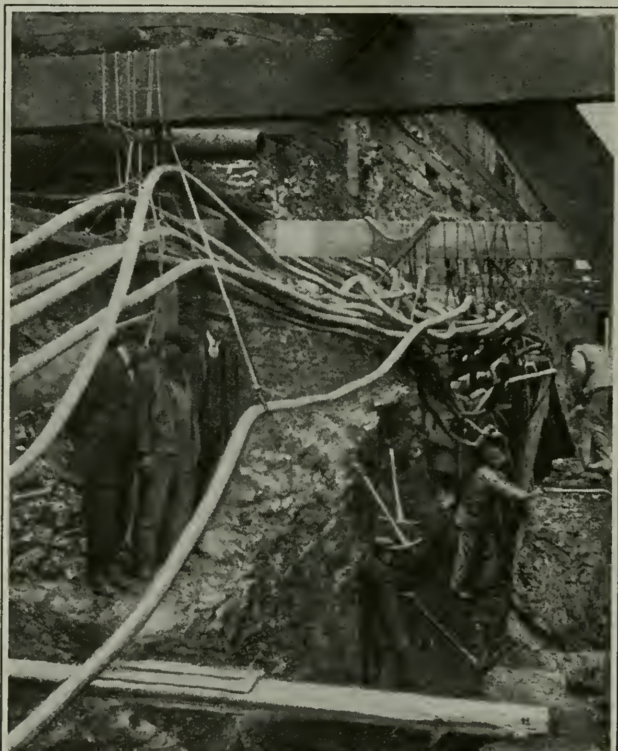
Amputating Pittsburgh's "Hump"

THE "Hump" in Pittsburgh was a hilly prominence upon which stood the County Courthouse. Adjoining it were the Frick, Carnegie, and other large sky-scrapers. It impeded travel. Hence it was decided to remove the "Hump." This involved the cutting down of fifteen thousand feet of city street, and affecting twenty-two important city blocks.

In this district thirteen public service corporations had underground conduits, cables, pipes, etc.

In the business section of most large American cities the overhead wires and cables have been so effectually placed underground that nothing reminds us of the mechanism whereby water, gas and electricity are supplied a few feet beneath the surface of the street.

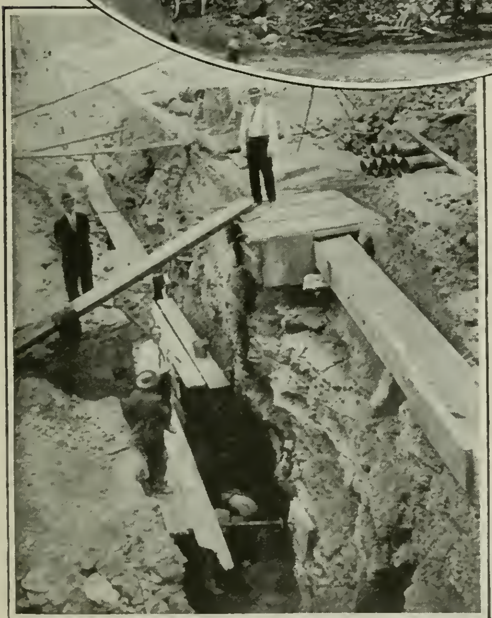
Particularly difficult was the task of maintaining in operative condition seven thousand, two hundred paper-insulated cable wires contained in lead cable-sheaths. These cables, twenty-one in number, were originally drawn into vitrified clay conduits and spliced in manholes located at the street intersections. When the cutting of the "Hump" proceeded and the street was down to the level of the conduits, it was found that the drilling and blasting in the immediate vicinity shattered the conduits, so that further excavating would cause the conduit line to collapse. The clay conduits were broken off the cables and the cables were planked up in a box or trough. Alongside the plank box was the trench, twenty-two feet deep, in which a conduit line was to be constructed by what is known as the "split duct" method. These special conduits are scored lengthwise inside and outside before being vitrified or baked and can be easily split in two. After a layer of half-ducts is laid in cement, it is possible to place the cables in position and replace the top halves of the ducts.



How the cables carrying most of Pittsburgh's telephone conversations were taken care of until the new conduits were ready for use

This procedure of lowering the telephone cables into split ducts saved about $40,000 which would have been expended in purchasing new underground cable to be pulled, spliced and cut into service, to say nothing of the occasional interruptions of service and confusion in transferring the working lines from the old cables to the new ones. The cables thus lowered below the new grade of the "Hump" cut contained three thousand, four hundred and eighty-one miles of copper wire, paper-insulated, twisted into pairs and enclosed in a lead sheath. The time required to accomplish

The "Hump" cut passed through the very heart of the City of Pittsburgh. The work took eighteen months



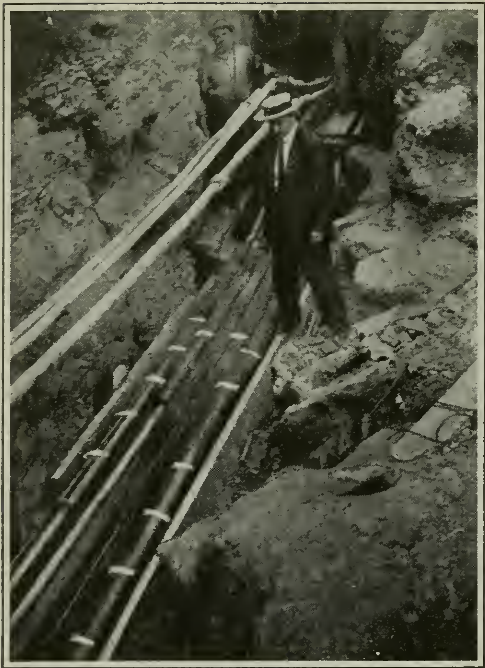
Cables were placed in a plank box, shown at the right. The ditch is twenty-two feet deep, cut mostly through blue rock and limestone by means of steam drills and dynamite

the work was eighteen months, costing the telephone company about $75,000.00.

This is the largest job of the kind ever attempted and successfully accomplished. At the rear of the telephone company's main exchange, located at 7th Avenue and Grant Boulevard, there is a central cable vault or underground room about eighteen feet square, extending out under the street, from which radiate in various directions the underground conduits leading to different parts of the city and to the basements of the large office buildings.

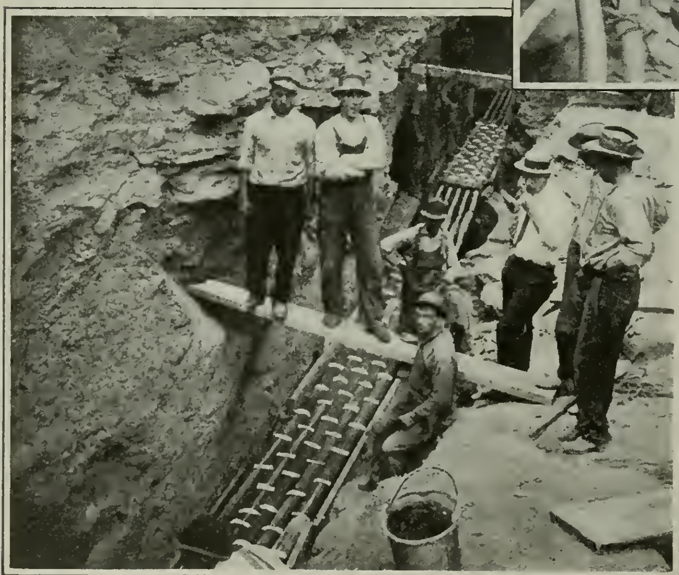
The particular conduit line leading into the "Hump" district which had to be rebuilt contained seventy ducts where it left the central vault, thence sixty ducts in Strawberry Alley, and branched out via Grant Street, Oliver Avenue, Diamond Street and Tunnel Street. It was necessary to rebuild the cable vault in question. Where the seventy-duct line was located on Pentland (formerly Fountain) Street, the "Hump" cut was only a few feet down. The new grade was cleared by removing thirty-five ducts off the top of the seventy-duct line and building them down on the side, thus making a

Cables systematically arranged and hung in the trench preparatory to being lowered into the split ducts



Laying the cables into split ducts without cutting or drawing through conduits as usual. The ducts used were the usual vitrified clay, but before baking they were scored inside and out, and easily split open by the brick-layer

The cables are in the ducts and the concrete which will seal them is about to be applied. The split conduit was a new idea, but it allowed for the "laying" of the cables instead of drawing them through the pipes



conduit line ten ducts wide and seven ducts high.

The work was carried on in the heart of a great city, and also in the midst of the added confusion of tearing down old and erecting new buildings.

In the transfer of cables from the old ducts to the new, the fact that this could be done without splicing and consequent interruption of service was particularly important. The long distance cables, moreover, were composited for the simultaneous working of telephone and tele-

The only cable cut. It was necessary to do this to get around an obstruction. There were 800 wires to be cut and spliced individually

graph, or else carried additional phantom telephone circuits superimposed upon the physical circuits. The cutting of these cables, which was the usual thing to do, would have entailed not only expense, but interruptions more serious than on the local service.

Walking Backwards Across the Country

A WALK across the continent backwards is the task set himself by Patrick Harmon of San Francisco, who expects to reach New York in July. Mr. Harmon is fifty years old, and is making a schedule of fifteen miles a day. He walks the whole distance to the East with his face to the setting sun, and the traditional wager of some $20,000 is to be won on arrival in New York within two hundred and sixty days set for the trip.

The whole route of his walk, 3,900 miles, is to be made with his face to San Francisco and his feet moving toward New York. Mr. Harmon uses a mirror, hung on a special frame, to guide him on his way, and is accompanied most of the time by walking companions.

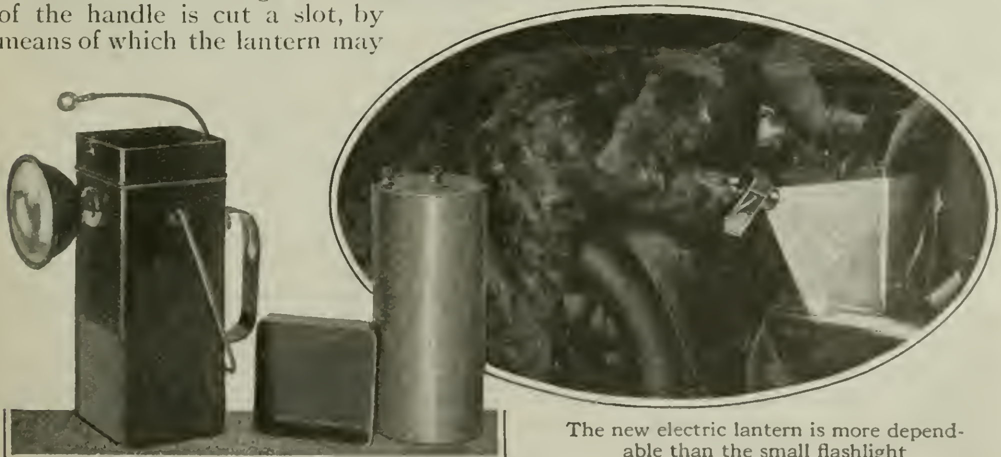
This man needs the mirror to see where he is going, for he is walking backwards from San Francisco to New York

A Convenient Flashlight for the Automobilist

A STURDY electric lamp which obviates the difficulty of searching for special shapes of batteries to fit it, has recently been placed on the market. An ordinary dry battery furnishes the current.

Two handles are affixed to the battery box, one of which is similar to the handle found on the old-style oil lantern. The other handle is close to the side of the lantern, and enables the user to manipulate the light in limited spaces. As shown in the illustration, this handle makes the lantern very serviceable as a motorists' "trouble light." In the side of the handle is cut a slot, by means of which the lantern may be readily hung on a nail or hook.

This light will be found serviceable especially for watchmen, farmers and others who formerly employed a smoking, flickering kerosene lantern, which is liable to go out when most needed, and which always carries with it a certain amount of danger.



The new electric lantern is more dependable than the small flashlight

A track surfacing and tamping gang on the New York Central. The compressor car is mounted beside the track to furnish compressed air to the tampers

Tamping Railroad Ballast with a New Air-Tool

A GOOD roadbed is one of the greatest assets of a railroad. There is almost as much difference between riding over a well and a poorly maintained roadbed as between jitneying over an asphalt and a cobble pavement.

Tamping the crushed-stone ballast underneath the ties is particularly difficult. Formerly tamping was done by hand with the aid of a pick or a long bar with a blunt end. Now, many of the progressive railroads use a novel type of pneumatic tamper. In tunnels and terminals, where compressed air is employed for operating electro-pneumatic signals, it is simple to connect the tools with the compressed-air pipe line by means of a hose. For work out on the road, where a supply of compressed air is not available, air is supplied by a small engine-driven compressor, mounted on a special car. The gasoline-engine also drives the car.

The men generally work in pairs on opposite sides of the ties

An interesting feature of this car is the method of quickly derailing it and placing it beside the tracks. Four small wheels are set at right angles to the main wheels. By placing a few lengths of timbers under these wheels, the car can be run off the track in a few seconds. Electric railroads employ a similar type of compressor-car, with an electric motor instead of a gasoline engine to run the compressor.

The pneumatic tamping machine works on much the same principle as the familiar pneumatic riveter. A piston or hammer delivers eight hundred sharp blows per minute on the end of a tamping bar, which is inserted in the nozzle in the lower end of the tool and which is locked in position. The bar cannot be knocked out, yet the operator can shift it from one position to another.

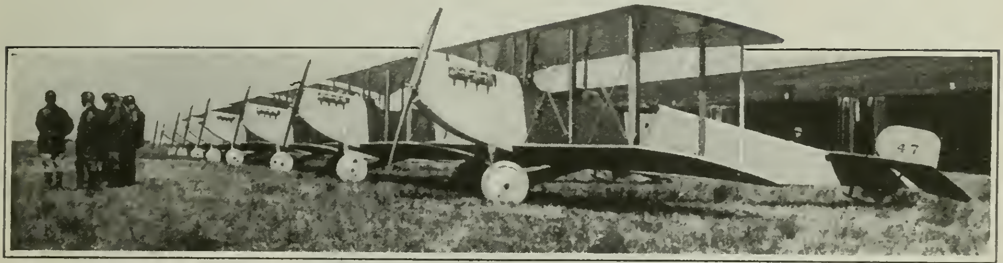
The tampers are usually worked in pairs on opposite sides of the tie. The face of the tamping bar presses against ballast beneath the bar under and to the center of the tie. This actually lifts the tie and track as much as may be desired, and packs the ballast tight. The blows are light; consequently the ballast is not broken as much as with hand tamping and less damage is done to the ties.

The New York Central found that its savings by changing from hand tamping to pneumatic tamping amounted to over $150 per mile of track.

Destroyers of the Air

By Eustace L. Adams

(*Continued from the March Issue*)



The first real aeroplane squadron of the United States Army, consisting of eight one hundred-horsepower Curtiss tractor biplanes. These machines are good American designs, showing European influence in the streamline fusilages, disk wheels and other details

EVEN before the advent of *Fritz*, the great German biplane, which for a brief time drove its adversaries from the skies, the Allies were working upon the plans for aerial battleships. One of the results is a French biplane with a wing spread of about seventy feet. Her wings tower thirty feet from the ground; her crew numbers twelve; her guns are two, and they throw three-inch high-explosive shells. By reducing the crew a great number of heavy bombs may be carried. The new machine is a welcome addition to a bombing foray over German territory. This battle-plane has held its own with *Fritz*, and is accredited with having done much damage during the recent French raids on Freiburg and German towns of military importance.

Twin-engined machines are now common on both battle lines. Machines with two guns no longer arouse interest. Aeroplanes mounting a single gun and one motor are scouts, for the most part, which need great speed and slight armament. A speed of well over one hundred miles an hour is not at all unusual for these machines, which correspond with the swift "destroyers" of the navy.

To fight off these heavy scouts, battle-planes are required, the best known of which is the German Fokker monoplane, which at first created consternation among the British aviators. This machine is a very high-powered monoplane, resembling the French Morane. The wing spread is very small and the planes are flattened, yet a two hundred horse-power motor is mounted on the fusilage. Speeds of one hundred and thirty miles an hour are said to be attained by this wasp-like machine. A single machine-gun is mounted in the bow, and is operated by the pilot. Owing to the need for lightness of weight, small fuel tanks are carried and the machine does not stray far from its hangar. When an enemy flyer is sighted, a Fokker rises, and because of its superior speed, can maneuver to any position it likes. It usually climbs far above its foe, and then, with engine at full speed, dives straight at its opponent, with its machine-gun blazing fire. The only hope of the Allied aeroplane, taken at a disadvantage from above, lies in a quick, twisting dive, followed by rapid flight for the protection of friendly anti-aircraft guns. The Fokker is essentially a machine for fast, decisive fighting, and because of its almost total lack of inherent stability, requires an expert aviator to operate it. The British, since the disastrous *début* of the Fokker as a fighting machine, are said to have evolved a monoplane which will successfully compete with it.

One of the most important of all these new machines has been built in this country, at Boston, Mass. The Sturtevant battle-plane is entirely of steel, and is a biplane of tractor type built with a remarkable simplicity. The steel con-

Courtesy of Illustrated London News

Capable of accommodating sixteen passengers, or of carrying a heavy cargo of bombs, the Sikorsky biplane was the first aeroplane to be built of gigantic dimensions. At the outbreak of war this machine was the largest in the world, but its usefulness was handicapped by its

struction that has been used consists largely of steel tubing, and the best practice in bridge work and structural engineering has been introduced, for the first time in aeroplane construction. All parts are interchangeable, and with the proper machinery, the aeroplanes can be manufactured in great numbers with great speed and at a very low cost. With this type of construction, machines of great size may be built which will have an unusually large factor of safety and great inherent stability.

The first model of the Sturtevant all-steel battle-plane has a so-called turret (in reality a stationary streamline body) half-way out on each wing. In these turrets may be mounted heavy guns, and in time of peace they may be used for passengers or freight. The first trials of this new machine were most successful, and the designer, Grover C. Loening, former Aeronautic Engineer of the United States Army, has been awarded a medal by the Aero Club of America for his meritorious work.

At the present time, aeronautical designers in America have been hampered by the fact that there is not a dependable aviation motor manufactured in this country to-day. In Europe there has been a great advance in the manufacture of aeronautical motors, chiefly because several automobile manufacturers turned their attention to this phase of the motor industry. Firms with international reputations for motor designing, such as the Mercedes in Germany, the Rénault in France and the Sunbeam in Great Britain, have designed aeronautical motors which are giving the greatest satisfaction under the most difficult war conditions.

Until very lately, the aviation motors made in this country have been manufactured by companies which had little or no previous experience in motor designing. The Packard Company has designed a promising twelve-cylinder aviation motor, and the Simplex Automobile Company is equipping the rejuvenated Wright Aeroplane with a well-designed and carefully built motor, which in its first tests has justified the hopes placed in it by its designers.

When automobile manufacturers cooperate with aeroplane builders and succeed in developing an aeronautical motor which is as dependable as the automobile motor of to-day, the most formidable obstacle in the path of aviation will have been overcome.

If the war has accomplished no other useful end, it has advanced the progress of aviation many years. In the United States, without the spur of military and naval aeronautics, aviation was regarded as a profession from circus performers, whose main duty was to "loop the loop," and provide thrills for the crowds. Now, with aircraft manufacturers turning out aeroplanes at the rate of sixteen a day, the public is beginning to realize that it is a remarkably healthy infant industry, closely rivaling the unprecedented growth of the automobile industry in its early stages. One of the foremost aeronautical experts in the country recently said to the writer:

"Within one year after the signing of peace between the European powers, the first aeroplane will make a successful flight across the Atlantic Ocean. Very soon aeroplanes will be carrying our mails to inaccessible spots. Shortly after this will come the carrying of passengers on a schedule as regular as that of our Twentieth Century Limited. Many of us will live to see the aerial expresses with many planes, multiple engines, and an enormous carrying capacity, which will take us to San Francisco or even to London and Paris as easily as we can now ride to Kansas City."

slow speed—a fault which has probably been remedied by now. The huge size of this aerial craft is shown by comparison with the men standing beside it. Remember that there are some aeroplanes now flying which are even larger than the one here pictured

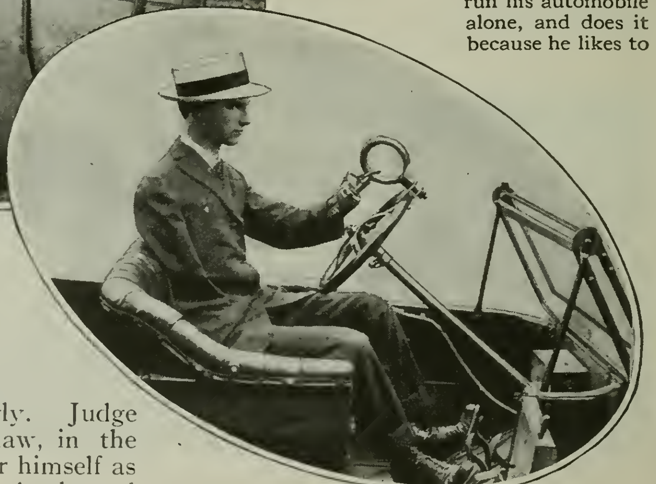
A Judge Who Has Succeeded Without Arms

OCCASIONALLY one meets men whose determination to succeed regardless of obstacles makes those obstacles act only as added stimuli to their progress. Such is the case of Judge Quentin D. Corley of Dallas, Texas, who ten years ago lost his entire right arm and his left arm above the wrist. With this handicap, many men would sink into a life of helplessness, however unwillingly. Judge Corley proceeded to study law, in the meantime earning a living for himself as a superintending contractor. At the end of a year he had devised a hook with which he could write and do many things. At the end of the second year he had been admitted to the bar, and in seven years from the date of his accident he was made County Judge of Dallas County.

Armless Judge Corley can put on his own necktie, as well as dress himself alone. He didn't learn to shave, merely because that hardly seemed worth while with barbers willing to help him

Judge Corley has now perfected a mechanism with which he has made himself independent of outside assistance. He is able to use a telephone, pick up large and small articles with ease, take money from his pockets, turn doorknobs, bathe himself, lace shoes, use a toothbrush, handle a knife and fork, and put on or take off his collar and necktie. But this is not all. He can do things which many men with both arms have not learned to do, such as swim, dive, bowl, drive a horse, and run an automobile. The accompanying illustration shows Judge Corley seated in his automobile, with his foot on the throttle and his mechanical hand on the wheel. He cranks his machine and, in fact, takes entire care of it.

Judge Corley is a young man who feels keenly the needs of a cripple. His attention is now directed to Europe. His plan is for each government to establish a temporary institution where cripples may be taught a trade or profession and the use of mechanical hands. The expense to the government would be remarkably small in comparison to that of maintaining permanent institutions for the care and support of cripples.



Judge Corley can run his automobile alone, and does it because he likes to

The Allies' Losses

RECENT information, believed to be correct, gives Allied losses in the European War until January as follows: Total British casualties, 549,467, including 24,122 officers; French total, 2,500,000, of whom 800,000 were killed, 1,400,000 wounded and 300,000 captured. It is estimated that nearly sixty per cent of the wounded return to the trenches. Official figures regarding the Teutonic losses are unobtainable.

An Automobile Converted Into a Railway Ore-Tractor

A FORD automobile which was fast reaching the end of its usefulness in a mine in Texas was recently knocked apart, put together again on a short, heavy chassis, and mounted on railroad-wheels for use on a narrow-gage track. Although the automobile had been driven more than twelve thousand miles, it fell to its new task with a will and has been behaving admirably ever since.

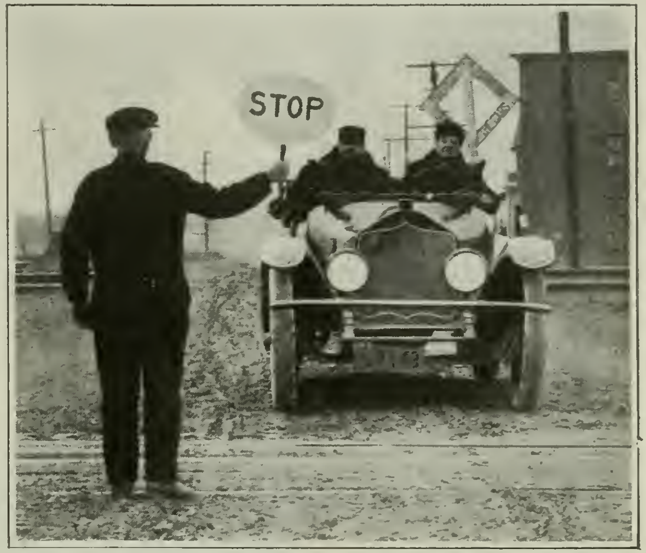
The weight of the full load pulled by the improvised locomotive, consisting of three two-ton ore-cars, is about sixteen thousand, five hundred pounds. Dragging this weight between various points about the camp it travels on an average of eighteen miles a day, consuming during that time about four and one-half gallons of gasoline and one gallon of oil.

The cost of converting the touring car into a day laborer was one hundred and fifty dollars.

Stopping the Speeder with a New Danger Sign

A DISTINCT novelty in safety devices is now being tested on nearly one hundred grade crossings of the New York Central Railroad. Upon the approach of a train, the watchman, instead of waving the customary white flag, holds in the air a white sign, across the face of which is painted the word "Stop" in staring red letters. The warning is painted on both sides of the novel signal and is visible at a considerable distance in either direction.

The officials of the railroad feel that the sign will be more effective than the

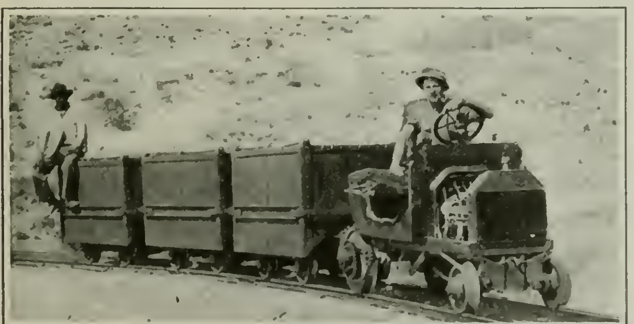


The old-fashioned white crossing-flag having outlived its usefulness, the New York Central now uses a big white disk with "Stop" painted on it in red

familiar flag. If the experiments prove a success, the new device will be used at all grade crossings on its system. At night a red lantern with the word "Danger" painted on the red glass will be used.

Italians Build Highest Powered Motor Ship

AN Italian shipbuilding concern has recently completed the construction of the world's highest-powered motor-ship. This record-breaking craft, designed for the Brazilian Navy, is a submarine depot-ship, three hundred and twenty-six feet long, and propelled by two Diesel engines, each of three thousand two hundred horsepower. It is rumored that the ship will not be delivered to Brazil, but will be used as an adjunct to the Italian submarine fleet at least for the war.



A Ford automobile which was converted into a mine locomotive at a cost of one hundred and fifty dollars

A burl that looks like a leg

Pranks Played by Trees

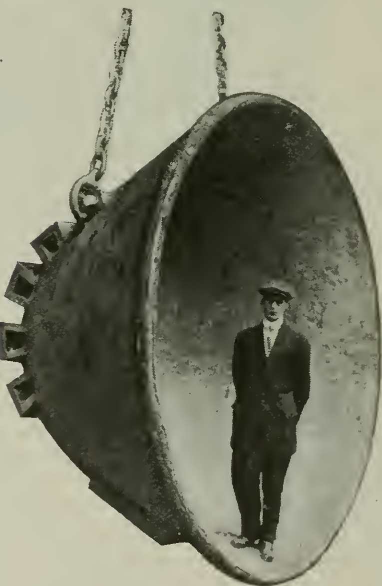
BURLS are abnormal growths common to almost every species of tree. They are produced as a result of some injury, such as forest fires, insect attacks, gnawing of animals, or excessive pruning. The effect of the injury is to stimulate the growth of dormant buds or to give rise to a great many new ones which cannot develop into branches, but do form a gnarled and interwoven mass of woody tissue of very intricate design.

This unnatural growth is very dense and hard. In most trees it is very small, but in the case of the redwood, the largest tree that grows, it reaches a size which makes it of value.

Nature grew these legs —on a tree

Giant Ladle for Molten Cinders

A GIANT ladle for carrying away molten cinders from the furnace of a Maryland steel company has recently been cast, weighing nineteen thousand, seven hundred and ten pounds. A fair idea of the proportions of this huge ladle can be gained by a comparison with the figure of the man who is standing in it. It is ten feet in diameter and nine feet deep.



A ladle to hold the cinders of a steel furnace

With a Trans-Continental Burromobile

A TRANS-CONTINENTAL "burromobile" recently made its appearance in Los Angeles, California, after having crossed the country, from the Atlantic to the Pacific. The speedometer on this machine showed that more than five thousand and forty-two miles had been covered, and John A. F. De Lion, the driver, tells us that he is not yet ready to "settle down." In the accompanying picture John, the owner of the car, is seen seated in the machine; the boy who is standing is a traveling companion; while Jack, the four-footer behind, is the means by which this car has been "lifted" from many a sandhole and out of mud hub-high.

John started from Philadelphia on June 30, 1912, and throughout the intervening time he has been on the road. The route selected led John to New York, Chicago, Omaha, Denver, El Paso, Phoenix and San Diego. He expects eventually to tour the entire length of California and even to proceed farther up the Pacific Coast.

The donkey, strangely enough, goes behind the car.

The burro goes along to help the car

Mahogany Steamboat Cabin for a Home

The mahogany cabin of a topheavy boat now does duty as a cabin

WHEN the steamer "Lilian" was built her designer had her fitted out with a solid mahogany cabin, made of the heaviest and finest mahogany wood obtainable, only to discover when she was launched that she was topheavy. It was necessary to remove the expensive mahogany cabin and dispose of it. Accordingly it was sold to an eccentric resident of San Diego, who hauled it up the steep embankment to his vacant lot and lives in it.

The cabin makes a fine little bachelor home and is spotless in its polished splendor without and within. The heavy French plate-glass windows and Venetian blinds also add a note of distinction. Several reminders of the sea are still present inside the cabin-home.

A Giant Pair of Scissors With a Symbolic Meaning

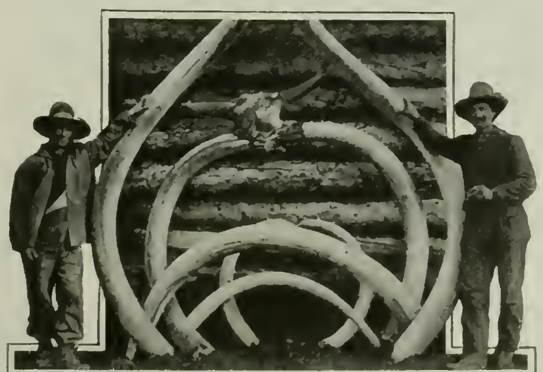
Joe Stecher, the wrestler's, scissors are longer than his legs, but not so mighty

JOE STECHER of Dodge, Neb., owns the largest pair of scissors in the world. Also he possesses the greatest scissors grip in his powerful lower limbs. It is that scissors grip of his which has made him famous as a wrestler.

Recently the friends of Joe Stecher gave him a big celebration at his home, and presented him with a three thousand dollar diamond-studded belt. One of the notables of the state, invited to address the assembly on that occasion, spent no time preparing a speech about a diamond belt, but instead went to a big manufacturing plant and ordered a pair of shears eight feet in length. The factory put men to work and worked them overtime to produce the monstrosity of cutlery.

When this speaker, Colonel James C. Elliott of West Point, Neb., was introduced, he presented, not the diamond belt, but the giant scissors.

Mammoth Tusks from Alaska

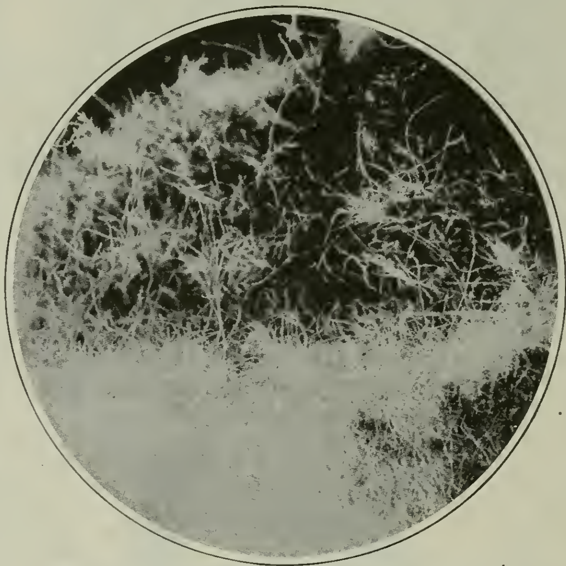


Enormous fossil tusks from Alaska

THE huge mammoth tusks shown in the photograph were dug out of the earth at Silver Creek near Dawson, British Columbia, just across the boundary from Alaska. They are far larger than the tusks of the greatest of modern elephants and the animal who swung them must have been a giant even among mammoths. The buffalo skull and horns seen in the center of the picture, large as is its massive head, show by comparison how huge must have been the head of the mammoth.

How Blotting Paper Absorbs Ink

EVERY student of physics knows that water will run up a narrow tube by capillary attraction. Anything immersed in water has a similar attraction for the water; that is, the object becomes wet by the water that clings to it. The amount is limited by the weight of the liquid itself. Place your hand in water, and your hand, when withdrawn, is wet. The limited attraction between the hand and the water is gaged by the weight of the water that clings to the hand.



Blotting paper absorbs ink on the same principle as a handful of hay will absorb a liquid

Imagine several hands placed close together in water, but not touching one another. If this composite hand were formed of ten single hands, it would attract ten times as much water as the one hand would attract and hold on its surface. So, a wisp of hay, composed of a hundred spears of dried grass, placed in water, will remove a hundred times as much of the fluid as would cling to one spear. Bushes in a marsh will remove a certain amount of water which will, by capillary attraction, cling to their submerged parts.

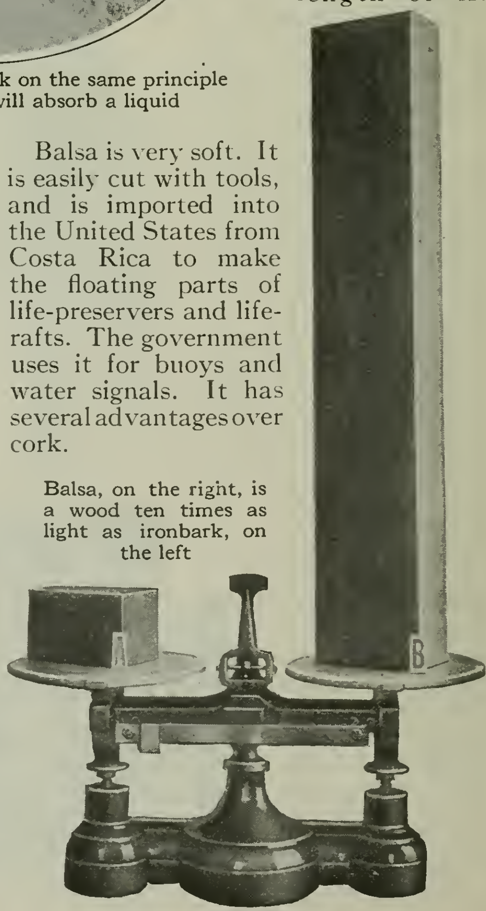
Under the microscope, fibrous blotting paper, when absorbing ink, resembles, on a small scale, a marsh matted with shrubs and sticks and twigs, around which water is flowing as ink runs about and among the fibers that together form the spongy paper. There is a limit to the amount of liquid which a "blotter" will absorb, as there is a limit to the amount of water that a marsh will absorb without overflowing. That limit, in the "blotter," is the combined capillary attraction of the fibrous shrubs and sticks and twigs that together form the paper.

Balsa, Lightest of Woods

EXPERIMENTS made by the Missouri Botanical Garden of St. Louis show that the wood called balsa, native to the West Indies and Central America, is nearly twice as light as cork.

In the photograph a piece of balsa-wood (B) is balancing a piece of Australian ironbark (A). The two blocks have the same width and thickness, but *B* is ten times the length of *A*.

Balsa is very soft. It is easily cut with tools, and is imported into the United States from Costa Rica to make the floating parts of life-preservers and life-rafts. The government uses it for buoys and water signals. It has several advantages over cork.



Balsa, on the right, is a wood ten times as light as ironbark, on the left

Gasoline Horses for Small Farms

Is the Small Tractor Here at Last?

An eighteen-horsepower tractor hauling barley over a smooth California highway

THE amazing popularity of the small gasoline engine and the motor-car on the farm—even the motor-truck where introduced—makes it seem perfectly natural that the internal combustion tractor should pull the plow and take the place of the horse in all field work on the average farm. But the history of agriculture for nearly eighty years has shown that the general application of mechanical power to the working of the soil is a problem far more difficult than the use of motors in stationary work or road transportation.

The problem, however, is apparently near a solution, and the year 1916 may see the practical fulfilment of an ideal that has occupied the minds of thousands of inventors, *i. e.*, the production of farm tractors mechanically and economically suited to the average farm, as well as to the great ranches of the West and Northwest.

Steps in the long evolution may be set down in order:

1770—Cugnot's road locomotive.

1800–1825—Development of steam road locomotives and their practical legislation off both American and English highways.

1858—Fawkes' steam plowing engine in Pennsylvania.

1870–1875—Adoption of the differential gear and friction clutch.

1875–1890—Development of the steam threshing engine, self-propelled.

1890–1905—Development of large steam plowing tractors.

1903—First commercial gas-tractor.

1910–1912—Gas-tractors actively displacing steam for plowing on a large scale.

1913—Success of the power-lift plow cuts crew of plowing outfit to one man, and makes smaller tractors profitable.

1914—Amazing variety of small tractors produced, following virtual collapse of market for large tractors and constant increase in the cost of horse and man labor.

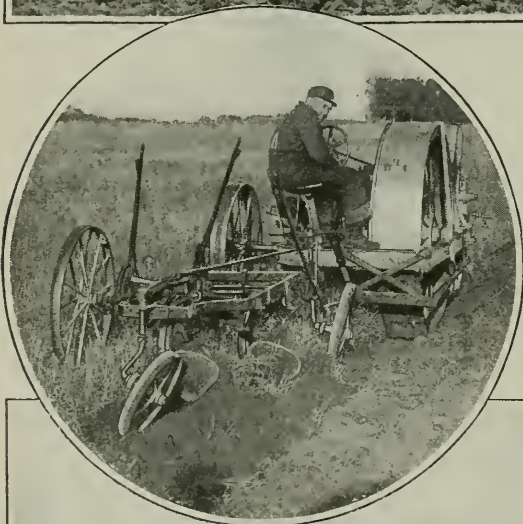
1915—Numerous tractor demonstrations throughout the Middle West focus attention of hundreds of thousands of farmers upon light tractors pulling two or three plows.

1916—Will see thousands of these small tractors, with the improvements suggested by one or two seasons' work, put to practical test by farmers. Partial success apparently assured by recent experience.

A small tractor starting out from a state fair ground to give a plowing demonstration

From the foregoing it will be seen that the widely successful light tractor has hardly arrived though it may be almost here. Changing conditions—higher horse and labor costs, greater familiarity with the gas-engine on the farmer's part, a growing inclination to plow deep and farm more scientifically—these, rather than mechanical improvements, favor the light tractor of to-day as against very similar machines of five years ago.

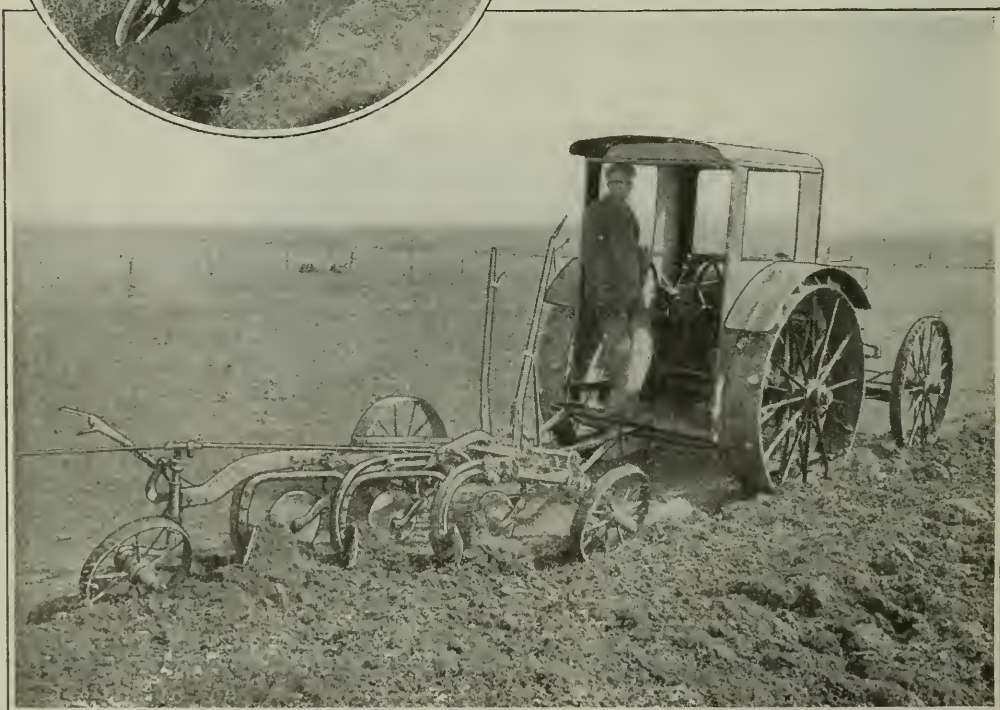
The light tractor problem is difficult. From the profit-and-loss standpoint, it costs more in proportion to build and to



Above, an 8-16 horsepower tractor plowing under a heavy growth of sunflowers

To the left, an illustration which shows that the possible width of furrow cut is much less in proportion to the width of a small round wheel tractor than in the larger outfit. The plow must travel at or near the right-hand side of the tractor or else the tractor must move partially upon the plowed ground, with a loss of tractive power and the undoing of part of the plow's work

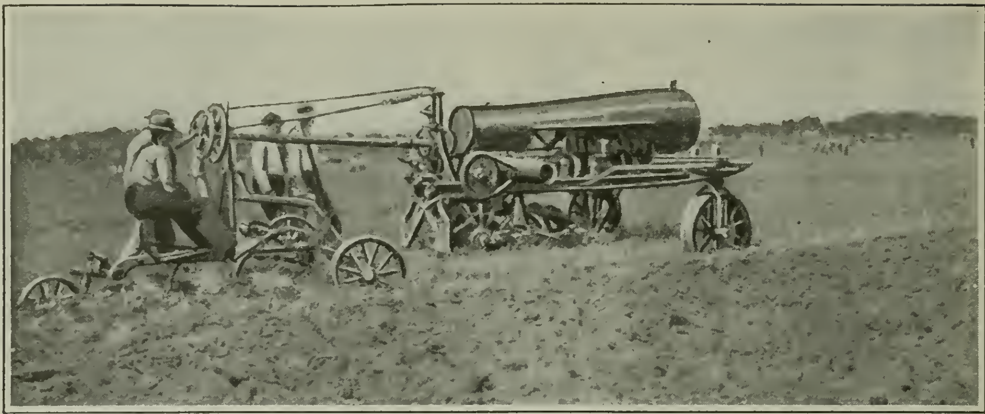
Below, a tractor plowing with one drive-wheel in the furrow. The front wheel in the furrow helps to steer



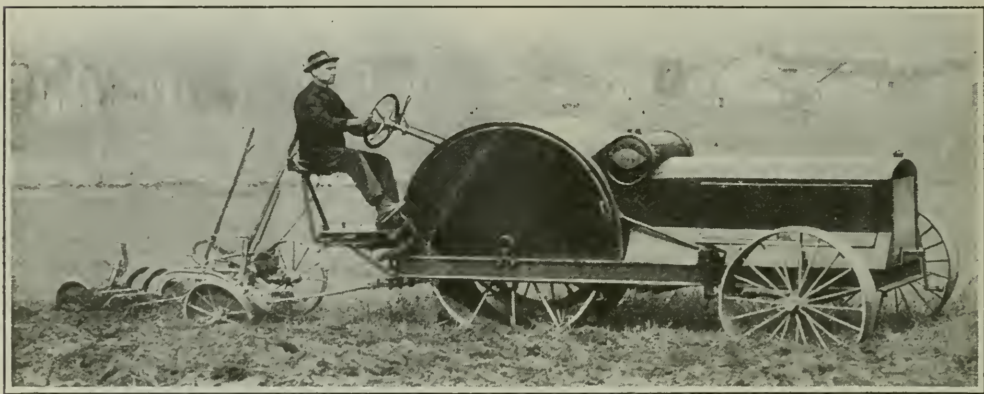
Above is an 8-16 horsepower tractor plowing sod. Note the self-steering attachment in front

To the right, a small tractor which is self-steering and which has a light-draft two-bottom plow

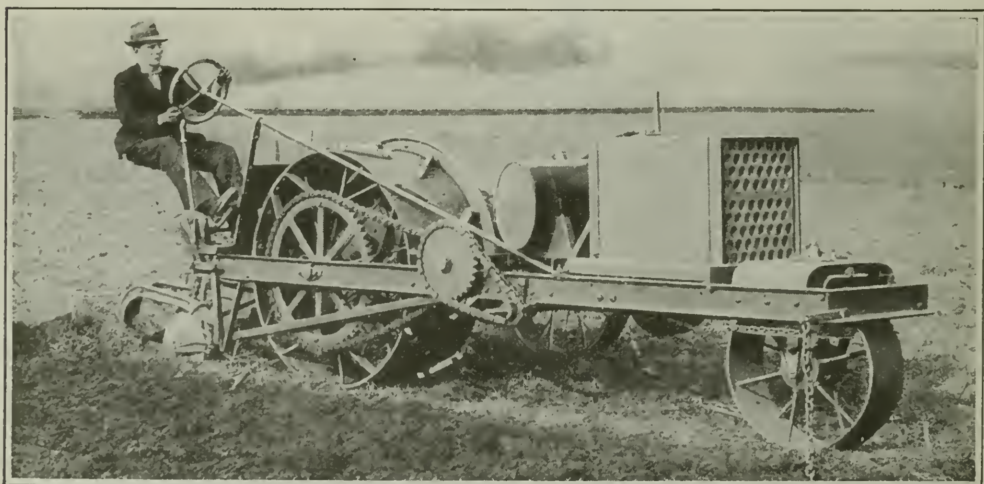
Below, a self-contained motor plow of the latest type, cutting three furrows at once. This illustrates one of the great advantages of the tractor, for it can really do multiple work, day after day, and with absolute reliability. Nothing but the worst sort of weather can stop it or delay its work



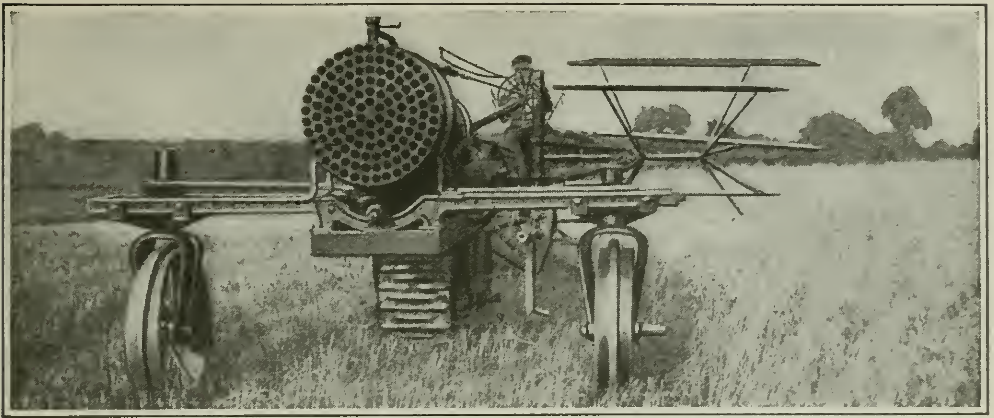
A tractor known to farmers as the steel mule



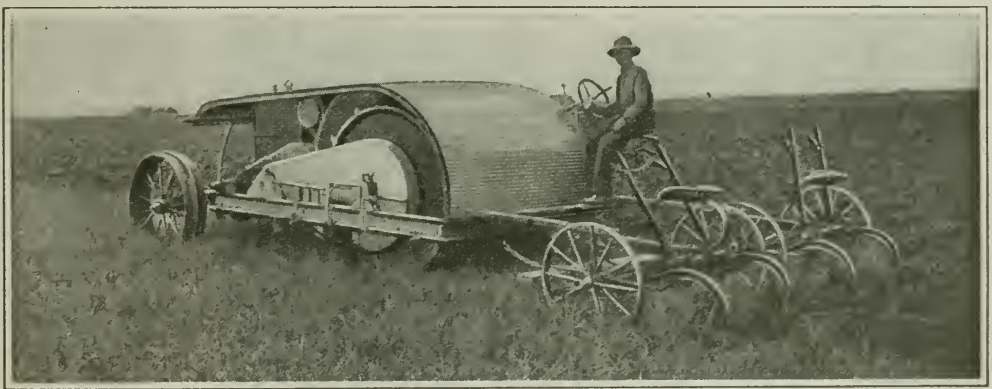
A well-enclosed type of small tractor



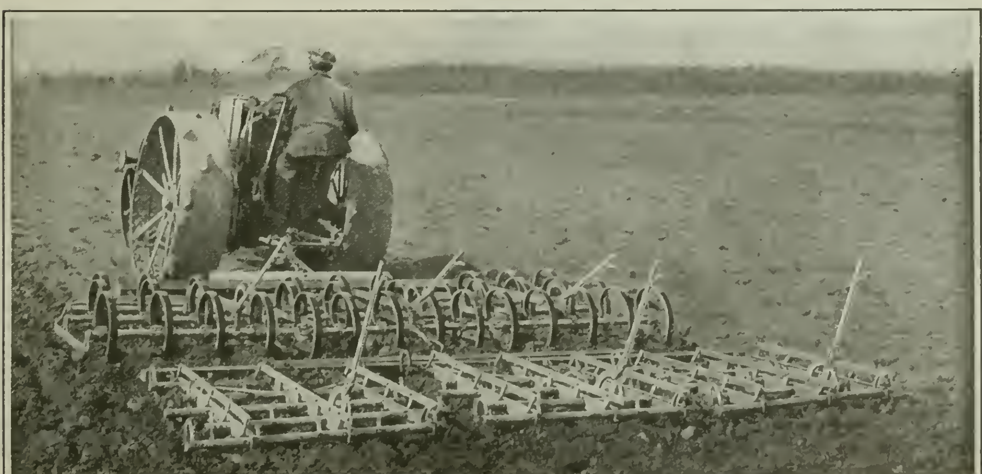
A single-drive-wheel tractor, with power lighting device for plows



The steel mule pulling a binder during the harvesting season



"Listing," a type of plowing common in the southwest. A drum-drive tractor is used

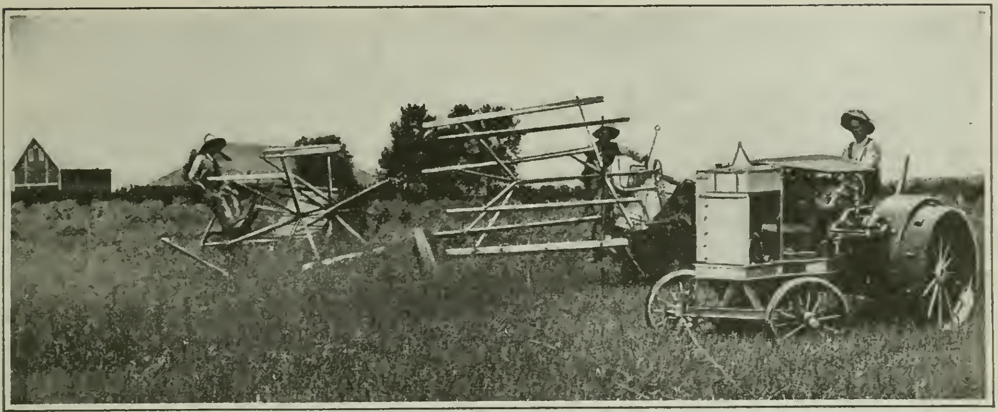


Two harrowings at once with an 8-16 horsepower tractor

Harvesting in North Dakota with a Ford car for motive power

Orchard plowing with a small caterpillar tractor. For such work the machine must be very low so that it can crawl under trees easily. This type of tractor can obtain an enormous grip on the soil because of the unusual length and breadth of its track or contact service

A small tractor running a big corn sheller. When a tractor is not engaged in field work, it can be otherwise employed usefully



A small tractor pulling two binders while harvesting oats

The designer of this machine describes it as a "four-to-five 'horse-pull' sieve-grip" machine. It is here shown with tandem disks. The peculiar wheel construction is intended to secure traction; in fact, its traction efficiency is very high in proportion to the weight and motor power

The use of the small tractor for threshing in the field has come into wide use in the West owing to its manifold advantages over the old method operate; probably much less to sell. It displaces a smaller percentage of the farm's total animal power, which cannot be wholly dispensed with.

The smaller units of machinery which it operates are apt to present a higher cost per unit of work. Its earning capacity in custom work off the farm is less. It appeals more as a convenience, but the ability to rush work at the proper time on the farm is often really justified by a greater net return, regardless of cost.

From a mechanical standpoint, the difficulties are perhaps even greater. The small tractor is called upon for a greater variety of work than its large counterpart—light hauling, cultivation, and other jobs formerly done only by horses. It must, of course, run stationary machines and thus take the place of some of the larger stationary and medium-sized portable engines. It must do its field work over unfavorable grades and surfaces such as do not usually confront the automobile and motor-truck.

In plowing, the possible width of furrow cut is much less in proportion to the width of a small round-wheel tractor than in the larger outfits, and this has presented extraordinary difficulties in the way of side draft, hard steering and unequal wear. The plow must travel at or near the right-hand side of the tractor, or else the tractor must move partially upon the plowed ground, with a loss of tractive power and the undoing of part of the plow's work.

This problem of hitching, probably more than any other, is responsible for the failure of the small-wheel tractor to follow at once the lines of the large units, which are now practically all of the four-wheel type, with the two driving-wheels at the rear. The small tractors which do follow this conservative type are probably further advanced at present than the many radical variations from it, though this may prove to be due less to the principle than to greater experience on the part of the manufacturers.

A small tractor loading a silo

Some of these variations are meeting with considerable success, especially that group which employs but one driving-wheel, mounted at the right-hand side so as to place the power directly ahead of the plows. An idler wheel on the left merely serves to distribute the weight of the machine and give the necessary stability.

Several small tractors dispense with the third and fourth wheels, carrying the entire weight upon two drivers. The hitch is made directly to the plow, cultivator or wagon, which completes what is virtually a self-contained outfit.

Other tractors, both three and four-wheel, are made self-contained by hanging the plows from the frame, usually underneath. The plows may be removed and the tractor used for pulling other implements. This type is at a disadvantage in soft ground, however, in that in case of miring down, the plows form an anchor from which it is difficult to cut loose.

Soil conditions are far from uniform, and the plowing tractor cannot depend upon momentum to help it through the hard spots and up short grades. For this reason, very largely, the tendency seems to be toward the use of the more flexible four-cylinder motor. For the same reason, and the low coefficient of friction between a wheel and the soil, such extreme lightness of weight has never been found practical in the tractor as it has in the motor-car.

The average soil resistance to the plow in well-tilled loam, is close to five pounds per square inch of cross-section of the furrow slice. A furrow fourteen inches wide and seven inches deep will therefore require a pull of five hundred pounds, varying of course, with the type of

Bring the fresh air to your pillow, and avoid danger and the annoyance of getting up in the cold to close the window in the morning

soil and its physical condition. A two-plow tractor, therefore, should have an effective drawbar pull of one thousand to one thousand two hundred pounds, regardless of the speed at which it travels.

As the effective pull of a round-wheel tractor is seldom over one-fourth to one-third its total weight, it is hardly feasible to build the conventional tractor with much less than two tons of weight. In present quantities, well-built tractors of this size can seldom be sold for less than fifteen to twenty cents per pound.

The problem of the light tractor designer has, therefore, been complicated by factors of cost and mechanical efficiency which have made progress very slow.

Besides the wheel-type of tractor there is another class using either one or two endless steel belts. The "caterpillar" type, so-called from the trade name of a leading example, has peculiar advantages in the small-unit field in that it can be built narrow, with a low center of gravity, and still obtain an enormous grip upon the soil owing to the length and breadth of its track in contact with the ground. Very successful small tractors of this type are in common use, and the earlier disadvantage of extreme wear on the tracks has apparently been overcome by the use of good material and ingenious construction. The tractive efficiency is high in proportion to weight and motor power, steering is easily accomplished, and on either soft or hard ground the broad surface of the track has obvious advantages.

Still another type, as yet of little commercial importance, discards the plow and uses instead a rotary cylinder, studded with flexible steel hooks to pulverize the soil. An ordinary tractor chassis of light weight is used, the cylinder requiring practically no assistance from the drive-wheels in its forward motion. In fact, tests have sometimes shown that the cylinder helps to propel the entire machine.

A Fresh-Air Funnel for Your Bedroom

THOSE who are too timorous to brave a widely opened window in the bedroom may have their supply of fresh air brought to them without exposure by the window-fitting illustrated.

The device is in reality a fresh-air tunnel made of light fabric and held in place by hoops of metal to insure an open air passage at all times when the air-chute is in use. At one end the chute opens through a window-board, thus admitting the fresh air. The other end is draped over the head of the bed.

The air-chute may be opened or closed by means of a string.

An Automobile Dressing-Room for a Motion Picture Actress

MISS BESSIE EYTON, a popular motion picture star now stationed in Los Angeles, objected to going about in the costumes she had to wear while being filmed. She devised a way to turn her automobile into a dressing-room.

A small automobile was converted into a dressing-room, with pipes for heat and hot water. It is now used as a dressing-room by a motion picture actress

Her wheel-dressing-room is a triumph of ingenuity over space. She has taken her small car and so carefully calculated every inch of volume that she has made a commodious dressing-room out of it. She has a place to make-up and a place for the costumes that will be needed during one day's work. The dressing-room is curtained, so that it is as private as the dressing-room of any theater.

But best of all she can have hot water and heat. A pipe with a drum and plate is connected with the exhaust-pipe, which runs through the car. Whenever she wants hot water or heat she has only to turn a valve and start the engine. This throws the exhaust through the drum, and in less than a minute the car is warm.

Did You Know That Flour Explodes?

DURING the last ten years, about twenty explosions have occurred in cereal, flour and feed mills, with the loss of two million dollars' worth of property, as well as the killing or injuring of over two hundred employees. Investigations regarding the causes of these explosions and subsequent fires have not proved conclusively what are the difficulties to be avoided. In eight cases, the explosions are believed to have originated from the sparks produced in the machines during the grinding process. Tiny particles of gravel or metallic substances coming into contact with the plates of the machine may produce enough sparks to ignite the dust within the machine.

Another possible cause for cereal dust explosions suggested is the use of naked flames.

Sea-Scouts as Lamp-Lighters

WHEN the men of a country have to go to war, their responsibilities must be assumed by the women and children. The sea-scouts of England are boys who came promptly forward with their services in any capacity which might be required. In the illustration may be observed a sea-scout performing the useful task of lighting the street-lamps. Equipped with a bicycle and lamp-lighter, he makes his circuit in short time and does it as well, we dare say, as any full-grown man.

England is using some of her boy sea-scouts to light street lanterns

These blocks differ in weight and should be arranged the heaviest first and so on down to the lightest

Prisoner doing one of the Bisch-Simon tests. This one consists of placing blocks in a frame; something similar to a jig-saw puzzle. A normal person finds it surprisingly easy; a defective makes an hour's work of it

If the blocks are placed properly they make a man's head. The prisoner is putting the nose where the eye belongs

Science and the Criminal

By Louis E. Bisch, M. D., Ph. D.

The author of this article is one of New York's foremost psychiatrists. He is an associate in educational psychology at Columbia University and director of the Speyer School for Atypical Children in New York. To him we owe New York's interesting experiment of studying the criminal as a human being rather than regarding him as a destroyer of property and life. The new psychopathic laboratory of New York's Police Department has been placed in his charge.—Editor.

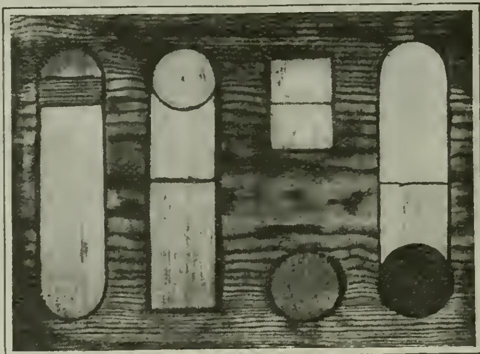
IF a seven-year-old child were sentenced to serve a term in Sing Sing, a storm of protest would arise which would reverberate through the country. Yet, in effect, this is what is done. Criminals whose mentality measures only that of a seven-year-old child are made to serve jail terms.

When a normal man commits a crime and is punished for it, the punishment is correctional. When a person of defective mentality commits a crime and is punished for it as if he were normal, the effect is to aggravate his tendencies rather than to correct them.

The primary object of our penal institutions is reformatory. A man of average intelligence, with a normal mind, may be led to see the error of his ways and to mend them through our penal measures. But the man who commits crime because of undeveloped or defective mentality cannot be benefited through any such means. A person who suffers from a mental defect which is curable should be not in prison, but in a hospital. And if his mental troubles are not amenable to treatment, he should be placed in an institution wherein his presence would be permanent, not temporary, and where his criminal tendencies would nor react against society.

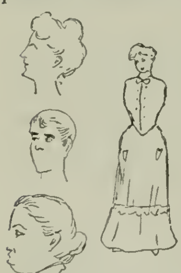
Feeble-minded persons are not benefited in any manner through the serving of a prison sentence. When they are discharged they are likely to repeat the offense at the earliest possible moment, and society is compelled to foot the bills for their frequent trials and commitments.

When Police Commissioner Woods became satisfied that a percentage of criminals should be dealt with as psychopathic patients rather than as normal men who have chosen to commit crime, he determined to test this idea. So it was that after a certain amount of experimental observation the Psychopathic Laboratory at Police Headquarters came into being.



The blocks must be placed in their proper openings—easy for you, but difficult for a defective

Before the laboratory was finally established we devoted forty-nine days to observations. Each day the prisoners at headquarters are "lined up" so that the detectives may recognize any familiar faces. At these daily "line-ups" we picked out men who appeared to be suffering from some mental defect and gave them a thorough mental and physical examination.

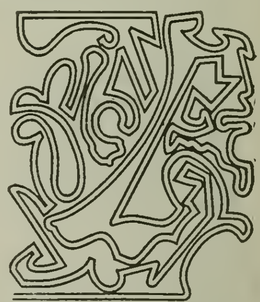


A defective takes time to puzzle out what is missing

During this experimental period, four hundred and nine prisoners were observed. Of this number, fourteen were found to be feeble-minded, one insane, two constitutional inferiors, two drug habitues, one hopelessly immoral, one an alcoholic. Only eight were normal. Out of the twenty-nine selected for examination, twenty-one were found to be defective mentally. Seven per cent of those appearing at the line-up were examined and five per cent were found to be abnormal.

The average number of daily arrests during the period of our preliminary observation was six hundred and twenty-three and the total number of arrests was thirty thousand, five hundred and thirty. We feel assured that observations extending over forty-nine days are sufficiently comprehensive to warrant us in assuming that what we found indicates a condition which exists the year around. And as six hundred and twenty-three is the average number of arrests which take place every day and five per cent of those arrested are abnormal, thirty-one persons who are unbalanced mentally are locked up every day. These prisoners suffer from all sorts of mental ills ranging from dangerous forms of insanity to the pitiful condition of a grown man with the brain development of a child.

Criminals of this type cannot be improved through the ordinary corrective methods. They serve their sentences and return to society only to repeat the offense and pass again through the Police Department, the courts, the District-Attorney's offices back to prison from which they emerge each time more dangerous. This means that they not only constitute a constant menace to society but are a needless expense as well. Their constant reappearance in the courts soon mounts up to a very considerable sum. Also, it goes without saying, prison treatment is far from humane in the case of such persons. Where their difficulty is one which may be cured, they require hospital treatment and where it is incurable they should be committed to an institution wherein they would be protected



A defective finds it difficult to trace the course of this maze with a pencil against themselves and removed forever from society.

At the conclusion of our experiments, the need for a sure method of detecting the mentally defective among the city's criminals became apparent and so after many conferences with the Department of Correction, Professor Edward L. Thorndike of Columbia University, Chief Justice McAdoo and a number of other magistrates, Police Commissioner Woods brought the Psychopathic Laboratory into being.

Before taking up my duties in the Laboratory, Inspector Faurot and I went to Chicago, where we studied the methods employed in the psychopathic laboratories there. Beside myself we have an expert psychologist, Dr. E. C. Rowe, who works in the laboratory every day. On our advisory board we have Edward L. Thorndike, Professor of Educational Psychology at Columbia, Dr. Frederick Tilney, Professor of Nervous and Mental Diseases at the College of Physicians and Surgeons, Dr. August Hoch, Director of Psychiatric Institute, New York State Hospitals, Dr. Woods Hutchinson, Arthur Train and Raymond D. Fosdick.

We have not confined ourselves to the use of any one particular test or scale for measuring mental ability, but have adapted to our particular needs certain parts of a number of well-known tests.

Every patient receives a thorough psychological, neurological and physical examination. If his case presents any peculiar problems we place it before our advisory board for special study.

Each day we receive a number of unusually interesting cases. I will cite a few at random.

Inspector Faurot turning over a case to the psychologist at the psychopathic laboratory at police headquarters. The inspector, at the right, is handing the history of the case to the psychologist

A physician making an examination of a prisoner at the psychopathic laboratory

A criminal who, because of his intelligence and the number and variety of his exploits, might have been a stage crook was brought in for examination. On the way to the laboratory he told the detective who had him in charge that the scrub woman who was working in the hall when they passed, knew him by name. He believed that the children in the street recognized him and was sure that all Italians did. When examined, this man showed a very high intelligence, but he was suffering from a form of insanity which might, at any moment, take a homicidal turn. From the nature of his calling it will be seen that this man was fearless, yet his insanity had taken the form of abject fear of recognition. His case was incurable. Obviously, prison was not the place for him.

A fugitive from justice was arrested. He had served two terms before, one for assault and one for abduction. Examination showed him to be a high-grade imbecile, his mental age being seven years. This condition is incurable and it is certain that each time such a person gets out of prison he will commit another crime. His ability to reason and his range of ideas were both exceedingly limited.

A waiter was arrested charged with attempted blackmail. He had sent a threatening letter to a company demanding $500,000. When examined, he was perfectly willing to talk about his efforts to obtain the money and believed it was due him. He was found to be insane and the only proper treatment for this difficulty is that which he would receive in an insane asylum.

The most revolting and hideous crimes are those committed by mental defectives. These persons possess an unusual amount of cunning, which makes their apprehension difficult. It is generally

A tree which braided itself into a rope

believed that many of the terrible crimes which have never been solved have been committed by defectives. It is impossible to know just how frequently and to what extent feeble-mindedness exists. It is the purpose of the laboratory to accumulate statistics concerning criminals who are definitely abnormal so that material will be at hand which may be used in the great struggle towards the prevention of crime.

A Braided Tree

NEAR Arlington, Ohio, is a small tree which departed radically from the way a well-behaved tree should grow. Two inches above the ground, this tree divides into three parts, which twist around one another in the curious manner shown in the illustration. At the height of five feet the three parts diverge like the branches of an ordinary tree. Note in the background a similar tree, but having only two parts.

An Adjustable Crutch

THE military hospitals in Germany have a crutch that fits every one. Extended, it will accommodate an eight-foot giant; or it can be shortened to fit a midget. It can be taken apart and used as a cane by the convalescent.

During the recent exchange of prisoners a wounded Canadian was allowed to bring his adjustable crutches with him, although it is the custom to fit every patient with an artificial limb or regulation crutches when he leaves. Adjustable crutches are considered part of the permanent emergency equipment of the hospital. Many other appliances, such as artificial limbs and hands, which can be used for many necessary operations, are being perfected for those crippled in war.

The Germans made these adjustable crutches to be used by long and short men

Shelter-Top for London's 'Bus Riders

LONDON rains and London fogs will before long have no terrors for that portion of the populace that prefers to ride atop 'busses in order to gain the benefits from the out-door air. Weatherproof coverings or tops are being installed on all of London's 'busses, and their construction is such that they can be put up or taken down in two minutes.

In the photograph, which shows the new rain-proof 'bus-top, can incidentally be seen rows upon rows of posters, one way of advertising which the British army is employing. Evidently proceeding along the theory that repetition is the best way to advertise for anything, the same poster is used over and over again, in the hope of driving home a lesson to the reluctant Briton.

Londoners no longer have to ride on their beloved 'bus-tops in the rain. Here is one of several designs of detachable tops now being installed

Better Than the Bread Mother Baked

THAT civilized person to whom has never come the pleasure of tasting bread as it is baked in the open—that is, baked in a shallow clay oven, fired by charcoal, as the bread of our southwestern Indians, the bread of the Bolivian Incas, and the Argentine cholos, is baked—has never really tasted bread as it was intended to taste. It is a little coarser, perhaps, than the snow-white bakers' bread of the large cities, but it has nourishment and flavor that are unmatched.

The brick ovens of our ancestors baked good bread. The bread from the clay ovens of Bolivia is said to be even more nourishing and delicious

In South America the oven is very simple in structure, consisting merely of a hollowed-out clay or mud mound, sometimes supported on a wooden framework, as is illustrated here, but usually by a rock pile.

Repair for Cracked Window

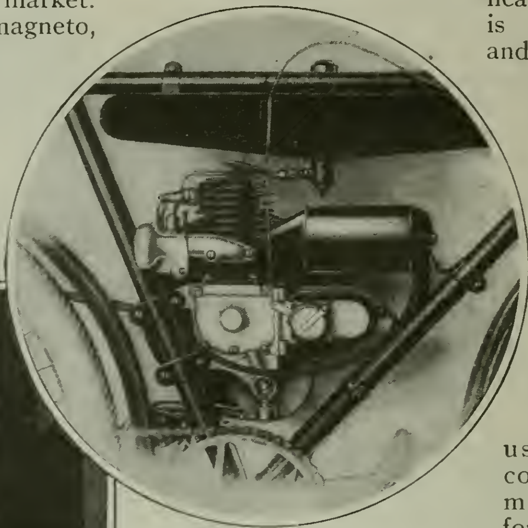
A WINDOW that is cracked can be repaired temporarily by bolting two roofing nail-caps where the cracks meet. Roofing nail-caps are large tin washers with small holes which must be reamed out to accommodate a machine screw.

A Detachable Motor for Bicycles

A SMALL motor, developing one horsepower, which may be quickly clamped to the frame of any standard bicycle has been placed on the market. The entire motor, including magneto, muffler and carburetor weighs but fifteen pounds, and the fully equipped motor-bicycle may be picked up and readily carried to any desired resting place.

The motor is said to be capable of propelling the bicycle and rider from two to twenty-five miles an hour. It is of the two-cycle or two-stroke type, which gives an explosion at every revolution of the crank-shaft, resulting in a marked absence of vibration. The speed of the engine is controlled entirely from one lever on the handlebar, which advances and retards the spark.

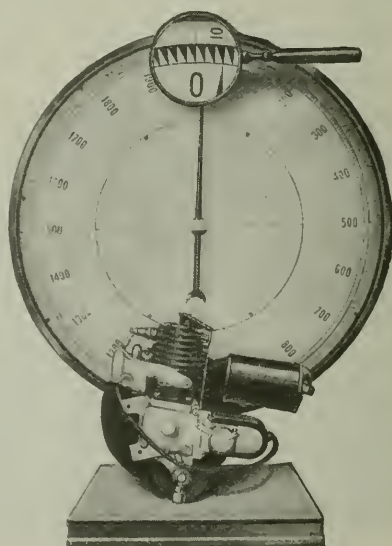
An American manufacturer makes a motor which is so light that the whole machine can be picked up and carried as easily as a standard bicycle



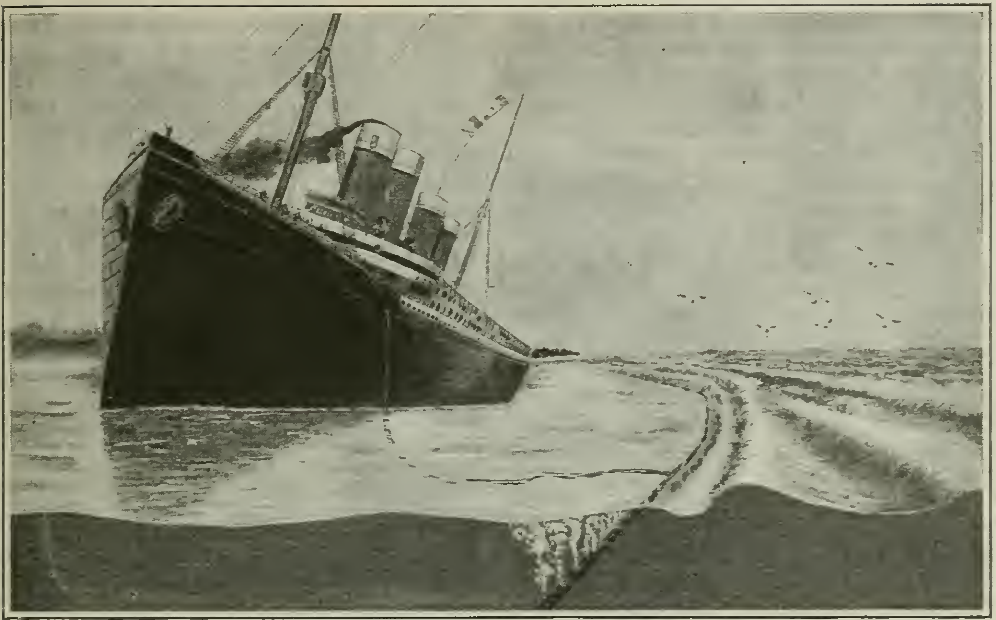
The motor is hardly more cumbersome than the flat boxes that fit inside the bicycle frame to carry clothes on cycling tours

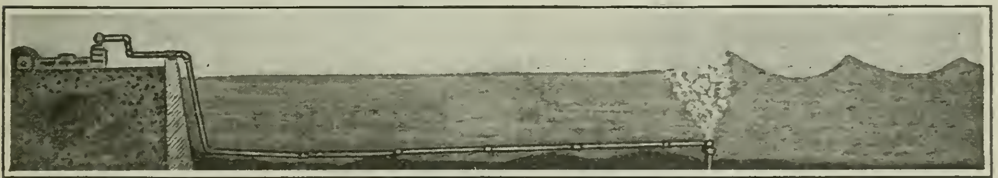
Soda Pulp Has Many Uses

THE uses of soda pulp have been greatly expanded during the course of the war. Resembling cotton in softness, strength and lightness, it is being used in the manufacture of explosives and articles of clothing which have hitherto demanded the use of cotton. For centuries, Scandinavian countries have lined the walls of their homes with soda pulp. It is a poor conductor of heat and therefore reduces the cost of heating; it is airtight and therefore keeps out the wind and cold. In Germany soda pulp is now being used as covering material for wooden barracks. Cellulose wrapping paper is being made from soda pulp, since its durability and strength have been shown to be very great. It may also be used for foot wrappings for soldiers.



The whole motor weighs only eleven pounds, ready to attach





Pouring oil on the troubled waters is no longer a marine necessity, if bubbles of air are handy. Inventors have been experimenting for years on a scheme for stopping breakers by means of compressed air

Breaking Storm Billows With Compressed Air

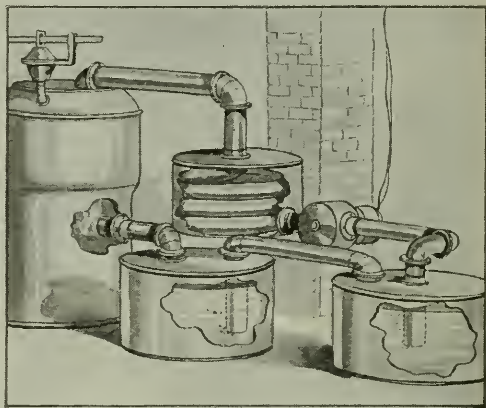
THE gnawing seas are ceaselessly busy changing our coast lines. The bulk of us are unaware of this, but the coast dweller, particularly he who lives near sandy beaches, can tell many a story of wind-lashed breakers and pounding surf. Whole stretches of the New Jersey coast have been undermined and demolished in this fashion. Our sandy western shores have been similarly assailed, and property owners on both seaboards have spent great sums in trying to rear barriers against these attacks. Unhappily, neither bulkhead nor jetty has proved permanently effective, and the fundamental reason of their failure lies in the fact that they are designed to halt the well-nigh irresistible onrush of the storm-tossed billows.

A test will shortly be made upon the southern coast of California of an ingenious system which represents a minimum of cost compared with what it is promised to do. It is not essentially an experiment, because the principles involved have been tried out before, with encouraging results. The lay mind instinctively pictures a rigid bulwark of some sort, for nothing short of this seems logically the medium to arrest the mighty drive of a great tumbling wave. And yet Mr. Philip Brasher, the inventor, employs nothing more substantial than a curtain of ascending air bubbles!

The feasibility of the scheme hinges upon two factors—a knowledge of wave motion and the catching of a billow before it has time to break. Despite what most of us think to the contrary, the body of a deep-water wave does not materially advance, but the vibratory impulse that creates the wave does move forward. We have an every-day illustration of this in the fluttering motions of a flag. But there comes a time in this disturbance, where water is concerned, when the mass affected does actually advance. This is when the body of the wave can not rise and fall without losing its balance, so that it tumbles over, breaks, and goes pounding up the incline of the beach and hurls its volume violently against anything standing in the way. The shallowness of the water is responsible for this, because there is not room for the abnormal vertical movement set up by the wave-making impulse with its onward drive.

Now, as Mr. Brasher reasons, if the wave-forming action of any particular body of water could be upset, then the creation of the billow would be nipped at its very beginning, and there would not be a chance for the development of that movement which would be capable of acquiring destructive momentum. It is like checking a flywheel at the start instead of trying to bring it to a standstill after it has attained some speed of revolution. To this end, the Brasher system has recourse to an air compressor connected with perforated pipes laid on the sea-bed, far out in the water, and deep enough to sustain waves before they become breakers—in other words, before their staggering masses tumble violently forward. In rising, the air bubbles tend to interrupt or to destroy the rotary motion of the water particles—that movement which is characteristic of the wave. By doing this the wave impulse is checked, and the billow subsides and passes shoreward into shallow water, effectually robbed of its power to do harm. This disruptive effect of the bubbles is magnified by employing compressed air, because the globules expand as they mount and increase their interference as they get nearer the surface where the lashing crest of a wave has its birth.

But the Brasher air-breakwater is not designed merely to safeguard beaches. It might be adapted for the temporary calming of the waters about a stranded ship so that her salvage might be undertaken at any time. An installation of this sort was made on the rocky coast of Massachussetts where a wharf could not be built in a sheltered haven. The air, supplied from a compressor, made it possible to load barges with stone at all times instead of waiting for favorable weather. It is easy to imagine other applications, for instance, such as the building of piers and the like which normally would be halted if the wind-swept waters were seriously disturbed.



This is a smoke laundry. After having been washed the smoke is enriched by oil and gases and is conducted again into the stove where it is thoroughly consumed

Laundering Smoke and Using it Over Again

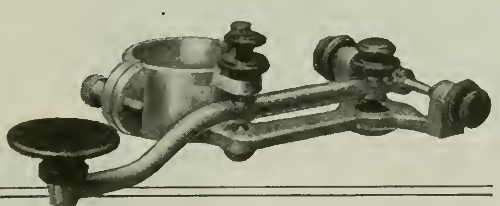
FOR the purpose of abolishing the smoke given off by a coal stove and of employing the unconsumed gas and particles of carbon which ordinarily go up the chimney and are wasted, an arrangement of pipes and water tanks has been devised. The apparatus consists of three tanks connected together and to the top and bottom of the stove. Smoke leaving the stove is conducted first to a cooling tank composed of a coil of pipe submerged in cold water. From this coil the smoke is drawn by a suction pipe into a second tank filled with water. Here the smoke is thoroughly laundered, passing on into the third and last tank, which is partly filled with water and kerosene.

The laundered smoke is enriched by the oil and passes again into the stove, where it is thoroughly consumed. From the standpoint of health, this arrangement is highly desirable.

Telegraphing with the Telephone

THE man at the telephone is telegraphing. He is Paul P. Banholzer of Philadelphia, connected with the steam engineering and electrical department of the Navy. He has increased the efficiency of the telephone by devising a telegraph-transmitter which can be attached to any telephone standard. The connection between the two instruments is purely mechanical and not electrical. The device does not require an additional electric circuit. Its advantage lies chiefly in the fact that the Morse signals sent by this instrument carry farther over a long distance telephone line than the voice and that the sounds produced are definite and unmistakable even to an inexperienced person.

A telegraph-key attached to a telephone, which places the whole vast telephone system of the country at the disposal of the telegrapher



The instrument is especially useful in telephone train-dispatching. If the telephone conversation is not clearly understood it can be verified, or supplemented by the telephone-telegraph instrument. The telegraph-key is mounted very much like any other telegraph-key, except that it is pivoted at its extreme end; the sound that it produces is sharper than that of the ordinary telegraph-key and is conducted to the telephone through the metal base and through clamps which encircle the telephone standard and fasten the instrument in place.

The apparatus is being tested out at the Philadelphia Navy Yard with wireless. It is claimed that if conversation can be transmitted by wireless telephoning, telegraphing by wireless telephone with this instrument, can be conducted by any "wire" operator, and that it will be possible to introduce wireless on all railroads. When telegraph wires are down, this device can be used on the telephone circuit in conduits underground.

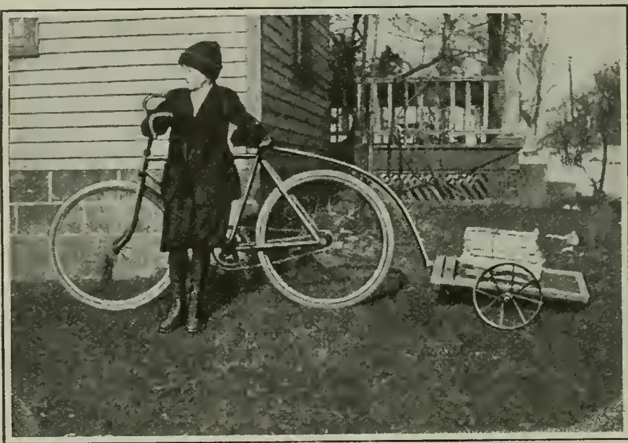
Cane Holds Doctor's Medicines

AN eccentric physician, who did not like to be seen carrying a medicine-case, devised a hollow hard-rubber walking-stick with a sliding metal holder for the bottles of tablets and powders and other first-aids. This metal holder is a half-tube, slightly crimped at the edges, so as to grip the bottles tightly enough to prevent them from falling out when the tube is pulled out of the cane. To all appearances the cane is just like other walking-sticks, but when the old physician removes the handle, by unscrewing it from the straight part of the cane, a sort of button is revealed, which serves as a means of grasping and pulling out the tube with its drugs.

The doctor did not care to carry a medicine case, so he filled a hollow cane with pills instead

How a Boy Delivers Packages with His Own Bicycle-Trailer

A BICYCLE-TRAILER of effective design has been built by a Battle Creek boy to expedite his work. With the trailer he finds it easy to transport bundles and boxes and to finish his task in much less time than if he attempted to haul the bundles on a small express wagon, such as that commonly employed.



The inventors of automobile appliances are now giving much attention to trailers. This boy invented his own trailer for carrying packages with his bicycle

The trailer is simple in construction. A two-wheeled platform is fastened to the bicycle by means of a curved rod, which follows the contour of the rear wheel and which is bolted to the saddle fittings.

The metal rod obviates any possibility of a rear-end collision, while the pulling power of the bicycle is not impaired. The trailer does not impose an unusual burden on the rider, especially when the wheels of the trailer are kept well oiled.

A Pocket Safe

CONVERT a pocket flashlight into a purse by simply taking out the battery.

Why the Automobile "Goes Dead"

It frequently happens that an automobile, particularly the Ford car, will stop suddenly and all attempts to "make it go" will prove ineffective. Battery and all other parts of the ignition, the magneto and spark-plugs, seem to be in good condition and yet the car will not "spark." In this case the fault probably lies in the contact-brushes of the magneto. A small particle of dirt, getting under the contact-brush, will effectively stop the car. Examining the brushes in such a case will save much unnecessary work, and a trip to the garage.

The Refreshment Tree

AT Mount Lowe, California, the thirsty visitor has only to turn on a faucet projecting from a large tree near the hotel and water begins to flow. No waterpipes are to be seen and curiosity is aroused at once.

As a matter of fact, the lower part of the tree is hollow, and the pipes were run along underground between the roots and up through the hollow part to a knot hole, where a faucet was attached. Around the faucet the hole was plugged up with cement which looks like the tree itself. Drinking is popular here, perhaps because the visitors think it is the tree of knowledge.

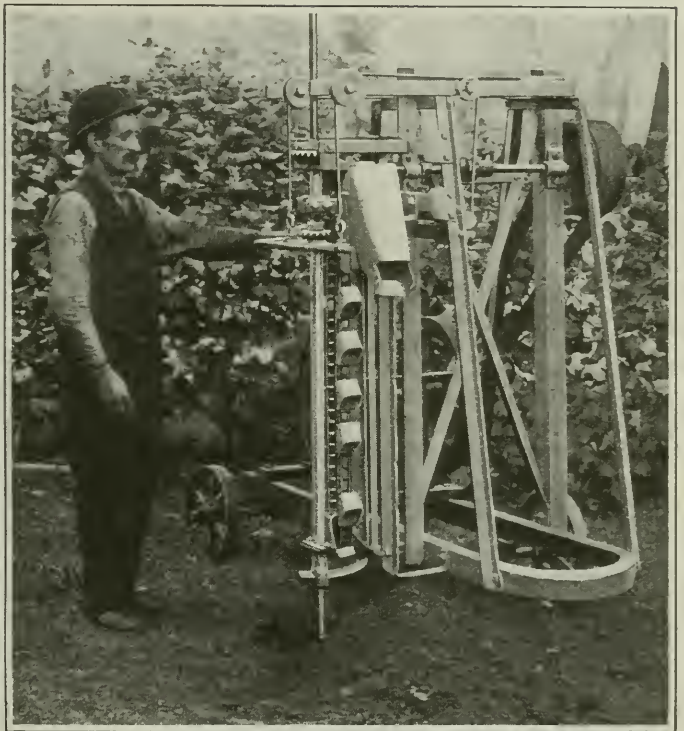
To passers-by the tree is an inexhaustible supply of water. But the source of water is a pipe ingeniously concealed within the trunk of the tree

Ingenious Machines to Work for the Gardener and the Farmer

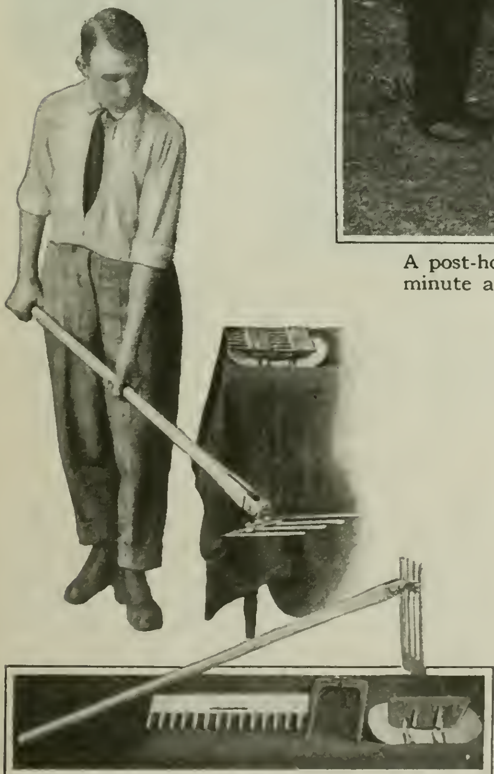
A Whole Garden Kit in One Tool

SEVERAL devices have recently been invented to make the task of creating your own garden agreeable.

A handy new implement capable of many uses has been invented by Joseph De Falco, of Vineland, New Jersey. It may be quickly converted from a hoe into a rake, from a rake into a weeder and from a weeder into a shovel. It has a handle to which any of these tools may be adjustably clamped; besides they can be tilted at whatever angle is handiest. A pivotally-mounted, ridged headpiece and a fastening-guide arranged to engage the teeth, make such adjustments a matter of choice with the gardener.



A post-hole digger of this type will make a hole in a minute and a half. It does the work of fifteen men



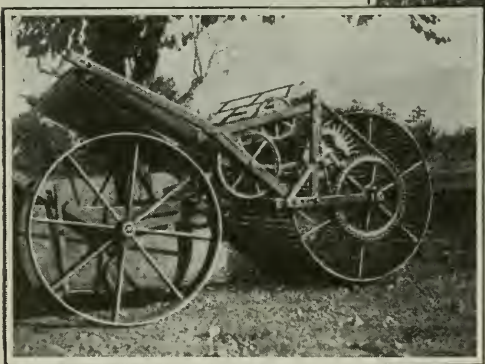
This garden tool is a hoe, a rake, a weeder or a shovel

Digging Fence-Post Holes by Means of a New Machine

FOR the gardener and the farmer a hole-digging machine has been invented by August Enstrom of Rock Island, Ill. Up in New England, where the fertile hills are rocky, there are good farms with perfectly built, picturesque stone fences extending in all directions. Sometimes they have cost almost as much as the farm is worth. A hole-digging machine would have made it easy to put in posts and have wire fences. The farmer could then have put his profits into the banks instead of his straight stone fences. The Enstrom hole-digging machine has a digging or cutting blade fitted on the lower end of a spindle which is driven by various gears from a gas-engine.

The machine also has an endless conveyor-belt with spaces which are constantly carrying up the earth dug by the cutting blade and depositing it in a chute which throws it to one side of the machine. This belt, of course, is also operated by the power from the gas-engine.

The machine is mounted on a truck which can be pulled around wherever the gardener or farmer wants to use it. In fact, the machine does the work of fifteen men. It digs a hole ten inches wide and over two feet deep in a minute and a half. When there are interfering obstructions it takes a trifle longer. The machine can be so adjusted as to make the hole any width desired.

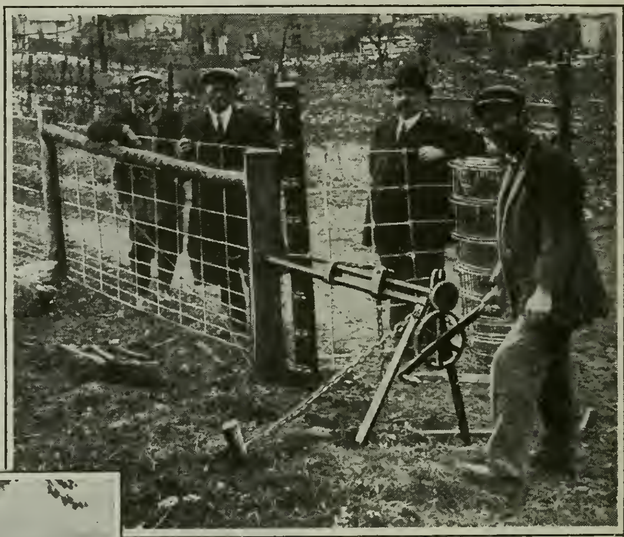


The newest fruit picker is a roller which lifts the fruit up from the ground after it has fallen from the tree

Stretching the Wire Taut

WHEN the holes are dug and the fence posts put in, the next problem is stretching the wire for the fences. C. N. Edwards, of Hillsboro, Ohio, has devised a new wire-stretcher, which is light and portable. It can be readily set up and arranged for use wherever desired for constructing and repairing wire fences.

The various strands of the wire fence are held between a pair of bars which are clamped together on opposite sides of the fence-wires. A chain fastens these bars to the traveler-block of the wire-stretching machine. This traveler-block is screw-threaded and operated on a screw-shaft, which carries a small gear. These gears mesh with a large gear turned by a double crank in the hands of the farmer or gardener. The gears are supported by a two-legged frame which gets further support from a long guide rod which rests against the last fence post.



A new wire-stretcher which pulls the whole of a web fence by one hand-operated gear

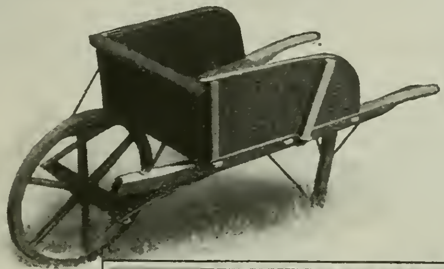
For Gathering Fallen Fruit

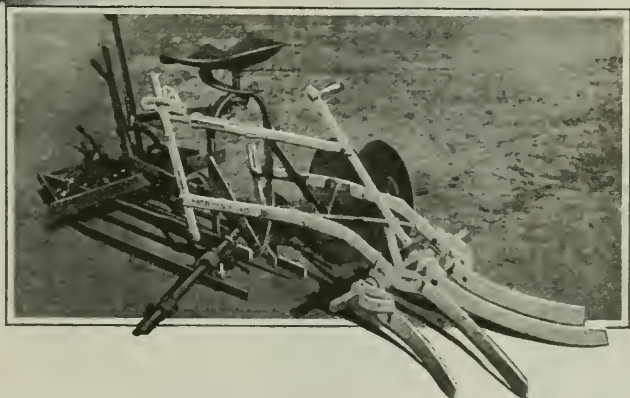
A CALIFORNIA fruit grower, Peter H. Lint of Los Gatos, has devised a machine for rapidly gathering up fruit which has fallen to the ground. A large roller with prongs projecting from it picks up the fruit and transfers it to the box carried by the rack. The machine is pushed along as if it were a huge lawn-mower. It is particularly useful in gathering fruit which has to be evaporated, such as prunes and apricots, and which will not be damaged by being pricked as a result of the novel method of gathering. Many varieties of fruit ripen about the same time on the Pacific Coast and there the machine is especially valuable because the prune-grower is in danger of being left short-handed.

Taking the Bump out of the Barrow

A MAINE inventor, George S. Nichols of Freeport, has taken the jounce out of the loaded wheel-barrow by attaching the ends of the wheel-axle to springs which are fastened to the side bars of the barrow-frame instead of around the axles directly to the ends of the side bars—the usual method. This makes it easy to handle a loaded wheel-barrow. When the wheel bumps against a stone the springs take up the jar instead of the wheel-barrow passing the jolt along to the man behind.

A wheel-barrow with springs takes more kindly to uneven roads than the old-fashioned sort





If this disk-sled attachment is applied to an ordinary sled-harrow, cross-harrowing can be done without a special implement

Making a Disk-Sled of a Harrow

CROSS-harrowing levels the ground, conserves the moisture and eliminates the furrows. A disk-sled attachment, invented by L. A. Gaume of Danville, Kan., can be readily fastened to any make of sled-harrow to do this work. The attachment has a spring pressure device by means of which the large wide ridge that is thrown up by the cutting-disk is divided into four small narrow ridges. The various harrow-knives level the ground, close up the furrows, lessen the work of harrowing, prevent evaporation of moisture from the land and reduce the danger of soil blowing. Any kind of soil may be worked with the attachment.

Effects of the War on German Industries

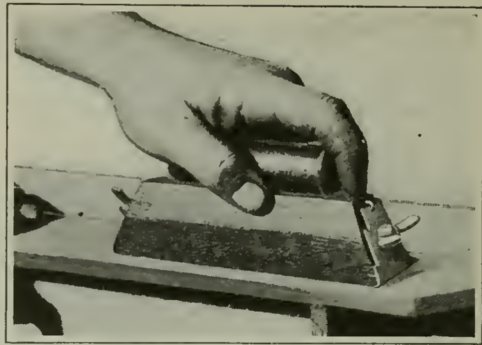
THE industrial situation in Germany has undergone many changes during the course of the war. A great insurance reserve for soldier workmen invalided in war was started so long as ten years ago, but the frightful struggle which is now in progress and its harvest of permanently disabled men were hardly expected. Soon after the war had started, however, the necessity for drastic measures became clear to the men prominent in the manufacturing industries, with the result that a method of developing and utilizing the productive capacity of crippled soldiers was instituted. In carrying out this work, the *Verein deutscher Ingenieure* provides prizes for methods and appliances which will enable disabled workmen to carry out the duties of normal men. Wherever possible, the veterans are returned to their former tasks. Often the problem of finding new employment for them must be solved.

The large iron, steel and machinery plants are caring for thousands of families, the heads of which were formerly employed in their shops. The expense to each concern averages over one hundred thousand dollars a year. It is a remarkable fact that the complicated systems of industrial insurance in existence have been able to make all payments demanded. Sick-benefit funds for the factory employees are already consumed.

A Sycamore Stump for a Lamp Post

IN a Pasadena, Cal., front yard stands an old sycamore stump about ten feet high. A foot or so from the top are the stubs of two branches. The owner of the property has conceived the idea of converting the stump into a lamp post. In the top and at the end of each branch stub he has placed an electric light bulb. These are connected with a source of current in his house by wires that run under the sidewalk and up through the trunk of the tree.

An old sycamore stump which was made both useful and decorative by the simple use of three electric lamps



Waste of sandpaper and of patience is eliminated by this efficient little block

Sandpapering Made Easy

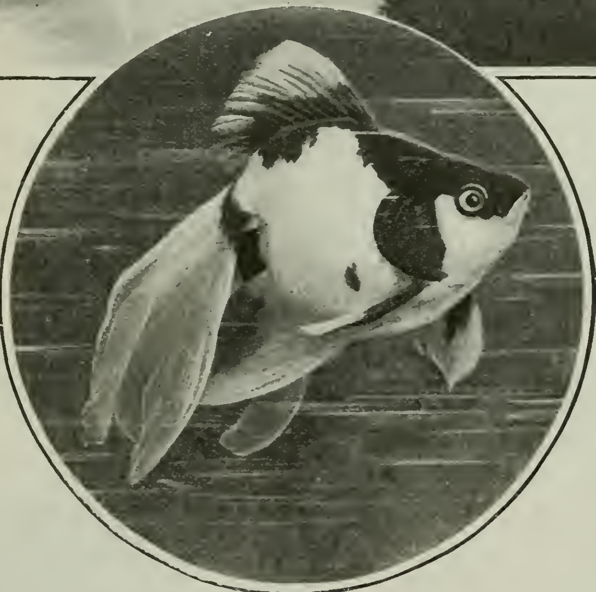
SANDPAPERING has always been a disagreeable job because there has been no convenient device for holding the sandpaper. A sandpaper-gripper invented by Logan H. Fowler of Colony, Kansas, provides a means for holding the sandpaper without crumpling it and without exhausting the patience of the man who is attempting to put the final polish on a piece of furniture.

The sandpaper is stretched over the bottom of a block and fastened by gripping members at each end. The block has a handle which is readily grasped in the hand; thus a convenient tool is provided for the carpenter or the cabinet-maker. It saves time and requires only about one-sixth of the amount of sandpaper generally used.

A Method for Packing Barrels

A DEALER who had at different times a number of barrels to fill with a fine powder, wanted to get as much as possible into each barrel. He hit upon the scheme of placing two lag-screws (about a half-inch by three inches) under opposite edges of the barrel somewhere near the center. By rocking the barrel back and forth a few times it jolted the powder down until it was quite solid. This method can be successfully used for a great variety of articles. Lag-screws cost but little and they will last forever. The square heads keep them from rolling. The screws will fit any size barrel and can be carried in the pocket so they will be handy when needed.

Raising Goldfish by the Acre



Millions of goldfish are raised on this farm. More money can be made out of goldfish than out of grain

Raising goldfish is no lazy man's job. You must wade in and sort out the marketable fish with your bare hands

Photo from life by Dr. R. W. Shufeldt

INTENSIVE goldfish farming is more profitable than cattle-raising, in the opinion of Eugene Catte of Langdon, Kansas. He has ten acres of ponds given over to the raising of the shiny little parlor fish. Millions of goldfish have been reared by Catte since he started in the business years ago, but the demand for goldfish continues to grow.

That fish farming is a paying business when conducted on a wholesale scale is evidenced by the fact that this Kansas farmer has been able to make as much money from his ten acres of goldfish ponds as other farmers from their one hundred and sixty acre farms. In fact, the industry has grown to such proportions that Catte has turned his big grain farm over to his son in order that he himself may devote all of his time to the raising of goldfish.

Years ago Catte started a private fish hatchery on a homestead he had taken up near the foot of the sand hills. He was able to convert some bogs and a spring into a fish pond, where he began raising fish for the market. There soon sprang up such a demand for small fish, however, that Catte found it more paying to turn his attention to goldfish. Now his business has grown to such an extent that his hatchery covers thirteen acres and is composed of fifteen ponds, ten of which are devoted to goldfish.

Catte's busy season begins in the autumn. Most of his time is spent in wading about in high rubber boots, sorting out the marketable fish with his bare hands. This is no lazy man's job. Goldfish farming consists in something more than reading the newspaper on the back porch, waiting for the fish to grow.

Expense in Motion Picture Making

By Albert Marple

IT IS indeed difficult for one who is not on the "inside" of the motion picture business to realize the expense to which a picture company will go to secure effects necessary for the successful filming of a photoplay. Sometimes the setting for a single scene costs hundreds and even thousands of dollars. When it is considered that even a one-reel play consists, generally, of something like fifty scenes, it may be readily understood that the cost of producing even a single reel play is enormous. What, then, must be the outlay for five, six and even seven-reel plays? A few months ago the writer traveled with a company during the making of a one-reel play. It took the company four days to put the play on and, although not a single setting was made for this production, the work being mostly outside the studio, that "one-reeler" cost the company about nine hundred dollars. The joke of it was that after being made and finished, that particular play was "pigeon holed" and, for some mysterious reason, was never copied for circulation among the motion picture theaters. This is but one source of the "incidental" expense of a company.

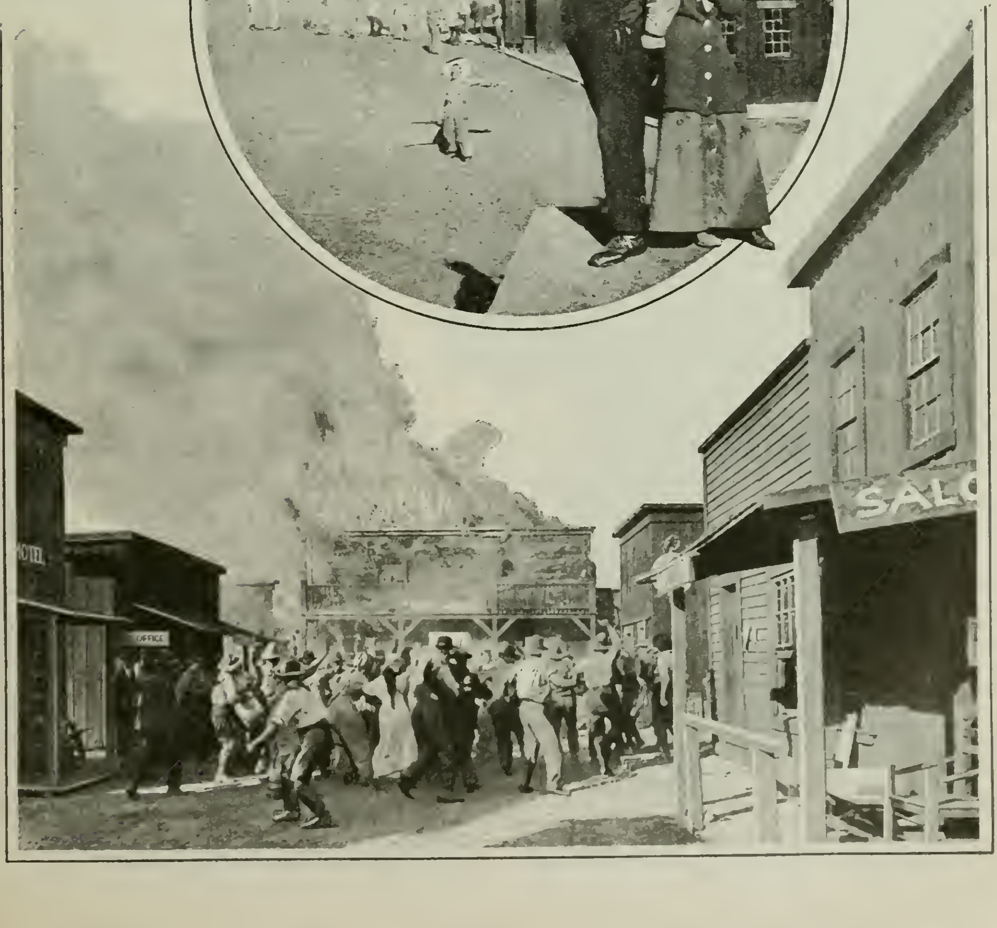
Street scenes cost the most. It is indeed seldom that a scene of this character does not run up into the thousands of dollars. Weeks and months of work will be put upon a street for a single scene. Just as soon as that particular scene has been successfully "shot," down it comes and another "street" rises in its place.

A street scene built for the play, "Terrance O'Rourke" is an exact reproduction of a street in Tangiers, Northern Africa. Employees of the

It took nine tons of powder to make this explosion, the smoke from which clouded the air for two minutes in the resulting motion picture

This "Street Scene in Old London" looks simple, but it was only a little less expensive than transporting the entire theatrical company to London itself. In the circle, a "Master Key" mine scene, all of which was made to order with the exception of the mine dump and railroad on the hill. The Western scenes are naturally less expensive than the reproduction of a European street, but their cost is rather more than would be expected

The Western mining town shown below was burnt at a cost of $1350



picture company combed libraries in search of information concerning Tangiers. After days of labor, assisted by librarians, they found a picture of a Tangiers street. From this photograph, artists constructed the scene. The buildings were made accurately to the scale of the photograph; the fixtures, the rugs hanging from the windows, the awnings, the palms on the roofs, the doorways, and in fact all details of the picture were painstakingly worked up into true dimensions after weeks. A citizen of Tangiers might have imagined himself at home if he had walked down that stage-street. This scene cost the producing company something like fifteen thousand dollars.

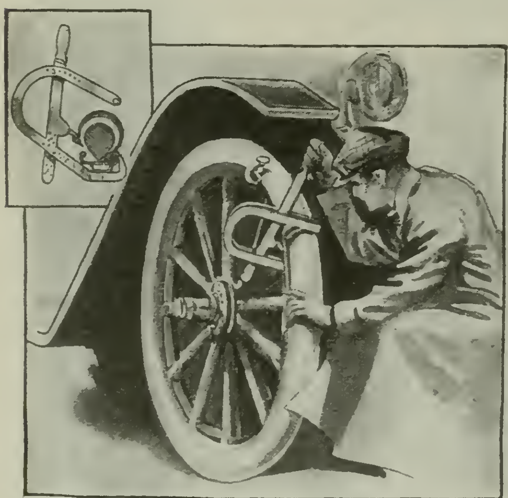
One of the most realistic bits of scenery work done by any company is a "mine." When this scene is thrown upon the screen the general opinion is that the "movie" company simply took possession of an existing mine long enough to make this picture. This mine, buildings and all, were constructed especially. It cost the company between fifteen hundred and two thousand dollars. It was built under the personal supervision of an "old timer," and it was done right. It was used in the "Master Key" serial.

A street used in "The Dumb Girl of Portici," one of the longest pictures ever made, consisting of ten reels, cost the company about ten thousand dollars. The cost here named was for the actual material used and the labor of constructing this street. The street took about three months to build.

People who attend motion picture shows are often heard to remark that "all motion picture fires are 'faked.'" That is not always so. In one film plot a fight starts in a gambling house. A bullet misses its mark and sails through a box of matches standing on a shelf. The matches ignite, the flames spreading to the walls of the building and from there along the entire street. This street cost over thirteen hundred dollars to build.

During a storm on the Pacific ocean the schooner, "Aggie," struck a rock and, after being abandoned by the crew, lay for several hours partially submerged beneath the waves. A film company saw a chance for a very unusual scene. The wreck was purchased, and a large company of actors was rushed many miles to the scene. Launches were chartered and several "takes" made. Later a thrilling play was written around these naval scenes, which, alone, ran up into the thousands of dollars.

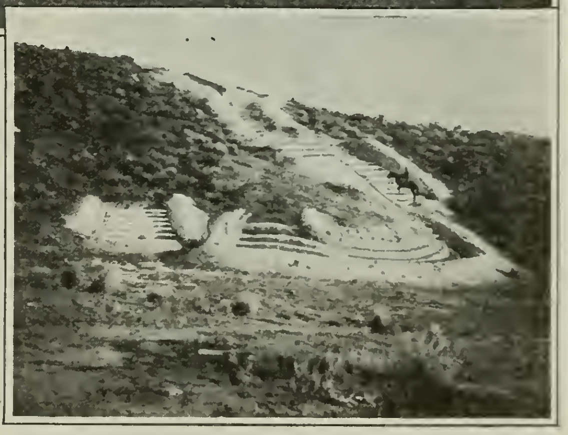
The foregoing has to do almost entirely with the "scenery" for the pictures, the outlay for actors' salaries has not been touched upon, although it is a gigantic item. The weekly salaries of many stars are written in four figures, and most leading actors receive "several hundred per"—week.



A tool which avoids torn fingers and the still more expensive torn tire casings

Attaching Tires to their Rims Easily

A TIRE tool for quickly attaching the casings of automobile and motorcycle tires to their rims has been brought out. A large U-shaped metal clamp passes from above the tire to the under side of the rim. A lever, with a protruding arm, swings from a pivot in the clamp against the edge of the casing that is to be forced into place. By bearing down upon the clamp, the protruding arm of the lever presses the casing into place inside the rim. A number of small holes are bored in the clamp and the lower end of the lever to adapt it for use with tires of various sizes.

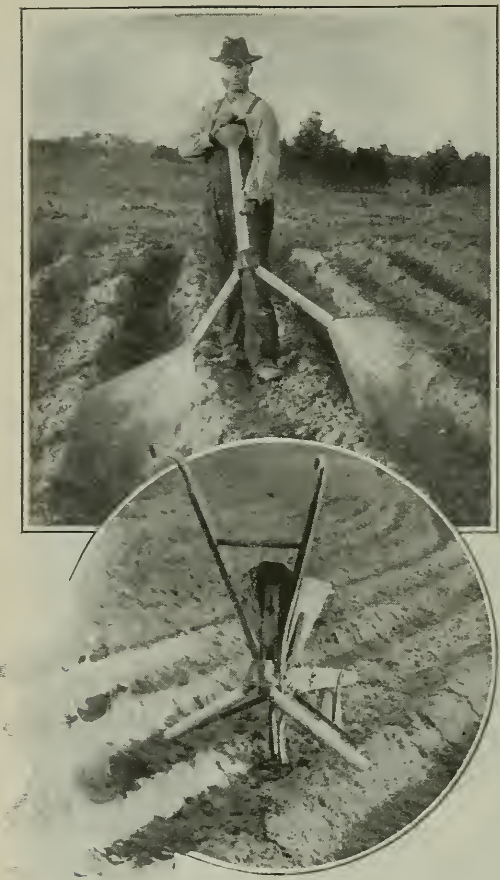


Petroleum Lands in Southern California are worth millions. To acquire them for nothing from the Government, the speculator works them on the plea that they contain gypsum deposits. So they do, but the oil is what he wants. His work, done to meet Government requirements, consists in carving out the stairs and terraces seen in the illustration

Fake Gypsum Claims

ONE of the most fantastic frauds of the times is that which is being perpetrated in acquiring for nothing petroleum lands in Southern California which may be worth from $1,000 to $2,000 an acre. It consists in entering lands underlaid with petroleum under the pretext that they contain valuable gypsum deposits. The gypsum is there, it is true, but it is commercially worthless; however, with the $100 a year "assessment" for work on a claim, it is possible to hold large acreages, while in reality even this hundred dollars' worth of work on most of these claims includes a very liberal estimate for the cost of the labor performed.

The people in the oil country smile very broadly at this assessment work, and, the work accomplished is of no value and is simply to enable the oil man conscientiously to make oath to the fact that he has done or paid for having done $100 worth of work on his claim. Thus there are to be found picturesque amphitheaters and other configurations done artistically in a poor quality of gypsum, and winding stairs leading to nowhere along the hillsides and slopes of the rich California oil fields. In this manner the oil lands are held against all comers until the particular oil speculator or syndicate gets ready to sell the land or finance a company, perhaps, actually to develop it for oil. A single well in any of these great Southern California oil fields may make the fortune of the man who strikes it, some of the gushers having produced upwards of a million dollars' worth of petroleum.



The double spray for fertilizer cuts down the farmer's work one-half. The same machine can be used for planting

Fertilizing Two Rows at Once

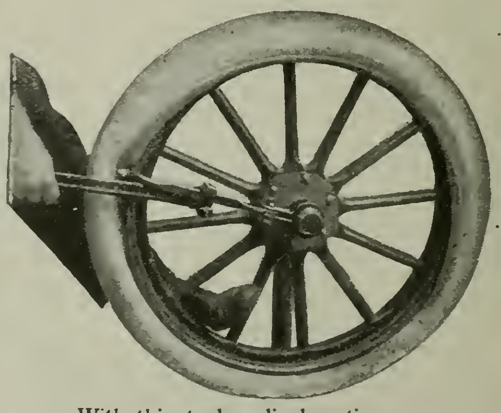
THE farmer or gardener can speed up his Spring work by putting fertilizer into two rows simultaneously instead of merely doing one row at a time. A bifurcated fertilizer spout makes it possible for one man to do the work of two. The device may be attached to any ordinary fertilizer distributer, and its spouts will deliver the fertilizer in opposite directions to the two rows. In some instances planting might also be done in double-quick time with this ingenious device.

Taking Off the Tire in a Jiffy

A TIRE tool, invented by John P. Cunningham, of York, Nebraska, simplifies the usually troublesome undertaking of removing an automobile tire from the wheel-rim. It is especially designed for use in connection with clincher tires. One person can brace his foot against the spoke and easily and quickly pry the tire off with this tool, without soiling his hands.

The device has a bar, the inner end of which is attached to a ring which fastens around the hub to act as a brace. The outer end of the bar has a peculiarly-shaped lateral offset portion, which is inserted between the edge of the tire and the flange of the rim. An operating lever is used by the autoist in conjunction with the other device. The lever has tongues that engage mid-way on the bar of the device that extends from the hub and engages under the tire. The offset portion of the device is worked along the tire by a rotary prying movement. It is then held securely by a ring device that engages around the hub. Then the autoist takes his auxiliary lever in hand, braces his foot against the spoke, spins the wheel around and off comes the tire.

It is almost equally useful in replacing the tire. The only difference is that the tire casing goes inside the upper lug of the offset portion of the tire that swings about the hub. The wheel is turned the same as in removing the tire. The offset lug, being on the outside of the casing, forces it over the rim into its proper position.



With this tool a clincher tire can be pulled off quickly and without damage by one person

The Undependable Fog-Horn

A victim of the freakish fog-signal. The British freighter "Chalcas," feeling her way past Point Wilson, at the entrance of Puget Sound, and guided by the blasts of the siren, suddenly ceased to hear the fog-horn. Before it could be picked up again, the steamer was wrecked and a loss of seventy-five thousand dollars resulted. The siren had kept blowing, but the steamer had entered one of the "zones of silence," and had ceased to hear

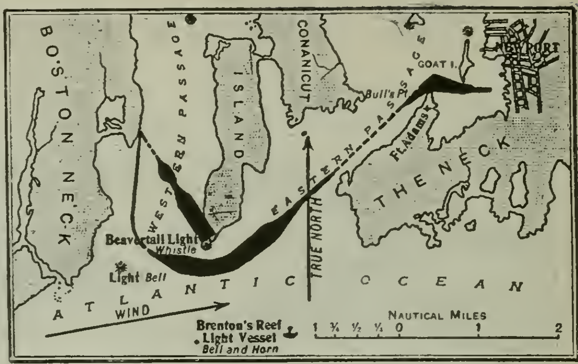
THE caprices of fog-horns present a less serious problem to the navigator than they did before the days of submarine signals, but as the use of the latter device is by no means universal, the erratic behavior of aerial signals is still responsible for many marine disasters.

Whether the signal be a siren, trumpet, whistle or bell, its range of audibility is subject to remarkable fluctuations. A signal under certain circumstances audible at a distance of ten miles, will on occasions be entirely inaudible at a distance of two; or, again, there will be certain zones or regions within a mile or two of the signal where no sound can be heard, while the signal is distinctly heard at much greater distances. These "zones of silence" have often been described, but never fully explained. Moreover, many misleading statements are current in regard to them.

That fog has a blanketing effect upon sound was believed until disproved by the classic experiments of Tyndall at the South Foreland and elsewhere in England in the 'seventies of the last century. Tyndall proved that, in general, sound carries farther in a fog than in clear weather. In the same series of experiments this physicist developed an hypothesis to account for zones of silence and aerial echoes. This explanation lays particular stress upon a supposed "flocculent" condition of the atmosphere, *i. e.*, the pressure of streams of air of mutually different temperatures and humidities, giving rise to invisible "acoustic clouds." Tyndall's hypothesis is, however, not now accepted in its entirety.

About the time of these experiments, similar investigations were carried out in America by General Duane and Professor Joseph Henry. One result of the American experiments for which the investigators themselves were not responsible, was the currency given to the idea that a "zone of silence" surrounding the source of sound is a more or less uniform and permanent phenomenon. Except under special conditions of topography, this is not the case.

A typical case of acoustic fluctuations is shown by one of the accompanying diagrams. On the night of November 6, 1880, the steamer *Rhode Island*, valued with her cargo at $1,000,000, was lost on Bonnet Point, in Narragansett Bay. This wreck occurred only a little more than a mile from the fog-signal at Beaver Tail Point—a Daboll trumpet—which was in full blast at the time, and, under ordinary circumstances, could be heard at a distance of six to eight miles. The conditions of audibility in this region were subsequently investigated by Commander (now Rear-Admiral) Chadwick, U. S. N. His observations were made from a sailboat, in clear weather. (It should be noted that the mere presence of fog has little, if anything, to do with the eccentric behavior of fog-signals. That these acoustic caprices are associated in the popular mind with fog, and often attributed thereto, is due merely to the fact that, except for experimental purposes, fog-signals are only operated in foggy weather.)



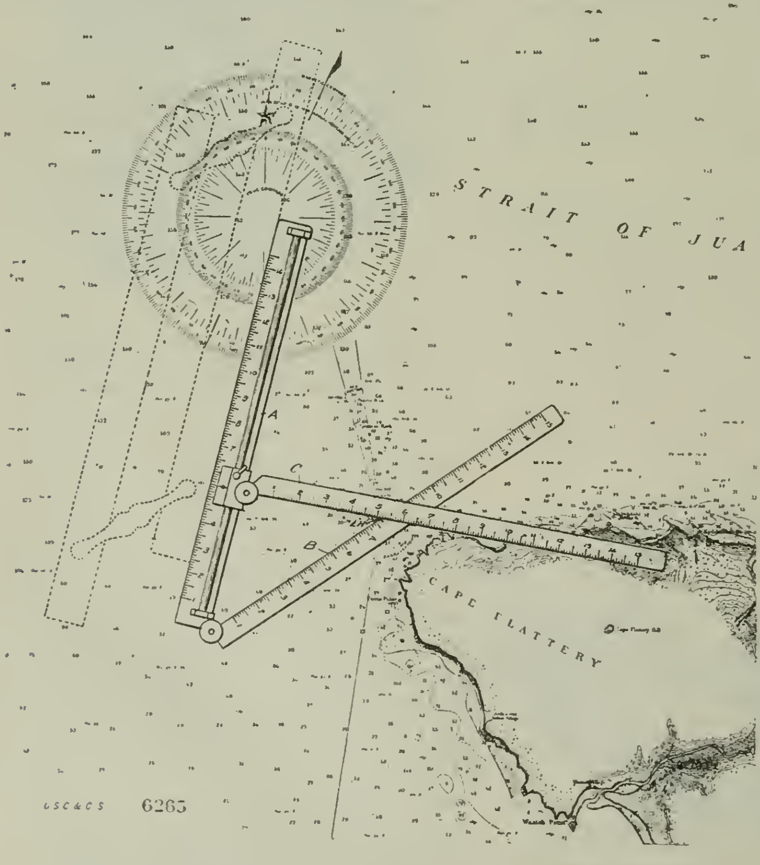
Narragansett Bay, the black lines showing how the audibility of a fog-horn fluctuated

On the accompanying chart the thickness of the line representing Chadwick's route shows the varying degree of audibility of the signal at Beaver Tail Point. The sudden fading away of the sound within a short distance of the signal was, in this case, partly the result of topography (abruptly rising ground behind the signal), and therefore a permanent condition; yet investigations made on another day, with different atmospheric conditions, would doubtless have yielded results differing to a large extent from those here shown.

Refraction, by the wind and by strata of different densities in the atmosphere, undoubtedly plays an important part in the anomalous behavior of fog-signals; but the subject is still obscure, notwithstanding the elaborate investigations that have been devoted to it by Stokes, Tyndall, Henry, Reynolds, Rayleigh, and many others.

The net result of the facts above set forth is that aerial fog-signals serve merely as a poor makeshift, pending the general adoption of submarine signals. Radio signals are also useful in this connection.

A device for utilizing both radio and sound signals to determine



With the fogometer, here shown, both radio and sound signals are used in determining a vessel's position in relation to the lighthouse, thus obtaining more accurate results a vessel's position in a fog, when sufficiently near a signal station, was introduced and patented a few years ago by Capt. W. J. Smith, of Seattle. It is called the "fogometer." The use of this device depends upon the fact that the transmission of a radio signal is practically instantaneous, while a sound signal requires an appreciable length of time to travel through either air or water. Moreover, the speed of sound in air is 1,090 feet per second, at a temperature of 32° Fahr., and increases with the temperature at the rate of about 1 foot per degree. Its speed in sea water is about 4,590 feet per second.

Gaging the Distance of a Ship in a Fog by Signals

Now suppose a vessel to be within hearing distance (by aerial or submarine signal) of a wireless station on shore, the ship having a wireless outfit. If the station gives a sound signal and a wireless signal simultaneously, the distance of the ship from the station can be determined by noting the difference in time between the two signals, as received on board. Capt. Smith has prepared tables showing the distances corresponding to various intervals of time, for both aerial and submarine signals.

The construction and *modus operandi* of the fogometer will be clear from the accompanying diagram. The three rules here shown are graduated in arbitrary units representing nautical miles. We suppose a vessel to be approaching the Strait of Juan de Fuca from the southward, in a fog, within hearing distance of the lighthouse off Cape Flattery, which is equipped with wireless. First her course is laid off as to direction only, with a parallel rule. Calling the lighthouse by wireless she requests the operator to despatch wireless and sound signals simultaneously, and to repeat the dual signal at the end of thirty minutes. The first pair of signals gives the ship's distance from the lighthouse, as above explained. This is, say, 7.7 miles. After thirty minutes the second pair of signals gives the distance as 5.1 miles. The distance run in the interval is found by log to be 5½ miles. We now have the three sides of a triangle, and set the fogometer accordingly, placing the vertex of the appropriate angle over the lighthouse. We next slue the triangle around until the offshore side, *A*, conforms to the edge of the parallel rule containing the course.

Finally, we mark the chart with a pencil point through the aperture at the end of the run (the intersection of sides *A* and *C*), and take a line through this point and the lighthouse, which, with the aid of the parallel rule and the compass rose on the chart, gives us the correct bearing of the lighthouse.

The *distance* of the lighthouse at the end of the run does not, of course, actually correspond to the length of side *C*, unless it should happen that the arbitrary graduations of the rules are identical with nautical miles on the chart; but this is immaterial, as the distance is known from the comparison of wireless and sound signals, as above described.

Objections to the Use of Combined Signals

It must be stated, however, in this connection that the determination of distances from the combined radio and sound signals is, in fact, not so easy as it might, at first sight, appear to be. During the past year the United States Bureau of Lighthouses made observations from the tender *Larkspur*, cruising near the Fire Island Light Vessel, which has a 12-inch steam chime whistle and a submarine bell, and was temporarily equipped with wireless. A report on these experiments states that "the comparatively short ranges of the whistle and submarine bell lead to such a brief difference of interval between such signals and the radio signals as to make highly accurate observations by stop-watches a necessity, thus limiting the usefulness of the method from a practical standpoint."

The Bureau is experimenting to develop an efficient fog-signal using radio only.

Detecting Flaws in Steel

RECENT experiments in this country have shown that with the aid of a Coolidge X-ray tube, defects in steel castings can be detected even through metal of considerable thickness. Radiographs, not a fluoroscope, are used.

Some Jobs You Would Not Want

To get a bird's-eye view of New York city's swarming streets newspaper photographers perch on girders five hundred feet and more in the air

Painting the iron-work of a skyscraper in course of construction. One step and . . .

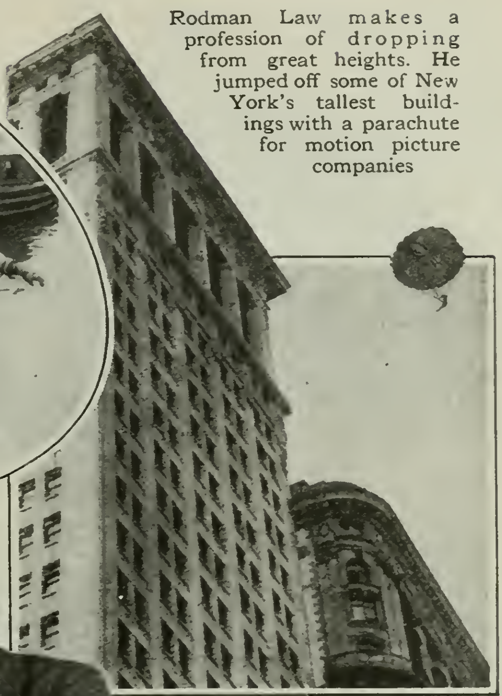
Below, a steeplejack at work on the flagpole of a big New York hotel. Old-time sailors were no more venturesome

Human spiders painting the cables of Brooklyn Bridge. Theirs is an all-year job. But for their work, the bridge would long since have collapsed

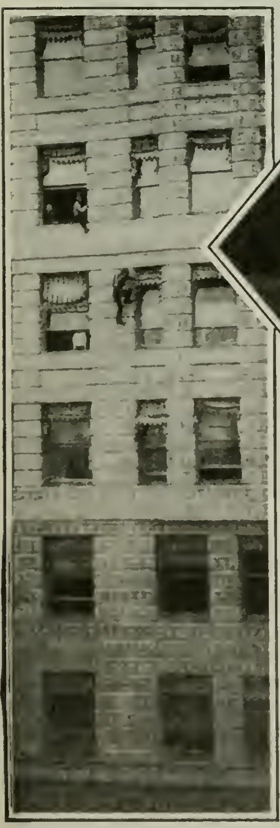
Photos copyright by International Film Service

Some Jobs You Would Not Want

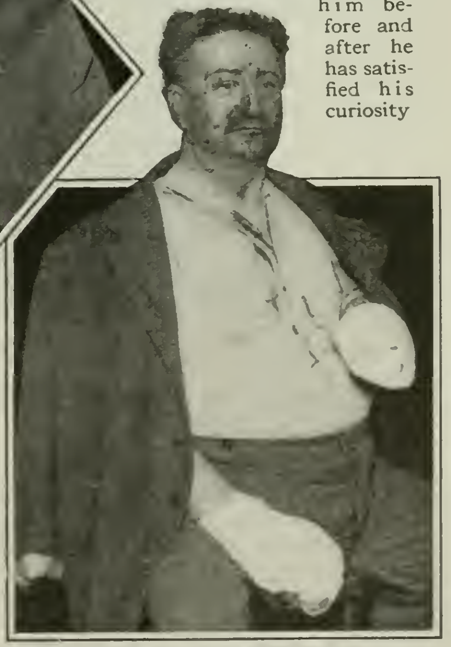
Diver plunging into the Chicago River to recover bodies from the "Eastland's" hold. Many divers risked their lives unhesitatingly in searching for the lost



Rodman Law makes a profession of dropping from great heights. He jumped off some of New York's tallest buildings with a parachute for motion picture companies



Egan, the Chief of New York's Bureau of Combustibles, opens Black Hand and anarchist bombs. The pictures to the left and below show him before and after he has satisfied his curiosity



The man shown in the picture on the left (he is climbing up the side of the Flatiron Building in New York city) claims that he has so perfect a sense of equilibrium that walking up a vertical wall is no more difficult for him than climbing a flagpole

Miniature Ships That Were Built to Prove a Point

IN an effort to show the constant necessity of deepening the channel leading into New York Harbor, the War Department has had an interesting fleet of perfectly modeled miniature ships made by H. E. Boucher of New York, ranging from the S. S. *Dreadnought* of nearly a century ago to the S. S. *Vaterland* of the present day. Other miniature ships in this fleet are the *Britannic*, *Borussia*, *Arizona*, and *Oceanic*, with drafts of from sixteen feet in the case of the *Dreadnought* to thirty-eight feet in the case of the *Vaterland*.

The steamers of the world's history, in exact relative proportions, are shown in a War Department model. The whole story of the steamer's development is graphically shown in tiny compass

The intention of the War Department is to prove that the increase in size of ocean vessels with their consequent increased draft means that sea harbors, to be adequate, should be dredged continually.

Pure Water for Six Hundred Thousand People

A SYSTEM of supplying pure water to the community between Buffalo and Lake Ontario, now using the water of the Niagara River, which is contaminated by the City of Buffalo, has been planned by an engineer residing at Washington, D. C.

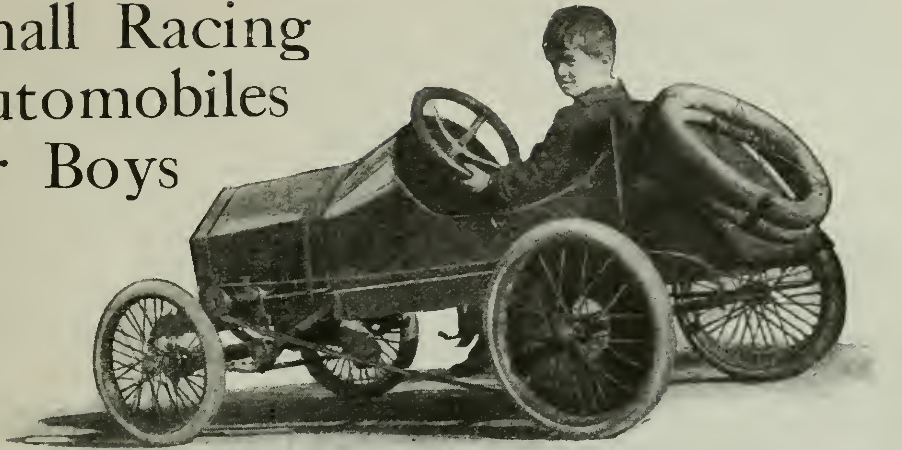
Not only will his water system furnish water to the cities on the lower level, but it will also serve as a source of power for manufacturers. Another important feature involved in his plan is to conserve the scenic beauty of Niagara Falls, which is now being seriously threatened by power plants. The scheme is to construct a canal between Lake Erie and Lake Ontario and provide adequate locks to compensate for the fall in water level so that the canal can eventually be used for traffic. More important to the people on the lower levels, however, than its use for power and traffic, is the prospect of an unlimited amount of fresh, pure water.

Numersous cities cast their sewage into Lake Erie so that its lower end is unfit for human consumption. From a technical standpoint, one of the most interesting phases of the proposed project is the way of reducing the danger now existing.

The canal will have two intakes, one above the city of Buffalo and the other below it. The latter conducts away the sewage from the city so that the towns farther down the river are most effectively immunized.

Another advantage of the canal will be its provision of a safe harbor at either end. The power plant which is proposed to do away with much of the water diversion at the Falls will be located at the end of the canal, overlooking Lake Ontario.

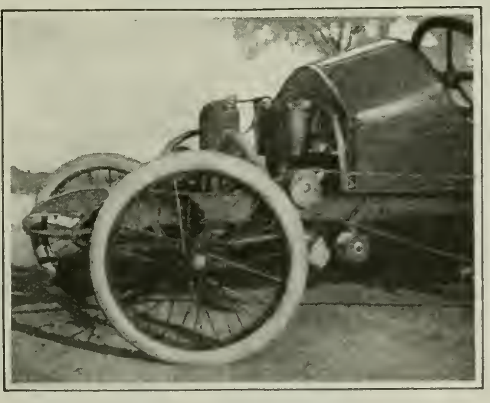
Small Racing Automobiles for Boys



A boy can now have an automobile just suited to his size

TO supply the demand for small runabouts for boys, a factory has been built in Culver City, California, where one-passenger cars are made with a simple mechanism easily mastered by a young driver. They are good for a speed of twenty miles an hour and can carry a weight of five hundred pounds.

The selected ash frame is three by one and one-half inches, with bolted angle-iron joints. The suspension is on four springs. A two-cycle engine is used, air-cooled, governor control, and the ignition is by coil and batteries. Power is transmitted by a flat belt.



Every unnecessary feature is eliminated so that a boy can take care of his car without the aid of a garage-keeper

Every needless feature is omitted in order to make a car which the small boy can learn to run, without too many complicated attachments to puzzle him. It was designed by Pendleton, the inventor of the electrical timing system of recording speeds—a man who has always taken a great interest in miniature racers.

Watering the Oyster

SOME fish dealers add fresh water to oysters to increase their size. The oyster when put in fresh water will "drink" or absorb considerable water and will increase in size in proportion. As oysters are usually sold by the pint or quart, any increase in their size due to the addition of water enables the dealer to fill the measure with a smaller number of oysters.

If four quarts of oysters and one quart of fresh water are placed in a container and the mixture allowed to stand for several hours, there will appear to be five quarts of dry oysters, for the container will be full and there will be little or no water in sight, as it is on the inside of the plump, succulent looking oyster. The average purchaser has no means of detecting the addition of water. The chemist, however, by determining the amount of water in the oyster and comparing it with the amount that an oyster normally contains, can readily detect the adulteration.

Increasing the bulk with water is not confined to shucked oysters. Some dealers float the oysters for several hours while yet in the shell in fresh water.

A newspaper holder that looks like a sword, made for Army and Navy clubs

Army and Navy Clubs Please Notice

A MAGAZINE and newspaper holder made in the form of a sword has been created by a famous furniture maker of New York. A personal design of his own, it is executed by hand, and the blade is a knotted branch split down the middle and stained a French gray. The handle, like a sword-hilt, is made of woven willow and fits the hand comfortably. The whole contrivance is singularly light and easily handled, and the usual long handle of such devices, which makes it difficult to use them comfortably, is eliminated. The new newspaper holder is in fact more easily held than a paper which is not so protected.

The hilt is black, in attractive contrast to the gray of the "blade." The device has already found its way into many clubs.

Music While You Work

A DRY-CLEANING establishment in Cincinnati has come to the conclusion that if its employes hear music at frequent intervals while they work it will not only make them happier, more contented and better workers, but that they will accomplish more than if they were without it.

Working upon this theory, there have been installed throughout the big establishment enough phonographs to keep lively music playing most of the day.

The records are selected with care, lest a funeral selection, a dreamy waltz, or a Sextette from Lucia should creep in. There are many lively dance records and popular songs. The workers hum and sing to the lively music and the speed of the music puts the speed into their work.

The music-while-they-work is said to be a South American idea, where music is recognized as a necessity of life.

If the regimental band makes soldiers step lively, why shouldn't this phonograph make ironing easier?

A Motion-Study Stopwatch Which Does Its Own Computing

IN the factory and other industrial establishments where accurate data are demanded as to costs and the time of mechanical operations is required, the stop-watch has become as much a part of the equipment of the plant as the engine or motor which drives the machinery. For a long time the ordinary stop-watch which was designed for the race-track was employed. It answered the purpose, but after it had been used the real work began. It was necessary to enter into a more or less lengthy computation in order to arrive at the output per hour or day.

With this watch the workman can fill out his time sheets accurately, and allow for an exact counting of time cost, which before has been an uncertain quantity in auditing

There has been recently introduced into this country, from the factory of a Swiss watch-maker, a time-study watch by which it is possible to arrive at the conclusion directly without resorting to the use of paper and pencil or even undertaking any mental calculation. It answers the demands of the professional rate-setter as well as the factory manager who wants only a reasonably close approximation. The dial is divided into tenths and hundredths and in addition to these desirable features, it contains figures spaced two-hundredths of a minute apart to indicate at any point of elapsed time exactly what the corresponding output per hour is. If the hand is stopped over .36 of a minute, the reading directly under it shows that the output is 167 per hour.

In the manufacturing business it is often desirable to know exactly what time is required in the performance of a particular piece of work. When an employee sees that the stop-watch is being held on him he will often lag so as not to set too swift a pace for himself. By the use of this watch it is possible to determine accurately the exact time spent in "loafing" and that actually required to perform the operation. Assuming that an employee performs a certain group of movements in an elapsed time of eleven minutes, a part of which time is known to have been wasted. The observer will follow up his first observation with another, stopping the watch during the fractions of the minute which the employee wastes by unnecessary movements or loafed time; the result obtained will be the actual time required for the performance of the task under imvestigation. The watch is started and stopped by the movement of the slide on the edge of the watch. For rapidly calculating time in efficiency tests, this watch cannot be equaled.

A Suitcase on Wheels

PORTERS and ambitious boys are wishing that some kind censor would prohibit the manufacture of a new suitcase carrier, for should the use of this ingenious device spread broadcast, the familiar cry, "Carry your bag, Mister?" will become a thing of the past.

A pair of wheels is set on a standard that may be quickly fastened to a suitcase, as shown in the illustration. An extra handle is attached to the end of the case, and the bag is wheeled along the ground with no more exertion than is required to wheel a riderlessbicycle.

No need to hire a red-capped porter if you have wheels like these on your suitcase

A farmer built a record silo tower and now finds that a windmill on top catches every breeze that blows

A Silo and Windmill Tower in One

SILOS have been built by the thousands within the last few years, but few farmers have made use of the combination shown in the illustration. This is a two hundred-ton silo of hollow-tile block construction which supports the farm's windmill tower. The photograph shows how the silo is filled with green corn in the autumn.

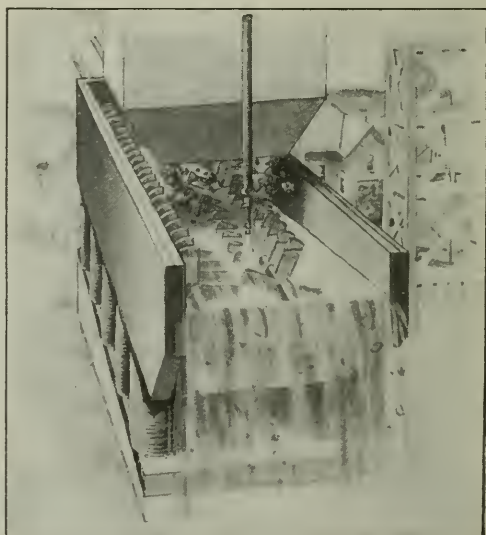
The silo walls, five inches thick, are made of hollow clay blocks, with each mortar joint re-enforced by a heavy wire. The door-frame is of concrete re-enforced with vertical rods, to which the wall-re-enforcing is tied. The roof is of concrete and metal lath, thus making the entire structure fire-proof, and wind-proof. Dead-air spaces make the walls impervious to moisture and reduce the loss from freezing to a minimum.

It is now a common practice among farmers to buy a twelve or fourteen-inch cutter co-operatively and to use it on five or six jobs in a season in filling silos. Such outfits have a capacity of from eight to ten tons per hour. One corn-binder is required in the field to keep the crew busy. Two men are employed in the field loading the cut corn bundles, and from three to five teams are needed to haul the corn to the cutting machine at the silo. This method has proved to be the most generally practised throughout the corn-belt states.

A Magnetic Machine Which Saves Waste Iron

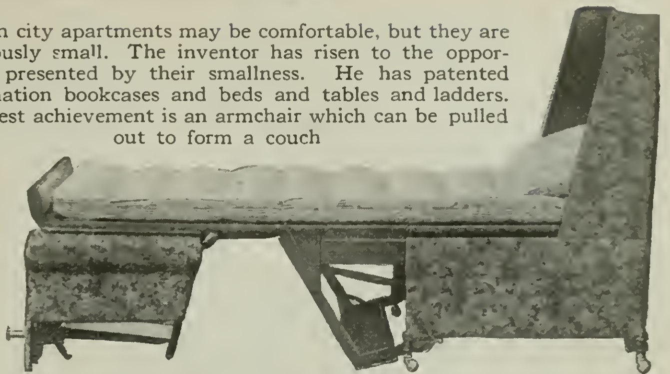
IN order to separate the tiny grains of ore from the lumps of gravel and sand, after the final washing process, thereby saving iron that would ordinarily go to waste, a magnetic ore machine has been developed which may substantially increase the income of mining properties.

The sand, gravel and finely divided iron particles are washed through a long trough beneath which a series of powerful electromagnets are situated. As the liquified mass slowly flows forward, the iron grains are drawn to the bottom of the trough and retained, because of the power of the magnets, against the floor of the containing walls.



Iron in the water is caught on the magnetized walls of the sluice-box, with a saving of many hundreds of dollars

Modern city apartments may be comfortable, but they are notoriously small. The inventor has risen to the opportunity presented by their smallness. He has patented combination bookcases and beds and tables and ladders. His latest achievement is an armchair which can be pulled out to form a couch



This Chair Does Duty Twenty-four Hours Every Day

IN this day of compactness, both in cramped city flats and suburban bungalows, a piece of furniture serving two purposes is in demand. A chair has been designed which, in emergencies, converts a parlor or dining room into a bedroom. It may do regular service in any room when a family has outgrown its bedrooms and cannot afford the additional rent of a larger apartment.

As a bed this chair, which does duty twenty-four hours a day, has good steel springs and a real mattress. It is large enough even for a tall man. It is opened by a single motion.

Finger-Saving Nutmeg-Grater

THOUGH a cook has ten fingers, that does not lessen the pain if one of them be hurt. Grating nutmeg in the old-fashioned way often means grating fingers in an old-fashioned way. To avoid this a little device is available for the up-to-date cook.

A metal case holds the nutmeg and a cap presses it firmly against the rough, abrading surface. All the cook has to do is to hold the handle of the contrivance safely in one hand while turning a little crank with the other. The rotary motion makes the grating continuous and rapid and one's finger tips need never touch the grater.

Though designed especially for nutmegs, this little device may also be used for grating other small objects, such as vegetables.

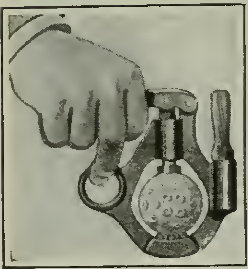
To Take Olives from a Bottle

AN implement which is used to secure the elusive olive in the bottle is shown in the illustration. It may also be used to remove cherries, pickles, chow-chow, lump sugar, nuts and the like. It clasps small objects firmly and eliminates the trouble of fishing in the bottle in a vain endeavor to spear the contents.

A Holder for Milk Bottles

HERE is a holder for the milk bottle that will save stooping, for the holder can be attached to the wall or door post. A pair of looped arms at the top forms a spring-clamp to engage the neck of the bottle. The spiral spring in which the holder terminates provides a support for the bottom of the milk bottle, holding it firmly in place.

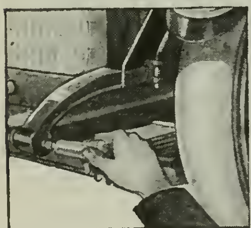
Mark Your Golf-Ball with Your Initials



A MARKER used for stamping the initials of the owner on golf-balls is shown in the illustration. Either two, three, or four initials may be marked. The type is inked by rolling the pad over it; then the lever is pressed firmly down, the middle finger in the ring giving sufficient purchase. If desired, the ball may be marked in two or more places.

The marked balls are very useful in preventing disputes as to ownership on crowded public courses, but also serve to clear up doubtful points as to ownership of lost balls and the like on private grounds.

Interchangeable Motor-Car Grease-Capsules



OIL holes on automobiles are a thing of the past and the later screw-down grease-cup, now universally used on automobiles, is apparently doomed to oblivion because of an exceedingly simple and effective device invented recently by an Englishman. It consists of a collapsible lead capsule, which is screwed on to parts that need grease lubrication, in place of the grease cup. Finger pressure on the capsule is sufficient to force grease into the bearing or part to be lubricated, and when the capsule is emptied a new, ready-filled one is screwed in its place. The old one is thrown away. No dirt, no grease, no loss.

The screw-thread, which takes the capsule and keeps it firmly during travel, is fastened to the part, instead of the grease-cup. It is made of brass and forms a grease-tight joint. Most of the parts lubricated by grease-cups are out of sight on the automobile, but even where visibility is desirable, the collapsible tubes can be used. It would be necessary to provide them with light brass or plated caps, where they are in exposed positions.

New Device Distills Water for the Home

FOR the housewife who wishes to make sure that her family is drinking pure water, a new water-distiller, recently placed on the market, should prove acceptable. The device is made of copper and is lined throughout with tin, as this metal is chemically unaffected by distilled water. The still consists of three drums, which comprise the boiler, the reservoir for distilled water, and the condensing chamber.

To obtain distilled water, the boiler and the cold water chamber are filled, and the still is placed upon the stove. The distilled water falls into the reservoir through a water seal. This seal is an important improvement, because it confines the steam from the boiler, thus increasing the pressure in the condensing-chamber and giving twenty-five per cent more condensation for the same amount of heat. The distilled water may be drawn off at any time through a faucet, the water in the cooling-chamber flowing into the boiler to take the place of that drawn off.

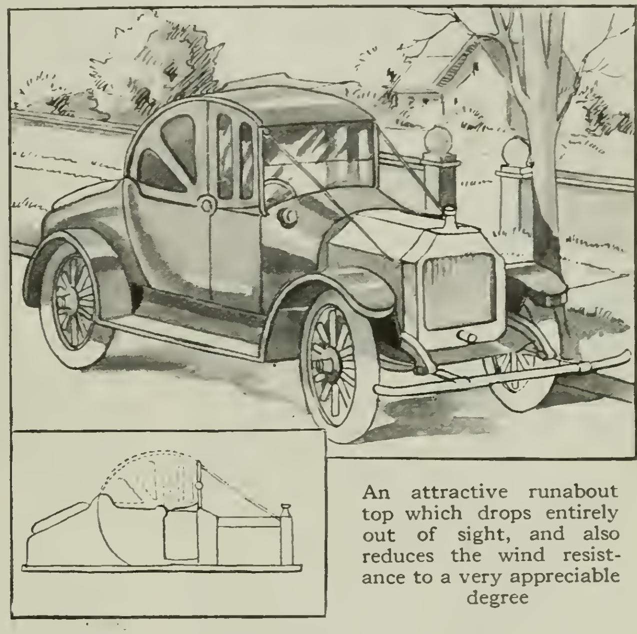
Deep Center-Punching

IN the boiler shop, where heavy center-punching is done, as on heavy tank and boiler heads and plates, the layer-out may save time and physical energy by the use of a center-punch that fits into a light pneumatic calking hammer. This can be easily made from any of the various air-tools that have been discarded.

A Disappearing Automobile Top

AN automobile top that drops out of sight behind the driver and passengers when not in use is the ingenious idea that a Colorado man proposes for the automobile manufacturer who desires in his product the utmost in simplicity of appearance. Another advantage of this top is the decrease in wind resistance of the car.

No part of the top protrudes from the car when it is down. The top is circular, being pivoted at either side. The pressure of small levers is sufficient for raising and lowering it with little difficulty. For touring car bodies two tops are necessary, one of which drops into a depression behind the driver's seat, the other disappearing into a similar pocket behind the rear seat.

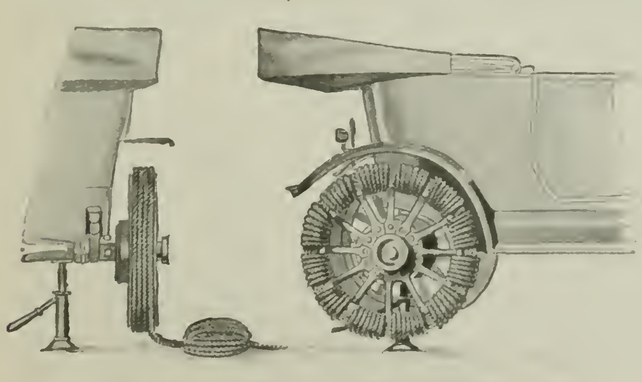


An attractive runabout top which drops entirely out of sight, and also reduces the wind resistance to a very appreciable degree

An Emergency Tire Made Simply of Rope

WHEN a blowout occurs on the road and no spare tube or shoe is on the car and the blown tube or casing is beyond further repair, the usual method of procedure is to run to the nearest garage on the rim. In every case this means positive destruction of the rim, if the casing is removed, and the serious damage of the rim or the destruction of the shoe, if it is left on the rim in an entirely deflated condition.

The inconvenience caused by the accident may be eliminated to a great extent by following the tactics of a driver who, instead of running in on the bare rim, purchased some rope from a nearby farmer and wound it tightly around the rim, felloe and spokes, as shown in the accompanying illustration. The first few turns of rope were wound circumferentially; the remainder was wound crosswise, so that holding places were obtained at four or five spokes. Sufficient rope was used to make the thickness of the novel tire equal to that of the rubber casing.



A rope will get you home safely when you have a blowout, if you follow directions given above

If properly wound, the rope-tire will not make riding very uncomfortable; in any event it is better than destroying a rim.

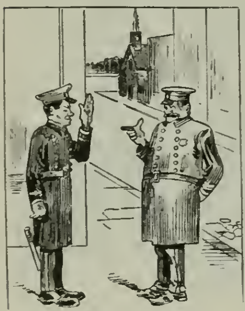
Many drivers, instead of using a covering of rope or other material, have been successful in saving the rim by stuffing the blown-out outer casing. In a few instances, grass or straw has served the purpose well, and in others old rags or other soft material, such as paper.

A Medley of Puzzles

By Sam Loyd

Off His Beat

"WHAT time of the morning is it?" asked the roundsman. It was then that Finnegan's mathematical bump stood him in good stead; for, being a few minutes late on his beat, he clouded the situation with the following truthful reply:



"Just add ¼ the time from midnight until now to ½ the time from now until midnight, and it will give you the correct time."

Can you figure out the exact time Finnegan made his speech?

Cheese and Crackers

CHEF LOUIS is showing the exact ratio in which cheese and crackers should be consumed. Says Louis:

"The balance board, which weighs ½ as much as the cheese has 4/5 of its length on one side of the balance point. Now what is the ratio between these quantities of cheese and crackers?"

This problem is literally a lesson in "balanced rations," which you can easily solve by a simple algebraic principle.

At the Auto Races

AN interesting question arose the other day at the Auto Races when three of the speed experts started on a hundred-mile race. A member of the sporting fraternity offered the odds of 20 to 1 against anyone's guessing the complete result of the contest. While the odds appeared to be surprisingly generous, an onlooker who prides himself on his aptness at figures claimed the bookmaker would have the advantage of such a wager.

Remember that one, two or all three of the cars might fail to finish. Then again, that all three might cross the finish line together, or that two might finish in a dead heat, etc.

Can you figure out in just how many varied ways the race might have terminated?

At the Stamp Window

UNCLE SAM'S postal clerks in an ordinary day's turn at the stamp window are confronted with all sorts of perplexing problems which they are expected to solve off-hand without betraying the mental gymnastics required.

One of these bright young men tells how the other day the cashier of a large mail-order house which buys in quantity, tossed a banknote through his window and said:

"Give me some 1-cent stamps; three-fourths as many 2's as 1's, three-fourths as many 5's as 2's and five 8-cent stamps for the balance of the money."

Can you tell the denomination of the banknote?

The postal clerk did not even have to use a pencil and paper, though you may, if necessary.

CASH PRIZES FOR PUZZLE SOLUTIONS

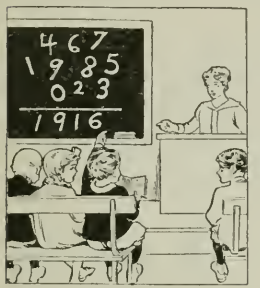
Fifteen Dollars in prizes will be awarded for solutions of the puzzles appearing on these two pages. The first prize of Five Dollars will be paid to the reader who makes a perfect score. Ten prizes of One Dollar each will be awarded to the first ten who send in meritorious answers. Should there be more than one perfect set of answers, the first prize will be paid to the reader whose letter was mailed first: the postmark will guide us in determining the mailing date. Answers to the April puzzles will appear in the May number. Names of the winners of the prizes in the June number.

Send solutions to Sam Loyd, Care POPULAR SCIENCE MONTHLY.

The solution of the March Puzzles appear on the opposite page. The names of the winners of the March prizes will appear in May.

Juggling the Digits

THE schoolmistress set a very pretty problem in simple addition for her class when she said, "I want you to arrange the digits 1, 2, 3, 4, 5, 6, 7, 8 and 9 and 0 in a sum which will total 1916. The use of fractions, proper or improper, is permissible so long as the sum total, when finished, will be exactly 1916."



Can you juggle the digits into the desired arrangement?

How Old Was Jimmie?

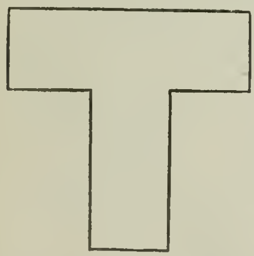
ON registration day in the public schools Jimmie Jones, brother of the famous Ann, smoothed down his hair and looked somewhat quizzically at the teacher when she asked him how old he was. Finally he replied:

"When I was born my sister was one-fourth the age of mother; sister is now one-third as old as father and I am one-fourth of mother's age. In four years I shall be one-fourth as old as father."

How old was Jimmie Jones?

Dividing the Farm

FOUR heirs to a piece of land formed like the accompanying outline of the letter T, brought their plans to a surveyor's office for instructions in carrying out provisions of the will, which were that each heir was to receive a piece of land of a uniform shape and size. The surveyor gave them the startling information that it was impossible to divide the actual land according to the terms of the will, but that he could divide the paper plan of the property so that it would conform to the terms, that is, he could cut the diagram into four pieces of the same shape and size.



Can you show how he accomplished this task?

On the African Firing Line

THE Zulu Chief found a cocoanut and threw it at the monkey. Said the monkey as he threw two in return, "I can't catch but I am great on the pitch."

Every time the Zulu threw one cocoanut the monkey tossed back two.

Since all the cocoanuts used in the engagement can be seen in the picture, who can tell just how many cocoanuts the Zulu had thrown when the artist snapshot him?

Answers to March Puzzles

THE PRESIDENTIAL PUZZLE

Candidate D jumps to square 7, removing man A; E jumps to square 8, removing B; C jumps to square 4, removing E and C again jumps to 10, removing D; F then jumps over C and lands in the White House on square 5.

PUZZLING KUGELSPIEL

Analysis will show that the first player must knock one pin from the 8 group, leaving groups of 7, 3, 4. He will then be able in successive plays to leave the following winning positions against his opponent: (2, 4, 6) (1, 4, 5) (1, 2, 3) (1, 1, 1) or the doubles (4, 4) (3, 3) (2, 2).

THE COST OF A VILLA

The Smiths' new home cost $2,253. The paper-hanger's bill was $148; the painter's, $230; the plumber's, $260; the mason's, $420, and the carpenter's, $444, a total of $1502. The lot cost $751.

AN ELEPHANT ON HIS HANDS

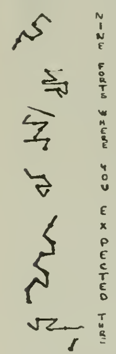
The data of that unconsummated elephant deal reveals the fact that the would-be seller asked five rupees for his animal, and that the prospective buyer's best offer was less than nothing, for he asked a bonus of three rupees to take the beast, which you see would be eight rupees less than asking price. Then the seller came down twenty per cent to four rupees, but there remained a difference of seven rupees between them and no deal.

My Adventures as a Spy

By Lt.-Gen. Sir Robert Baden-Powell

The author of this article is a famous British officer. Having joined the 13th Hussars at the age of nineteen, he served in India and South Africa, became distinguished in the Matabele campaign in 1896–7, and won fame in the Boer War for his brilliant defense of Mafeking in spite of famine, sickness and the lack of troops. None of his varied experiences are more interesting, however, than his exploits as a spy. Many of these episodes are related in his latest book ("My Adventures As a Spy," J. B. Lippincott Co.), from which this article is taken.—Editor.

IT has been difficult to write in peace-time on the delicate subject of spies and spying, but now that the war is in progress and the methods of those much abused gentry have been disclosed, there is no harm in going more fully into the question, and to relate some of my own personal experiences.



These hieroglyphics contain a secret message which can be easily read by those who know the semaphore signaling code, which consists of swinging two arms in different positions, either singly or together. The dots indicate where the letters join. For example: The semaphore sign for N consists of both arms pointing downwards at an angle of 90°. The letter I is shown by both arms pointing to the left at the same angle. The next N is shown again, and the letter E is a single arm pointing upwards on the right at an angle of 45°. In each word you read downwards.

As a first step it is well to disabuse one's mind of the idea that every spy is necessarily the base and despicable fellow he is generally held to be. He is often both clever and brave. Let us for the moment change the terms "spy" to "investigator" or "military agent." For war purposes these agents may be divided into:

1. *Strategical* and diplomatic *agents*, who study the political and military conditions in peace time of all other countries which might eventually be in opposition to their own in war. These also create political disaffection and organize outbreaks, in order to create confusion and draw off troops in time of war.

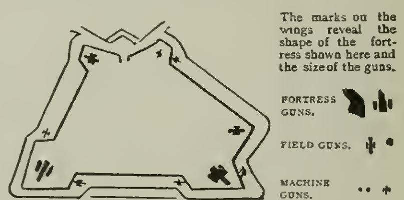
2. *Tactical*, military, or naval *agents*, who look into minor details of armament and terrain in peace-time. These also make tactical preparations on the spot, such as material for extra bridges, gun emplacements, interruption of communications, etc.

3. *Field spies*. Those who act as scouts in disguise to reconnoiter positions and to report moves of the enemy in the field of war. Amongst these are residential spies and officer agents. There are also traitor spies. For these, I allow, I have not a good word. They are men who sell their countries' secrets for money.

Tactical Agents

In addition to finding out military details about a country, such as its preparedness in men, supplies, efficiency, and so on, spies have to study the tactical features of hills and plains, roads and railways, rivers and woods, and even the probable battlefields and their artillery positions, and so on. The Germans in the present war have been using the

This sketch of a butterfly contains the outline of a fortress, position and power of guns. Only the marks *on* the lines are significant



The position of each gun is at the place inside the outline of the fort on the butterfly where the line marked with the spot ends. The head of the butterfly points towards the north

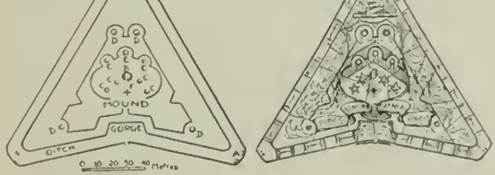
huge guns whose shells, owing to their black, smoky explosions, have been nicknamed "Black Marias" or "Jack Johnsons." These guns require strong concrete foundations for them to stand upon before they can be fired. But the Germans foresaw this long before the war, and laid their plans accordingly.

They examined all the country over which they were likely to fight, both in Belgium and in France, and wherever they saw good positions for guns they built foundations and emplacements for them. This was done in time of peace, and therefore had to be done secretly. In order to divert suspicion, a German would buy or rent a farm on which it was desired to build an emplacement. Then he would put down foundations for a new barn or farm building, or—if near a town—for a factory, and when these were complete, he would erect some lightly constructed building upon it. There was nothing to attract attention or suspicion about this, and numbers of these emplacements are said to have been made before war began. When war broke out and the troops arrived on the ground, the buildings were hastily pulled down and there were the emplacements all ready for the guns.

A smart piece of spy work. Veins on an ivy leaf show the outline of the fort. The tip of the leaf indicates north

Officer Agents

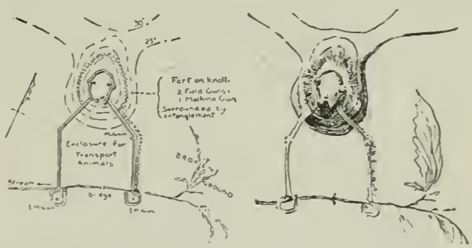
It is generally difficult to find ordinary spies who are also sufficiently imbued with technical knowledge to be of use in gaining naval or military details. Consequently officers are often employed to obtain such information in peace time as well as in the theater of action in war. But with them, and especially with those of Germany, it is not easy to find men who are sufficiently good actors, or who can disguise their appearance so well as to evade suspicion. Very many of these have visited England's shores during the past few years, but they have generally been noticed, watched, and followed, and from the line taken by them in their reconnaissance it has been easy to deduce the kind of operations contemplated in their plans.



A sketch of a triangular fort was transformed into a stained glass window design, with certain of the decorations signifying the location and sizes of guns

Catching a Spy

Spy-catching was once one of my duties, and is perhaps the best form of education towards successful spying. I had been lucky enough to nail three and was complimented by one of the senior officers on the Commander-in-Chief's staff. We were riding home together from a big review at the time that he was talking about it, and he remarked, "How do you set about catching a spy?" I told him of our methods and added that also luck very often came in and helped one. Just in front of us, in the crowd of vehicles returning from the review-ground, was an open, hired Victoria in which sat a foreign-looking gentleman. I remarked that as an instance this was the sort of man I should keep an eye upon, and I should quietly follow him till I found where he lodged and then put a detective on to report his moves.



The sketch on the left was made, giving all the particulars wanted. To bury it in such a way that it could not be recognized as a fortress plan if the spy were caught by the military authorities, it was turned into a sketch of a moth's head. Underneath in the note-book was written: "Head of Dula moth as seen through a magnifying glass. Caught 19.5.12. Magnified about six times size of life." (Meaning scale of six inches to the mile.)

From our position on horseback close behind him we were able to see that our foreigner was reading a guide book and was studying a map of the fortifications through which we were passing. Suddenly he called to the driver to stop for a moment while he lit a match for his cigarette. The driver pulled up, and so did we. The stranger glanced up to see that the man was not looking round, and then quickly slipped a camera from under the rug which was lying on the seat in front of him, and taking aim at the entrance shaft of a new ammunition store which had just been made for our Navy, he took a snapshot. Then hurriedly covering up the camera again he proceeded to strike matches and to light his cigarette. We followed close behind him till we came to where a policeman was regulating the traffic. I rode ahead and gave him his instructions so that the carriage was stopped and the man was asked to show his permit to take photographs. He had none. The camera was taken into custody and the name and address of the owner taken "with a view to further proceedings."

An instance of how an effective disguise can be assumed on the spur of the moment. This disguise was effected in two minutes

The Pluck of a Spy

Except in the case of the traitor spy, one does not quite understand why a spy should necessarily be treated worse than any other combatant, nor why his occupation should be looked upon as contemptible, for, whether in peace or war, his work is of a very dangerous kind. It is intensely exciting, and though in some cases it brings a big reward, the best spies are unpaid men who are doing it for the love of the thing, and as a really effective step to gaining something valuable for their country.

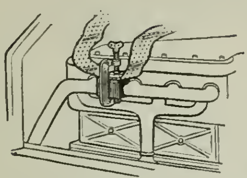
Many interesting schemes are resorted to in spying. Once I went "butterfly hunting" in Dalmatia. Carrying a sketch-book, a color-box and a butterfly net in my hand, I was above all suspicion to anyone who met me on the lonely mountain side, even in the neighborhood of the forts. I was hunting butterflies, and it was always a good introduction with which to go to anyone who was watching me with suspicion.

They did not look sufficiently closely into the sketches of butterflies to notice that the delicately drawn veins of the wings were exact representations, in plan, of their own fort, and that the spots on the wings denoted the number and position of guns and their different calibers.

The use of hair in disguising the face is perfectly useless unless the eyebrows are considerably changed. The brow and the back of the head are also extremely important factors in the art of disguise. The second picture shows the effect of "improving" the eyebrows of the face on the left, and also of raising the hair on the brow, while the third sketch shows what a difference the addition of a beard and extra hair on the back can make

The matter of disguise is obviously an important one. I was at one time watched by a detective who was one day a soldierly-looking fellow and the next an invalid with a patch over his eye. I could not believe it was the same man until I watched him from behind and saw him walking, when at once his individuality was apparent. It is wonderful what a difference is made by merely altering your hat and necktie. It is usual for a person addressing another to take note of his necktie, and probably of his hat, if of nothing else, and thus it is often useful to carry a necktie and a cap of totally different hue from that which you are wearing, ready to change immediately in order to escape recognition a few minutes later.

Vulcanizing Tires with Exhaust Heat

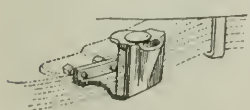


A DEVICE which enables the motorist to vulcanize tubes simply by using the heat developed at the exhaust tube of an automobile has been brought out by a Pennsylvania firm. The vulcanizer consists simply of a curved plate to fit over the exhaust manifold, a clamp for holding the inner tube in place, and a thermometer to indicate the temperature. By running the motor slowly the heat may be regulated so as to keep about 260 or 280 degrees, at which temperature the vulcanizing process will readily take place.

A Trouble-Proof Tire

PUNCTURE-PROOFING a tire from the inside is the latest idea of one well-known tire manufacturer. The "trouble-proof" tire, as this latest product is called, has a toughened chrome leather strip on the inside of the casing, where it touches the inner tube, and tires so treated have been run, according to the manufacturer's claim, for 12,000 miles without puncture. The idea is that the chrome leather strip will turn back the point of any kind of nail or spike, after this nail has penetrated the entire rubber casing itself.

An Oil Cup for Auto Springs

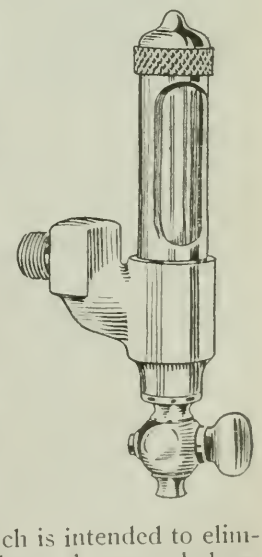


A SIMPLE but effective oiling device for the leaves of springs on Ford cars is the Mosco oiler, shown in the accompanying drawing. It consists of a reservoir which is formed between the clamp and the side of the spring; felt washers are used to prevent the leakage of oil. The device is held in place by two set-screws.

Hot-Water Bottle Fits the Back

ORDINARY metal hot-water bottles have never been popular because of their inflexibility, but the shape of a new aluminum one does away with this inconvenience. It is oval and curved so that it fits the back or a cheek swollen with toothache equally well. For the cold-blooded person who cannot afford an electric bed pad, and for whom a rubber hot-water bottle loses its heat too quickly, the new bottle will be invaluable. Perhaps one of its best points is the fact that it does not wear out, or become leaky. Water for it can be heated right in the bottle by holding it over a lamp or stove. A thick eiderdown cover makes it soft and prevents its burning the aching or cold member to which it is applied.

An Anti-Clogging Oil-Gage



OIL-gages for use on automobiles have the disadvantage of catching all sediment in the lubricant. Clogging is the result. Practically all gages are constructed on the principle of the drain of a water-sink, with its sharply-curved piping. A manufacturer of gages has realized this inherent error in ordinary oil-gages and has brought out a new type which is intended to eliminate clogging. It has a downward channel of large diameter, and is particularly adapted for Ford cars.

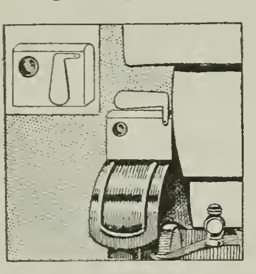
Why Weren't They Thought of Before?

Little Inventions to Make Life Easy

Light Your Umbrella if You Are Afraid to Go Home in the Dark

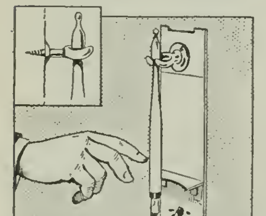
AN umbrella, made with an electric battery within its hollow handle, has lights affixed at each end of the stick and at the ends of the ribs. Push buttons in the handle make and break the circuit. The inventor has the idea that his umbrella will be of value in theaters and in dark streets and alleys.

Signaling to the Driver Behind You



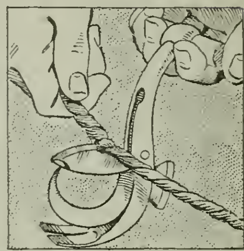
BY pressing an electric button on the steering wheel of an automobile, a red light is made to appear in a small box fastened on the rear mudguard, and a small semaphore arm is raised to indicate danger. When the button is pressed a second time, the semaphore drops and the red light changes to green.

Pen Rack Removes Ink from Nib



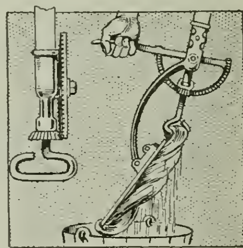
A PEN RACK to be fastened against the wall, has a pronged hook which holds the penholder in a vertical position, with the penpoint down. When the penholder is hung up and allowed to swing back it is suddenly arrested by a ledge and the ink is spattered against the blotting paper.

A Freight Hook of Many Uses



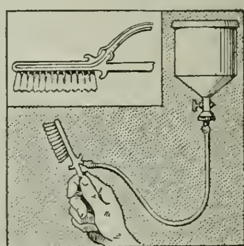
SEVERAL improvements are made over the familiar hook commonly used by teamsters and freight handlers. At the lower part of the hook, the shank becomes separated and is curved upward to form a claw, very useful for pulling nails. The fulcrum of the claw is shaped like a hammer head, and may be used for driving nails. Hinged to and countersunk in the shank is a blade which serves for cutting and as a keeper for the hook.

Do Not Wring Your Mop by Hand



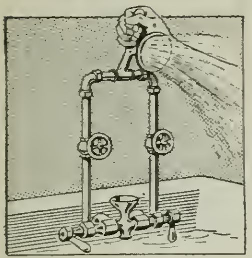
A GEAR, actuated by a handle, turns a hook to which is attached one end of a mop. At the same time, the pressure frame is moved upwards by a set of gears, also actuated by the movement of the handle. Thus, when the handle is moved, the mop cloth is tightly stretched by the shifting of the presser frame, and the small loop is turned until the mop is wrung out.

A Fountain Tooth Brush



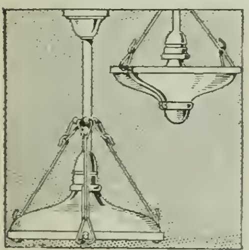
THIS toothbrush is equipped with a hollow head and passages leading from this cavity within the brush to the bristles. Near the handle is attached a tube which conveys a medicated solution from a tank suspended above directly to the interior of the brush.

Adjusting a Shower Spray's Angle



A SHOWER-BATH attachment intended to control the angle of discharge is made by attaching two upright pipes to the discharge-taps of the supply-pipes. At the desired height elbows are affixed to the pipes to join them in the center. At this point a swiveled T-pipe is connected to both ends of the pipes, so that the angle of the upright portion of the T may be changed at will. To the upper end of the T-section are added the adjustable shower attachment and a handle.

Both Direct and Indirect Lighting

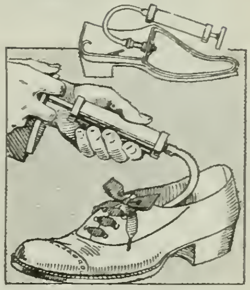


A REFLECTOR for an electric light is made so that the fixture may be used for either direct or indirect lighting. The reflector is shaped like a canopy, and is held in either position by wire or chain crows' feet leading from the main support. The lamp-receiving socket is enclosed in a standard, which may be coupled directly to the support when the fixture is used for direct lighting. When indirect lighting is desired, the lamp socket is covered by a metal cap.

A Coffee Percolator In Your Cup

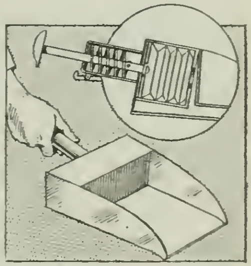
A SMALL percolator with which a guest at a restaurant may make a cup of coffee to suit his own taste holds an ordinary cupful of liquid. In the container, which is clamped upon the cup, is placed ground coffee and hot water and clear coffee drips through the strainer into the cup. When all the water has dripped out, the container is set aside.

Blow Up Your Shoes with Air



IN order to keep expensive and delicate shoes in proper condition when they are not being worn, the pneumatic shoe-tree exerts an even pressure on all parts of the fabric. A metal form partially surrounds a flexible sack which, when filled with air, takes the place of the old fashioned wooden tree. The sack naturally follows the lines of the shoe, so the leather is not forced out of shape.

A Vacuum Cleaner Dust-pan

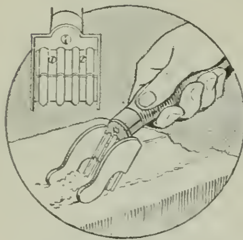


A DUST-PAN is made with a false bottom and with a chamber in the large end. In this chamber is a bellows, actuated by a plunger in the handle. The passageway leading from the bellows through the false bottom ends in a lip just below the normal edge of the dust-pan. To remove the last dirt from the floor, the slot is placed over it, and by means of the bellows the dust is quickly sucked in.

A Spring Cover for Milk Bottles

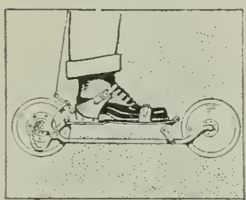
AN attachment made of spring steel which consists of a stout handle and a lip and cover for pouring out the contents of a milk bottle is held firmly to the bottle by the tension of the spring steel. This exerts an upward pressure on two grips at the base of the bottle, and a downward pressure on the ring which forms the pouring lip at the top. A cover is hinged to the ring at the top, so that it opens by a pressure of the thumb.

This Ice-Shaver Saves Muscle



A SHEET metal blade provided with a corrugated cutting edge is secured to two side-arms, which act as a guide when the device is in operation. The entire device is fitted to a convenient handle. In use the cutting edge is pressed to the ice and is guided by the metal side-arms.

A Foot-Propelled Motor Skate

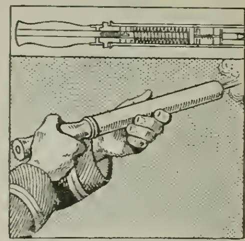


THE accompanying sketch shows a novel form of skate in which the power of locomotion is supplied by the feet of the skater. The foot-piece is mounted between the two wheels, slightly lower than their centers. Within the frame proper is concealed a strong steel revolving screw, which communicates with the rear wheel by means of the ratchet gearing shown in the diagram. To set the skates in motion the skater applies the power to the screw by pressing down on the foot-plate, which is connected with the screw by the crank in front of the toe. Thus the drive-wheel, which is the rear wheel of the skate, is set in motion. The model shown is provided with two wheels; but this same mechanism may be applied to the four-wheeled skate with equal facility.

A Tooth-Brush Which Fits Your Finger

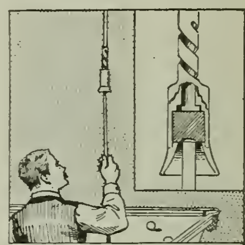
A CASING composed of all-absorbent fabric, and fitted on one side with a bead or flange, is held on one finger while cleaning the teeth. To the end of the device a string is fastened, which may be used to hold the case on the finger while in use, or may be used to clean between the teeth.

A Policeman's Club Which Is Also a Gun



A POLICEMAN'S club is provided with an internal mechanism whereby the club may be converted into a firearm, to discharge one bullet. By means of a system of springs, the firing-pin is held retracted until the handle of the club is unscrewed for a short distance. This action releases a safety catch, and the cartridge is ready to fire. In discharging, the handle is pulled back and released.

Chalking Billiard Cues Mechanically



A CYLINDRICAL holder for chalk is cast integrally with a short rod, in which is a spiral slot. The entire device fits over a rod projecting down from the ceiling. On this rod is a pin, which fits into the spiral groove on the chalk holder. When the cue is placed in the funnel-shaped opening of the holder, an upward push causes the device to revolve until the pin has reached the end of the spiral groove.

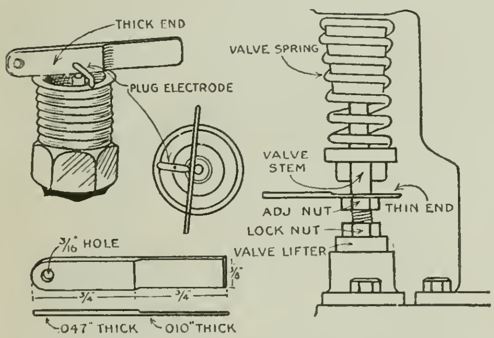
Parting Thick Tresses

A BOHEMIAN inventor has patented a comb intended for owners of thick hair which refuses to stay parted. As shown in the illustration, the device consists of two combs which are secured to an elastic band. The combs are inserted in the hair at the point where the part is desired, and then drawn apart. At the same time, the band is being stretched over the head and holds the hair down flat. The combs can then be released from the head, while the band is retained in position.

For Practical Workers

A Useful Gage for Motorists

A VERY simple but useful attachment for the automobilist's key-ring is shown in the accompanying illustration. It can be made of spring steel



The little piece of steel illustrated can be used in the ways shown and in many others

or hard brass, steel being preferred, however, since it can be hardened and tempered. It is made from a piece of stock about .050-in. thick, 1½-ins. long and ⅜-in. wide. Before hardening, a $\frac{3}{16}$-inch hole is drilled in the end and the corners rounded off to make it easily inserted on a key-ring. The piece is then ground down to about .046 in. to .047-in. thick for about half its length, and to about .010-in. thick for the remainder.

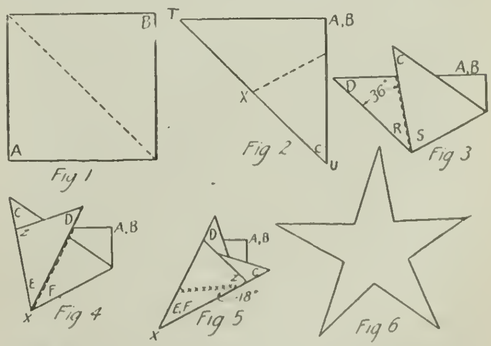
The thick end will be found valuable for setting the gap between the electrodes of the ignition spark-plug; the thin end will be useful when adjusting the clearance between the valve stems and adjusting nuts on valve-lift plungers. The gage can be easily made and will be found very useful whenever such a tool is needed.—VICTOR PAGE.

How Betsy Ross Made a Five-pointed Star with One Cut

WHEN George Washington and two other Revolutionary leaders called on Betsy Ross to bestow upon her the honor of making the first flag, they expressed a desire to use a star of five points. She immediately folded up a bit of paper and, with one cut, formed a perfect five-pointed star. This is the way to do it:

Fold a perfect paper square diagonally, as in Fig. 1. Then make another fold, as in Fig. 2, *X* being the middle of the line *T U*. The fold must give an angle *R*, Fig. 3, of about 36 deg. This is approximately half the angle *S*. A little practice will enable anyone to make this fold.

The point *D* of Fig. 3 is folded over as in Fig. 4, angles *E* and *F* being equal. The two points *A* and *B*, which are together, are then folded over, as in Fig. 5. If the edges are all together, a diagonal cut, shown in Fig. 5, will make a perfect star, having five points.



Making a Five-pointed Star with One Cut.
Fig. 1. Fold in square of paper. Fig. 2. *X*, middle of *TU*. Fig. 3. Angle *R* is half angle *S*. Fig. 4. Angle *E* is equal to angle *F*. Fig. 5. Ready to cut. Fig. 6. Completed star

Making and Using a Small Still

AMATEUR chemists and photographers as well as other experimenters often find themselves in need of pure or distilled water. This still will prove a help and is an interesting apparatus to make. It is easily operated and will distill a comparatively large quantity of liquid.

The principle of distillation is the mere raising of a liquid to its vaporizing point and the collecting and condensing of its vapor. The most important part of the still is the condenser, which is shown in the detailed diagram. It consists of a large glass tube about 1¼ ins. in diameter and about 12 ins. long. Each end is sealed tightly with a good sound cork stopper.

Three tubes known as the condensing coils are about ¼ in. in diameter and 16 ins. long, and are passed through the stoppers and glass casing. Two short lengths of tubing are placed in the corks to allow the cooling water to enter the casing and to provide an overflow outlet. The condenser ends should be painted with shellac or dipped into molten paraffin wax to seal any leaks. Connect the three coil tubes with rubber tubing, as shown, to make one continuous circuit, and to allow the vapor to enter one end and pass through the casing three different times before the condensed liquid emerges. Mount the casing upon a wooden base with two brass straps.

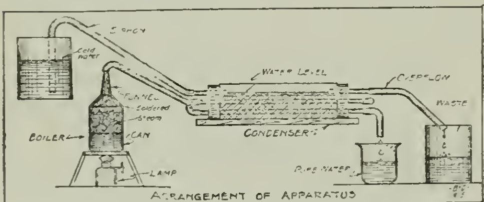
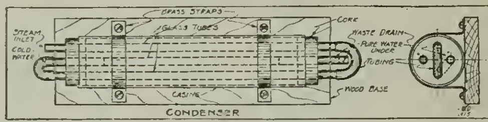


Diagram of the arrangement of apparatus for a small still

The diagrammatic arrangement of the apparatus shows the system of operating. The boiler is easily made from a can and small funnel as shown. Solder the funnel carefully to the top of the can. Fill the boiler by submerging in the liquid. Use a Bunsen burner or alcohol lamp for vaporizing the contents. Connect the boiler to the inlet of condenser by means of rubber tubing. A vessel of cold water is used to cool the condenser, the water being siphoned to the water inlet on the condenser through tubing. Make certain that the coil tubes are entirely covered with the cooling water to insure perfect condensation. Allow the waste water to drain off and collect the distillate in a clean vessel.



Detailed diagram of the condenser

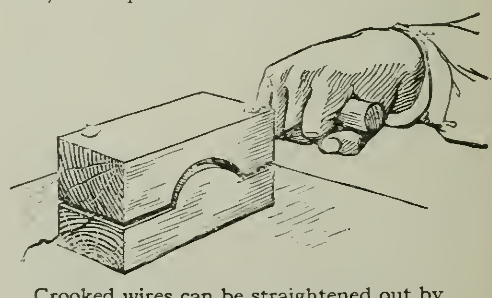
Remember that distillation is based upon the principle that the boiling points of different liquids differ. With this in mind many interesting experiments can be made with the apparatus described. Any desired liquid may be removed from a mixture of various liquids by keeping the boiling point of the mixture the same as that of the desired substance.

The boiling points of some common liquids at sea level are as follows:

Water 212° Fahr.
Alcohol 173° Fahr.
Ammonia 140° Fahr.
Chloroform 140° Fahr.
Saturated Salt Sol. 226° Fahr.
Turpentine 315° Fahr.
Sulphuric Acid 590° Fahr.
Ether 100° Fahr.—B. F. DASHIELL.

Straightening Kinked Wire

KINKED wire can be straightened satisfactorily with two blocks of wood, cut and fitted as shown in the accompanying drawing, and bolted together loosely. The wire is passed between them, wrapped around a short strip of hard wood and pulled with a firm, even pressure.


Crooked wires can be straightened out by merely running them between these two blocks of wood

How to Construct a Simple Cyclecar Starter

A RELIABLE home-made starter for cyclecars, or other light cars, capable of being operated from the seat, can be made in the following manner:

Drill a ½-inch hole in the end of a strong piece of wood, 1 in. by 1½ ins. by 3 ft., shown at *A* Fig. 1. Make a bearing by fitting in a piece of steel or brass tubing. Make another hole *B* ⅜ in. in diameter, about 1 ft. from the first one;

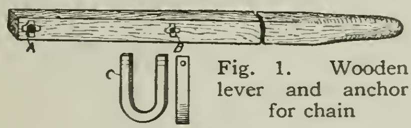


Fig. 1. Wooden lever and anchor for chain

and fit in a bearing. Bend a piece of steel, ½ in. by ½ in., into a U-shaped form as at *C*. After drilling holes in the ends, connect this piece to *B* by means of a bolt.

Saw off the crank of the car a few inches from the bearing. It must then be tapered and a 14-tooth motorcycle sprocket keyed and bolted on, as shown in Fig. 2.

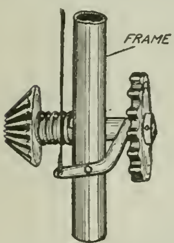


Fig. 2. Motorcycle sprocket on crankshaft

Place a spring on the inside of the casing to bear against the engaging ratchet, thus forcing it to catch when the sprocket is turned, Fig. 2. To throw this ratchet out after the engine has started, a small wire or cable is run from the seat to a bell-crank, and this forces the sprocket and ratchet out. The long lever-arm is now fastened by the bearing *A* at some convenient place on the frame, allowing for a free movement back and forth. The piece *C* is then bolted on at *B*, Fig. 1. A wire rod, attached to *C* is fastened to a chain, which passes over the sprocket and connects with a coiled spring. When the arm is pulled forward, this spring draws it back. The relation of parts is shown in Fig. 4.

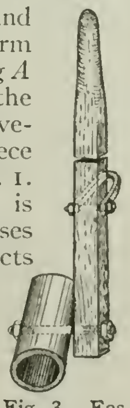


Fig. 3. Fastening and attachment of wooden lever

To operate, the wire lever fastened to the seat is first released, allowing the ratchet to spring into mesh. The lever-arm is then pulled up with a jerk; this spins the engine over from one to two turns, depending upon the size of the sprocket and the distance of *B* from *A*. When the motor starts, the wire from the seat is drawn back and the ratchet is pulled out of gear. In case the motor kicks, the lever simply flies out of the hand and falls down on a spring cushion or on the wire rod. No damage is ever done by a kick, since, by the time the engine has turned over once, most of its energy is lost. The main advantage over a crank lies in the increased leverage derived, and also in the greater number of turns which can be given the engine. With this starter, the greatest amount of force is delivered just at the point when

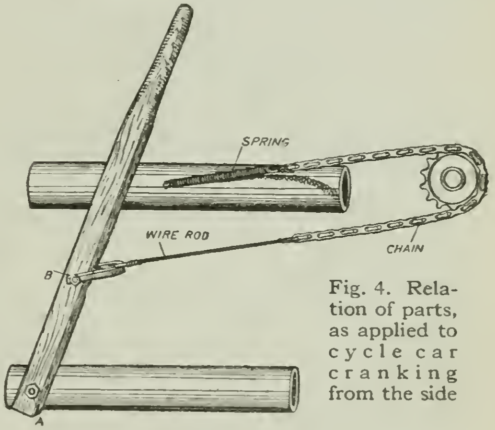


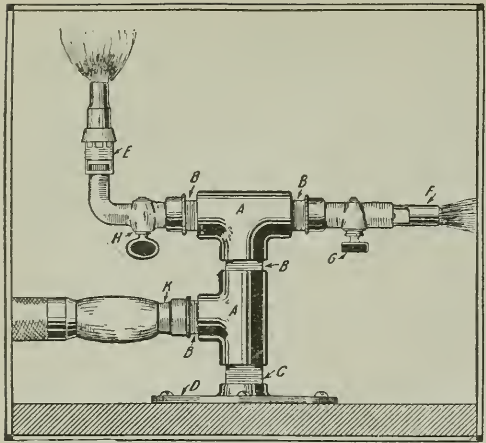
Fig. 4. Relation of parts, as applied to cycle car cranking from the side

the engine has its highest compression, which makes it desirable for magneto ignition. There is positively no danger of getting a broken arm with this starter.

The diagrams are for a cyclecar, cranked from the side. By means of a series of pulleys and wire cable, the same principle applies where the engine is cranked in front. —N. S. McEwen.

Removing Tires with a Clothes-Pin

SINGLE-CLINCH bicycle-tires may be quickly removed by means of an ordinary clothes-pin. Separate the prongs of the clothes-pin until it splits. The larger piece may be used in prying the bead of the tire away from the hooked edge of the rim, and also for lifting it over the edge. Use the other prong to prevent slipping back into the curve of the rim.—G. M. Morrison.



Arrangement of parts and connections for Bunsen burner and blow-torch

Bunsen Burner and Blow-Torch Combined

A COMBINATION Bunsen burner and blow-torch can be made from ⅜-inch gas fittings. The cost should not exceed $1.

The following material is needed:

Two tees, *A*.
Five 1-inch nipples, B, C.
One floor plate, *D*.
One air-mixer from an inverted gas burner, *E*.
One air-mixer from an upright gas burner, *F*.
One straight valve, *G*.
One "L" valve, *H*.
One valveless hose connection, *K*.

The fittings should be assembled as shown.

By careful adjustment of the air-mixer, *F,* an intensely hot blue flame twelve to eighteen inches long can be secured. By regulating the mixer, *E,* the usual Bunsen flame may be obtained. —A. C. Fisher and J. B. Whittaker.

Brass Tube Cleans File Teeth

TEETH of a file clogged with lead or other metals can be cleaned with a short length of brass tubing. The file should be held on edge and the tubing forced along the teeth. Wedges will be formed at the end of the tubing, which will force out the metal which has formed between the file teeth and thoroughly clean the file.—E. B. Williams.

Cutting Glass Bottles and Tubes with Oil

TO cut a glass bottle or tube, fill with lubricating oil to the level you wish the vessel to be cut. Then heat an iron rod to the point of redness and slowly dip it in the oil. When the oil gets hot, the vessel will crack round the top of the oil, making a clean, even break that can be dressed off on a grindtone.—A. E. Smith.

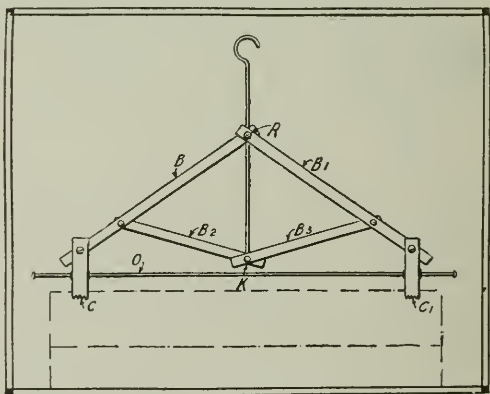
A Coarse File for Soft Metals

LEAD or other soft metals can be filed with an ordinary flat file which is annealed and cut along one edge with sharp angular teeth. Afterwards, the file should be rehardened.

—E. B. Williams.

A Trousers-Hanger

THE pieces *B*, B^1, B^2 and B^3 are flat strips of metal riveted to make flexible joints. The rivet *R* is made with a hole in its head large enough for the rod to slide through and connect to the rivet *K,* while *C* and C^1 are clips to

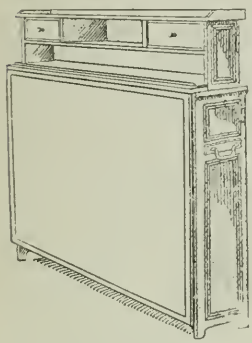


This trousers-hanger is easily made and is more efficient than those which can be bought at most stores

hold the trousers, and are connected to *B* and B^1 by flexible joints. The clips slide on the rod *O*. The weight of the trousers will be exerted at the point *K*, thus pushing out the strips *B* and B^2 and stretching the trousers. This appliance is not only light and non-breakable, but it is also easy to make. Every man should welcome it.—Leo M. Lafane.

A Piece of Furniture with Many Uses

LACK of space in business offices or dwellings makes it difficult to use many pieces of furniture, such, for instance, as a writing desk, drawing table, cupboard or blackboard. In some cases the professional requirements of engineers and draftsmen make a number of pieces of furniture necessary, but these take up much space, and may even require several rooms to contain them. A great economy of space is effected in the combination illustrated. It can be converted into a desk either horizontal or inclined, for the transaction of ordinary business; a drawing table whose height and slant can be regulated for a standing person; a blackboard of good height; and lastly, a closet. The whole is not more than ten inches thick when folded.



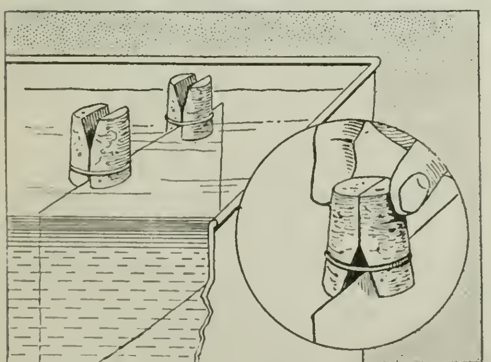
The desk closed

The main box part, which serves to hold drawing instruments and the like, is provided with a top portion containing drawers, adjustable at various heights. This holds the large drawing board hinged to it, the base of the board resting on a pair of legs with adjustable top. The legs can be folded back into the main box when the drawing board is let down. By turning up the drawing board so that it mounts straight in the air and exposes the under side, we have a blackboard, located at a convenient height.

The desk extended and raised serves as a fine drawing board

Washing Blueprints and Bromide Enlargements

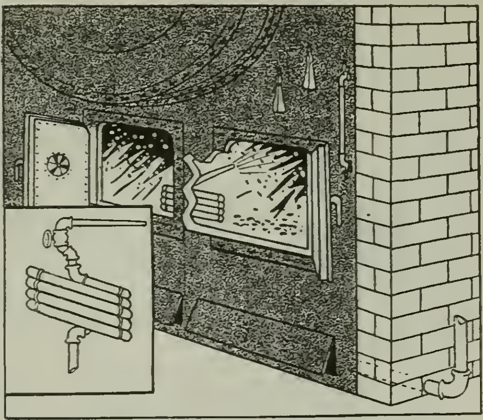
THE difficulty of washing blueprints and bromide enlargements (especially of the larger sizes) often makes one hesitate to attempt much work of this kind.



Cork floats easily attached to large sheets make the washing of bromide enlargements an easy task

The difficulty of washing large enlargements and blueprints can readily be overcome in the following manner:

Procure some large corks, and in each cut a groove around the cork near the smaller end, to serve as a retainer for a rubber band. Then cut the cork lengthwise through the center, and cut a wedge-shaped piece from the top, or widest part of the cork, as shown in the illustration. Place a rubber band in the groove to form a sort of clamp. Attach several of these cork floats to the edges of the prints to be washed, and place them in the washing receptacle, which must be deep enough to enable the prints to hang vertically. As hypo and blueprint chemicals always sink, the prints are thoroughly washed in the shortest possible time.—C. I. REID.



A superheating coil for oil-burning furnaces gives an even pressure and complete combustion

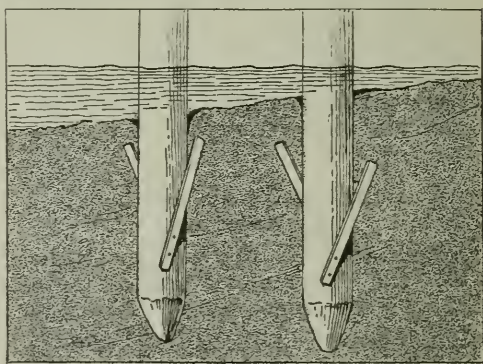
Save Fuel for Oil-Burners

IF the feed-pipe of an oil-burner is lengthened and bent into several convolutions which are placed directly beneath the burner, the oil is thinned and gas is formed, with the result that an even pressure is gained and more heat per unit of oil is obtained. In many cases it will be found that the increased pressure will be sufficient to justify doing away with the pressure pump ordinarily used. Care must be taken in installing superheating coils of this type; otherwise explosions and disastrous fires may result.

A Speedometer Light for Ford Cars

THERE are numerous 6-volt speedometer lights on the market, but it is very hard to obtain a bulb that will not burn out when used with the current direct from the Ford magneto, the voltage of which is about 12. If suitable resistance is placed in series with a 6-volt light to cut down the voltage to 6 volts, the standard 6-volt light will work very well on a Ford. Twenty-five feet of No. 26 B. & S. gage German silver wire is the proper amount. It may be wound upon a piece of porcelain tubing or any other non-conductor. After it is wound it should be thoroughly wrapped with friction tape to protect it. To install it, one wire from the resistance coil can be connected to the binding post where the wire from the magneto binding post connects on to the binding post of the coil box underneath the hood.

The resistance can be fastened to the dash underneath the hood by taking several turns of tape around the coil and driving a tack in each end of the tape. This will hold it in place very satisfactorily. The other wire from the coil should be run to the other side of the car, being careful not to get it grounded to any metal parts of the car. It should then pass through a hole drilled through the dash at the exact place where you want the light located, through the light, and then should be grounded to the iron frame of the machine at any convenient place. It is best to buy a speedometer light with a pull-chain switch socket, but if you cannot obtain this kind conveniently you will have to get a small dash switch of some kind and place it in circuit with your light. This light, if carefully installed, is very satisfactory. The author has one on his car and knows of two others who have used the same idea and are very well pleased with the results.—IVAN M. WELLS.



Simple barbs of wood attached to piles will prevent them from working up when driven in quicksand

Driving Piles Into Quicksand

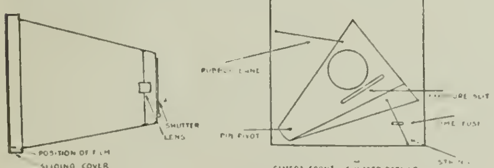
WHEN driving piles in quicksand, under water, the piles have a tendency to rise from 1′ to 3′, unless the hammer is left set on them for several hours. To avoid this waste of time, cut up some tough saplings of about 2″ diameter, into lengths of about 2′, and spike them to the piles like barbs, as shown in the illustration. The results are very satisfactory.—J. L. BAYLEY.

Making a Kite-Camera

FEW of us can have the experience, at the present time, of a ride in an aeroplane, but it is quite possible to see how our surroundings look from a high viewpoint, by taking pictures from a kite. It would take a very large kite, indeed, to carry some forms of ready-made camera, but it is easily possible to make a camera light enough so that it can be attached to any good kite and still be capable of making perfect pictures.

The lens is probably the most important part of a camera, and for a kite-camera nothing would serve the purpose better than a single achromatic lens, such as is fitted to small box cameras. Such a lens is light in weight and capable of making very good pictures. The lens can be bought very reasonably, or one can be taken from some other camera. The lens should be obtained first of all, before starting the construction of the camera, as the dimensions of the camera box must be in proportion to the focal length of the lens. A lens of two or three inches equivalent focus is satisfactory. The equivalent focus of the lens can be determined by focusing the sun on a piece of paper. The distance of the lens from the paper when the sun is focused to a burning spot is the distance at which the lens is to be placed from the plate or film.

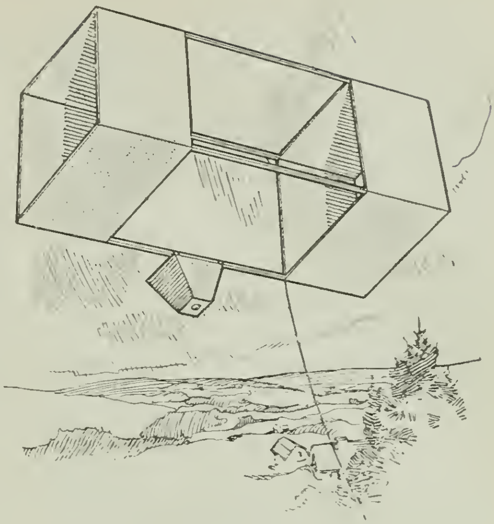
For the purpose of kite photography a camera taking pictures two inches square is big enough. If larger pic-



The camera used should be built of the lightest materials and every allowance made for air resistance

tures are desired they can be subsequently enlarged. The construction of the shutter and camera box is explained by the diagrams.

The box of the camera is made cone-shaped in order to reduce the weight and air resistance. The sides of the



A kite-camera is easily built. It makes bird's-eye photographs

camera are made of light but stiff cardboard, glued together with a strong adhesive. The back of the camera is made in the form of a tight-fitting cover, also made of cardboard, and the inside measurements should be the same as the pictures to be taken. The lens is fitted to an additional partition of heavy cardboard fitted inside of the cone, at the same distance from the back of the camera as the focal length of the lens. By sliding the lens back and forth slightly in its tube, a sharp focus can be obtained on distant objects, and the lens is then firmly fixed in position.

The front of the camera, also of cardboard, is provided with a circular opening which must be large enough so as not to obstruct the view of the lens. On to the front is fitted the shutter, which consists of a sheet of cardboard blackened on the inner side, and cut in a triangle shape. Into the shutter, near the center, is cut a slit, which serves to make the exposure, by admitting light through the lens when it moves across the aperture. The size or width of the slit regulates the time of exposure, and a few trials should be made in order to obtain the most suitable width for the speed of the lens and film to be used. In general, the slit can be as large as it is possible to make it without admitting light to the film while the shutter is closed in either direction, right or left.

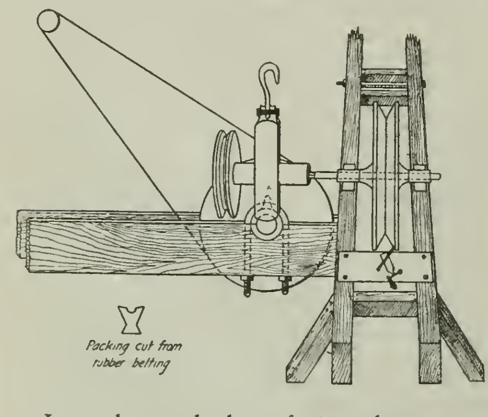
The shutter is pivoted at the lower end, and the motive power is supplied by a rubber band which draws the shutter to the left when it is released to make the exposure. The exposure is made by means of a time-fuse attached to a string which holds the shutter to the right, against the pull of the rubber band, until the fuse has been consumed, when the string is burned off and the shutter released. At that moment the picture is made. The shutter must fit tightly and must admit no light to the inside of the camera, except through the exposure slit.

When the camera has thus been completed it should be covered on the outside with black needle paper, to make it absolutely light-tight, and the inside of the box should be blackened with a pure black ink.

The proper length of fuse to use, so as to release the shutter after the kite has attained the maximum height, can be determined by making a trial flight with the camera attached to the kite, timing with a measured length of burning fuse. A length of fuse corresponding with the length burned until the kite reaches the greatest height, is attached to the string, and the camera is now ready to be loaded with film, which is done in a dark room by the light of a ruby lamp. Films of the correct size can be obtained from a film pack, or a roll film can be cut up into pieces of the correct size. The film is laid into the back or cover of the camera with the dull or emulsion side towards the lens, and the cover placed on the camera.

After making sure that the shutter is in proper position for making the exposure, the camera can be taken out into daylight and attached to the kite. A fairly stout rubber band looped around the middle of the camera box and around one of the wooden struts of the kite will hold the camera securely in place. The camera should always be fastened to the kite in such a manner that it points almost straight downwards when the kite is in flight; then the pictures give the impression of great height.

The kite used for taking pictures from above should be fairly large and of good construction. The box type of kite is very suitable for the purpose, and many other forms will also prove very satisfactory. Besides the pleasure of making pictures of our familiar surroundings from above, and the great novelty of such pictures, a kite camera can also be used for many practical purposes.



Large sheave wheels can be turned out accurately without the use of a lathe if care is taken in adjusting the timbers and handling the gearing

Turning Out Large Sheave Wheels Without a Lathe

IN turning out sheave wheels of large diameter, a lathe is not always available. The work can be accomplished in the following manner:

Place two large timbers over the motor-pit (which should be parallel to the line shaft), and put spreaders between them. Bolt the timbers together and brace them up. The sheave wheel is then swung between them, as shown in the diagram. Remove the hand-chain wheel from a 2-ton chain-block and substitute a 14-inch pulley for it. Take off one of the lift-chain wheels and insert the square end of the lift-chain axle in the square socket previously cut in the end of the sheave wheel. Bolt down the chain-blocks with two U-bolts to a piece 12″ by 12″.

A heavy steel plate is then placed across the timbers in front of the sheave wheel, on which is mounted the extra tool post-head of the lathe. With this arrangement, the speed may be reduced and sufficient power gained for practical work.—H. V. Abeling.

A Two-Jaw Chuck

THOSE who have a wood-turning lathe sometimes find need of a small chuck. The following will be helpful to them:

The frame *A* of the chuck (Fig. 1) may be made from a wagon-tire or other piece of steel 1/8″ thick and 1″ wide and as long as necessary. Bend over about 3/4″ at each end, being careful to make the corners square. Drill a small hole in the exact center of the frame for the center *G* of the shaft (Fig. 2).

Fit a round iron ring *B* snugly on the shaft. Fasten this ring on the shaft with a key, set-screw, pin or the like. Secure this ring to the frame with four strong rivets *D*, Fig. 1.

Cut two slots *C* (Fig. 1) in the frame, as shown in the diagram. This is the hardest part of the work. The best way

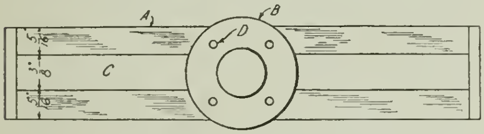


Fig. 1. Top view of the chuck, showing its parts and construction

is to drill holes not quite as wide as the slot, but as long, and file square. This will require patience.

The jaws *E E* (Fig. 2) will require some sawing and filing, but are not as hard to make as the slots. Get two pieces of steel 1″ square and 1 1/2″ long, and file them to the shape and dimensions shown in the drawings, being careful to make the surfaces that slide on the frame fit as snugly as possible.

Thread two 1/4″ bolts, *F*, round one end and file two flat places on the other, so they can be turned with a wrench. Drill a seat in the ring *B* for the round end and let the other end project about 1/4″ through the holes at *K K* (Fig. 2).

Drill a small hole close up to the end

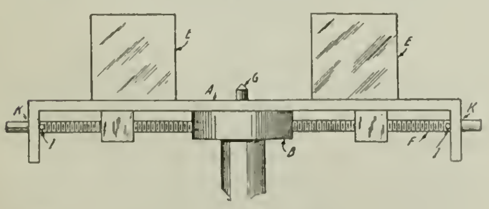
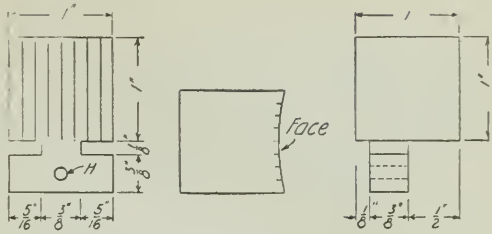


Fig. 2. Side view of the chuck in position on the shaft



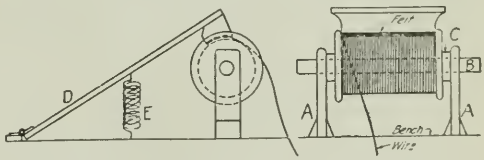
Construction details of jaws of the chuck

of the frame and put a small pin through it to keep the bolt from coming out; or screw a small collar *I I* up as far as it will go and fasten it there (Fig. 2). The bolt goes through the hole *H* in the jaws, which is tapped to fit. By turning the bolt the jaw may be made to slide along in the slot.

To get the jaws in the frame, the upper end of the slot must be widened. Then the jaws may be put in the slot and turned around.

How to Wind Springs Easily

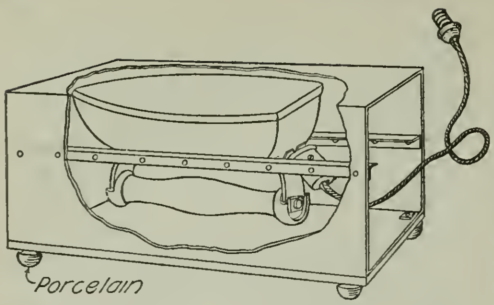
WHEN winding small springs with a lathe, much time is consumed in unraveling the wire from the spool, which is necessary to prevent tangling. The following method is quick and saves the end pieces. The supports, *A*, *A*, shown in the diagram, may be fastened



With this scheme, time and wire are saved in winding small springs on a lathe

directly to the bench, or to a board.

Drill holes in each support to receive the rod holding the spool. A collar *C* for holding the parts together, is fastened to each end of the shaft inside the supports. The board *D* is attached to the bench by a hinge, as in the diagram. On its upper end is a block of wood, which fits over the spool between the flanges. A piece of heavy felt is attached to the under side of the block. This takes up the irregularities, when the layers of wire change. The spring *E* holds the block firmly against the wire. The tension on the spring should not be so great as to cause trouble in pulling the wire from the spool.—C. ANDERSON.

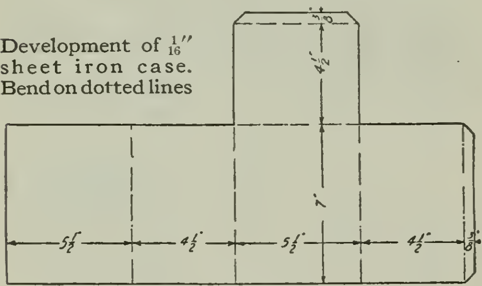


An electric iron, supported bottom side up, makes an excellent electric stove

Using an Electric Iron as a Stove

AN electric iron can be converted into an electric stove with the aid of a case cut from a sheet of stiff iron according to the dimensions given in the accompanying illustration, and bent and riveted as shown. The iron rests on angle irons riveted to the sides of the case. Wires carrying electric current to the heating-coil should enter the case through a porcelain tube in the base.

Development of $\frac{1}{16}''$ sheet iron case. Bend on dotted lines



How to Make a Leveling-Board

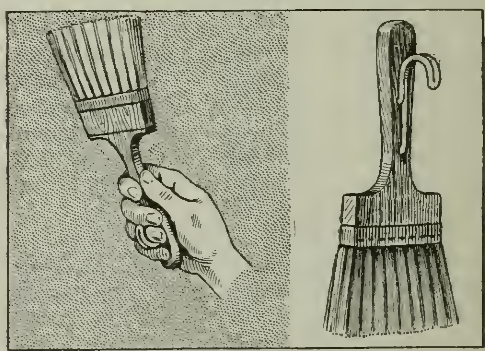
AN excellent leveling-board can be made from a rough board and a few nails. Attach two pieces of wood to the ends of the board, temporarily, allowing them to project slightly beyond the edges. To these pieces fasten a strong thread or cord, drawn as tightly as possible without breaking. Lay the board on its side and, every few inches, drive small nails in the edge of the board, making the head of every nail even with the thread. In the same way, drive a few nails in the opposite edge, near the center of the board, for the level to rest on, taking care that the opposite edges are parallel.—J. L. BAYLEY.

A Handy Drawer-Catch

TO keep the contents of a drawer in the workshop safe without using a lock, so that the drawer cannot be opened by outsiders, drill two holes in the closed drawer, one on each side, through the top of the bench into the strips on which the drawer slides. To lock the drawer all that is necessary is to pass a bolt through each hole. A jig, fixture or a heavy piece of metal is then placed over each bolt so that they will not be detected. The bolts should be a snug fit so as to avoid rattling of the drawer.

A Paint Brush Hook

THE handy man who has had his paint brush fall in the dirt will appreciate this simple and easily-made device which effectually prevents the brush from slipping out of the hand. A small gimlet or a hand drill and a pair of pincers are the only tools necessary. A piece of fairly heavy wire is bent into the shape illustrated, the two projecting ends are inserted into the holes in the handle of the brush and are bent flat on the opposite side. The brush is grasped as usual, the hook coming between the two middle fingers.—F. P. BAEYERTZ.

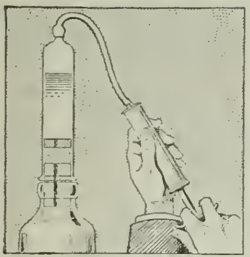


A hook helps to hold the paint brush in the hand and also to hang it on a bucket edge or ladder rung

To Bore Endwise in Wood.

IT is often necessary to bore in the end grain of wood. The ordinary bits, however, catch in the wood and split it. This can be overcome by using bits which have had the lips filed off. This simple expedient will obviate any further trouble.

Filtering Mercury

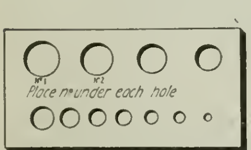


THE mercury used in a laboratory for experimental purposes often picks up particles of grit or metal filings that can be most easily removed by filtering. This should be done under pressure.

Put the soiled mercury in a glass syringe tube. Closing the small end with the finger, insert a thin section of perforated cork, then some asbestos wool, and finally a perforated India-rubber cork. The asbestos should be sufficiently tight to prevent the mercury from passing at ordinary pressure. Tie on the cork with twine and invert over a suitable vessel. Then compress the air above the mercury by means of a cycle-pump, using only just enough pressure to drive the metal through the filtering material. It will come out clean and bright, leaving the impurities in the asbestos fibers.

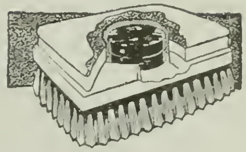
As the wide end of a syringe tube has a distinct rim, there will be no difficulty in wiring the cork in position to avoid the possibility of its being forced out by the compressed air.—H. J. GRAY.

A Simple Bit Gage



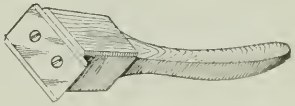
THE amateur mechanic who relies upon his sense of touch or "feel" to select a bit of the proper size, frequently makes the mistake of choosing the wrong size and thus drills a hole which may be too large or too small for his purpose. This source of error may be eliminated if a piece of sheet brass is perforated with a number of holes corresponding in size with the bits in one's outfit. The sizes should be marked in the brass beneath each hole; and when a particular bit is wanted, the desired size can be determined by inserting the bit into its corresponding hole. By this method errors are easily avoided.

Blacking Box Inside Brush



A BLACKING box can be made, which is lodged inside the polishing brush. To this end the large and flat brush has a wood backing which is hollowed out at the middle for fitting in the blacking box. A second wood piece of the same size as the brush backing is applied upon the latter and it is also hollowed in the center, so that the blacking box is contained in the cavity formed between the two wood portions. The top wood piece is held on in any suitable way which will allow it to be readily removed and replaced.

Razor Blade Floor-Scraper



A VERY serviceable floor scraper can be made very quickly from a piece of wood and an old plane iron. The handle should be shaped from hardwood to which the plane iron is fastened as shown. Besides using it on the floor it will be found very handy for scraping off old paint.

A Novel Polishing Pad

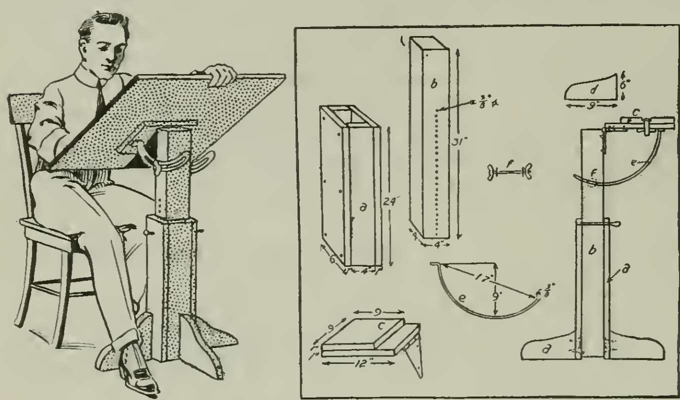
A VERY useful and efficient polishing pad may be easily made with a small empty spool, some cotton-wadding and a piece of flannel. Cut the flannel in a circular form about eight inches in diameter, placing the cotton-wadding in the center, the outer portion of the flannel being drawn in and tied firmly to the center of the spool. When polishing operations are to be commenced, simply pour the polish through the whole in the center of the spool.—GEORGE H. HOLDEN.

A Handy Drawing Table

A DRAWING table, which can be adjusted for height and angle, will amply repay its builder in convenience for the time and pains spent in its construction. The materials are reasonable in cost.

After the stand is constructed, any drawing board may be attached to the upper part, and the screw-heads should be countersunk.

A complete list of the materials re-



A drawing table which can be made by an amateur. The diagrams show the structural details

quired is as follows:

2	Wood strips	24″	x	6″	x	1″
2	" "	24″	x	4″	x	1″
4	" "	9″	x	6″	x	1″
1	" strip	31″	x	4″	x	1″
1	" "	9″	x	9″	x	1″
1	" "	12″	x	9″	x	1″

2 lengths of iron rod ⅜″ x 12″

1 heavy barn-door hinge.

1 bolt 2″ x ⅜″ with a thumbscrew tap.

1 bolt 5″ x ⅜″ with two 1″ washers and two thumbscrews.

1 pin (a cheap screwdriver with the flat part filed off will do).

Acid Engraving in Steel in Your Own Handwriting

TAKE the tool to be marked, and heat it until it melts wax. Rub and melt wax over the area which is to be etched and harden the wax by cooling. Do not heat the wax and rub on a cold tool, as it hardens too quickly and does not hold, when writing on it. Use a pointed file or scratch-awl to mark or write with. A fine point makes a fine line; a flat point makes a wider line. Write or mark through wax, so that the writing tool touches the steel; blow off crumbs of wax and apply the acid.

Formula—Etching Acid

Muriatic Acid	1 part
Nitric Acid	1 part
Water	1 part

Mix in bottle, using a glass stopper as other corks do not last.

Apply acid with a fountain pen filler very slowly. Etching should continue until the acid turns a rusty color. Then wash off the tool in water, heat it and wipe off the melted wax with a cloth. Polish the tool. Oil it to prevent reaction of water to rust. Do not put the used acid back in the bottle, or allow the smallest drop of acid to touch any uncovered part of the tool, as it will eat a hole in it.

All this takes about five minutes. To retard the action of the acid in etching, add another part of water. This is only done when a number of tools are to be etched.

It is best to wax all at one time, writing on all, and leaving the etching as a last operation. Do not leave the bottle containing the acid near any tools. The fumes will rust them.

Lighting a pipe in the wind is difficult because it is hard to keep the match burning until it reaches the pipe. Scratch the match on the pipe, and all such troubles will be avoided

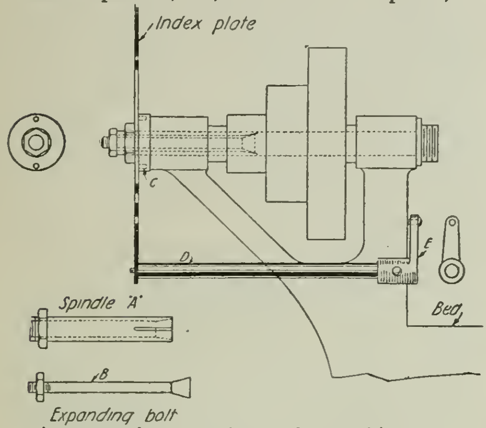
Lighting Your Pipe in the Wind

A MATCH - SCRATCHER, easily shielded from the wind by the hand, is formed by making grooves on the side of one's pipe with a three-cornered file as shown in the illustration.—THOMAS SHEEHAN.

Attaching an Index Plate

BY the following plan, an index plate can be attached to a hollow spindle lathe which has no convenient place for attachment.

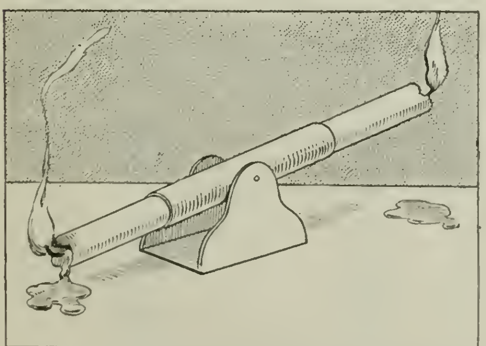
The spindle, *A*, to hold the plate, is turned to fit the bone of the lathe spindle and has a $\frac{1}{4}''$ hole drilled through the center. One end is tapered and split to receive the tapered bolt *B*. The plate should have two pins riveted to it to fit the holes in the spindle end. The bar *D* and the arm *E* are made according to the design of the lathe.—A. H. Johnson.



A convenient method of attaching an index plate to a hollow spindle lathe

A Candle Motor

AN interesting and novel form of motor can be made from two ordinary tallow candles. When properly made, the motor will have a rocking or seesaw motion due entirely to the melting of the burning candles.

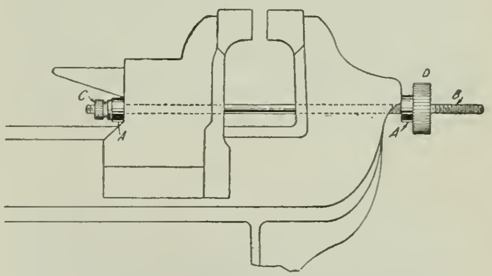

The lower candle burns faster than the upper, and, becoming lighter, is raised. The seesaw motion continues, therefore, as long as the candles last

As the illustration shows, the device consists of a cardboard tube having an inside diameter to receive the candles snugly. The tube is hung on an axle in the center of a wooden stand or bearing made of three simple pieces of wood, as shown. The tube should be fairly well balanced. Candles are then inserted in the ends, also well balanced. If one end proves heavier than the other, light the candle at the heavy end, and allow the tallow to melt until that end rises; then light the other candle. The alternate dripping from the two candles will cause the tube to rock back and forth like a walking-beam. It will keep going until the candles are entirely consumed.—Charles I. Reid.

An Emergency Vise Repair

HAVING broken the threaded shaft of a 3″ vsei it cao be repaired as follows:

Take two pieces of brass 2″ by $\frac{3}{8}''$ by $\frac{1}{4}''$ and in the center of each piece bore and tap a hole to admit an 8-32 thread.



A vise repair which can be made quickly in case of an emergency

A threaded brass rod 6″ long, two knurled nuts and a knurled 8-32 nut about $\frac{3}{4}''$ in diameter are the other materials needed.

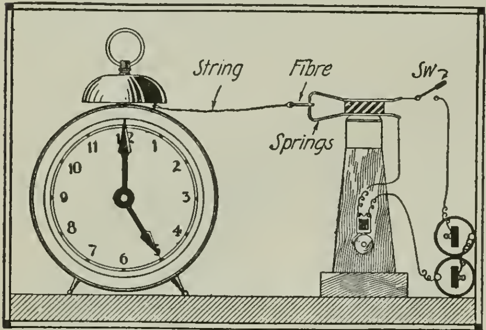
The various parts are assembled as shown in the diagram. The brass bars are marked *A*, the threaded rod, *B*, the small knurled nuts, *C*, and the large nut, *D*.—T. W. B. Best.

A Trick in Sawing

AMATEUR carpenters often have difficulty in sawing a square cut. If when starting to saw they will hold the saw so that the reflection of the work extends in a straight line, there will be no difficulty in sawing the wood at right angles with the edge.

An Electric Alarm Operated by a Clock

A GOOD electric alarm-clock is suggested in the accompanying illustration. A small fibre pin is inserted between two bent springs and attached by a cord to the hammer of an alarm-clock.



When the alarm goes off the fibre pin is pulled out, the wires make a circuit, and the electric bell starts

When the alarm goes off, the fibre pin is jerked out from between the springs. They close like teeth and complete an electric circuit which consists of dry batteries and a door bell. A switch, *SW*, opens the circuit.—J. W. Klaus.

Protecting Labels on Bottles

INSTEAD of coating the labels of chemical bottles with paraffin, the usual rule, a better plan is to coat them with a mixture of candle wax and petrol. After this is applied, a high luster can be obtained by painting the surface with a solution of "white lac" in methylated spirits. The result is a brightly varnished label which is impervious to most chemicals.—G. E. Welch.

Workbench Made From Old Piano

OLD square pianos that have outlived their musical usefulness can be bought very cheaply, and the solidness with which they are constructed fits them admirably—after a few important alterations have been made—for workbenches. All of the mechanism should be removed, including the keyboard, and the piano body sawed to the desired height. The top may be replaced when the height has been shortened, and it makes a substantial table. The exact type of the piano and the tools which are available to the workman will decide the details of the reconstruction.

The piano from which the writer constructed a workbench has proved a source of other value. About fifty feet of well seasoned lumber were secured, several gross of screws from the action, several pounds of lead and a basketful of good ivory. The strings and felt will also find future use.—T. E. White.

A Library Paste Which Does Not Dry

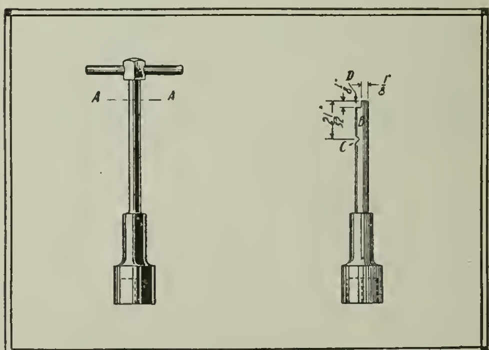
A JAR of library paste can be prevented from drying out by the following procedure:

Break off a piece of glass tubing just long enough to reach to the bottom of the jar. In one end of this tubing place a wad of cotton and push the end containing the cotton down through the paste. In the open end pour a little water which will gradually seep through, moistening the paste. The paste will be moist but not watery.

—Loren Thoreau Ward.

Handling Small Bolts Easily

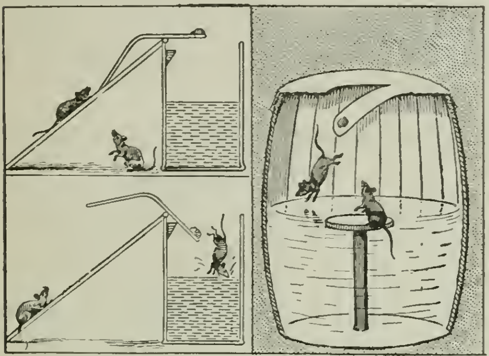
A TOOL for turning small bolts can be made from a discarded socket wrench. The handle of the wrench should be cut off, and the protruding spindle machined, as shown in the accompanying illustration. The finished spindle will readily fit an ordinary "Yankee" screwdriver.—B. G. McIntyre.



Small bolts are easily handled with this rebuilt socket wrench

Catching Rats Wholesale

WHERE there are many rats, a trap which will catch a large number, without being reset, is a great advantage. An excellent device may be made from a large bucket, half-filled with water.



Many original rat-traps have been devised by the soldiers in the trenches, where the vermin flock in droves. Here are two of the traps, now in use

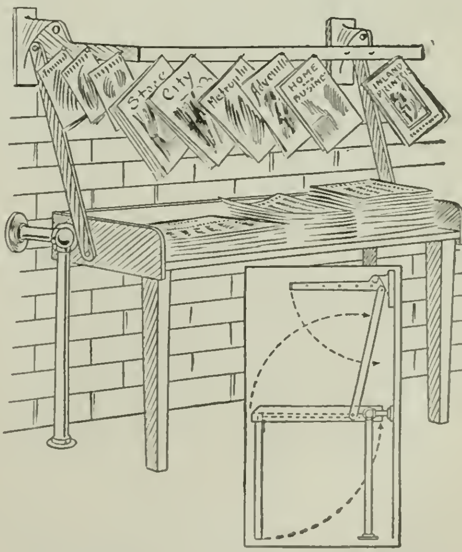
Place a board against the edge of the bucket for the rats to ascend. Provide a metal piece, which can be pivoted at the upper end of the board and bent into the shape shown in the diagram. The pivoting may be easily effected by simply stretching a wire over the flap and fastening it to screw-eyes in the end of the inclined board. Place lard or bacon at the overhanging end of the metal piece for bait. The rats ascend the inclined board; when the bait is reached, their weight overbalances the upper flap, and they plunge into the water, the flap resuming its original position.

Another good method requires a barrel of water. Attach a small board to the end of a stick and place this in the barrel vertically, so that the board forms a small platform, which should be submerged slightly in the water. Cover the top of the barrel with parchment or even strong paper or cardboard. Make a U-shaped cut in this covering to form a tongue for holding the bait. A rat approaching the bait is precipitated into the water. He soon reaches the platform and cries out in distress; other rats come and they also fall into the water. A fight for the board ensues and the would be rescuers are slaughtered together with the original victim.—F. P. Mann.

A News Stand and Blueprint Washer Combined

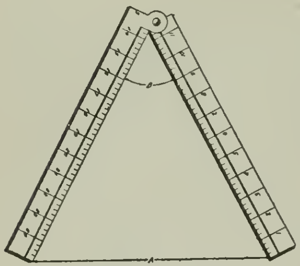
A COLLAPSIBLE news stand which can be turned to the desirable, if not closely related use of blueprint washer can be made effectively from ordinary ½″ lumber and 1″ piping. The piping adds much to the rigidity of the news stand and offers the opportunity for the extra use of blueprint washer with the simple assistance of a garden hose. The magazine rack makes an excellent drying place for the blueprints.

As constructed, the stand will fold close to the wall and can be hooked or locked in position. The main support of the stand is made of 1″ piping, fastened to wall and sidewalk. The shelf turns on the elbow fitting which is also the outlet for the blueprint washing system. The front legs are hinged and shut back on the shelf when it is closed. The rack is set out from the wall by a bracket built so that when the shelf is closed up against the wall, the guards push the back of the rack pinions up and drop the rack down inside the shelf. This closes the entire apparatus inside the shelf with the exception of the front legs, which can be locked down.



The magazine rack can be turned into a blueprint washer. An inventive boy designed and built this

Laying Out Angles with a Two-Foot Rule



The two-foot rule can lay out angles

THE average carpenter who has any occasion to lay out an angle which does not require absolute accuracy, such as can be obtained with a protractor, can secure fairly accurate results with the use of the accompanying table. A standard two-foot rule is required. By opening the rule to different angles we secure corresponding varying openings measured in inches between the edges of the rule, as designated by the letter *A*. Suppose we wish to measure an angle of 20°. By consulting the table for 20°, we find the distance *A* to be 4 5/32″. Using a pair of dividers or an additional rule, spread the two-foot rule apart until the distance *A* measures 4 5/32″ in length. Then the angle *B* will measure 20°. The table has been computed within 1/32″, that being sufficient for all practical purposes.—S. H. SAMUELES.

TABLE FOR LAYOUT OF ANGLES BY TWO-FOOT RULE

B	A	B	A	B	A	B	A	B	A	B	A
DEG	INCH	DEG	INCH.	DEG	INCH.	DEG	INCH	DEG	INCH	DEG.	INCH
1.	7/32	16	3 11/32	31	6 7/16	46	9 3/8	61	12 3/16	76	14 25/32
2	7/16	17	3 17/32	32	6 5/8	47	9 9/16	62	12 3/8	77	14 15/16
3	5/8	18	3 3/4	33	6 13/16	48	9 3/4	63	12 9/16	78	15 3/32
4	27/32	19	3 31/32	34	7 1/32	49	9 31/32	64	12 23/32	79	15 1/4
5	1 1/32	20	4 5/32	35	7 7/32	50	10 5/32	65	12 29/32	80	15 7/16
6	1 1/4	21	4 3/8	36	7 7/16	51	10 11/32	66	13 3/32	81	15 19/32
7	1 15/32	22	4 19/32	37	7 5/8	52	10 17/32	67	13 1/4	82	15 3/4
8	1 11/16	23	4 25/32	38	7 13/16	53	10 11/16	68	13 7/16	83	15 29/32
9	1 7/8	24	5	39	8 1/32	54	10 29/32	69	13 19/32	84	16 1/16
10	2 3/32	25	5 3/16	40	8 7/32	55	11 3/32	70	13 3/4	85	16 7/32
11	2 5/16	26	5 13/32	41	8 13/32	56	11 1/4	71	13 15/16	86	16 3/8
12	2 1/2	27	5 5/8	42	8 19/32	57	11 15/32	72	14 3/32	87	16 17/32
13	2 11/16	28	5 13/16	43	8 13/16	58	11 5/8	73	14 9/32	88	16 11/16
14	2 29/32	29	6	44	9	59	11 13/16	74	14 7/16	89	16 13/16
15	3 1/8	30	6 7/32	45	9 3/16	60	12	75	14 5/8	90	17

By following this table, an angle of any degree, from the smallest to the full right angle, can be laid out with an ordinary carpenter's two-foot folding rule

A Simple Way of Making Facsimile Rubber Stamps

LAY a piece of carbon copying paper face up upon a smooth table. Over this, place a sheet of paper and with a lead pencil write the name. The name will be reproduced on the back of the paper. Lay the carbon paper face down upon a piece of very smooth zinc, and upon this, place the paper on which the name has been written, this also face down. Then with a pencil go over the lines, which now read backwards, thereby tracing the lines upon the zinc.

Next, prepare an acid-proof ink by mixing equal parts of pyrogallic acid and sulphate of iron. Go over the lines on the zinc with a pen dipped in this ink. When dry, apply hydrochloric acid to the face of the zinc. After it has eaten deeply enough, wash off the acid in running water.

A plaster cast is then taken and a reproduction made with rubber in the manner described in the March, 1915, number of MODERN MECHANICS AND THE WORLD'S ADVANCE. The zinc can also be mounted type-high on a wooden block and used in a printing press.

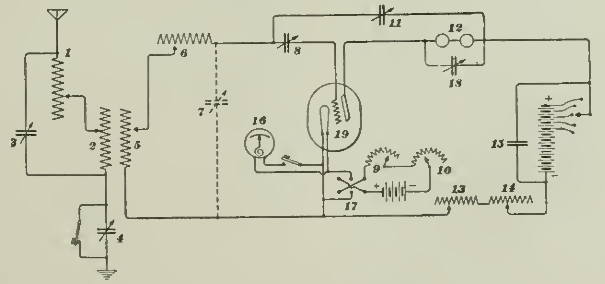
For those who are not experienced in vulcanizing rubber or who do not care to go to the trouble, the following is recommended: India rubber, cut up into small pieces, is dissolved in highly rectified spirits of turpentine until semi-fluid. This is then poured into the plaster cast, which has been previously dusted with powdered graphite.

An Undamped Wave Receiver

By W. Ross McKnight

YOU are missing much enjoyment, if your wireless set is not equipped to receive signals from stations employing undamped ("continuous") waves. Arlington transacts considerable business with a Poulsen arc transmitter. Tuckerton and Sayville, working with Germany, use undamped waves, as well as a new government station, NAJ, on the great lakes. A number of other stations which use arc sets are located on the Pacific Coast and in the Southwest. Notable among them is the new Navy station at Darien, Panama Canal Zone with call letters UBA. It is expected that others will be established from time to time. Again, it is not impossible for the advanced experimenter to "get" the Nauen and Eilvese stations in Germany, if he be in position to erect an aerial some six hundred or more feet long.

Persons who have experimented with the audion detector have found that it may be rendered extremely sensitive to some spark signals by certain critical adjustments of the lighting and high voltage batteries. When in this state, the audion is a perfect generator of high-frequency oscillations. Not every bulb, however, can be made to "oscillate" merely by adjusting either or both of the battery systems. Also, this condition, when obtained by these means, is not stable and reliable, nor is it flexible enough to accommodate itself to tuning to various wavelengths and to various spark-frequencies, both of which are important considerations.



Wiring diagram of the undamped wave receiver

Consequently, instruments and manipulations are wanted that will enable one to turn his audion into a high-frequency generator with the certainty and reliability that water may be turned from a faucet.

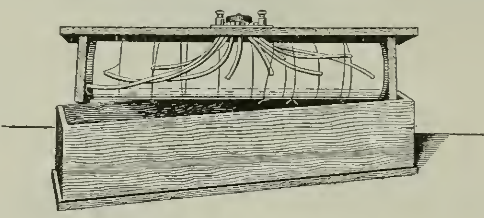
The following information will enable any amateur having an audion, to receive signals from undamped wave stations located within, say, 1000 to 1500 miles, and, under favorable conditions of

CASH PRIZES FOR RADIO ARTICLES

The POPULAR SCIENCE MONTHLY is offering cash prizes for radio articles. See page 481 of this issue for details.

location and skill, from the Navy station at Darien, which is about 1800 miles from Washington. He may also receive signals from spark stations many hundreds of miles farther away than before, and "bring in" the stations which he has been hearing from two to ten times as loudly as before.

The accompanying illustrations portray an arrangement of three tuned circuits, the open (antenna) circuit, the secondary circuit, and the audion wing (high potential) circuit. The various condensers and inductances shown are the usual tuning devices.


How the inductance coils are made

The antenna in use with the set here described consists of two stranded copper wires 250′ long, spread 4′ apart on bamboo spreaders, raised 30′ above level ground, located up in the mountains of northeastern Pennsylvania. The antenna, with the aerial tuning inductance, primary of inductively-coupled tuner and the condenser shunted around the aerial tuning inductance and the primary winding, permits of tuning to resonance with from 1000 to 8000 meters wavelength. Tuning to shorter wavelengths may be done by cutting in the condenser shown in the ground wire. With this set it has been easily possible to read signals from the Navy station at Darien, Panama, day or night, ever since the station was opened.

The constants of the aerial, inductances and condensers may be varied, of course, and those in use or on hand in most advanced amateur stations may, perhaps, serve the purpose; but in the aggregate a fine degree of resonance must be procured. All inductances (save those of the tuner) are in oak boxes; the tubes are fastened to the lids by brackets, with the switches on top of the lids. This arrangement permits the entire unit to be lifted out of its box without disturbing connections, if desired. Tap leads inside are covered with soft rubber tubing. Coil boxes may be placed on end to save space.

The tuner is of the familiar inductively-coupled navy type; the inductances in both tuner circuits are variable by switches only, 16 ten-turn and 18 one-turn in the primary, and 12, equally spaced, in the secondary. Inductance 1 is made of a paper mailing tube, 3″ outside diameter, 18″ long, and wound closely over 16″ of its length with No. 25 DCC wire. Including the ends of the winding, ten taps, equally spaced, are led to a ten-point switch. Inductance 6, in the secondary circuit, is made of a paper mailing tube, 3″ by 18″, wound closely for 16″ with No. 36 DCC wire; and 10 equally spaced taps are led to a ten-point switch. Inductance 13 is identical with inductance 6. Inductance 14 is of the same dimensions but it is wound with No. 25 wire for use when tuning to shorter wavelengths, and to permit fine variations in conjunction with inductance 13 when tuning to long waves. All condensers (except that around the high-potential battery) are of the familiar segmental variable type, with range of capacity from 0.0008 to 0.001 mfd. Condenser 3 is filled with castor oil, giving it a maximum capacity of approximately 0.004 mfd. It is used to boost the wavelength of the antenna circuit.

Rheostats 9 and 10 are employed to regulate the filament voltage. One is the ordinary rheostat that is a part of every audion detector. It has a total resistance of about 10 ohms. The other has a total resistance of only 1½ ohms in 10″ of length. This second rheostat is not absolutely essential, and may be omitted, but it has been found to be very convenient to have such a rheostat for closely regulating the lighting voltage, whether storage or dry cells are used. The condenser 15 shunted across the high potential battery is of the ordinary telephone type, of from 1 to 2 mfds. capacity. Condenser 18 may be either a true variable, or a variable-fixed condenser susceptible of several changes of capacity. The function of these condensers is to provide paths of low impedance, for the high-frequency currents, around the high-potential battery and the telephones. It is considered good practice to have a condenser across the telephone terminals with an audion detector, however used.

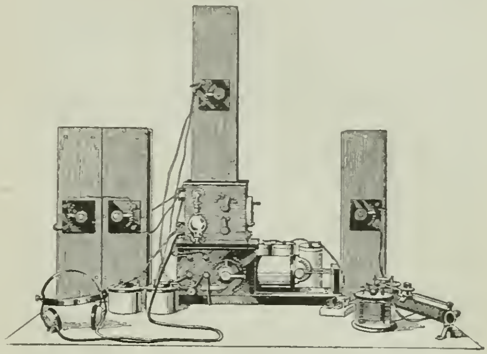
The leads to condenser 15 must be amply protected against any possibility of shortcircuiting the high-potential battery. If a telephone-type condenser is used, after the leads are soldered to the lugs (which are close together) it is a good plan thoroughly to cover the lugs, the solder, and the wires which are exposed, with sealing wax or paraffin. Condenser 11 must be one that does not "contact" inside, for a shortcircuit of the high-potential battery is possible when all inductances are tuned out. It is a good idea to insert a ½ ampere fuse in the high-potential battery circuit.

Condenser 11 is the one most handled in tuning. It is used in conjunction with inductances 13 and 14 to bring the wing circuit into resonance with the secondary circuit, and cause the bulb to oscillate. In the wiring diagram, 16 shows a voltmeter across the filament terminals; though not positively necessary, it is useful. If one gets accustomed to regulating the lighting voltage with a voltmeter, the likelihood of "crowding" the filament is almost eliminated, and hence, a longer life of the bulb may be expected. The bulb may be shaded to prevent strain on the eyes. In the diagram, 17 is a pole-changing switch provided to reverse the lighting battery; it is a very desirable adjunct. Any d.p.d.t. battery switch will do.

Condenser 7, usually used to tune the secondary, is not necessary with this set. Tight coupling is employed with long waves. Any necessary variation of capacity for short waves may be effected by slightly changing the coupling. The fixed condenser usually found within each audion detector, in series with the grid, should be removed or bridged over; the variable condenser 8 takes its place in this set.

Assume, now, that we have assembled these component parts and wish to "pick up" Tuckerton, Arlington, or Sayville—stations working with long wavelengths of from 6000 to 8000 meters:

Couple the tuner closely; throw in all of the aerial tuning inductance and those of both primary and secondary of the tuner; throw in all of the secondary loading inductance; set condenser 8 at about half capacity (according to the scale); set condenser 11 at zero; throw in all of inductance 13 and about half of 14, adjust the lighting and high-potential


Arrangement of complete receiver

batteries as usual, then slowly turn up condenser 11.

The lamp should begin to oscillate, and this will make itself manifest by a peculiar muffled "boiling" sound and a change in the sound of static. A loud or troublesome hissing sound indicates too much high-potential or lighting voltage, or both, and should be avoided; the bulb is not in its most responsive condition when this is present. A very slight blue glow is usually observable in the bulb, back of the wing, when it is doing its best. If immediate results and signals are not secured, raise and lower the high-potential and lighting voltages in various combinations and manipulate condenser 11 until the bulb oscillates. Swinging condenser 8 through its arc, and changing the polarity of the lighting current may have important effects—it depends upon the bulb.

Not all audions oscillate with equal facility, but I have never handled one that would not oscillate with a little patient persuasion. Holding a lighted match to the bulb until the glass is very warm tends to break down its unwillingness to oscillate. The sensitiveness of a given bulb while oscillating seems to be directly comparable to its sensitiveness in ordinary use. Since not all audions, nor even both filaments in any one audion, are equally sensitive, this should be kept in mind so that one will not expect an insensitive bulb to give the finest results, under any conditions.

Experience and observation have shown that the "X" grade Hudson filament bulbs are the most satisfactory and economical.

Once the proper adjustments are discovered, the setting will be practically a constant for a stated wavelength, and it will likely be found that all the undamped wave stations mentioned may be tuned to maximum strength of signals by slight changes in the capacity of condenser 11, perhaps tuning up condenser 3 for Sayville.

The continuous-wave stations are heard in clear, flute-like tones, the pitch of which may be varied in a wonderful and amusing manner by slight change of condenser 8 or 11, or both, or the primary of the tuner, or inductances 13 and 14, or simply touching a metal part of the secondary circuit.

Particularly close tuning with arc stations is necessary, since usually two waves of practically equal energy but of slightly different length are emitted. One of them (the main wave) represents the dots and dashes and the other (the compensation wave) represents the breaks. Some difficulty may be experienced in entirely suppressing the compensation wave, but the difference between the two may always be made sufficient for clear reading.

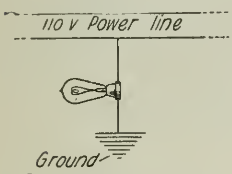
With this set the phenomenon of "stepped-up" voltage of the high-potential battery may be taken advantage of to procure a further increase in volume of signals of spark stations. Arlington's spark signals may be brought in to a degree of loudness painful to the eardrums by throwing in all of the tuner inductances, all of the secondary loading inductance and all of inductance 14, condenser 11 remaining at zero. South Wellfleet (WCC) can be made to "come in" like a grandfather bullfrog by similar manipulation, making due allowance for the shorter wavelength. The same is true, generally, of spark stations anywhere within reach, that work on 1000 meters wavelength or over. A far distant and relatively weak spark station may come in, not with the true note, but with a "whisper" effect. It is usually not practical to obtain perfect oscillation of the audion, resonance with and amplification of signals from stations using wavelengths of 600 meters and under, because of the circuit difficulties involved.

The experimenter who sets out to rig up a receiving set of this character is urged to avoid loose connections, imperfect contact at switches, bunched and parallel connecting wires as much as possible, and sloppy work generally, and to employ persevering patience in tuning the set to various stations until adeptness is acquired. All switch handles should be of good insulating material, and no part of the operator's body should be allowed to come into contact with binding posts, switch levers or bare wires; the capacity of the body will prevent delicate adjustment. The inductances and condensers of the three circuits should be kept separate, each circuit a reasonable distance from the other, say a foot. Proper allowance must be made for the fact that signals that may be coming in ever so clearly may sometimes be almost or entirely suppressed by placing the hand or arm close to certain of the coils or condensers, or even close to the connecting wires. This is particularly true of undamped signals being received on a lower harmonic of the true wave.

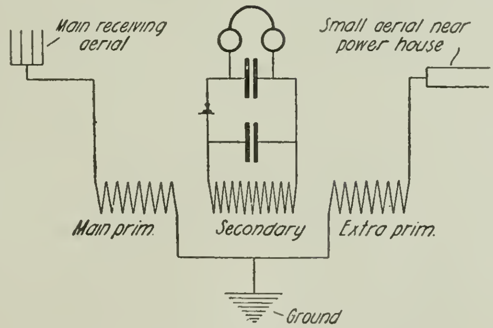
Just a few words about winding the coils with the finer wire: Use a lathe, if available, or improvise one with a tool grinder, replacing the grinding wheel with a circular block that will just fit inside the tube; one tack will hold the tube to the block. A similar block, supported and free to turn on a stud, will hold the other end of the tube. By locating the spool of wire on a rod about 25 to 50 ft. away and starting the winding carefully, the whole tube may be wound in a few minutes at high speed; the wire will "feed" itself, barring accident. The taps may then be brought out by lifting the proper turns with the point of a knife blade, cutting the wire, unwinding a turn of each end, twisting them together and soldering the bare ends. The tubes may be wound with the coarser wire by hand and taps brought out as they are reached in winding. Any experimenter whose wireless is equipped to receive undamped waves, should be able to obtain very interesting and valuable results.

Arc Light Interference

IN the November and December issues of POPULAR SCIENCE MONTHLY there were published several queries and answers on the matter of arc light interference with received signals. Our readers were asked to contribute suggestions which they found helpful in overcoming or reducing this sort of disturbance. A large number of replies have been received, and the proposed methods are here described. It appears that at least two kinds of inductive disturbances are encountered. The first of these is the ordinary "induction hum," heard in nearly all wireless stations that have alternating current power lines running into or very near them. The second type is that which is caused by the flickering and fluttering of carbon arc lights in operation, and which is usually transferred to the receiving wireless aerial by induction from adjacent power lines.



Grounding line through the lamp

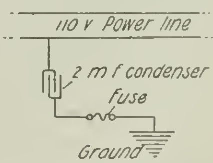


Balanced primary method of reducing arc light interference

The induction hum is the most common and the easiest to eliminate. It is troublesome when direct-coupled receiving tuners are used, but may often be cut out by changing over to an inductively-coupled receiver. One experimenter states that by running his aerial lead through a fixed condenser before connecting to his tuning coil, he reduced the interference greatly. Another writes that he secured good results by placing a 7-volt tungsten lamp in series with the antenna lead, keeping the lamp lighted to a certain brilliance (determined by experiment) by means of a battery and rheostat. The real reason for any improvement gained from either of these last two methods is not apparent; the use of inductively-coupled apparatus, however, has not only been found effective by practical test, but also is theoretically correct.

Another way of cutting out the hum is effected by merely opening the main switch which brings power into the house containing the receiving instruments. This method prevents internal induction from the leads, but, of course, cannot be used when it is desired to utilize the electric power for transmitting signals or for lights. In some stations the trouble has been stopped by connecting one side of the incoming 110-volt line to ground, through a fuse which will blow on 2 amperes or so, or by grounding through a condenser or small 110-volt lamp. Which of the two power wires is to be grounded through the lamp, condenser or fuse in this way must be determined by trial. In grounding through a condenser the fuse should also be used, for protection in case the condenser punctures.

Some of the above methods are effective not only for the alternating current induction, but also for the ragged, harsh noises from arc lights. Especially helpful is the plan of grounding the power lines, for in many cases the arc induction is picked-up by the regular lighting lines and brought to the wireless station over them. Both kinds of disturbance have also been reduced in wireless stations by connecting the diaphragms of the receiving telephones to ground, either directly or through a condenser. Often it helps merely to touch the aerial or ground lead with the finger, or to rest the hand upon a metal plate connected to the blocking condens-



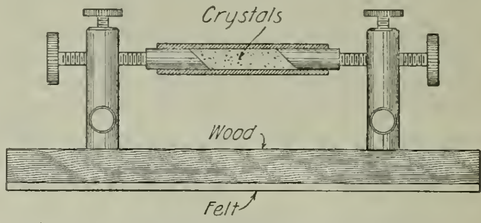
Grounding line through the condenser and the fuse er or one of the telephone leads. Some correspondents have suggested permanently connecting one of the telephone tips to the telephone diaphragm by use of a small metal strip, saying that by trying the several possible combinations, they were successful in finding an arrangement which actually reduced the interference without weakening the signals. A variation of this method is to use the metal-capped telephones and to ground the cases, either directly or through a condenser. Sometimes it is sufficient to connect the case or one of the telephone terminals to the operator's body by bending a piece of tinfoil over the ear-cap and connecting it to the case or cord tip. It has also been found useful to connect together the metal cases and headband, as well as to connect together a certain one of the four tips and the metal case. Which cord-tip to connect in this way must be ascertained by trial.

It has been learned that at a number of stations both the induction and the arc noises can be reduced if the antenna is changed so as to point directly away from the power lines. When the aerial and the 110-volt wires are parallel there is, of course, the greatest inductive effect between them, and when they are about perpendicular the induction is least. Sometimes a position not exactly perpendicular gives the smallest interference, because of an irregularity in the magnetic field around the power wires.

Taken as a whole, the elimination of arc noises remains a big problem at some stations. In many cases the remedies suggested above will reduce the disturbances so much that they will cause no trouble, but it is likely that at some other stations the interference will persist in spite of the hardest work to get rid of it. If it becomes necessary, the "balanced primary" method may be tried as a last resort; in this arrangement a small extra antenna is erected near the power lines and connected to ground through a second primary which opposes the effects (on the secondary) of the regular primary coil connected to the regular receiving aerial. This more complicated circuit may prove worth while, since, by its use, the noises have, in some cases, been almost entirely cut out after the simpler plans failed.

A Crystal Detector

THE main advantage of this detector is that a great number of sensitive spots on the crystal are obtained. A coherer-stand may be used, by substituting



A great number of sensitive points on the crystal are obtained

small galena crystals for the filings. In the absence of a coherer-stand, use two large binding posts, two brass rods and a piece of glass tubing which will fit snugly over the brass rods. The mineral is prepared by placing a sensitive piece of galena in a small piece of cloth and then pounding the crystal into small pieces. The small crystals are then separated from the powdered mineral, and placed in the glass tube . Adjust the detector by turning the glass tube and moving the brass rods until the maximum sensitiveness is obtained. A buzzer is used to excite the circuit in order to secure the best adjustment easily. Great care should be taken not to touch the crystals with the hands, since moisture or grease will decrease their sensitiveness to a great extent.

Restoring Electric Light Bulbs

OFTEN when the electric lights of the tungsten filament type go out, or burn out, it is caused by the breaking of the filament wire. When this is the cause, screw the bulb into the socket of a flexible cord and turn on the current. By holding the bulb in a horizontal position, manipulate it by turning and rolling and tapping it with the hand to cause the filament wires to cross. When successful it will instantly light. While lit, hold it in a quiet position for a few minutes till the wires weld, after which it can be used for regular service.

The writer has been able to recover over 60% of light bulbs he has tried, and they have lasted from three hours to three weeks.—JOHN HOECK.

The Tuning of Radio Telegraph Receivers

By John Vincent

THE article of this series which appeared last month discussed the difference between free and forced oscillations in radio telegraph circuits, and applied the laws of resonance to several of the more common types of sending apparatus. It is interesting to note that the same simple fundamental laws of tuning govern the operation and adjustment of receiving apparatus, in very nearly the same way. The need of securing agreement in frequency between the arriving waves and the receiving aerial circuit is as great as the need of tuning together any two circuits involved in radio telegraphy.

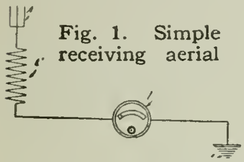


Fig. 1. Simple receiving aerial

As has been shown, the traveling electromagnetic wave which is sent out in all directions from a transmitting station has a definite wave-frequency. It is more usual to speak of each particular wave as having a particular *wavelength*, but it is just as accurate to consider the *wave-frequency*. The frequency of any wave may be found by dividing its length in meters into 300,000,000, according to the examples given in January. As has also been shown, every antenna circuit has a definite frequency of resonant vibration; this frequency depends upon the effective inductance and effective capacity of the entire antenna and connected instruments, and this frequency is that which would be assumed by an alternating current (or free oscillation) set up in the antenna system by first charging its capacity and then allowing it to discharge freely through the circuit to earth. The frequency of this free oscillation may be figured out, according to the rule given in the March article, when the capacity and inductance are known.

The frequency of free oscillation is practically the same as the frequency of the forced oscillation which will cause the largest current to flow in the antenna circuit. The equivalence of these two quantities, as explained in connection with transmitters last month, holds for receiving-circuits as well. In other words, the resonant free-oscillation frequency of an antenna system not only represents the wavelength which will be best radiated from that antenna, but also the wavelength which will be received with the greatest intensity.

This law may be worked out for a simple circuit arrangement such as shown in Fig. 1, where the antenna A is connected to earth E through a variable tuning inductance L_1, and a current indicator I. Suppose the instrument I is a sensitive hot-wire ammeter of the sort used in wavemeters, and that the aerial is rather large and is erected within a mile or two of a powerful transmitting station. Suppose that the antenna is of the flat-top variety, having four wires hung on 30′ spreaders and with a total length of 150′; this aerial will have a capacity of about 0.001 microfarad. If the high power sender is in operation, at a wavelength of 5000 meters, strong ether-waves of frequency 300,000,000 ÷ 5000 = 60,000 cycles per second will pass by the receiving station. If, now, we tune the receiving aerial to this frequency by adding to the coil L_1 until the total antenna inductance equals about 6.94 millihenrys, the ammeter I will show the greatest deflection. If either more or less than this amount of inductance is used, the current in the antenna will be smaller, for the reason that 6.94

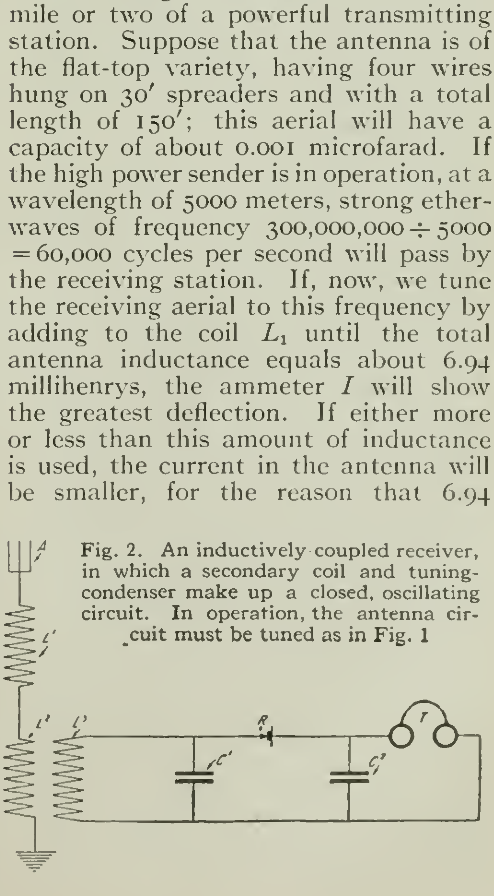


Fig. 2. An inductively coupled receiver, in which a secondary coil and tuning-condenser make up a closed, oscillating circuit. In operation, the antenna circuit must be tuned as in Fig. 1

millihenrys with the antenna capacity of 0.001 mfd. *tunes* to the wave-frequency of 60,000 cycles and therefore to the wavelength of 5000 meters.

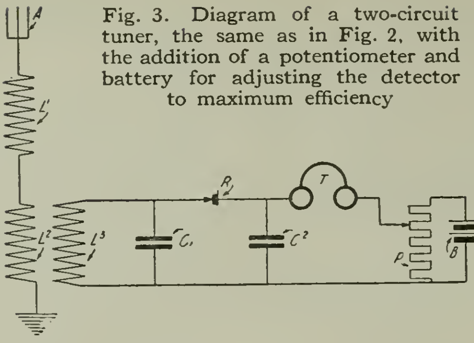


Fig. 3. Diagram of a two-circuit tuner, the same as in Fig. 2, with the addition of a potentiometer and battery for adjusting the detector to maximum efficiency

The principle of tuning the antenna circuit, then, is to change its inductance or capacity or both in such a way and by such amounts that the resonant wavelength agrees with the length of the incoming wave. That is to say, the free-oscillation frequency of the circuit must be made practically the same as the frequency of the forced oscillations generated in the antenna by the received electromagnetic waves. These waves, of course, produce forced oscillations of their own frequency; hence it becomes necessary merely to adjust the antenna so that it will naturally radiate the wavelength which it is desired to receive.

If a secondary circuit is coupled to the antenna, as in Fig. 2, the same general conditions apply. In this diagram the antenna A is connected to earth through inductance coils L_1 and L_2, as before. The lower coil is used as the primary of an inductive coupler, whose secondary is the third coil L_3. Across this secondary is connected a variable tuning condenser C_1, and in shunt to this the crystal detector R and the stopping-condenser C_2. This latter instrument has connected to its terminals the telephone receivers, T. In operation, the antenna circuit must be tuned to the frequency of the incoming waves by varying the inductance of L_1 or L_2, exactly as in the example just considered. If the antenna capacity is 0.001 mfd. and the incoming wave has a length of 5000 meters, the sum of the effective primary inductances must be about 6.94 millihenrys. A distribution which would agree with good practice would allow 0.05 millihenry for the antenna itself, 5 millihenrys for the loading-coil L_1 and the balance (1.89 millihenry) for the primary coil L_2. It would be entirely feasible to have the entire inductance of coils L_1 and L_2 in a single primary winding, but the convenience of a separate loading-coil for long waves makes it desirable to divide the coils as indicated.

The secondary coil L_3 and the tuning-condenser C_1 make up a closed, oscillating circuit of the kind discussed in the January article. In order to transfer the most power from the primary or aerial circuit to the secondary, so that the detector may be operated by the strongest impulses, it is necessary to adjust the time period of the secondary oscillation to agree with that of the primary. In other words, the secondary must have its inductance and capacity adjusted so that it is tuned to the wave-currents flowing in the primary. The resonant frequency of the secondary must be made the same as that of the primary, and the same as the frequency of the incoming wave. If the secondary coil L_3 has an inductance of 4 millihenrys, the condenser must be set at 0.00173 mfd. to give resonance for the assumed wavelength of 5000 meters. When the adjustment is such that the effective values of capacity and inductance are these, and when the coupling between the coils L_2 and L_3 is chosen so that the transfer of power is at the rate which is best for the detector in use, the loudest signals will be heard in the telephones.

The numerical values of inductance and capacity given in these two examples, it must be noted, are the *effective values* for the circuit considered. That is to say, the assumed frequency of oscillation will occur if the circuits behave as though these exact values of coil and condenser were used. The real measured values of capacity and inductance may be somewhat different (though not very much) from the quantities worked out by applying the simple rules; this is because the coils in the circuit react upon each other and partially destroy the pure inductive effect of each, and because the simple capacity of the tuning condenser is not the only capacity in the circuit. For instance, in Fig. 2 it is necessary that the secondary effective capacity shall be 0.00173 mfd.; this is not the value of C_1 itself, since the capacity added by the presence of the detector, stopping-condenser and telephones must be considered. The capacity of the detector is very small and, since the stopping-condenser and telephones are in series with the detector, the resultant added capacity is still smaller. If, instead of the arrangement shown, the telephones had been connected across the detector, the limiting capacity would have been that of the 'phone windings, which is sometimes fairly large. A good reason for placing the telephones in shunt-to the blocking-condenser instead of in shunt to the detector is therefore brought out; the detector capacity is so small that tuning is governed almost entirely by the tuning-condenser C_1 when the arrangement of Fig. 2 is used.

A two-circuit tuner is shown in Fig. 3. It has all the elements as in Fig. 2, with the addition of potentiometer P and battery B for adjusting the detector R to its point of maximum rectification efficiency. The tuning to incoming waves is accomplished as in Fig. 2; the antenna circuit is first tuned by adjusting the inductances until its resonant frequency agrees with that of the waves desired, and then the secondary circuit is tuned to the same frequency by proper adjustment of inductance L_3 and capacity C_1. It should be noted that the same arrangement of telephones is shown here as in Fig. 2; the potentiometer, battery and telephones are connected across the stopping-condenser C_2 and not directly across the detector R, so that their capacity will not become prominent in the tuning of the secondary. This arrangement, as compared to the more common connection, gives greater ease of adjustment over a wide range of wavelengths, and makes sharper tuning possible.

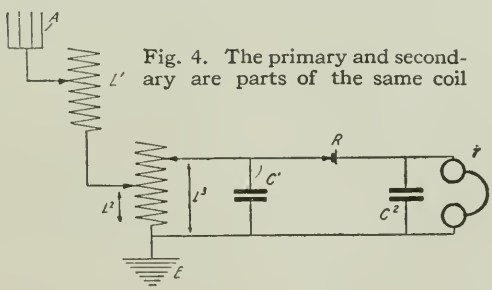


Fig. 4. The primary and secondary are parts of the same coil

The same principles of tuning may be applied to direct-coupled apparatus, as shown in Fig. 4. Here the primary and secondary are made part of the same coil, the proper amounts of inductance for each being tapped off by moving the sliding or switch-contacts as shown at L_2 and L_3. Obviously, the sum of L_1 and L_2 gives the amount of primary or antenna-circuit inductance, and the inductance of L_3 is that used in the secondary. To tune the secondary circuit to the desired frequency L_3 and C_1 must be used; L_1 and L_2 tune the primary. The coupling between primary and secondary is determined by the distribution of the total antenna-circuit inductance between the coils L_1 and L_2. For any given wavelength, the larger L_1 becomes, the smaller is L_2 (since it is necessary that their sum shall remain the same) and the *looser* the coupling between primary and secondary. The less of coil L_1 is used, the more of L_2 it becomes necessary to cut into circuit, and the *closer* the coupling. With a direct-coupled apparatus of this sort, having a separate primary loading-coil L_1, it is possible to secure as exact tuning as with the inductively-coupled apparatus; the bad reputation of "two-slide" tuners, as to dullness of tuning, has arisen mainly because the coupling is so tight that only broad tuning can be had when all the primary inductance is directly part of the coil which also forms the secondary.

In many cases it is not necessary to have as sharp selectivity as may be secured from the circuit of Fig. 2; in these instances the secondary tuning condenser C_1 may be dispensed with, as shown by Fig. 5. Here the primary L_2 and the loading-coil L_1 are adjusted as usual to the wavelength which it is desired to receive; the secondary is so broadly tuned, however, that it is not necessary to regulate its inductance by small amounts in order to secure loud signals. If a single-pole switch is placed in the lead to C_1 of Fig. 2 (as shown in Fig. 1 of p. 306 in the February issue) it becomes possible to use either the broad or the sharp-tuned secondary system, as may be desired. For any given wavelength more inductance on the secondary will be required to get loud signals with the arrangement of Fig. 5, than for Fig. 2; this is because the secondary circuit of Fig. 5 actually is broadly tuned by the capacity of the detector, blocking-condenser, telephones, etc., acting with the total inductance of the secondary. Since the natural capacity of these other elements is small, a larger secondary inductance is made necessary to reach the desired wavelength.

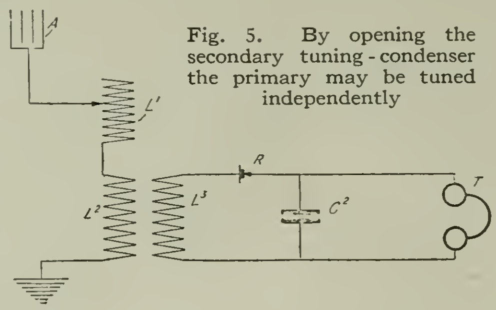


Fig. 5. By opening the secondary tuning-condenser the primary may be tuned independently

Where still less closeness of tuning is necessary, the arrangement of Fig. 4 may be modified by omitting the loading-coil L_1 which permits variation of coupling, and by doing away with the tuning-condenser C_1, as shown in Fig. 6. This results in the ordinary close-coupled direct tuner, which is useful for picking up signals when interference is not severe. By connecting in the tuning-condenser C_1, as shown by the dotted lines, it is possible to improve the selectivity of the system in some measure, especially if the blocking-condenser C_2 is made of very small capacity or even left out altogether.

It will, of course, be seen at once that in tuning the secondary circuit of any of the receivers described above, one may choose a great many combinations of inductance and capacity in order to have resonance to a certain frequency. For instance, the wavelength of 5000 meters is reached when the secondary inductance is 4 millihenrys and the condenser 0.00173 mfds. If the inductance were 2 millihenrys, twice the former capacity, or 0.00346 mfd. capacity would be required. The best ratio of inductance to capacity depends largely upon the type of detector used; for most crystals, the condenser may be about 0.003 mfd., maximum for wavelengths from 1000 to 5000 meters, and correspondingly smaller or larger for shorter or longer waves. For the audion, where the highest possible voltage should be applied to the grid, it is best to use comparatively large values of secondary inductance, with the corresponding small secondary condensers; C_1, for audion working, had best never be larger than 0.001 mfd., even for the longest waves.

The size of the stopping-condenser C_2 is also a matter of interest. For crystal detectors, it is customary to use capacities of from 0.01 to 0.04 mfd. at this point in the circuit. By making the stopping-condenser variable in steps of about 0.005 mfd., it is possible to select a best value for each particular operating condition; in general, the higher the telephone resistance and the higher the incoming spark-frequency, the smaller the stopping-condenser may be. The smaller this condenser is made, after it passes below about 0.01 mfd., the less is the damping of the secondary circuit, and the sharper is the tuning. Too great reduction of the capacity, however, in the attempt to gain selectivity, results in weakening the response to the signals. The size of the blocking or grid-circuit condenser for the audion is much less than for the crystal detectors; C_2 is then best made variable, with a range including values as small as 0.0001 mfd. or less.

In operating any of the sharply tuned circuits shown in the foregoing, it must be remembered that the best settings of primary inductance, coupling, and secondary inductance and capacity are largely dependent upon each other. In tuning-out interference and "bringing in" a particular station, the best plan is first to open the secondary tuning-condenser circuit to give the arrangement of Fig. 5; this makes it possible to tune the primary independently and accurately to the inductance value which gives the loudest signal when the coupling is made fairly loose. This primary adjustment is then left fixed, and the condenser C_1 cut into circuit to tune the secondary. By selecting the best setting of C_1 in connection with several values of L_3, one particular value which gives the best signals is found. This is left fixed, and the coupling is gradually opened. For each looser position of coupling, the primary inductance and the secondary tuning condenser are varied slightly, to the point which gives loudest signals; thus a final adjustment is found which gives either (1) the loudest possible signals from the desired station, or (2) readable signals with a minimum of interference.

How to Build the Mast for a Wireless

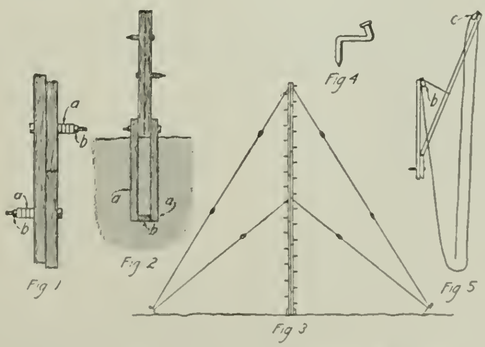
THE person who wishes to install a wireless station can easily find ample directions. When it comes to a support for his aerial, however, it usually says to erect a mast sixty to ninety feet high, without giving the details of its construction. Following are the materials needed for a mast sixty feet high:

10 pieces, 12′ by 2″ by 4″, straight-grained hemlock.
2 pieces, 4′ by 2″ by 4″, chestnut.
1 ½-inch bolt, 10″ long.
29 ½-inch bolts, 8″ long.
116 blank nuts to fit on ½-inch bolts.
120 ft. of rope.
2 pulleys; also guy wires and insulators.

The first thing to consider is the foundation. This is made of two 4′ chestnut pieces, shown at *a* Fig. 2. The durability of the wood may be increased by applying a coat of tar paint. Bore a ½-inch hole in each timber 3′ from the end. Nail a block *b*, 4″ thick, between the other ends; this holds the pieces the proper distance a part. Dig a hole where the mast is to be erected and place the wooden pieces in it, with the block at the bottom. Allow the ends to project 8″ above the ground, which should be stamped down very firmly to insure stability.

For the mast proper, saw one of the 12-foot pieces in half. Lay one of the halves on top of a 12-foot piece so that their butts are even at one end; and 3″ from their butts bore a ½-inch hole through both. Bore another ½-inch hole 3′ from the butts; then one every 2′ along the whole length of the mast.

Bolt the one 6-foot piece and the three 12-foot pieces together. The bolt is slipped through the holes, four blank nuts put on the bolt and then a threaded nut screwed on. The blank nuts are designated by *a* and the threaded one by *b* in Fig. 1. This 24-foot section is laid so that its butt can be bolted to the foundation with a ½-inch bolt 10″ long, as in Fig. 2. Before raising this section, drive a 6-inch spike bent as shown in Fig. 4. Thread a pulley with rope and hook it upon this spike. The tackle will then be in place when the section is raised. After raising the 24-foot section to a vertical position and guying it temporarily, drive a 6-inch spike into the end of a 12-foot timber, after bending the spike as shown in Fig. 4. Then hook the second pulley *c* on the spike, Fig. 5. The end of the rope from pulley *b* is tied to the piece a few inches from the center. The reason for this operation will be made clear by examining Fig. 5. Each time a 12-foot piece is raised, the tackle is always raised for the next timber. When in position, each piece is bolted to the one raised before, and so on to the top. Two sets of permanent guys are attached to the finished mast, as indicated in Fig. 3, one set being 30′ and the other 60′ from the ground. The guys should be insulated every 30′.—E. R. Thomas.



Construction details of the wireless mast

Construction of Unipolar Dynamos

THE direct-current dynamo, as pictured by almost everyone, is a complicated machine having many poles and an iron armature which is wrapped up with many turns of copper wire and which has at one end a huge copper commutator on which copper or carbon brushes bear gently, to conduct the energy to distributing wires and cables. Very few, however, realize that there is another type of direct-current machine which, although suitable, as yet, only for some special uses, may eventually earn an important place for itself. This machine is the unipolar dynamo.

In the old style dynamo, the current

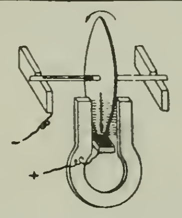


Fig. 1. Barlow wheel acting as a current generator

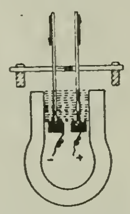


Fig. 2. Two wheels that revolve in opposite directions.

set up in the armature windings is alternating, because the conductors, as they revolve, pass successively under a magnetic north pole and then under a south pole. In order that direct current may be delivered to the line, an expensive and delicate commutator is required, which reverses the connections with the line every time the current begins to flow in a direction opposite to that in which it was flowing before.

If arranged so that the armature conductors, as they revolve, cut across a magnetic field always in the same direction, the current generated will always flow in the same direction, and no commutator will be required. This arrangement has received the name of unipolar dynamo.

The most practical form of unipolar generator in use is, to a certain extent, a reproduction of the apparatus known as the Barlow Wheel (Fig. 1). It consists of a metal disk mounted so that it projects between the poles of a magnet. Connections are made to the shaft of the wheel and to the periphery of the disk by means of sliding-contacts. These contacts can be compared, in some respects, with the brushes of multipolar dynamos. If, now, the disk is rotated, the lines of force passing through it from pole to pole will be cut, and if the sliding-contacts are connected together, an electric current will flow in the circuit so formed. The disk is equivalent, electrically, to a large number of radial conductors connected in parallel, and hence, the voltage of the machine is the same as that obtained from a single conductor only; however, on account of the very large cross-section of the disk, the machine can supply a very large amount of current. It is evident that in the construction just described, the disk always cuts the lines of force of the magnet in the same direction, and hence the current supplied by the machine is direct and absolutely continuous, showing no pulsating effects.

It is known that in order to induce a tension of one volt in a conductor moving across a magnetic field, the conductor must cut one hundred million lines of force per second, and from this, it is evident that in order to have a unipolar dynamo delivering current at a high tension, it is necessary either to use a very large disk and magnet, or to rotate the disk at an abnormally high speed. Two or more disks, connected in series, can be used also, but in that case, adjacent disks must either be rotated in opposite directions, as shown in Fig. 2, or insulated from the shaft and connected by means of sliding-contacts. Adjacent disks may also be connected with the shaft, revolved in opposite magnetic fields (Fig. 5), and connected together by sliding-contacts on their periphery; for, if the conductors connecting the disks were revolved with them, an electric force would be induced in

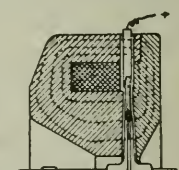


Fig. 3. Unipolar dynamo with one disk

them, equal, and opposite to that induced in the disks, so that the total voltage of the machine would be that of one disk only.

The development of the seam-turbine, however, has opened a large field to the unipolar dynamo, by providing a simple means for obtaining very high rotative speeds, although there is as yet one inconvenience to this coupling, i. e., sliding-contacts that will operate well at the high peripheral speed of the turbine-driven disk, which speed is as high as 80,000 feet per minute in the small-sized machines direct-coupled to a De Laval turbine. In connection with this, it must be remarked that commutator sparking is always liable to occur when ordinary turbo-generators are used, whereas this inconvenience is entirely eliminated with the unipolar dynamo, there being no commutator.

Figs. 3, 4 and 5 show the essential parts of three different types of unipolar dynamos, and of these types, the first and last are the most efficient, since no gears are needed, the wheels being keyed to the same shaft. The magnet of the Barlow Wheel is displaced by powerful electromagnets almost entirely covering the surfaces of the disks, thus creating a very large magnetic field for the armature to revolve in at high speed. The short arrows in these three figures indicate the path followed by current when the dynamos are in operation, while the dotted lines show the direction of the lines of force set up by the large coil forming the electromagnet.

In the construction of unipolar dynamos, the voltage of the machine is practically the only electrical point to be considered, inasmuch as mechanical considerations, stiffness for example, compel the designer to give the disk sufficient cross-section to carry a large current. For instance, with a single-disk, unipolar machine, required to give 50 volts at the terminals at 20,000 r.p.m., a steel disk 16″ in diameter cutting across a magnetic field of a density of 95,000 lines of force per square inch, would be sufficient, and for that speed and diameter, a disk not less than ¼″ thick at the periphery would be required to avoid its bending. Such a disk, with eight sliding-contacts, can safely carry 400 amperes, yielding an output of 20 k.w.

In unipolar dynamos, the main electric losses are those due to the resistance of the disk and that of the magnetizing coil; for the lines of forbe being always cut in the same way, hysteresis and eddy-currents are practically cast out. This is a great advantage over the multipolar dynamo, since with a high speed, the reversals of flux are very quick, and the hysteresis losses are large. Magnetic leakage is very much less important with a unipolar than with a multipolar generator. In fact, there is no need to consider it when figuring out the magnetizing windings.

Inasmuch as the disk-armature, if made of steel, can be very accurately faced and mounted, and is a good con-

HIGH SPEED GENERATORS

Peripheral speed between 40,000 and 60,000 feet per minute. Air-Gap density, 95,000 lines per square inch.

RATING K.W.	NORMAL VOLTS	NORMAL AMPS.	NO. OF DISKS	LENGTH OF AIR-GAP	DIAM. OF DISK	PERIPHERAL SPEED	R. P. M
10	25	400	1	1/32″	16″	41,900	10,000
20	50	400	2	1/32″	16″	41,900	10,000
30	50	600	1	3/64″	21″	56,100	10,100
100	100	1000	1	1/16″	48″	46,500	3,700
200	200	1000	2	1/16″	48″	46,500	3 700
450	300	1500	2	3/32″	60″	55,000	3,500
750	500	1500	4	3/32″	60″	45,500	2,900

LOW SPEED GENERATORS

Peripheral speed between 15,000 and 25,000 feet per minute. Air-Gap density, 95,000 lines per square inch.

RATING K.W.	NORMAL VOLTS	NORMAL AMPS.	NO. OF DISKS	LENGTH OF AIR-GAP	DIAM. OF DISK	PERIPHERAL SPEED	R. P. M.
10	20	500	1	3/64″	30″	15,700	2,000
30	50	600	2	3/64″	32″	18,200	2,200
100	100	1000	2	1/16″	48″	23,800	1,900
300	200	1500	4	3/32″	60″	18,950	1,200

ductor for the magnetic lines of force, the air-gap can be very short, thus effecting a large saving in the magnetizing current. At the same time, unipolar dynamos can be very much overloaded without danger of burning the insulation, as the magnetizing coil, the only piece that need be insulated, can be wound with asbestos-covered wire. Consequently, the temperature can rise as high as necessary to carry a big overload for a long time, this overload being limited only by the capacity of the prime-mover, in the case of a shunt-wound generator. This is a great advantage over multipolar dynamos, as in these, cotton-and-shellac insulation is so profusely used, that a comparatively slight overheating is sure to injure the windings.

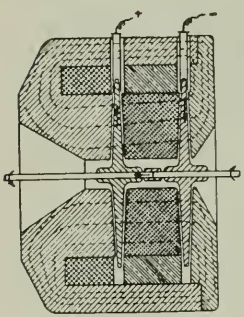


Fig. 4. Unipolar dynamo with two disks revolved in opposite directions

The table on page 625 furnishes some idea of the relations of size, voltage and output of the most efficient types of unipolar dynamos.

The only serious drawback of the unipolar dynamo is the low voltage that it supplies, but on account of the simplicity of the construction, several machines can be connected in series, or a machine with several disks can be used, and then the voltage delivered is large.

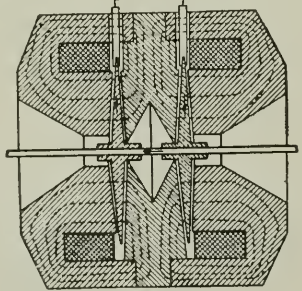
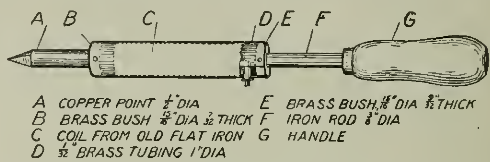


Fig. 5. Unipolar dynamo with two disks revolving in the same direction in opposite magnetic fields

The unipolar turbo-generator presents, as a whole, the most compact and efficient equipment known. The turbine is economical, and the unipolar requires no gears to be coupled to the turbine, and so receives the whole turbine power.

An Electric Soldering Iron

AN electric flatiron may be used in making an electric soldering copper by removing the coil and fitting over it a piece of brass tubing, 1″ by 5″. Cut a slot in one end to receive the plug contacts, and into the same end fit a handle in a bushing; into the other end fit a bushing holding a copper point. The plug from the flatiron may also be used, and can be quickly separated from the soldering tool—S. BERNSTEIN.



The coil from an old electric flatiron is used in making the heating element of this electric soldering iron

Storage Battery Hints

SINCE the introduction of the electric starting and lighting for automobiles, hundreds of thousands of people have become acquainted with storage batteries, while the expansion of the field of electric passenger automobiles and trucks has brought thousands of storage batteries to garages for charging and overhauling. Charging a storage battery is not the simple thing it may seem, and much damage is done to batteries by careless handling. A few simple instruments, designed to remove all guesswork from charging, have just been brought out by a Philadelphia concern. They are as follows:

A rubber bulb-syringe for filling and equalizing the acid in the batteries.

A pocket thermometer, graduated from 20 to 220 degrees Fahr., especially designed for use in batteries while charging. The temperature of a storage battery should never be permitted to rise too high.

A hydrometer syringe, containing a hydrometer graduated especially for such work. The sharp point of the syringe is inserted in the storage cell opening, and the central portion of the syringe filled with the liquid. The hydrometer inside the glass cylinder will indicate the state of the battery: 1300 stands for fully charged; 1275 for 75%; 1250 for 50%; 1225 for 25% and 1200 for exhausted.

What Radio Readers Want to Know

A Tikker Receiver and How it Works

C. M., Indianapolis, Ind., inquires:

Q. I should like some information concerning the "tikker" for the reception of undamped oscillations. I have heard considerable regarding continuous waves but so far have not been able to ascertain just how a tikker is constructed.

A. However constructed, the tikker is nothing more than a circuit interrupter arranged to open and close some portion of the receiving tuner circuits at a rate of 200 to 500 times a second. The original Poulsen tikker consisted of two light gold wires, one of which was attached to the vibrating member of an ordinary buzzer which, when set in operation, interrupted the circuit from the secondary winding of the receiving tuner to the telephones. At a later date another form of tikker was devised which consisted of a toothed wheel driven by a small motor and in contact with a brush.

The very latest type of tikker is known as a "slipping-contact detector." Of simple construction, it comprises merely a grooved wheel (with a perfectly smooth surface) rotated at a speed of say 1000 revolutions per minute. A small piece of thin steel wire is placed in light contact with the groove. The constant gripping and slipping of the wire during rotation causes a variation of the accumulated energy in the telephone condenser, thus setting up audible pulses of current in the telephone circuit.

The tikker, regardless of the type of construction, occupies the same position in the secondary circuit of the receiving tuner as the crystal detector, but generally the secondary winding is constructed of Litzendraht to give a circuit having a minimum value of damping.

Range; Aerials; Quenched-Gap

D. P. D., Limon, Colo., asks:

Q. 1. Will an aerial 100 ft. in length by 50 ft. in height be satisfactory for receiving messages from coast stations with 1000 to 1500 miles of mountainous country intervening? The local conditions for this work are good, since there are no high buildings or hills in the immediate vicinity. This aerial will have an altitude of 5600 ft. above the sea level. Will I be able to receive ship stations with it?

A. 1. If receiving apparatus of the vacuum-valve amplifier type is installed little difficulty should be experienced in receiving signals from the coast stations during the night hours.

Q. 2. Does a series condenser cut down the sending distance of a transmitting set?

A. 2. Speaking generally, it has the effect of cutting down the flow of current in the antenna system and therefore reduces the range. The insertion of a series condenser generally has the effect of increasing the total resistance of the antenna system.

Q. 3. Will an aerial 50 ft. in length by 40 ft. in height, composed of 4 wires spaced 3 ft. apart, be satisfactory for transmitting 100 miles using a. 1. k. w. closed-core transformer and a rotary spark-gap?

A. 3. It will be rather difficult to consume the full output of this transformer at a wavelength of 200 meters because the capacity of the condenser cannot exceed 0.01 mfd. If the receiving station is fitted with suitable apparatus you will experience little difficulty in covering the desired distance at nighttime. During the daylight hours we should prefer a 2 k. w. or 5 k. w. transmitting set operated at an increased wavelength.

Q. 4. Which is considered the more efficient, a rotary-gap or a quenched-gap when the necessary high potential is obtained from the 1 k. w. transformer?

A. 4. The quenched-gap may be made the more efficient electrically, provided the transmitting apparatus is harmoniously designed throughout. A well-designed quenched-gap transmitter has a specially constructed motor generator and transformer. The range of the average amateur station will be increased by the use of a quenched-gap provided certain precautions in the design of the apparatus are observed. For example, the oscillation transformer should be so constructed that the inductance value of the primary and secondary windings can be regulated inch by inch. Likewise the degree of coupling between the primary and secondary windings must be very closely adjustable.

The potential of the transformer requires careful regulation. In motor generator sets this is accomplished by means of the generator field rheostat, but where the energy is taken direct from the city mains it may be necessary to supply a transformer having variable tap-offs in the secondary winding, in order that the correct value of voltage may be obtained. In addition, the high potential transformer must be one that possesses considerable magnetic leakage. If of the closed-core type, it should be fitted with a magnetic leakage gap. The open-core transformer naturally possesses this characteristic. If you are not wholly familiar with the design and requirements of the quenched-gap discharger, the rotary-gap is recommended on account of its simplicity, easy construction, and permanence of adjustment.

Induction from Streetcars

F. M., Washington, Ind., writes:

Q. I am about to purchase certain wireless telegraphy instruments, but inasmuch as my receiving aerial will be located near a streetcar line and powerhouse I desire to know what effect these wires will have on the reception of signals?

A. Although you may expect to receive interfering sounds from these wires due to electrostatic induction, they will not wholly prevent the reception of signals. If possible, place the receiving aerial at right angles to the power line.

Receiving-Tuner Doubts Cleared Up

W. B. H., Fresno, Cal., inquires:

Q. In the December, 1915, issue you give certain dimensions for an inductively-coupled receiving tuner to cover a range of 1500 meters. The statement is made that the primary and secondary windings should be made of No. 28 B. & S. fage copper wire. To me this seems incorrect. I cannot understand how the secondary voltage will be any different from that of the primary if the same size of wire is employed. Before commencing the construction of such a tuner I should like to have this matter cleared up.

A. It is perfectly feasible to cover the primary and secondary of the receiving tuner with the same size of wire. For the average crystal detector it is customary in some forms of commercial apparatus to use No. 32 S. S. C. wire on the secondary. A step-up ratio of turns in an oscillation transformer does not necessarily mean a stepping up of voltage, since there are other factors which must be taken into consideration. Please understand that the actual wavelength to which the tuner described in the December, 1915, issue will be adjustable depends upon the capacity of the condenser in shunt to the secondary winding. With a secondary winding 5 ins. in length by 4*d* ins. in diameter, covered with No. 32 wire and shunted by a condenser of 0.001 m.f. capacity, the tuner will be adjustable to wavelengths in the vicinity of 4000 meters.

Where to Place Receiving Aerials

R. P. C., Nineveh, N. Y., asks:

Q. I wish to construct an aerial 60′ in height by 200′ in length. Our buildings are surrounded by hills. In which location do you think I would achieve the better results for receiving purposes, namely, by suspension of the wires on 20′ poles atop of the barns which are 40′ in height, or by placing them on 60′ poles upon the hill, which is 200′ above the barns? Our elevation is 1145′ above the sea level. Approximately over what distance may I expect to receive messages?

A. For general work we should prefer to erect the aerial on the hill, provided that the receiving apparatus can be housed in the immediate vicinity of the aerial. The actual distance over which messages may be received depends entirely upon the type of receiving apparatus in use. With the average amateur equipment fitted with a crystalline detector you should be enabled to copy messages at nighttime during the favorable months of the year from all commercial stations located on the Atlantic coast and Gulf. With an extremely sensitive long distance set, say one employing a regenerative receiving circuit in connection with the audion, you should experience no difficulty in receiving messages from the radio station located at Nauen, Germany.

A Receiving-Condenser for 1500-Meter Loose-Coupler

W. M. K., Windsor, Ont., inquires:

Q. 1. I should like to put this department to trouble again by asking for information concerning the size of a receiving condenser for a 1500-meter loose-coupler. Approximately how many tinfoil sheets should be used and what are the required dimensions?

A. 1. We assume that reference is made to the fixed condenser in shunt to the head telephones. Two sheets of tinfoil 30 ins. in length by 2*h* ins. in width, separated by a thin piece of paraffin paper and rolled up on circular form, will give a sufficient value of capacity for the average requirements. The variable condensers must be of the air dielectric type such as supplied by electrical supply houses advertising in the columns of this magazine.

Q. 2. Approximately over what distance can I receive with this set connected to an aerial 90 ft. in length and 50 ft. in height at both ends, keeping in mind that the tuner is adjustable to a wavelength of 1500 meters?

A. 2. During the nighttime this apparatus should be responsive to stations 1000 to 1200 miles distant. The daylight range is problematic.

Sustained Waves and Government License

H. W. D., Jr., Schnectady, N. Y., asks:

Q. 1. May an amateur make use of a set responsive to an undamped wave?

A. 1. There are no regulations governing the type of receiving apparatus employed at the amateur station. If an undamped oscillation transmitter were employed it would be necessary to secure a U. S. station license.

Q. 2. What is the fundamental wavelength of a four-wire aerial 120 ft. in length, 45 ft. in height at one end and 50 ft. at the other with a lead-in of 25 ft. placed at an angle of 70 degrees to the aerial?

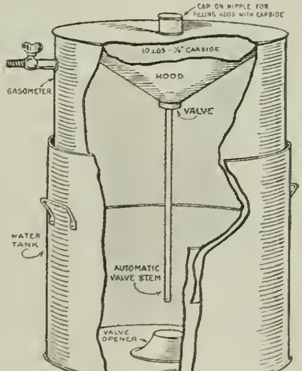
A. 2. The natural wavelength of this antenna is approximately 320 meters.

The Home Workbench

Making an Acetylene Gas Generator

THE gas generator used by the United States Life Saving Corps and also by the Volunteer Life Saving Corps for their searchlights on beach-wagons is not difficult to construct. Carbide about ¼ in. in diameter is used, and costs, retail, 10 cents per pound. Fifteen pounds will light a home three hours each evening for one month, at a cost of $1.50. For each pound of carbide a gallon of water is used. Hence to make a 15-pound carbide generator, a 15-gallon tank must be used. Only galvanized iron should be used, as it corrodes the least of any metal.

After deciding upon the size (say 15 pounds), take two 15-gallon tanks. Select one which will fit, inverted, inside of the other, allowing enough space to slide up and down without binding (see diagram). Another small tank, half the height, is used to catch the falling carbides. This holds the sediment, prevents it from spreading and simplifies cleaning. Besides, it is the only tank which corrodes. To determine how large to make the hood, use 15 pounds of dry earth as a medium for measuring. Pile it in a cone, the width corresponding to the width of the tank. The height measurement gives the depth of the hood. A model of the hood should first be made out of pasteboard to avoid waste or error in cutting. It should fit snugly, inverted in the gasometer tank. Cut off the point of the hood to allow a 1-in. hole for a valve-opening. Lay the model flat on metal and draw around it, cut with shears, roll carefully around a pipe to get the shape, and solder together. A 1-in. flat washer is used, being soldered into the valve-hole on the inside to act as a guide for the valve-head when it is closed. A ¼-in. pipe soldered into a 1-in. cap for a valve-head and stem can be used, the length of the stem being 2 ins. longer than the gasometer (see diagram). Place the valve in position, solder the hood in the gasometer, and make sure there are no leaks in any of the tanks. If you are not sure of the tightness, turn both tanks upside down and test with water.



A government gas generator which is easily built by an amateur

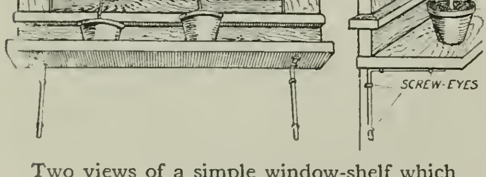
In the top of the gasometer drill a 2-in. hole, solder in a nipple, and screw on a cap with a leather washer. This is used for filling the hood with carbide. A gas-cock is soldered in the side of the gasometer near the top for the gas supply, for the hose, or for the pipe to the gas line. A 1-ft. acetylene burner gives 100 candle power.

To operate the generator, fill the water tank with water and the hood with carbide. Close the gas-cock and place the gasometer in the water-tank. Open the gas-cock to let the air out. The gasometer will sink very slowly until the valve-stem touches the bottom, thus opening the valve and letting the carbide escape into the inner tank and generate gas. The gas will raise the gasometer three-quarters of the way up, and thus close the valve automatically. Close the gas-cock, make the proper connections, and the apparatus is ready to use. As gas is consumed, the gasometer descends until it opens the valve. More carbide falls into the receptacle to generate fresh gas, thus raising the gasometer and closing the valve again. When through with the light, turn off the gas-cock. This stops the generator. As the gas cannot escape, it remains in the same position until used again.

The gas is generated in the larger tank, rises to the smaller tank and lifts it. The weight of the gasometer prevents it from going too high and also gives the pressure to the gas. The gas cannot flow down and around and out through the spaces between tanks, since the quantity of water forms a perfect seal.—T. F. Busch.

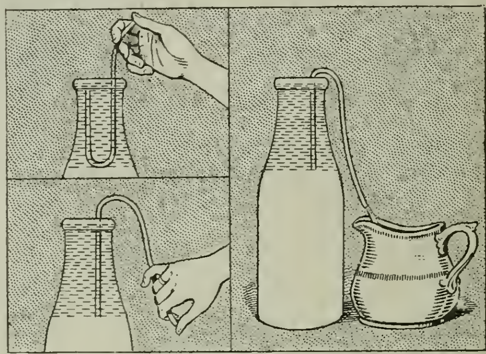
A Novel Window-Shelf

PROCURE from a blacksmith two 3/8″ iron rods about 16″ in length. Bend these in the center at a right angle. Then put eight ordinary screw-eyes—the eyes must be large enough to permit the rod to pass through—into the wall and into the under-side of the shelf-board as the illustration shows. With a pair of pliers open up the eyes of those in the wall, which is an easy matter. Now insert the rods and bend the eyes back over them. The shelf-board can now be slipped on the projecting ends of the rods, care being taken that they go through both the front and rear screw-eyes. Unless the screw-eyes are long enough to be driven into the scantling, supporting upright strips for these will be necessary.



Two views of a simple window-shelf which can be easily removed

When it is desired to remove the shelf-board to facilitate sweeping, for instance, just pull it out and swing the ends of the rods back against the wall as if they were on hinges. They may even be removed if desired.



The cream may be taken off the top of a milk bottle with a syphon more rapidly and effectively than with a spoon

A Siphon to Remove Cream from Bottles

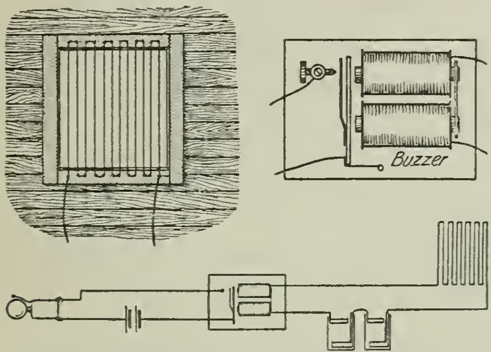
AN easy and effective means of removing the cream from bottles of milk is shown in the illustration. The siphon is filled by inverting the short end in the neck of the bottle until the cream runs in; the thumb is then held over the long end and the siphon placed in position. By adjusting the depth to which the short end reaches in the bottle, the entire amount of cream can be removed without withdrawing any milk. The siphon is easily cleaned by running hot water through it. An ordinary rubber tube will do.

A Wash-Wringer Attachment

TO facilitate the moving of the wringer to and from the wash-room, saw off one end of the bottom at right angles, drill a hole in it, and fasten on a caster. The caster should be one of the type which does not pivot about and should be so placed that it barely touches the floor when the wringer is upright. When it is desired to move the wringer, pull it back on the caster and push it ahead.

A Burglar-Alarm for the Unprotected Chicken-House

CHICKEN-FANCIERS and poultry-farmers will be interested in an electric alarm which is set ringing by thieves. The favorite means of entrance, provided the door is securely locked, is through the windows of the coop. The installation of the usual type of burglar-alarm involves an outlay for costly equipment. The apparatus to be described is inexpensive, and may be easily installed.



When the chicken thief breaks the thin wires covering the window, he opens the circuit, the buzzer-armature drops, and the alarm bell rings

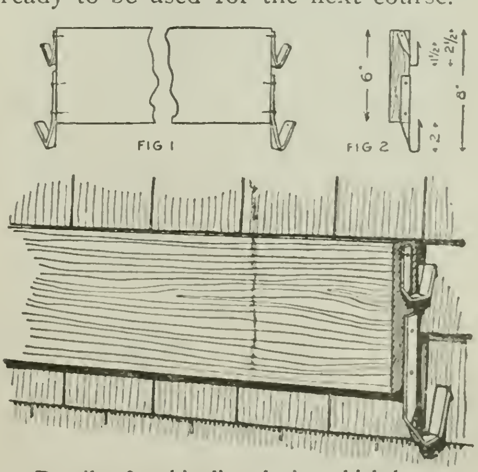
A row of wire nails about 1″ apart should be driven into the window-frame above and below. Fine cotton-insulated, magnet-wire should be strung up and down over the two rows of nails, as shown in the diagram. The two ends should be led to a gravity cell, and also to the magnets of a buzzer. The armature of the buzzer should be disconnected, but not removed, as it will have another use. By consulting the diagram of connection it will be obvious that if the wires over the window are intact, the armature will be drawn down upon the magnet-cores, away from the contact. Wires connected with a bell and dry batteries in the house—the distance makes no difference—should be brought to the armature of the buzzer and to the contact that touches it.

The operation is as follows: When a marauder attempts to enter the window, he breaks the wires—which he assumes to be strings—with a sweep of the hand. The circuit, suddenly opened, allows the armature of the buzzer to fall back against the contact. This closes the bell circuit and causes the bell to ring in the house. If there are several windows in the chicken-barn, the wires covering all of them should be connected in series. Gravity or blue vitriol batteries should be used for the magnet circuit.

How to Shingle Without Leaving Nail-Holes

THE illustration will show how a 1′ by 6′ straightedge, or longer, can be used to lay shingles 2½″ by 8″ or 2″ by 7″, according to the weather, on the side of a building, without nailing the straightedge on to the shingles and thus leaving unsightly holes. Any blacksmith will make four hooks out of ½″ by ⅛″ iron and twist them so that the shank can be screwed on the ends of the straightedge, and so that the hook part will extend down and under the last course of shingles, as indicated in Fig. 2.

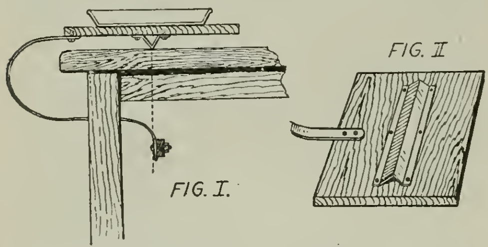
The iron is drawn out to 1/16″ thickness, and the spurs on the hook part are made by cutting a V in the hook while it is hot and turning it back and filing it down to a sharp edge. This spur holds the straightedge in place. It is well to have this part of the hook offset clear of the ends of the straightedge (Fig. 1). After the straightedge is in place, a slight tap of a hammer over the shingle will drive the spur into the shingle underneath. No holes will be left to mar the face of the work. A slight jerk will pull the spur out and the straightedge is then ready to be used for the next course.



Details of a shingling device which keeps the edges straight without driving nail-holes into the exposed ends

A Self-Rocking Developing-Tray

A SIMPLE form of mechanical rocker, which may be relied upon to keep up a steady, gentle movement for a long period without attention, is a great convenience to the busy photographer. A flat, square board, rather larger than the developing-tray, is pivoted on the apex of a zinc triangle, as shown in Fig. I. The zinc triangle is easily made from a strip of sheet zinc



The counterbalance swings under the table and the tray rocks easily and continuously without attention

as long as the side of the board and bent into the form of a V, with flanges for attachment to the board. It should be screwed along the exact center of the under side. An alternative is to use a triangularly-shaped piece of wood, 1¼″ thick, nailed through from above. The wood must, of course, be rather hard. A piece of strong, flat iron, 3′ or more in length, must be fastened at one end to the under side of the base, also in the center, but at right angles to the pivot. This is shown in Fig. II.

With the board standing on the edge of the table, the iron should be bent into a curve reaching under the edge of the table as illustrated. A weight of several pounds is firmly secured to the free end of the iron. This weight can be made by casting ten or twelve pounds of lead scrap into the shape of a disk, a hole being made through the center for bolting the disk to the arm. The disk weight must be fastened securely; else the movement will be jerky, and much energy will be lost. In bending the iron, it will be necessary to adjust it by degrees until the board is found to balance freely on the pivot and come to rest in a level position.

The rocker leaves the operator free to attend to other matters while development is proceeding. If it is desired to open the darkroom door, a sheet of cardboard should be laid on the dish, and a light-proof cover should be placed in position. A cardboard box slightly smaller than the board, makes a good cover, if lined with two thicknesses of black twill, with additional pieces at the corners. This rocking arrangement is a time-saver for any photographer.

A Whole Tool-Box in One Tool

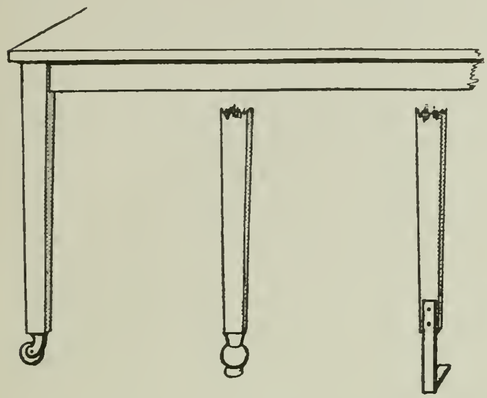
THE day of the family tool-box may soon be a matter of past history if a device that is now on the market can do all that its manufacturers claim for it. The tool that threatens to do this revolutionizing is 10 inches in length and weighs 11 ounces. It can do everything that a variety of household tools can do and other things besides. Here are a few of the tools whose work it intends to accomplish: Hammer, lifter for hot pans and dishes, tack-puller, screwdriver, nut-cracker, box-opener, wrench, pliers, rule, measure and ice-chipper. It works automatically.

This "Jack-of-all-tools" may be used to lift a hot plate off the stove or to hammer the tacks in the parlor carpet

FULLY one-half of all the automobiles sold in the United States are bought by farmers and others living in rural communities.

How to Make a Kitchen Table Fit You

DOES your kitchen table fit you? The average woman is 5′ 4″ in height. An ordinary table, built for her,



Is your table of the right height? If it is too high any one can saw off the legs; here are shown schemes to make them longer

is 30″ high. Thousands of women should have their tables a little higher or a little lower to avoid the fatigue that results from working at a table which does not fit.

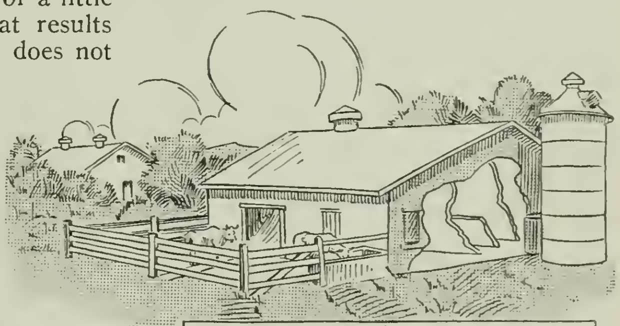
Mrs. Frederick, the writer on domestic efficiency, after conducting a series of tests, states that ½″ should be added or subtracted from the height of the table for every inch of the person's height above or below the average 5′ 4″. A table may be raised by boring holes in the legs and inserting casters, or by screwing on four rubber-tipped door stops. For a very tall woman, four right-angle braces may be screwed on to the lower parts of the legs, the short sides of the braces resting on the floor.

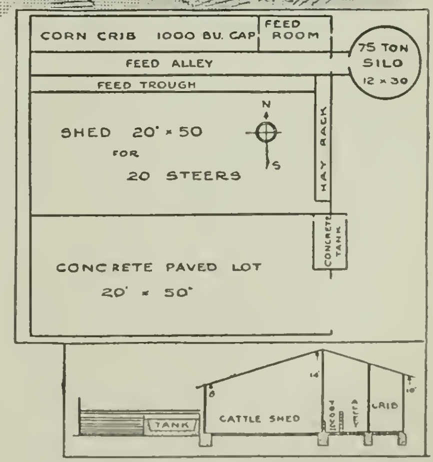
Feeding Twenty Steers

FOR the average farmer of the middle western states, who annually fattens a carload of steers, a plant can be made which will be found good from every point of view. It is not expensive; it is arranged for convenience; the labor cost of feeding is lessened, and all the work of feeding is under cover. A good, sensible, warm shelter is provided for fat stock. The feed-lot is paved with concrete. This saves manure and makes a much better surrounding for the steers.

An economical constructiton will require the following amounts of materials. Labor will cost but little. Farm hands can do the work during the "nothing to do" period on the farm. These prices hold good in the West:

45	bbls. cement for pavements, floors and walls..	$ 72.00
8	cedar posts, 12′ long for shed supports	4.00
8	cedar posts, 14′ long for shed supports	5.00
2500′	of 2″ x 6″ framing lumber	70.00
30	squares galvanizing metal	95.00
500′	crib siding for corn crib	15.00
		$261.00
	Silo	300.00
	Total	$561.00





Twenty steers can be kept and fattened in this small and cheap plant, the designs shown being sufficient for starting work

A Can of Paint and How to Use It

By H. A. Gardner

Assistant Director, Institute of Industrial Research, Washington, D. C.

PREPARED paints, contained in sealed packages, are the most economical and convenient. The brand selected should be composed of pigment and liquid, the pigment being white lead (corroded or sublimed) admixed with zinc oxide, with or without a small amount of chemically inert pigments. These pigments should be ground in a liquid composed of linseed oil with a small amount of drier and thinner. Small amounts of color pigments have been added to such mixtures, if the paint is tinted. These paints are suitable for the exteriors of all wooden structures.

If the painter desires using a paint mixed by hand, paste paints may be obtained either in the form of white lead ground in oil or zinc oxide ground in oil, which may be mixed together, or purchased in the form of a paste paint made of these two pigments. It is customary to add to 100 lbs. of a paste paint from 4 to 6 gallons of linseed oil and a pint of liquid drier. The mixture may be thoroughly stirred in a barrel or tub. Labor and time are necessary to produce a smooth paste. Loss by spattering should be avoided, if possible. A gallon or more of turpentine may be used to take the place of part of the oil for first-coat work. If a colored paint is desired, color ground in oil may be added to produce the desired result. The paint should then be stirred for half an hour or so in an endeavor to get the color thoroughly into the mass in order to prevent streaking.

What Color Shall I Paint My House?

The color of a paint to be selected for a house requires consideration. In many rural localities, white paints are used, and they contrast pleasantly with the green of the surrounding foliage. It must be remembered, however, that white paints which have been tinted, by grinding into them small percentages of permanent colors, are more economical to use, since the wearing value of these tinted paints is from 30% to 60% greater than the wearing value of whiet paints. For instance, if a white paint is applied to one house and a similar white paint, tinted with say 3% or 4% of color, is applied to another house in the same locality at the same period of time, the surface painted white will probably require repainting at the end of a period of three years, while the surface painted with the colored paint will be in an excellent state of preservation and will probably not require repainting for two more years. Therefore tinted paints should be used whenever durability is the commanding consideration. The property owner should also remember that the lighter shades or tints are in many instances best adapted, since the lighter colors reflect the heat rays from the sun, while the darker colors, such as dark red, dark blue and very dark gray absorb the heat. For this reason, a house painted in light colors will be cooler in the summer than one painted in very dark colors.

Before the paint is applied, the wooden surface must be freed from moisture. If new, weathering of the wood for a short period is generally advisable in order to allow thorough seasoning and drying-out of absorbed moisture. Painting should never be done in damp weather. A successful job depends upon the application of the paint during clear dry days. If the wood has not been painted before, any visible sap streaks or knots should be brushed with turpentine just before applying the paint. This treatment will soften the resin in the wood and allow the priming or first coat of paint to soak thoroughly into and combine with the resin, thus preventing scaling. For the priming coat, there should be added to a gallon of prepared paint from 2 to 4 pints of turpentine, or benzol when obtainable. The mixture should be thoroughly stirred until it is uniform throughout. It may then be applied by brushing out to a thin coat on the new wood. The turpentine will serve to carry the paint into the pores of the wood and thus provide a good substantial bond. The paint, moreover, will dry rapidly to a hard surface which will provide a permanent foundation for subsequent coats. Upon the priming coat depends the success of the whole painting job. Even if the coat looks thin, the hiding power of the paint should be sacrificed in order to obtain this thorough penetration and hard drying.

When the priming coat has become thoroughly hard and dry, which, as a rule, will take at least three days, although a week is better, all the nail holes and other imperfections in a wooden surface may be closed up with putty. There may then be applied the second coat of prepared paint as it comes from the container, without the addition of any material except a small quantity of turpentine if the paint is heavy. One pint of turpentine to a gallon of paint is generally sufficient for this purpose. The turpentine will cause the second coat to dry with a semi-matt surface. After a suitable drying period, the third coat may then be applied. No turpentine or thinner should be added to the third coat of prepared paint, since it is desired to obtain a film rich in oil, that will dry to a high-gloss surface. When old surfaces are to be repainted, all loose, scaled paint should be removed and rough, checked surfaces lightly sanded with fine sandpaper. The work may proceed for new surfaces as for the second and third coats.

How to Paint Rooms

A few years ago the use of paint was largely confined to exteriors of buildings. Interior walls were often left bare. Discoloration and dampness followed. The modern method is to decorate all interior wall and ceiling surfaces with paints which are of a washable character. These paints may present either a flat and light-diffusing surface, or a high-gloss, enamel-like surface. The flat or high-gloss paints are obtainable in prepared form. Before applying such paints to plaster or cement-wall surfaces, a wash treatment with a 25% water solution of zinc sulphate is advisable, in order to neutralize the lime present in the wall. Later, when the walls are thoroughly dry, the paints should be applied in two or three-coat work. High-gloss paints should always be applied over an undercoat of flat paint. Light cream color and the very light shades of pink, green, blue or very light gray give the greatest amount of light reflection in a room.

What Paints and Painting Cost

Paste paints cost about $3.00 to $4.00 per gallon, while prepared paints sell for $2.00 to $2.50 per gallon. A paint in prepared form, ready for application, will cover from 300 to 1400 sq. ft. per gallon, depending upon the character of surface to which it is applied. On smooth iron surfaces, the greatest spreading rate is obtained, and on rough concrete surfaces, the lowest spreading rate. On wooden surfaces the average spreading rate is about 900 sq. ft. per gallon, one coat. In estimating the amount of paint required for a surface, the total number of square feet should be calculated by multiplying the width by the height, of each side. The total area should then be divided by 300, which will give approximately the number of gallons required to produce three-coat work. For instance, if the total area for the four sides of a house is 6300 sq. ft., 21 gallons of paint will be required for the work. If the cost of the paint is $2.35 per gallon, the material cost will be $49.35. The cost of labor for properly applying the paint should be figured at double the cost of the paint. To the total must be added cost of brushes, ladders, incidental materials, etc. It is readily seen, therefore, that the cost of the paint is a small part of the cost of painting, and for this reason only the best paint should be used in order to secure a job that will last for the longest time without repainting.

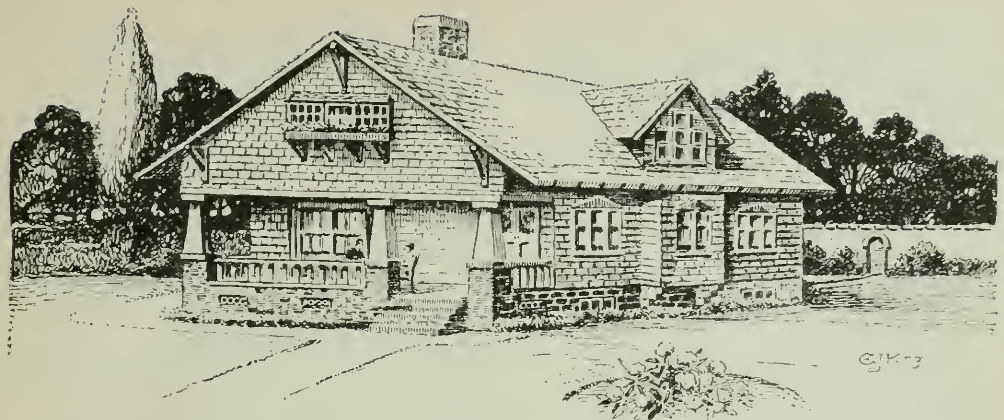
Why Good Paints Save Money

The property owner should remember that it is a very good business proposition to keep buildings of all types, especially dwellings and farm buildings, well painted. By so doing, the value of a property increases at least 25%. If wooden structures are left bare and exposed, the surfaces become roughened and the wood is subjected to warping and cracking. When dampness enters such exposed wood, conditions become favorable for the action of destructive fungi and rotting may take place. Application of good paint, however, will preserve wood almost indefinitely. Striking illustrations of the truth of this statement are afforded by the condition of those well painted, century-old dwellings to be found throughout the original colonies of this country. Moreover, paints not only decorate and preserve wood, but they make it more resistant to fire. For this reason, the application of paints to shingled roofs is often advisable. For instance, prepared paints contain 60% to 70% of non-combustible, metallic or mineral pigments. When such paints are applied to shingles a very waterproof, semi-metallic film results. The film smooths the rough, fuzzy surface of the wood and prevents warping at the edges, thus doing away with the formation of pockets in which hot cinders, blown from a passing locomotive or carried from a neighboring fire, might lodge.

Paints for Various Surfaces

Painting the exterior or interior walls of a dwelling constitutes only a part of the many uses for paint. Painting metals of various kinds, varnishing and staining woodwork, and many other applications call for the use of an immense variety of paints and finishes. A list of many of these is shown in the chart.

PAINT FOR EXTERIOR SURFACES	WOOD	Weatherboarded Dwellings, Churches and Factories, Fences and Wooden Structures.	Paint prepared on a Lead and Zinc Base. Preferably tinted. Class "A."
		Shingled Roofing and Siding.	Same as Class "A" or a Creosote Shingle Stain.
		Sheds, Barns and Outbuildings.	Same as Class "A" or Prepared Iron Oxide Paint.
		Porch Floors.	Colored Floor Paint containing Durable Varnish.
		Window Shutters.	Same as Class "A" or Chrome Green Shutter Paint.
	METAL	General Structural Iron and Steel Girders, Roofing, Siding, etc.	Rust Inhibitive Prepared Paint, Red Lead, Iron Oxide, etc. Class "B."
		Galvanized Iron.	Prime with 5% Water Solution of Copper Salt. Dry, and apply Class "B" Paint.
		Tinned Roofing and Copper Flashing.	Clean all grease with Benzene. Apply Class "B" Paint.
	STONE	Brick Walls and Fronts.	Same as Class "A" or Prepared Red Iron Oxide Paint.
		Cement and Concrete Structures, Ball Parks, Pavilions, Stucco on Brick or Frame, Cement Tanks, Posts, Silos, Culverts, etc.	Prime with 25% Water solution of Zinc Sulphate (to neutralize alkali). Dry and apply Class "A" Paint or Cement Coater.
PAINT FOR INTERIOR SURFACES	WOOD	General Trim, Stairways, Doors, Paneling.	Class "A" Paints finished with Enamel or Varnish.
		Doors, Paneling, Floors, etc. Transparent finish.	Fillers, Stains and Varnish as desired.
	METAL	Same as for Exterior Work.	Same as for Exterior Work.
	STONE	Ceilings and Walls of Portland Cement, Keene Cement or Sand Lime Plaster.	Alkali Neutralizing Primer, then Sanitary Flat Finish Oil Paint.
		Ceilings and Walls of Bath Rooms and Kitchens.	Alkali Neutralizing Primer, then Class "A" Paint, and Varnish or Washable Enamel.
		Cement Floors.	Alkali Neutralizing Primer, then Class "A" or Prepared Floor Paint.



An attractive bungalow of moderate cost. The detailed construction of this confortable home is described in the following article.

Building a Bungalow. I

By Geo. M. Petersen

THE style of architecture best adapted for the homes of a great number of the American people, both for suburban and city use, is without doubt that commonly known as the bungalow.

The bungalow originally came from India and other Far Eastern countries where light construction and cool, well ventilated buildings are desirable. These bungalows are really garden-houses and are generally one story in height with large, roomy verandas. The bungalow was introduced in California and now is common to all parts of the United States, the construction varying, of course, with the different climatic conditions.

Because of the fact that the bungalow is primarily a garden-house, it is well to locate it on a large lot, on a slight elevation if possible, and surround it with trees and shrubs. For city use, the building should be set well back from the street, from 25 to 30 ft. at least, while in the country it should be located in the center of a large piece of ground or garden spot.

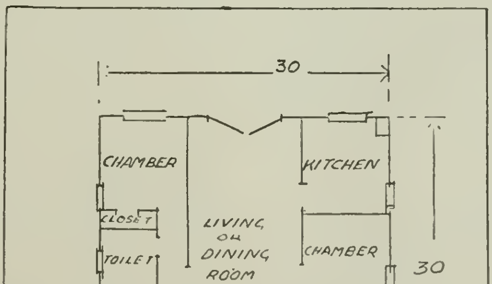


Fig. 1. Floor plan of an original Far Eastern bungalow

Due to the fact that a large number of architects, or at least so-called architects, have classed all of their architectural misfits under the heading of "bungalows" it is not uncommon to hear people express themselves as being unfavorable toward them. Others think they are only a fad and will soon go out of date, while others, and the writer is among the latter class, think that the bungalow is the most desirable kind of dwelling in which to live; that it has come to stay and that, when properly planned and built, it is the most artistic and cosy home to be desired.

The advantages of the bungalow are

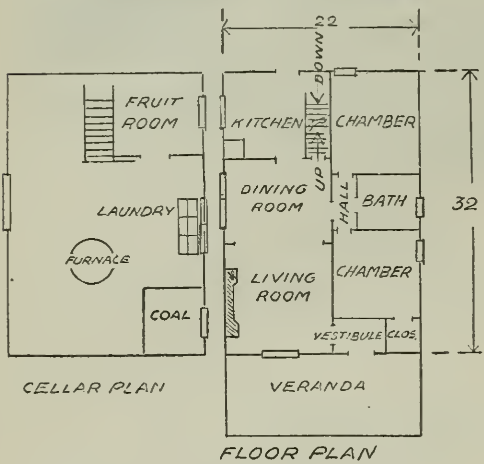


Fig. 2. A two-story city bungalow which was built for $1800

many, the one which appeals most strongly to the women being the fact that all of the work is on one floor and the continual running up and down stairs is done away with. This fact also helps to solve the servant problem in the suburban districts as many women who have never done their own housework in the old two-story houses have done away with their servants and are getting along without servants, through the handy arrangement of the bungalow. It is this same all-on-one-floor idea that is making two family flats so popular in the larger cities of the United States to-day. In short, the bungalow may be termed an efficient dwelling.

The size of the bungalow must naturally vary to meet the requirements, as to sleeping rooms, arrangement of rooms, etc., as well as to come within the finances of the builder, and at the same time look good on the lot.

The floor plan of an original Far Eastern bungalow is shown in Fig. 1. It has been remodeled for use in the colder climate of this country. It is a very simple affair, is decidedly cool and comfortable in the summer and remarkably warm and cosy in the winter. It can be readily heated at a small expense for fuel and is an ideal house for a small sum of money. This type of dwelling is particularly suitable for shore cottages, since it makes an ideal summer camp when built without a cellar and heated only with a large fireplace and the kitchen stove. This house can be built for the small sum of about $600, including ceiling the interior with wall board, or plaster, painting and plumbing. Of course this figure does not make any provision for hardwood trim, floors, tile bathrooms or anything of that nature, but is for the completed house, finished in a good substantial manner with good lasting materials.

The houses shown in Figs. 2 and 3 have been built by the writer for $1800 each, including cellar, furnace, fireplace, plumbing, laundry trays, electric lights, wall paper, shades, interior and exterior painting and, in fact, everything complete. These plans are strictly city homes in every sense of the word and are good enough for anyone, although they may be small for some families. A regular two-story bungalow is shown in

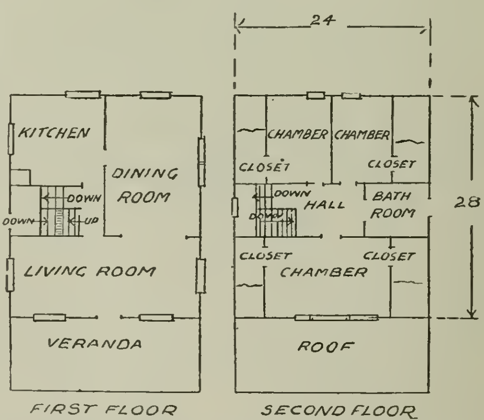


Fig. 3. This house, also, was built for $1800, including furnace and plumbing

Fig. 2, and, while it appears exceedingly small from the street, it is really very roomy. The one drawback to this type of bungalow lies in the fact that it is almost impossible to keep the sleeping rooms cool in the summer, due to the fact that the sun beats down on the roof all day long. In the one-story bungalow there is a small air-space and, in some, a good-sized attic, which acts as an insulator against the heat. With the two-story type shown, however, there is no insulating space between the roof proper and the ceiling of the sleeping rooms except the thickness of the rafters, usually about 6 ins., and sometimes only 4 ins., which is not sufficient to protect the interior of the house from the outside heat. Of course this disadvantage may be overcome to a certain extent by covering the roof with asbestos shingles or with some other roofing material which will resist the heat, but unless the roof is well shaded by trees it will be almost impossible to keep the roof cool enough in the heat of summer to stop the heat from entering the second floor.

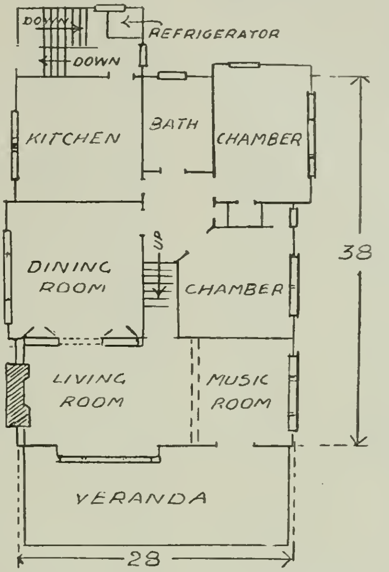


Fig. 4. Floor plan of a successful bungalow, costing $5,100 complete

One of the finest small bungalows which the writer has ever had the pleasure of erecting is illustrated in Fig. 4. While not costing as much as many others constructed by him, it is nevertheless a complete bungalow and for this reason it will be used as an example of what a modern bungalow should be. It was erected at a cost of $5100, complete, including a steam-heating plant and an automatic water-heater.

This bungalow is 28 ft. in width and 38 ft. in length as shown on the plan. The cellar has 7 ft. of headroom under the girder and 7 ft. 8 ins. of headroom under the joists, which not only obviates a continual bumping of one's head, but is of great assistance to the proper installation of the heating plant. The foundation walls extend 2 ft. above grade and are built of blue flint stone above grade and of limestone below. Limestone is used below, since flint "sweats" underground so that a flint stone wall is damp practically all of the time. Limestone, on the other hand, does not make a pleasing effect above ground, in the majority of cases, as it is inclined to be full of little holes and imperfections which stand out as glaring defects in the bright sunlight. The square bays which project on the east and west sides of the house are supported by large stone corbels in place of the ordinary wood brackets. The eaves overhang the house about 2 ft. 6 ins. and are pattern-cut rafter-ends, as shown in Fig. 5. The exterior is covered with gray-stained shingles which come very close to matching the gray of the massive stone chimney which extends up the outside of the building. The trim, or outside woodwork, other than the shingles, was painted white so that the color scheme of the building was merely stone gray and white. Bungalows, in general, should be painted with quiet color combinations such as the one just given; with two shades of the same color or with direct contrasts, a dark color such as green or brown is used for the body and white, pearl gray or some other direct contrast is used for the trim. Bungalows may be covered either with lap, bevel siding or shingles, although the latter are usually the most pleasing. Stucco or brick veneer may be used, although a bungalow loses a great deal

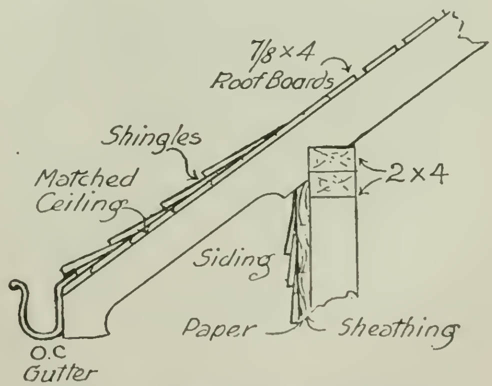


Fig. 5. The eaves of the bungalow are artistic in pattern with cut rafter-ends

of its cosy appearance when the exterior is of plaster or brick.

The interior of the house is finished complete with clear quarter-sawed white oak, including the kitchen wainscot, cupboards, etc. It may be well to state here that there is often considerable confusion in the owner's mind as to

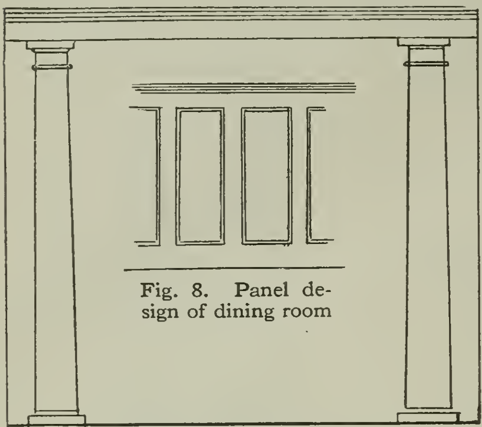


Fig. 8. Panel design of dining room

Fig. 6. Simple columns between music and living rooms

what is really the best grade of oak, since the grades are decidedly misleading. "Clear" oak is the best grade and "Number One" is second. "Select" is the third grade and perhaps the most commonly used, since it makes a very fair trim when finished. This third grade allows for small tight knots and pin worm holes, but is otherwise sound although the allowed percentage of lengths under two feet is very large, in the flooring grade.

Separating the music room from the living room is a very simple colonnade consisting of only two large columns, as shown in Fig. 6, while the living room and dining room are divided by a massive buttress having china cabinets on the dining room side and panels on the living room side, as shown in Fig. 7. The dining room itself is finished with a heavy beam-ceiling and a 5-foot 6-inch batten panel wainscot, the panels of which are made up of three plies of white oak veneer to prevent shrinking or warping. The panel design is shown in Fig. 8.

The doors throughout the house were all made specially for the job and are single-panel doors having a five-ply oak veneer panel.

In the rear hall, as marked on the plan, the linen closet was built with a clothes-chute underneath. The operation of this chute was decided on by the owner and it is certainly a good idea. The baseboard lifts up, the soiled clothes are dropped on the floor and pushed through the opening into the cellar box, from which they are taken directly to the laundry trays in the cellar.

The bathroom is finished in white tile and white enamel, with white enameled fixtures. The floor is laid of white hexagonal tile one inch in diameter, while the walls are wainscoted 5 ft. from the floor with 3 by 6-inch oblong glazed tile with tile cove and cap. The lavatory is an oval pedestal design and the closet is a low front-wash-out type. The tub is of standard enameled iron.

The average owner does not understand the grading of enameled ironware and therefore calls loudly for a "five-year guarantee" article. This is really an extravagance as a "two-year" guarantee is absolutely as good for the following reason; enameled ironware in general, and bathroom fixtures in particular, are known as "five-year," "two-year" and "non-guarantee" fixtures. This means that the best grade is guaranteed against any defect for the term of five years, the second grade for a term of two years, and the third grade for no time at all. The difference between the first and second grades, however, is very little, except in price.

(*To be concluded*)

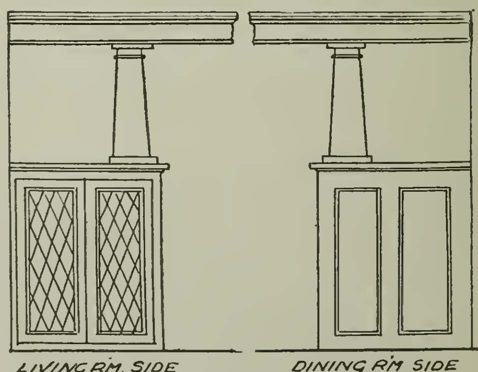


Fig. 7. Buttresses between dining room and living room

How I Made $22.50

By Reading the

Popular Science Monthly

ON an investment of seventy-five cents I realized a profit of twenty-two dollars and fifty cents, or three thousand per cent.

It was the POPULAR SCIENCE MONTHLY that paid the profit.

I have been a constant reader of POPULAR SCIENCE for some time. Often I wondered who wrote the interesting articles which I read. One night I was in my workshop etching glass by a method described in a previous issue. The work was halted by the absolute necessity of having perfectly clean glass to work upon. Finally I hit upon alcohol and powdered chalk. The result was all I hoped for.

The number of the Popular Science Monthly containing the article on Novel Window Attractions was rented for six dollars and a half

After finishing the work I sat down for a smoke, thoroughly satisfied with myself—as we all are after a job well done. Picking up the current issue of "our" magazine I prepared myself for an enjoyable evening. Suddenly I came across a small reading notice at the bottom of a page—something that I had not seen before. It read:

"*Ideas submitted to this department are paid for at space rates when published.*"

That sounded good, but what could I sell? I have it! That alcohol-chalk stunt—it's good, dustless, and practical. So I sent in an article on a "Dustless Window Cleaner." It was accepted and paid for. I've written a few articles since then that paid more.

While talking to a local merchant one day, he told me what he paid a Boston man for window attractions. I thought it over that night. I brought out my bunch of POPULAR SCIENCE MONTHLIES and went through the index of each for window attractions. Luck! I know what the word means now.

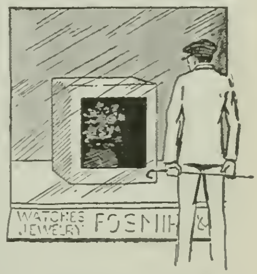
A dye house paid a dollar for the idea of a "Facetious Dyer's Sign

Do any of you remember "Novel Window Attractions" in the January, 1915, issue, page 81? Look it up. It will pay you to do so. I rented the magazine to my friend, the local merchant, for one dollar per night, first two nights, fifty cents each night thereafter. He had it four nights. Another merchant paid me for five nights more.

"Magic Mirror for Show Windows" (December, 1914, page 668) paid me in rent the same terms, five and one-half dollars.

"Colored Lights in Window Display" (April, 1914, page 1467) paid me in rent from a florist, two nights, four dollars.

The most prominent dye house in town paid me a dollar for "A Facetious Dyer's Sign" (September, 1914, page 238).



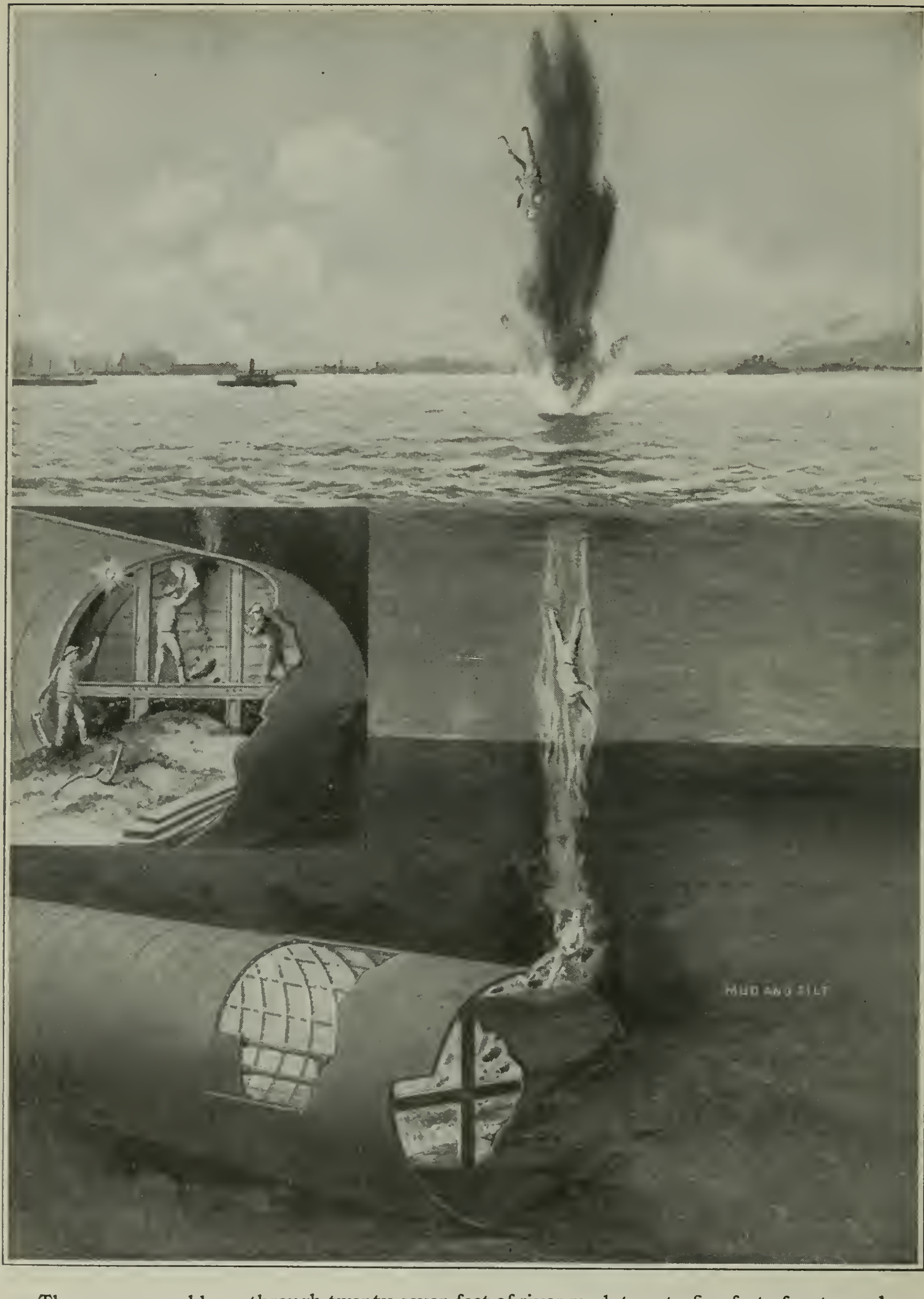
"Colored Lights in Window Display" paid me in rent (for the magazine) from a florist, two nights, four dollars

I made up about a pint of "Acid Ink Eraser" (July, 1915, page 89), and sold five two-ounce bottles at twenty-five cents a bottle.

I wish to take this opportunity to thank the POPULAR SCIENCE MONTHLY, the editors and contributors. I have itemized what I have made. Study the figures; look up articles; and then—"Go Thou and do likewise."

Received:		
Articles, Popular Science Monthly, space rates		$15.00
Rent, "Novel Window Attractions"		6.50
" *"Magic Mirror"*		5.50
" *"Colored Lights"*		4.00
Information, "Dyer's Sign"		1.00
Sale of "Ink Eraser"		1.25
Estimated Materiel and Labor	$10.00	
Cost of magazines from from which articles were taken	.75	
	$10.75	$33.25
		10.75
Profit on Investment		$22.50

L. E. FETTER,
591 Middle St.,
Portsmouth, N. H.



Three men were blown through twenty-seven feet of river mud, twenty-five feet of water and twenty feet into the air on top of a geyser of mud and foam while engaged in excavating the bed of the East River, New York city, for the building of a new subway. They were working in what is known as a shield, which is pushed forward foot by foot as the workmen progress. Compressed air prevents the water from rushing into the shield. The great pressure of the air forced the three men one after the other through a hole in the river bed. One of the men, the first to be ejected into the river, survived

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Workmen Shot From Tunnel Through the Bed of a River

By Eustace L. Adams

BROOKLYN BRIDGE was jammed with mid-afternoon traffic. On the East River, far underneath the lofty structure, tugs and barges were busy with their endless tasks. Suddenly passengers on the bridge and crews of boats heard a muffled roar, and a geyser shot from the river twenty feet into the air. Dark forms mingled with the water, and a moment later, when the rush of the geyser had died down, three men were seen floating on the surface of the river.

One of these men quickly disappeared from sight. His dead body was later recovered. The other two swam for shore and were rescued. One of them died before he could be taken to the hospital. The other lived. All three men (sand hogs, who had been digging in an atmosphere of compressed air under the river) had been blown from their posts in front of the great steel shield which is boring through the East River bed to the open air. They were shot through twenty-seven feet of river mud, twenty-five feet of water and an additional twenty into the air on top of a geyser of mud and foam.

The first knowledge that the officials at the Brooklyn end of the new subway tube had of the accident was when a number of terrified workmen rushed into the compressed air caisson, clamoring to be let out. Among these was one man who had been a witness of the accident, and from him a coherent story was obtained.

The tunnel in which this strange accident occurred had been pushed out under the river for about three hundred feet, by what is known as the shield method. When engineers commence their underground tunneling, a heavy steel shield is built at the end of the shaft where the men are at work. This shield is pushed forward into the mud or dirt for a distance of two feet by a number of hydraulic rams which are capable of exerting a pressure of five thousand pounds to the square inch. In the shield are a number of doors which allow the workmen, or "sand hogs," to dig away the dirt, stones and mud in front so that the shield may be moved another two feet.

The question naturally arises: What keeps the mud and water from coming into the shield and overwhelming the workmen? A short distance behind the shield is a bulkhead wall, containing air locks. The entire space forward from the airlock is kept filled with compressed air. This air, when maintained at the proper pressure, balances that of the water and keeps it from flowing into the tunnel. If sufficient pressure is exerted by the air-pumps, the water is driven still farther away, and the workmen may work on dry ground, instead of on mud of a molasses-like consistency.

As they excavate in front of the shield, the workmen plank up the opening they have made and remove the planks just before the shield is to be pushed forward. The shoring serves merely to keep loose earth and stones from falling upon the men as they work.

Four men, who were outside the shield,

had just removed some of the shoring when earth began to drop rapidly away from one spot in the top of the tunnel. One of the men seized a bag of cement which is kept for such an emergency and attempted to block up the rapidly growing hole. Suddenly there was a report like a pistol shot. His startled comrades saw the man jerked up out of sight. Then they realized what happened. The man had been blown away like a pea in a pea-shooter. One of the men managed to save himself by clinging to the shield. The other two victims were shot upwards to the surface of the river.

The instant that the work of rescue had been completed, officials began the work of repair. It was found that the accident had been caused by a spot in the bed of the river which had been unable to withstand the air pressure of twenty-four pounds to the square inch that had been maintained in the tunnel. As a result the bottom of the river had blown out like a faulty automobile tire when overcharged with air.

Only once before in the history of tunneling has a workman been shot through the bed of a river and survived. Eleven years ago a "sand hog" was blown through the bed of the East River during the construction of the present subway system. Although severely injured he survived the shock, and by a curious coincidence was working on the tunnel in which the recent accident occurred.

Militia Aero Corps

TWENTY-FOUR states are at present organizing aero corps to be included in their National Guards and Naval Militias.

Climbing Steel Poles with the Aid of Iron Shoes

IT was always an easy matter for a lineman to stick the points of his climbers into the sides of a wooden pole and reach the top with the agility of a squirrel. With the introduction of steel poles for high tension electrical lines, some other climbing help had to be found. A forged steel shoe has been invented, which is neatly strapped over the regular shoe.

Spikes help a lineman to climb a wooden pole, but not a pole of steel. A shoe has been invented which enables a lineman to clamp himself step by step on the steel pole

The toe of the steel pole-climber curves upward. On its tip there are two steel projecting bearings or clamping points, and these points tell the secret of the device. A square steel block, having four sharp corners is placed just beyond the toes of the steel shoe. When dull from use these corners may be substituted one for another.

This special block bears on the outside of the steel pole, and a steel point situated at the end of the climber bears on the opposite side.

The climbers have a clamping action between the block and the point on the edge of the steel pole. This action is accomplished by the pressure of the lineman's weight on the end of the climber. Naturally his weight will come at the right point in climbing the pole. As he raises his foot for the next step, the lifted heel releases the grip of the climber. The steel climbers weigh about as much as the old style grippers used for the wooden poles.

An Invisible Ink

WHEN the juice of an onion or lemon is substituted for ink, no visible effect is made on the paper until heated, when the writing will stand out very plainly.

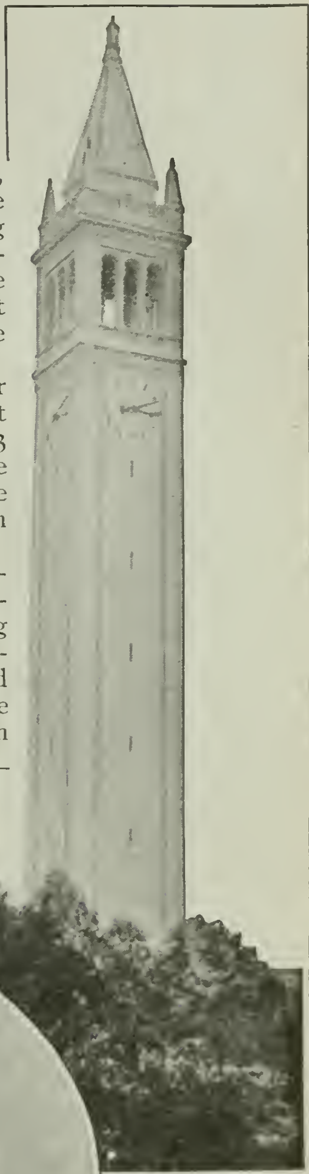
Rocking a Three-Hundred Foot Masonry Tower with Your Hand

BY the mere pressure of your hand you can rock "Sather Campanile"—the three-hundred-and-two-foot memorial tower just completed on the campus of the University of California.

In order to minimize the danger from earthquake shocks, the architect, Professor John Galen Howard, and the engineer, Professor Charles Derlith, Jr., so built the strong steel frame of the Campanile that cross-bracing is eliminated at alternate stories. As a result the vibration of the tower is like that of a steel rod one end of which is thrust in the ground. In an earthquake the tower would vibrate like a tree.

According to Professor Elmer E. Hall's tests, the tower has a vibration period of 1.13 seconds. By pressing against the steel frame at the top of the Campanile every 1.13 seconds he was able to rock the tower, so that earthquake recorders (seismographs they are called) registered the vibrations. However, the amount of motion was less than the thickness of this sheet of paper.

The plan on which the tower was built is to prevent a re-enforcement of the rocking caused by an earthquake vibration. For instance, a child can set a hammock swinging violently simply by pushing at the right moment, no matter how heavy the load may be. If the pushes are not timed correctly, the swinging is retarded. It is the same with the Campanile. The plan is to prevent cumulative swaying, such as would occur if the period of the earthquake and the vibration of the tower were the same, and such as would cause the structure to collapse. Mrs. Jane K. Sather erected the memorial to her husband.

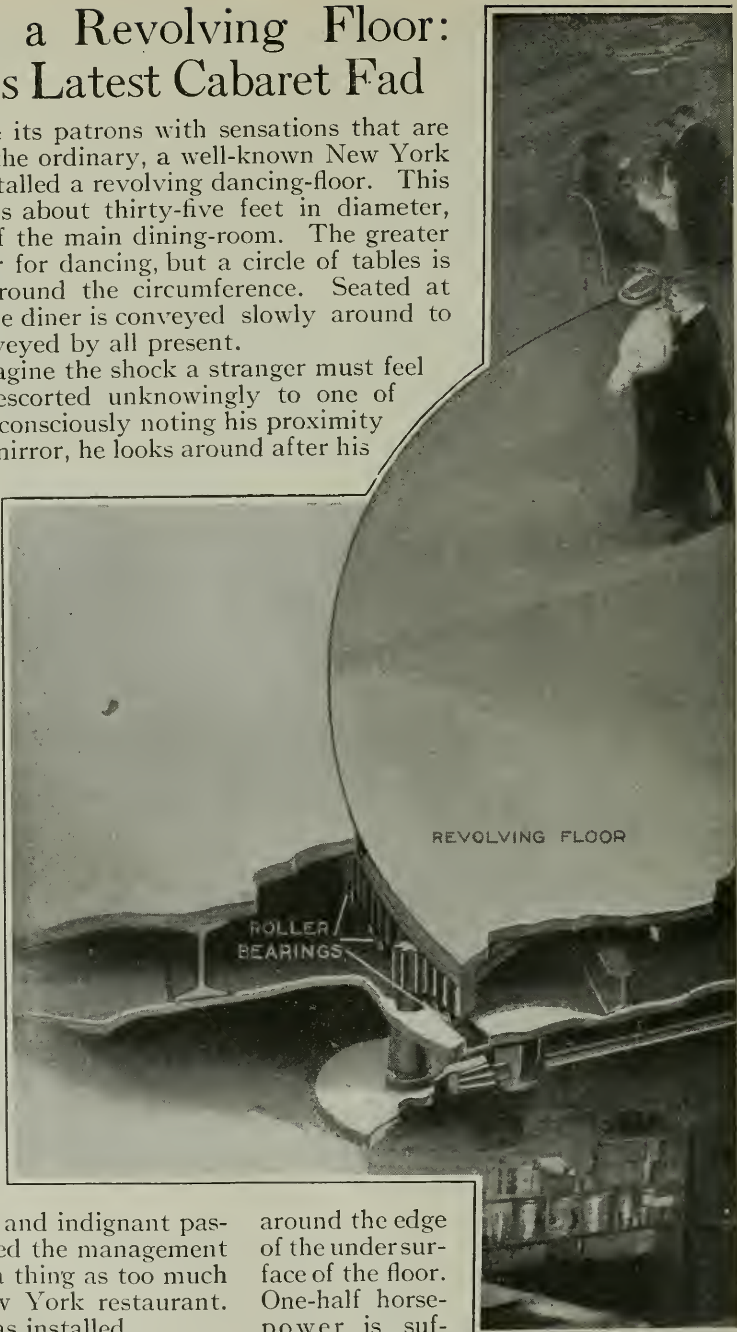


The pressure of your hand will swing the bell-tower at Berkeley, Calif., which in height is second only to Washington Monument. It was erected. as a memorial, by Mrs. Jane K. Sather at a cost of two hundred and twenty-five thousand dollars

Dancing on a Revolving Floor: New York's Latest Cabaret Fad

IN order to provide its patrons with sensations that are somewhat out of the ordinary, a well-known New York restaurant has installed a revolving dancing-floor. This circular floor, which is about thirty-five feet in diameter, occupies the center of the main dining-room. The greater part of it is left clear for dancing, but a circle of tables is generally arranged around the circumference. Seated at one of these tables, the diner is conveyed slowly around to survey and to be surveyed by all present.

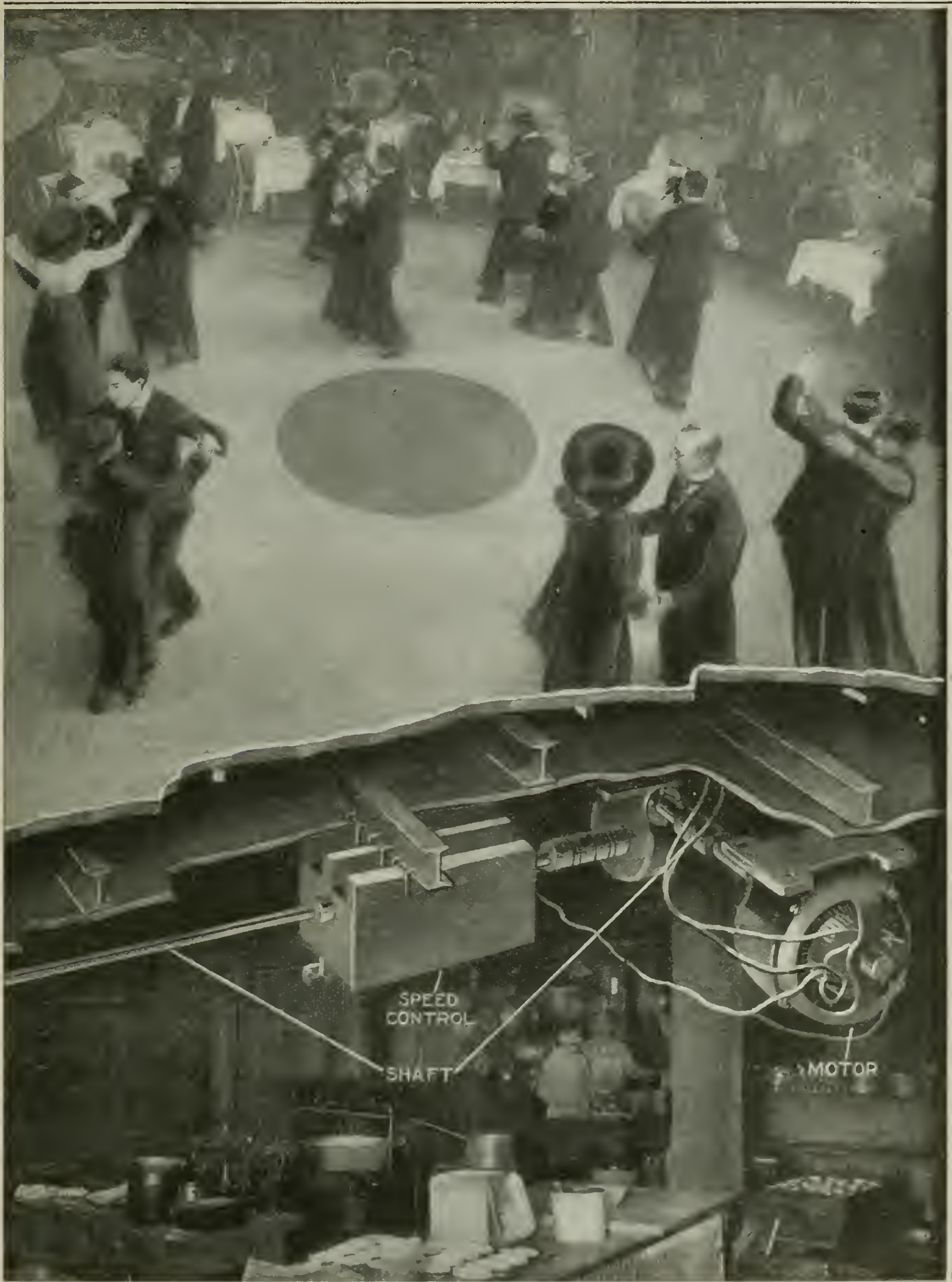
One can readily imagine the shock a stranger must feel when, having been escorted unknowingly to one of these tables and subconsciously noting his proximity to a certain pillar or mirror, he looks around after his study of the menu card and finds himself in a totally different position.



The ordinary speed of the floor is one revolution in eighty minutes. The motion is hardly perceptible as one steps on to the floor, but is sufficient to swing one all the way around during the course of a dinner. The original intention was to revolve the floor rapidly enough to give a kind of a merry-go-round effect, but a polished floor is slippery and centrifugal force is constantly on the watch for the unwary. Upset tables, broken mirrors, and indignant passengers soon convinced the management that there was such a thing as too much speed even in a New York restaurant. Hence a regulator was installed.

The manner in which the floor is driven is very simple. It is pivoted at the center and is supported on rollers. A small motor, mounted on the ceiling of the room below, provides the motive power. It drives a small pinion which meshes with a rack running entirely around the edge of the under surface of the floor. One-half horsepower is sufficient to turn the heavy floor, though it is often loaded with a hundred people.

In the center of the floor is a large circle of glass through which colored light is thrown. A fancy dancer can thus obtain beautiful effects.



A New York restaurant is responsible for this newest development of the dancing craze. At first they tried to turn the floor at high speed, but this was found too fast for New Yorkers. Now the floor turns at a solemn but relentless rate. The whole floor, with as many as one hundred persons, is turned by a one-half horsepower motor, so well arranged is the mechanism

The Making of a Telegraph Boy

Training Messengers to Become Managers

A tailoring department is maintained, for the boys must look neat enough to enter the finest hotels in the city. Each boy is measured and provided with two suits for which he pays a small weekly rental. Three tailors keep the uniforms clean and in repair

IT is a big undertaking to produce useful and capable men from boys whose opportunities for education have been limited and who are practically without training. Yet that is the task assumed by one of our great telegraph companies. Its messenger boys are to become not merely bearers of dispatches, but men of character.

Fred Geigle, manager of these boys—and there are several hundred of them—is the man who has charge of the work. He employs and discharges, reprimands or punishes, as the occasion arises. But above all he sets out to win a boy's confidence. Mr. Geigle himself commenced as a messenger boy and worked his way up step by step to the manager's chair. Surely he knows just the conditions under which the boys work. On the other hand, the boys feel instinctively that he is their friend. To him they go confidently for assistance in any difficulty.

From the time the boy hands in his application every precaution is taken conscientiously by the company to safeguard him.

Between calls there is an opportunity to become expert with the typewriter and to learn how to use telegraph instruments. Every boy with any ability has an opportunity to work up to a responsible office position

Neatness and courtesy are valuable business assets. The rules presented to a new boy stipulate that his uniform must at all times be in perfect condition, must be clean, in repair, buttons all on, and coat kept buttoned. The company provides as many changes of uniforms as are needed to keep the boys up to the standard in appearance, for which service each boy pays a small weekly rental. Three tailors are employed constantly to keep the uniforms clean and in repair. In the summer, washable blouses are provided instead of coats. The company maintains free baths for the boys, with free towels and soap.

Each boy is instructed in simple matters of courtesy. He is taught when and where to remove his cap. He is made to feel that he is identified with an important commercial house, and that his deportment should be such as to be worthy of his company. He knows that if he does not conduct himself properly he will be reported to the manager. His oversights are entered upon the index card, and adverse entries count against him when the time comes for promotion. In this practical manner the boy is taught that good manners bring their reward in dollars and cents.

Great quantities of clothes for messenger boys are kept in the stock room. Each new applicant is fitted with a suit of correct size. The necessary alterations are made in the company's tailoring department

The company also maintains a small circulating library for the use of the boys, a former messenger acting as librarian. Every boy in the messenger service is entitled to the free use of this library.

The company desires to assist every boy to fit himself for something better, if the boy cares to do so; and to further this object, a typewriter is placed in the messengers' waiting-room. Any boy is at liberty to practice upon it while waiting for calls. A set of telegraph instruments has also been installed, with an inside connection, so that any ambitious boy may learn telegraphy and carry on communication with another boy at the end of the line in the same room.

Especially commendable work which Mr. Geigle performs is in training his boys to be men. A messenger boy is subjected to many experiences which rarely come to the boy employed in a business house. The boy's honesty and integrity are tested hourly by the very nature of his service, and he himself is subjected to the wily approaches of those who would profit by his commissions. Thus the boy is compelled to be doubly fortified, first entrenched within his own consciousness lest he be tempted to do wrong; and secondly, he must be ever watchful for the temptation from without which would ensnare him and despoil his employers.

Among several hundred boys, it sometimes happens that one is not so careful or particular in some matters as he should be. This lapse is reported to the manager, and the boy comes before him for explanation. A boy is never discharged for a first offense, unless it be of a very serious nature. Instead, the manager talks it all over with him in the desire to be helpful rather than harsh. The boy is given an opportunity to try again in another location, from which reports are also made. Should the boy fail even a second time to progress satisfactorily he is given still another trial, with the earnest, patient counsel of the manager to show him the right course to pursue.

Making Weather Forecasts with Flowers

WEATHER conditions may be predetermined by means of a unique arrangement, easily prepared by anyone. Procure a bouquet of paper flowers. They may be made or purchased, but their colors must be pink and blue. Dip the flowers in a saturated solution of chloride of cobalt and allow to dry. Repeat the process five or six times; and place the flowers in a suitable vase.

When wet weather is approaching, the flowers retain their original colors, but when it is going to be dry, the pink flowers become purple and the blue ones turn green.

Bringing home the harvest. The sack contains turtles, weighing in all over a hundred pounds. They are sold by weight—shells and all

Turtle catching is an art in the practice of which the skilful use of special tools is an essential. The chances are very great that J. S. Bassler, professional turtle-catcher for American restaurants, caught the turtle that made your soup to-day. He does it with a long spear, digging the turtles out of their holes and throwing them into sacks for transportation on his own back to his wagon

Catching Turtles as a Business

DID you ever wonder where the turtle in your soup at the fashionable restaurant came from? Did you know that many of the buttons on your clothes were made from the backs of snapping turtles? In early September, when turtles are house-hunting among the pebbles and worms in the muddy bed of some fresh water creek, preparatory to sleeping away several months of cold winter weather, men are getting ready to wake them up in the middle of their nap by jabbing a steel hook into their backs. The work of hunting turtles, though it begins in the early autumn, continues all through the winter months.

The hunting of turtles has become a specialty with J. S. Bassler, who can boast of catching four and five tons every year. He uses a heavy steel rod bearing a hook at the end. Fitted with rubber boots and warm clothes, Mr. Bassler wades along the stream, jabbing the hook into the muddy bottom. Rudely awakened from his comfortable, ice-cold bed, the turtle is jerked out of the water on the end of the hook.

The turtle hunters usually select some country having numerous small streams. Here they pitch their tent and remain for several days, working within a radius of eight or ten miles from camp. After the streams are exhausted, they move on to another section of country. Sometimes five hundred pounds of turtles are found in the same hole, and thousands of pounds are caught during the usual stay in each camp.

The live turtles are placed in large bags and carried to the road where they are loaded in a wagon. A bag of turtles weighs between one hundred and one hundred and twenty-five pounds. The turtles are later packed in sugar barrels, one on top of another, each barrel weighing as much as three hundred and twenty-five pounds. They will live in this condition for many days. The chief markets, like New York and Chicago, pay from six to twelve cents a pound for turtles, including the shells.

Turtle soup is made from ordinary snapping turtles and not from green sea turtles, as gourmets fondly believe.

Why Logwood Is Worth $200 a Ton

THE great bulk of the logwood from all regions of its growth is used to obtain black dyes which result from its use with alum and iron bases. The use of logwood dates back over two hundred and fifty years, and from that time on the logs from Yucatan and Honduras have been considered far superior to those obtained from Jamaica and Santo Domingo. It may be of interest to note that the logwood tree is not a native of Jamaica.

The first shipment of logs that came into England in about 1550 was obtained at points on the Spanish Main and it seems that at first the dyers were unable to obtain durable colors. In order to protect the public the use of logwood was forbidden in 1581 by an Act of Parliament. The dyers in France and Germany, however, soon developed the use of logwood. After that English dyers were again permitted to use it, with the result that the demand for logwood began to increase. The wood from Campeche soon brought a price as high as $500 per ton, and that from Jamaica about $250. At the present time the Campeche wood sells for about $200 per ton and that from Jamaica and Haiti $100.

The world's present annual consumption of logwood is estimated at about 200,000 tons, of which the United States consumes approximately 30,000 tons. The import statistics for 1914 show that 20,000 tons of logwood came from Jamaica and about 10,000 tons largely from Haiti. The Bureau of Statistics of the Department of Commerce and Labor supplies the following figures in reference to the sources, quantities and values of logwood imported during 1910.

SOURCE	QUANTITY	VALUE
British Honduras	1,005 tons	$ 16,491
British West Indies	11,187 "	137,906
Haiti	19,022 "	200,544
Mexico	449 "	5,381
St. Domingo	434 "	3,914
Other Countries	221 "	4,212

The present bad condition of the dye trade in the United States has called forth numerous propositions for remedying the difficulties, but nothing practical has been done.

An Automatic Animal Fire Escape

BY the use of an automatic, animal fire escape just presented by a Western inventor it is possible to clear any size stable of animals in five short seconds. In the operation of this fire escape the element of chance does not enter. It has a positive action, and as all working parts are controlled by gravity there is nothing to get out of order at the critical moment. The value of an apparatus of this kind will be realized by anyone, for a fire seldom destroys a stable of any considerable size without a num- of the animals being lost. This results generally from the fact that the animals, frightened by the fire and smoke, become unmanageable and, if loosened, rush into the flames. The new device does away with all danger from this source and in addition provides a means of escape.

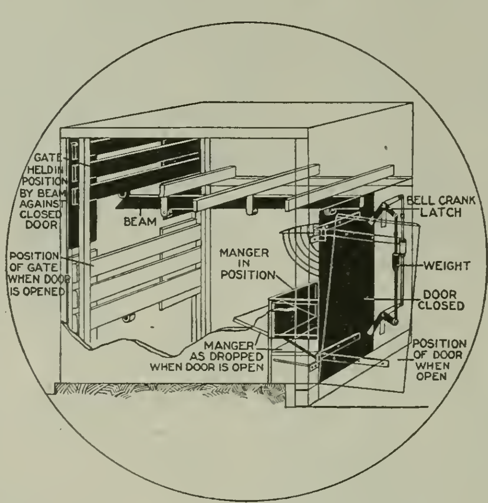
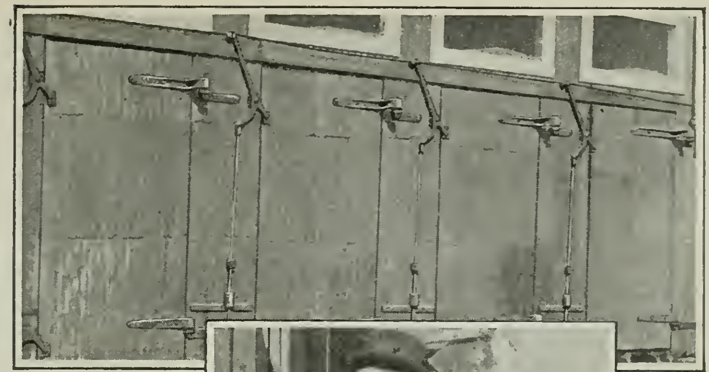


Diagram of the automatic horse fire escape. A gate drops, the manger collapses, and the halter is loosened when the outside fire-escape door of the stable is opened

When the fire escape is to be arranged, the stalls are located along the sides of the stable. Each is arranged with a door in the exterior wall, which is provided with a mechanism which at the same time that the door is held shut, holds up a gate above the open end of the stall, or behind the animal when the stall is occupied. A manger with collapsible parts is mounted in proper relation to the stall and a special halter is provided. Each manger is made up of two distinct parts—a front and a bottom. In the edges of these where they unite when in normal position is located a slot or groove, in the form of a one-inch hole, half of which is in the bottom and half in the front. Through this hole is run a one-inch rope, with a knot at its lower end and a ring at its upper end. When the manger collapses, the rope is instantly released and the animal freed. All working parts are operated by gravity. When the door, which is hung on gravity hinges, is unlatched it falls open, thereby allowing the bar which supports the rear gate to roll forward. This releases the gate, which drops, preventing the animal from backing into the stable. As the door is opened still farther the manger collapses and falls to the floor, the opening of the door having released the supporting rods. One large business house in Los Angeles, at the stables of which company the accompanying illustrations were made, has a series of ten of these escapes in one row. By a single operation, performed by hand or automatically, all of the escapes may be tripped, as shown on the opposite page.

If a fire breaks out, the device works automatically. This result is accomplished by running a cable along the interior of the building. This cable is cut into short pieces and connected with fusible links, these being placed as near to the woodwork as possible. From the interior the cable is run through the outside wall close to the lever which operates the fire escape doors. The end of the cable is then attached to a trip to which a weight is fastened, this weight also being connected to the lever which releases the door latches. In the event of a fire the cable separates, on account of one of the fusible links being melted, this releasing the trip which allows the weight to pull down the lever and which, in turn, automatically releases all of the fire doors. This device is the invention of John Betty of Los Angeles.



Solidly locked when not needed, the outside doors of the stable are held shut by triggers connected with a shaft which runs the length of the building and is operated by a single lever. The device can be arranged to operate automatically in case of fire. In this case a weight lifts the lever—the weight being released when any of the fusible metal sections of a cable are burnt out in any part of the stable

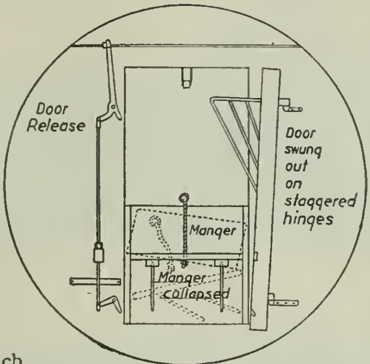


Diagram of door release system. The timber at the top of the doorway is a shaft connected with the gate at the rear, which closes as soon as the outside door is opened

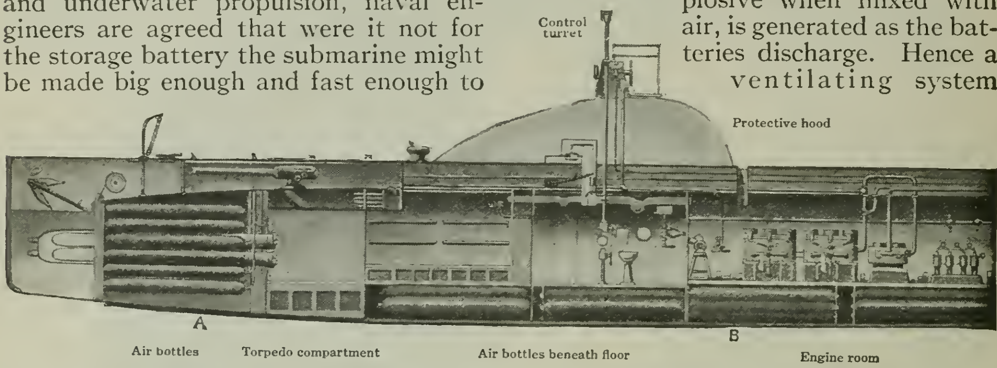
A Stable Door Which Opens When a Fire Breaks Out

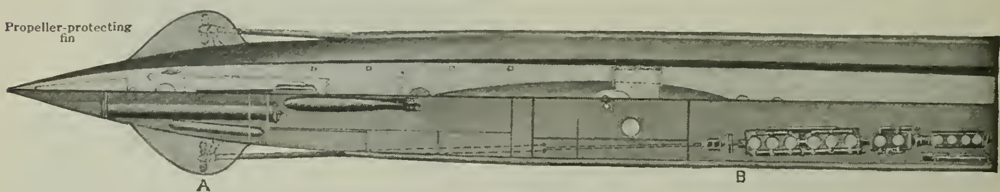
When the door, which is hung on gravity hinges, is unlatched, it falls open. When released, the gate drops and the animal is prevented from backing into the stable. As the door is opened still farther the manger collapses and falls to the floor, the opening of the door having released the rods which support it. This all occurs in an instant. The animal is forced to move out into the open air

Doing Away with the Submarine's Storage Battery

TERRIBLE as the submarine seems, it could be made still more terrible if it were propelled by a system simpler than that at present employed. Although no perfect engine has yet been found which is suitable for both surface and underwater propulsion, naval engineers are agreed that were it not for the storage battery the submarine might be made big enough and fast enough to take its place in the battle-line of a high-sea fleet. Some day we may see squadrons going into battle accompanied by submersible vessels of huge dimensions, which will have armored decks and which will be capable of making speeds of twenty-five knots and more. Compared with the battle possibilities of these future craft even the largest of present German U-boats will seem puny and toy-like in comparison. But before we shall see them the present type of surface propelling-engine must be vastly improved, and above all the storage battery must be abandoned.

An oil or any other internal-combustion engine cannot be employed to drive a submarine under water because of the poisonous gases generated and because it breathes air more voraciously than any human being. Hence an electric motor, deriving its current from a storage-battery, is installed on every submarine for underwater propulsion. The weight of that battery is about three hundred and seventy pounds per horsepower per hour. Hydrogen gas, which is in itself not poisonous, but which is highly explosive when mixed with air, is generated as the batteries discharge. Hence a ventilating system must be provided. In the lead-type of battery, which is in use side by side with the Edison nickel-iron cell, the greatest care has to be exercised to exclude salt





Eliminating the Storage Battery from the Submarine—the Neff System

These drawings are a longitudinal vertical section and a sectional plan of the Neff system. The two small cross-sections at the bottom are taken through the points marked A and B below the two larger drawings.

Both the forward and aft compartments contain steel bottles in which air is compressed at 2,500 pounds pressure; other air bottles are placed beneath the floors. The engines drive propellers near the bow of the boat. Protecting fins guard the propellers from injury.

The engine-room is supplied with air in two distinct ways; one for surface running and the other for submerged running. The superstructure is open to the sea and serves to hold a considerable amount of air after the submarine has begun to submerge. This trapped air is automatically fed to the engines for the first few water; if that should come into contact with the liquid of the battery, chlorine gas—the poison gas of European battlefields—would fill the vessel.

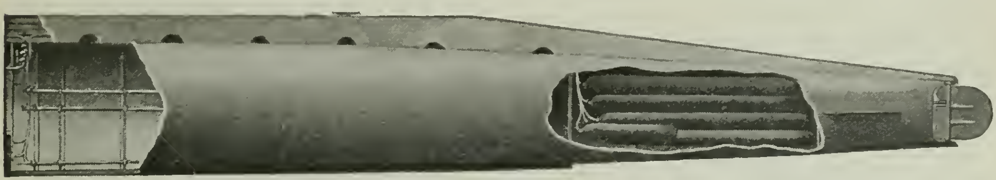
Although the Edison cell will not generate chlorine, even if salt water should leak in, it does generate an excessive amount of hydrogen when discharging. Whatever type of cell may be installed the storage battery is heavy, cumbrous, dangerous and very limited in the amount of power that it is able to deliver.

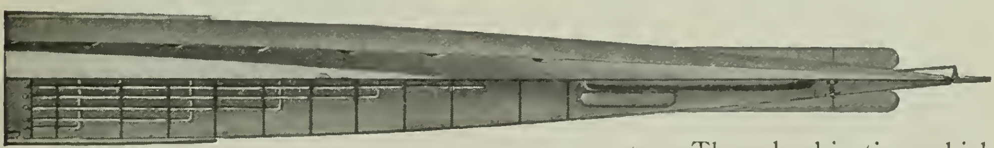
Realizing that the submarine must be freed of the storage battery, the Navy Department has taken a great interest in what is known as the Neff system of submarine propulsion, which takes its name from Abner R. Neff.

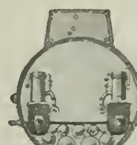
About three years ago a California company spent about $130,000 in completing a submarine boat, seventy-five feet long and seven and one-half feet in beam. It was driven only by oil engines; it had no storage battery at all. In order that the crew might live despite the poisonous gases given off by the engines, a compressed air ventilating system was installed. The six men on board stayed under water thirty-six hours—a record submergence.

It was in this boat that Mr. Neff became interested. He made improvements of his own and engaged engineers to contribute their ideas. A trial board appointed by the Navy Department approved of the ventilating and propulsion system. The only objections which have been raised to the system are military in character. Against the Neff system it has been urged that large quantities of air would be emitted, when the submarine is running under water; a wake of air bubbles would be left on the surface to betray the craft and to make it easy to follow its submerged course. Another objection is the noise made by the Diesel engines under water; the pounding of engines and air compressors could easily be picked up by sensitive sound-receiving devices.

As might be supposed, the inventors of the Neff submarine system are ready with replies. They point to the manner of handling the exhaust from the engines—indicated in a general way in the accompanying illustration. The burnt gases are led to a system of condensing tubes outside of the hull. The expanded gases, having been condensed, are drawn







minutes—a feature of importance when the submarine is cruising at the surface in a heavy sea and the atmospheric air-feed may be cut off momentarily.

The air bottles are tapped as they are needed. A high-pressure airline leads from these bottles throughout the vessel; the high pressure system in turn supplies a low pressure system of pipes. As soon as the atmospheric air-feeding devices have been cut off the air pressure within the vessel drops; and this drop is utilized to cause the feeding of air automatically from the stored supply.

The exhaust from the engine passes out through an exhaust manifold from which an exhaust-pipe leads, discharging beneath the propellers. Mechanical exhausters are also provided in case the water pressure is so great that the natural suction effect produced by the travel of the vessel through the water is insufficient.

inboard by mechanical exhausters and in turn pumped overboard. Underneath the hull the exhaust is sprayed out and carried back to the propellers. If there are any bubbles left they are churned up by the propellers as by an egg-beater. Thus the betraying wake left by a train of air bubbles is to be eliminated.

The noise from oil engines under water, to which objection has been raised by naval officers, is caused by a final expansion of gas, after it leaves the cylinders, from a pressure of about fifty pounds down to atmospheric. This is accompanied by rapid sharp reports and a reverberating roar. In the Neff system it is claimed that the exhaust is silent, because the engine is exhausted into a condenser or a closed chamber from which it is drawn at a partial vacuum and discharged overboard at nearly the outside water pressure. The remaining noises are due to the movements of the machine parts, such as the clicking of valves. All this noise, it is claimed, may be reduced by proper regulation and adjustment. In testifying before the Committee on Naval Affairs of the House of Representatives, Mr. Neff pointed out what the Popular Science Monthly has already shown—that the characteristic hum of an electric motor can be picked up at a distance of fifteen miles by microphones and that this hum is easily distinguished from the vibration of engines. Hence there is just as much objection to the electric motor as to the Diesel engine under water.

Whether or not the Neff system will be adopted by the United States Navy no one can say. The Navy is frankly interested in the project, but, following the usual government policy, it prefers to adopt the system only after it has been completely developed by some private company. About $300,000 have been thus far spent on the system. Its promoters are unwilling to make any further sacrifices. Here we have a good example of the use of a Naval Advisory Board. The Neff system may not be perfect; but it has assuredly commendable features enough to justify the Board in carrying on the further development with government funds. If private companies were to wait for inventors to submit commercially perfect devices we would have no tungsten lamp, no harvesting machinery, no electric motor. All new inventions are crude. They must be regarded as material for development by laboratory engineers. Not until the government assumes that attitude are we likely to improve our fighting machinery.

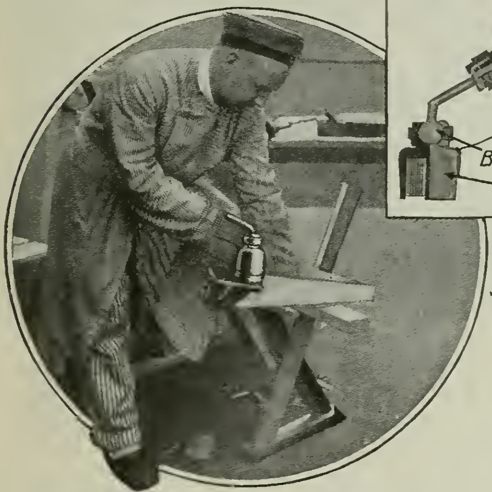
The llama of South America corresponds to the camel of the East as a beast of burden in the desert regions of the Andes

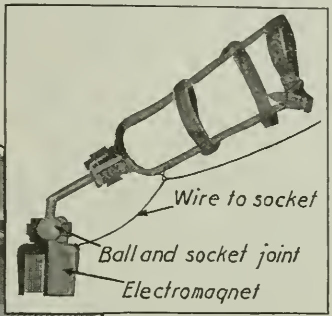
Llamas as Powder-Carriers

In the semi-desert Andes countries the llama is the general beast of burden, corresponding to the camel in the Old World. The photograph shows a troop of these singular animals transporting American powder to an interior Bolivian mining district, far from any railroad. The llamas are heading for the Andean Mountain passes, led by a reliable old bellwether. Two or three gauchos (herdsmen) will manage a bunch of fifty or sixty animals; for the creatures give little or no trouble unless overloaded.

The Electromagnetic Hand for Armless Veterans

AT a meeting of the *Verband Deutscher Elektrotechniker* (Association of German Electrotechnicians) the suggestion was made that the *Verband* consider the design and development of artificial arms, equipped with electromagnetic seizing and holding mechanism. The underlying idea is simply this:





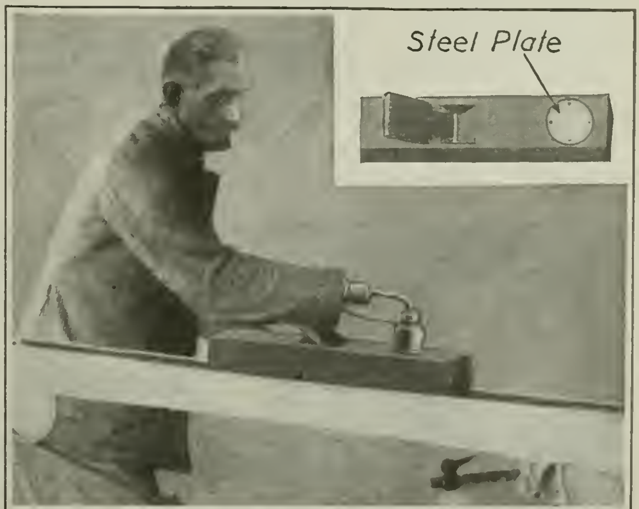
Construction of the electromagnetic hand. To the left, how the hand is used in sawing

The sleeve enclosing the stump of the arm is provided at its outer end with a pot-shaped or bell-shaped magnet, which can be adjusted or held in a ball-end socket, so as to bring the retaining face of the magnet to any position desired. The magnet may then be either clamped tight or else left movable against slight resistance. The pot-magnet is connected with a current supply by means of a screw-plug. Connection is made by moving some other part of the body, for example the foot, the chin, the remaining arm, the damaged arm itself, or even the whole body.

The pot-magnet makes it possible not only to grasp all iron objects, but also to hold them tight or to lift them and move them for any length of time. During these manipulations the connection between the stump and the object (tool) is not a rigid, but a movable one. For this reason the magnetic hand may be used by all workmen who work with iron tools or iron articles. As a rule, the tool need not be specially altered or given a special shape for the mutilated man, since the magnetic hand is capable of grasping the tool at any place, provided it is made of iron.

In filing, for instance, the magnet is placed on the outer end of the file. The file is moved exactly as if it were guided by a healthy arm; for the magnet can move relatively to the sleeve. A carpenter's plane is provided at its extremity with a small iron disk and is manipulated in exactly the same manner as any other plane. Stampings cut out by machine dies can be removed perhaps with greater ease than with a normal hand.

Still other grasping movements, for instance a pinching movement, may be carried out without difficulty. Even the delicate closing movement of a pair of pliers may be effected.



The plane must have a piece of steel on its upper face so that the electromagnetic hand may have a hold

A new auger which will work in any position and around almost any obstruction. It can be used in a corner, under a shelf, or even inside a box with equal facility

An Auger that Works Anywhere

A NEW auger that will work in any position has been invented by Wm. H. Stiner, of Kennett Square, Pa. The chuck is made to take a tool of any size up to 2-inch. The great value in the device is that it will be of use in so many difficult places, it can be placed between two rafters and used to bore a hole, and the handles can be taken out and placed in other positions at will, thus enabling the operator of the tool to do many difficult jobs that could not possibly be undertaken with the ordinary tool.

Handy Instrument for Physicians

AN instrument for making diagnoses in the case of injured eyes, ears, noses or throats has been designed for physicians and nurses, and it is so small and compact that it can be easily slipped into the vest pocket. A nickeled case contains a cell or dry battery which lights a miniature lamp. By the use of various attachments, the ear and nose can be examined, the diseased or injured portion being magnified by a small glass that is attached. By means of a strap, the instrument can be fastened to the front of the head for use by the surgeon in emergency operations.

Ice Dynamited so Yale Crews May Row

THE Yale crews began practice early in March on the Quinnipiac River, but not until a path was cleared with dynamite through the solid ice fields. The condition of the frozen river annoyed Coach Guy Nickalls. The rowing instructor had to contend with work in the gymnasium for the varsity oarsmen until he ordered practice on the water, which was then one immense sheet of ice. For the first time in the history of rowing in this country dynamite was brought into play. Nickalls organized a blasting squad consisting of Mather Abbott and Charlie Wiman. When the coach's dynamite crew finished their work a long lane had been cleared for the shells.

A handy appliance for diagnosing diseases of the eye, ear or throat. An electric light illumines the parts and a magnifying glass aids in the examination

Embalming a duet by Lina Cavalieri and Lucien Muratore. Cavalieri was formerly a member of the Metropolitan Opera Company. Muratore is a distinguished Italian tenor. The photograph shows in a general way how songs with orchestral accompaniment are recorded. Sometimes the phonograph projects through a partition, so that the singer sees only its mouth. Often five or six phonographs are used simultaneously to make records. In making master records, the artists always sing twice

Singing for the Phonograph

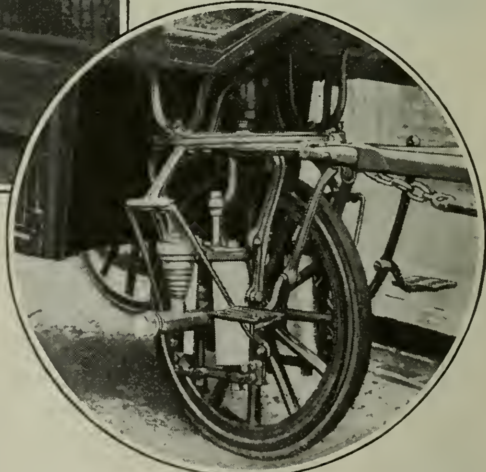
THE recording of the human voice on the phonograph is almost a science in itself—not so much as the artist is concerned as the laboratory head who is responsible for the clearness of the ultimate record. While each phonograph company has its own system of arranging the recording phonograph relatively to the orchestra and artist, the essential principles are very much the same in all laboratories.

As a general rule the musicians are perched midway between floor and ceiling, with their instruments pointing toward the horn of the recording phonograph. Men who play the tuba and similar brass instruments turn their backs to the phonograph so that the mouths of the instruments may project their growls and blasts toward the horn. In order that the tuba players may see the conductor of the orchestra, mirrors are placed in front of them, which reflect the movements of his baton.

For violin solos, an ordinary violin is used, the artist usually playing directly in front of a horn projecting through a partition. This is true of chamber music and all records in which the violin tone can be heard with sufficient distinctness. In heavy orchestral pieces, however, a special instrument called, after its inventor, the Stroh violin, is used. It seems that the sounds of the ordinary violin are difficult to produce, especially at a distance. Stroh devised a violin which has no sounding-board. It comprises simply a bridge, over which the strings are stretched in the usual manner, and a horn which amplifies the sounds. This instrument is now used in all phonograph laboratories. On the finished phonograph record its sounds are hardly to be distinguished from those of an ordinary violin.

Many experiments have been made to determine the best shape of room in which to make records. Edison, for example, tested almost every conceivable form. He even went so far as to build a room in the shape of a horn, the small end of which terminated in the phonograph itself. The singer stood practically upon the edge of this huge horn's mouth, for such was the room. The results were no better than those obtained by stationing the singer in front of an ordinary phonograph in an ordinary room. As a result we find that no special effort is made by the phonograph companies to utilize rooms of special shape so as to gather all sounds and concentrate them upon the record.

A London cabby designed this three-wheeled cab. The third wheel prevents the cab from tipping over, even when making the shortest and quickest of turns



It is difficult to believe that the technique of making records cannot be improved. In view of the elaborate studies of echoes and reverberations made in large auditoriums for the purpose of improving their acoustic properties, it seems that the time is now ripe for a new series of experiments which will show how those sounds may be gathered which are now lost.

The record made by the artist is called a master record. In fact, two records are made, one being hermetically sealed and stored away in the company's archives for future generations. The other record is used for the preparation of a die for making commercial records.

This Cab Simply Can't Tip Over

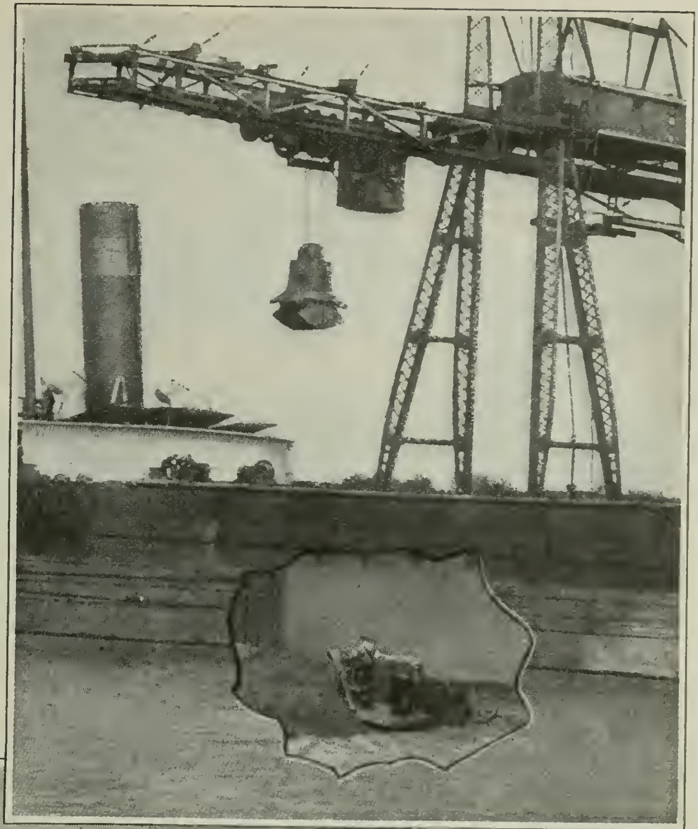
A CITY cabman of London has devised and built an attachment in the form of a third wheel for his cab, which, he claims, adequately prevents the cab from upsetting, even in going around the sharpest and swiftest of curves. The additional wheel is placed under the driver's seat, almost in dangerous proximity to the horse's heels. It is fitted with springs on either side and performs the incidental function of absorbing jars and jolts. Even in spite of the added factor of safety which the third wheel provides, it is doubtful if the cab will continue to be popular in London. Cheap taxicab service and the famous London 'bus have crowded the horse almost entirelv from London thoroughfares. Hansoms, which are just now beginning to lose their vogue in New York, have not been seen in London streets for several years. One of the last to be removed has been placed in the British Museum as a relic for future generations to gape at.

Gasoline in Bulk for Panama

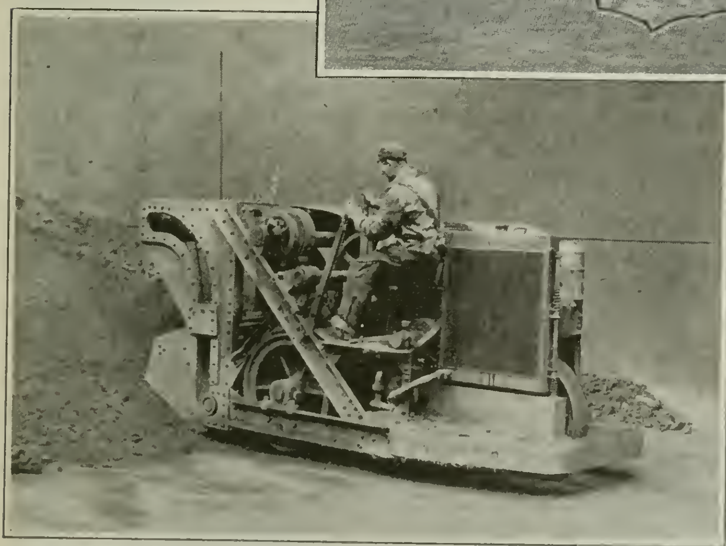
GASOLINE is being shipped in bulk to Panama. The first consignment arrived at Balboa in February and was unloaded into the new storage tank recently erected by the Panama Canal Commission. In Panama there is now stored fuel for ships of all sorts, gasoline, crude oil and Diesel oil. Considerable gasoline is still on hand in Panama in drums, the supply being sufficient to last at the present rate of consumption about five months.

Machine Shovels Faster Than Forty Men

ON the Great Lakes, where bulk cargoes of coal and ore make up the majority of loads carried by the giant freighters, one of the greatest factors of loss is that occasioned by the difficulty in gathering together the last remnants of coal or ore which remain in the out-of-the-way nooks and corners of the hold and which the unloading machine cannot reach. When the piles of ore or coal have been diminished so far that the bottom of the hold is in sight, the customary practice is to send gangs of men with shovels to shift the piles into the convenient reach of the power-shovel, or "bucket" as it is called.



The scraper-shovel quickly sweeps out the corners unreached by the lifting-bucket

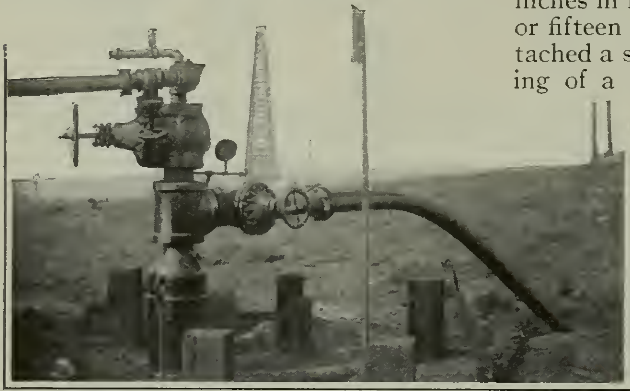


A sturdy "shover" which pushes coal or any other loose material into big piles under the hatches. The steam shovels can then hoist full buckets

To do away with this waste of time, a Cleveland concern has brought out a machine which takes the place of the shoveling gang. The machine does the work of about forty capable shovelers. On one occasion, the automatic shoveler moved one hundred tons of ore into the path of the bucket, approximately in two hours less time than the hand gang formerly required. The machine consists of a high-powered gasoline engine operating a lift-shovel at the front of the machine. When the shovel is raised as far as it will go, it is turned over in a dumping position and the load discharged. The wheels are fitted with rubber tires.

Gas Flows Back to the Earth

IN the Midway oil-field of California natural gas is being returned to the earth from one pocket to another. Two flowing oil wells on this lease produce a considerable quantity of gas along with the oil. Already there is more gas than is needed for fuel or domestic purposes in the field. Instead of permitting this gas to go to waste it is carried by pipe lines to a hole that was drilled for oil several years ago. Under natural pressure the gas finds an outlet at about five hundred feet. Apparently it is being stored away in underground reservoirs at that depth.



Too much natural gas is obtained from a California oil-field. For that reason it is piped back into natural underground reservoirs for future use

Buying Telephone Poles by Weight

SOME of the telephone and telegraph companies have adopted a plan of weighing poles which they buy as a means of ascertaining just how well seasoned they are. Men who are experienced in handling poles are able to calculate with a remarkable degree of accuracy the approximate weight of a pole that has been properly seasoned. Should a pole prove to be much heavier than their estimate, it has not been properly seasoned as a general rule; the over-weight is due to the presence of sap in the wood.

The accompanying illustration shows a weighing device which is utilized by one concern. A tripod supports a long lever, the short end of which is a few inches in length and the long end twelve or fifteen feet. To the short end is attached a simple weighing device consisting of a balance-arm and sliding and fixed weights. Hanging from this by means of heavy chains are two sets of wood tongs.

The pole is slid between the tripod to such a position that its weight will be about evenly distributed on either side. The points of the tongs are embedded in the wood, then the long arm of the lever is brought down and the pole is lifted from the ground and its weight ascertained. The leverage is so great that one man is generally able to lift the average pole.

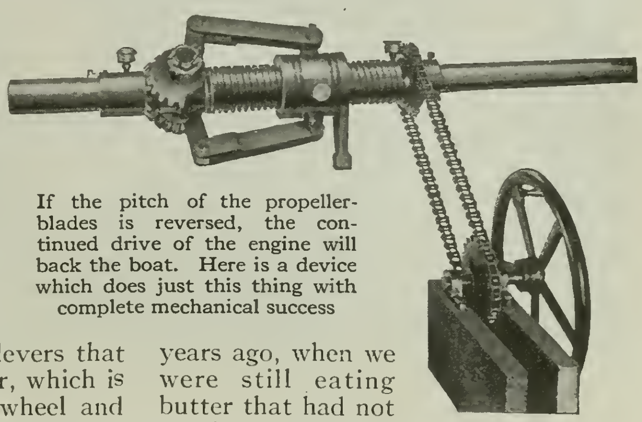
Only the well-seasoned poles are dipped in the preserving bath. This bath adds greatly to the life of the base of the pole, as the chemical, which is kept hot by a fire beneath the vat, enters every pore and crack in the base.

Before dipping in the preserving bath, telephone poles are weighed to determine whether or not they are well seasoned

THE East will have to look to the West for progressive ideas. Palo Alto, California, a town of about 7,000 population, has a town incinerator of a daily capacity of 30 tons of mixed refuse.

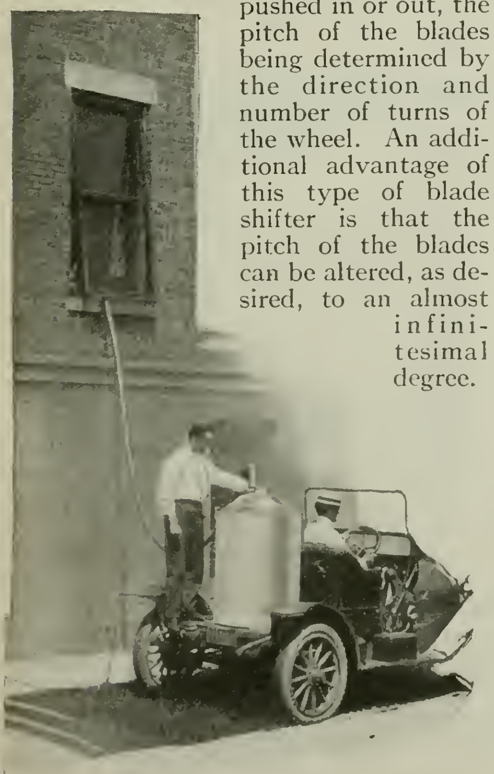
Reverses Tug's Propeller-Blades

WITH small boats, the quickest and surest way to back-water is to reverse the pitch of the propeller-blades. Numerous motor-boats are equipped with mechanism which performs the task by the mere shifting of a lever, but in the case of larger craft the blades of the propeller are so heavy that to reverse them by an ordinary lever would be almost impossible. A large tug that plies San Francisco Harbor was recently equipped with a propeller-blade reversing mechanism, which, while embodying the old lever principle, accomplishes its purpose in a surer and more ingenious way.



If the pitch of the propeller-blades is reversed, the continued drive of the engine will back the boat. Here is a device which does just this thing with complete mechanical success

The blades are shifted by levers that are controlled by a worm-gear, which is in turn operated by a hand-wheel and chain. When the wheel is spun, the worm revolves, causing the levers to be pushed in or out, the pitch of the blades being determined by the direction and number of turns of the wheel. An additional advantage of this type of blade shifter is that the pitch of the blades can be altered, as desired, to an almost infinitesimal degree.



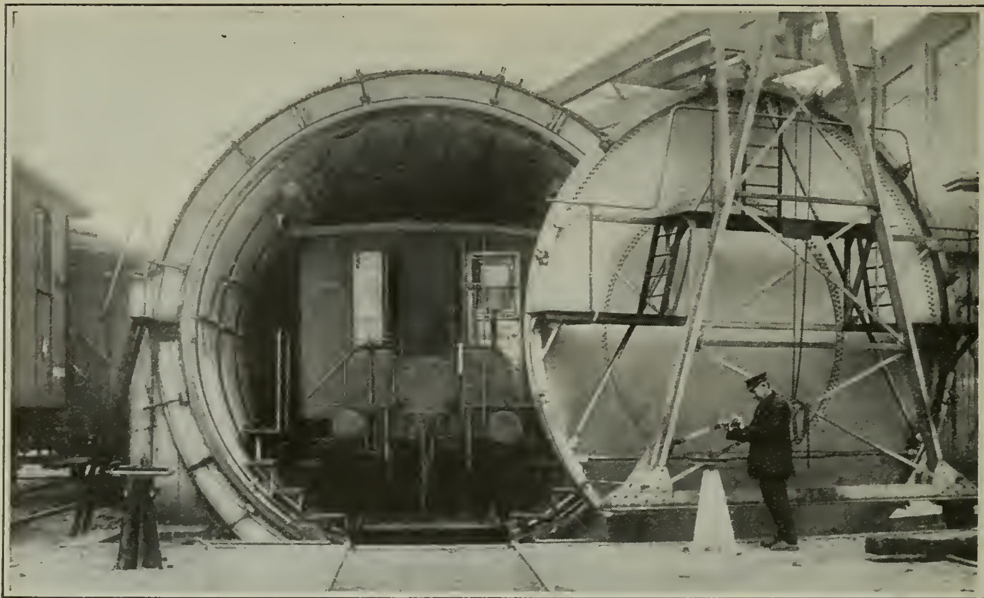
Cyanogen gas carried to your door—or window—to fumigate your house

Fumigating Has Improved, But Are We Less Afraid of Germs?

IN these days of sanitary living, sanitary breathing, sanitary sleeping, sanitary eating, etc., fumigation has come to be one of the most popular of indoor medical sports. Not a great many years ago, when we were still eating butter that had not previously gone under the vigilant microscope of the health officer, we considered that a little block of sulphur burned in a room after someone had had measles would annihilate the last germ. Not long ago, however, an enterprising physician somewhere in the United States examined a sample of wallpaper that had been on the wall since a case of diphtheria had run its course there a score of years before. On the sample he found an agile, active colony of diphtheria germs. This was not the sole cause, but it was one of the immediate causes of wide-spread, better fumigation.

Cyanogen, deadliest of gases, is now smoked into a room in which patients having contagious diseases have lived. The latest and one of the most effective ways of dealing death to the lurking microbe depends on a tank fastened to the rear of an automobile. The automobile is driven up alongside the house to be fumigated, a hose is attached to the top of the tank and led into the room.

Structurally, the automobile fumigating machine is highly interesting. An electric motor, attached to an air-pump, is started in the bottom of the tank, causing air to be forced through the mixture of chemicals. This air draft carries the death-dealing gases through the tube into the room.



To protect themselves from Russian vermin, the Germans are disinfecting all trains from Russia. Large cylinders, into which railway cars are run, are closed by tight end-covers, whereupon poisonous gases are turned on

Fumigating Tank That Contains a Railway Coach

EVERY railway train which returns to Germany from Russia is usually so infested with vermin that the German Government, in self-preservation, has had to resort to wholesale fumigation methods.

Fumigating tanks so large that standard-sized railroad coaches can be rolled into them, have been installed by the government at several railway centers. When the car has been placed inside such a tank, gigantic steel disks are clamped tightly over the ends of the enormous tube and fumigating gases forced in. All germs lurking in the car are killed in a few minutes' time.

Twenty-eight box-elder shoots were planted in a square. They were bent and trained to form a garden-chair

A Nailless Chair Made by Good Soil, Fresh Air and Sunshine

HERE is a chair made by Mother Nature. Fresh air, sunshine, and fertile soil were her only tools.

In 1903 John Krubsack of Embarrass, Wis., decided to make a chair different from any he had seen. He planted twenty-eight box-elder shoots in a five-foot square. He watched over them carefully; for if a single shoot had died his plan would have been spoiled.

After five years the little shoots attained a height of seven feet. Mr. Krubsack was then ready to begin real work on his chair. He bent the tender shoots and then fastened them. When, after several years, the joints became solid, the owner cut the shoots and trimmed the branches.

The chair has eighty-seven joints, and weather conditions will never cause it to fall apart.

Spraying Concrete

THE important work of re-enforcing the levees along the Mississippi River was recently aided by the addition to the usual equipment of an apparatus which sprayed concrete into the crevices of the pavement and levee facing. A large tank containing a mixture of sand and cement was filled with compressed air and the mixture forced at high pressure from the mouth of a large funnel with such force that a permanent adhesion was made.

Courtesy of Professional Memoirs

Concrete sprayed from a hose filled pavement crevices quickly and efficiently

Motion-Picture Silhouettes

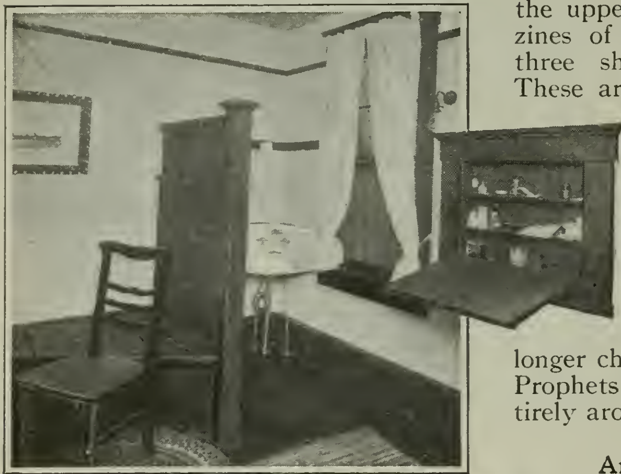
THE moving-silhouettes of C. Allan Gilbert's films are produced in a converted stable near Washington Square, New York city.

The coach-house has been fitted up like an ordinary motion-picture studio, with its inner walls done over in white. The lighting arrangements are such that the players are photographed in bold relief without any shadows.

The actors work on a stage which is as narrow as it is long. They pose in profile. Figures can be made to throw long shadows under a light, and this has been advantageously done when an actor is to appear double the size of his neighbor. The camera is placed in a pit, so that the lens is on a level with the player's feet. But should it not be possible to get over a situation unaided by the players, J. R. Bray, the animated cartoonist, comes to the rescue with drawings which match the genuine acting perfectly.

Moving-silhouettes are innovations in motion-picture photography. Novel effects are produced by so adjusting the lights that long, superhuman shadows are cast when a gigantic figure is to stalk on the screen

Space and Time-Savers for the Home



How a room was made attractive by a little home-built furniture

Bedroom Hid in a Living Room

CONVENIENCE and the saving of space are of prime importance in city flats and country bungalows. Here is an illustration which shows how comfort was brought to an ugly room that served as both bedroom and living room.

The addition of the wall-closet with its drop-shelf provided not only a writing-desk, but a cabinet for bottles and other small objects constantly in demand. When not in use as a desk, just that much space is saved. The built-in seat is utilized for a clothes-closet and it also screens the unsightly porcelain washbasin and its pipes. It is a simple matter to add a drop-shelf to a cabinet already built-in. One seen recently concealed an electric stove and an entire light housekeeping equipment.

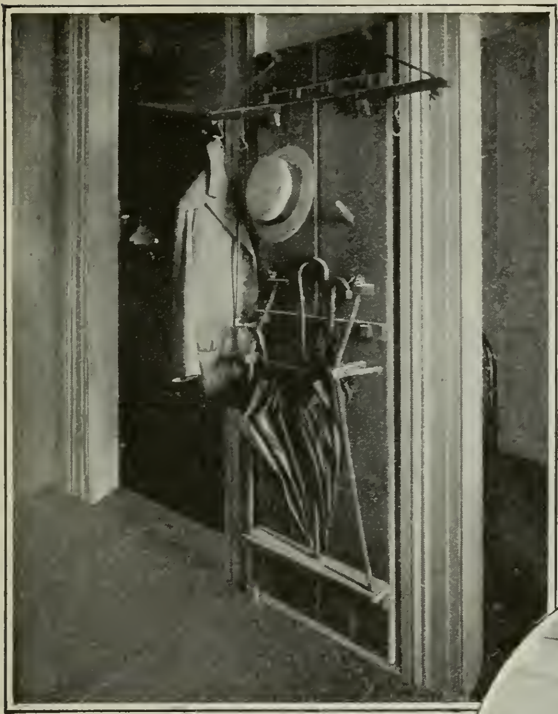
A Handy Magazine-Shelf

A CORNER arrangement for magazines in the form of swinging shelves, obviates the necessity of mutilating the walls by the use of brackets and nails. The boards are joined in the corners by means of cleats underneath, helping to add to the stability of the shelves. The lower shelf is wider than the upper, affording a place for magazines of larger size. Three long and three short chains provide support. These are attached to hooks in the shelves, the two side chains finding their anchorage at the highest point of the mantel and a correspondingly high point on the door-frame. The middle one extends to a hook in the ceiling. Short lengths of chain run from their hooks in the lower shelf to the longer chains. A framed Frieze of the Prophets (by Edwin Abbey) extends entirely around the corner.

An Improvised Hall-Tree

IF you have no place to hang your hat, a couple of boards, a few yards of rope and a half-dozen pieces of wood can easily be made to fulfil your needs. Two wide boards, the height of a doorway, are cleated together as a foundation. The upper cleat is used as an anchorage for a pair of wooden arms which are swung at an angle in order that the coat-hooks will not interfere with the

The convenient magazine racks filled an empty corner and ornamented the room



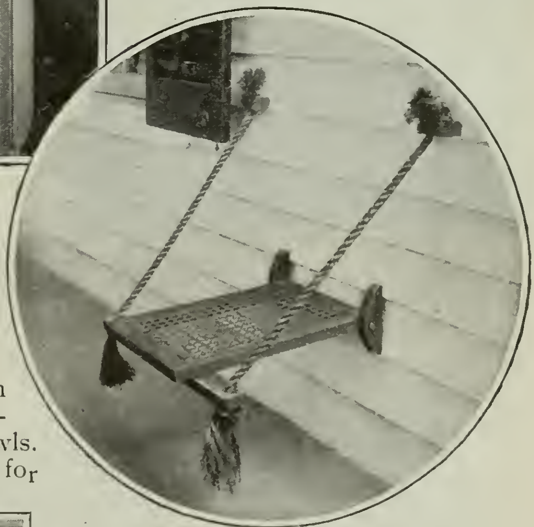
An attractive hall-rack that was made of miscellaneous boards and rope

hats on the pegs below. These "arms" are fitted on wooden pegs that extend through the cleat in such a manner as to permit them to be movable. Heavy wire is bent by pliers to form hooks for the coat-hangers. The hat-pegs are really a pair of wood-handled awls.

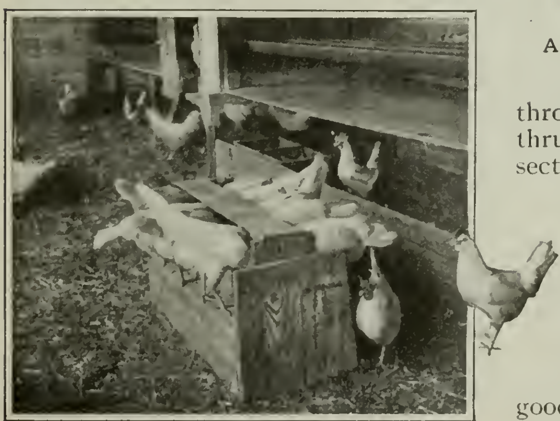
The lower cleat affords support for a six-inch shelf which serves as an umbrella rest. Holes are bored in the outside corners, through which holes the rope supports are passed to the two deep wooden pegs projecting out far enough to receive the umbrellas, and thence to the pair of brackets above the center cleat.

A Nautical Porch Seat

NEARLY every attic has a rickety chair the seat of which might be rescued and converted into a comfortable porch chair such as the one pictured. Attached to a substantial cross-section in front, the back secured to two wooden cleats on the wall, the seat is complete. Two heavy ropes are fringed and knotted through the wooden brackets, then thrust through the holes in the cross-section of the seat.



A porch seat with a nautical air—made from an old chair-seat



Bad table manners gain a hen nothing with this home-made feeding trough

Teaching Hens Good Manners

HERE is a contrivance for correcting the hen's bad table manners. Observe how over-crowding is rendered impossible. The narrow strips of standing-room, and the lack of head-room explain the good behavior. A few packing-boxes and some nails are all that is needed to build this feeding-trough.

Three Tools in One

A RECENT invention is a spade which can be turned into a post-hole digger, ditching-tool, or even a weed-cutter. The tool consists merely of a straight wooden handle, a ferrule, and steel blade like that of an ordinary spade with more

There is often need for a hoe of this size, and it is always a convenience

This spade can be used for starting a hole and also for removing the dirt. At an acute angle it is an excellent ditching-tool; at an obtuse angle, a weed-cutting device. Above, the spade as a post-hole digger. Below, as a right-angled hoe

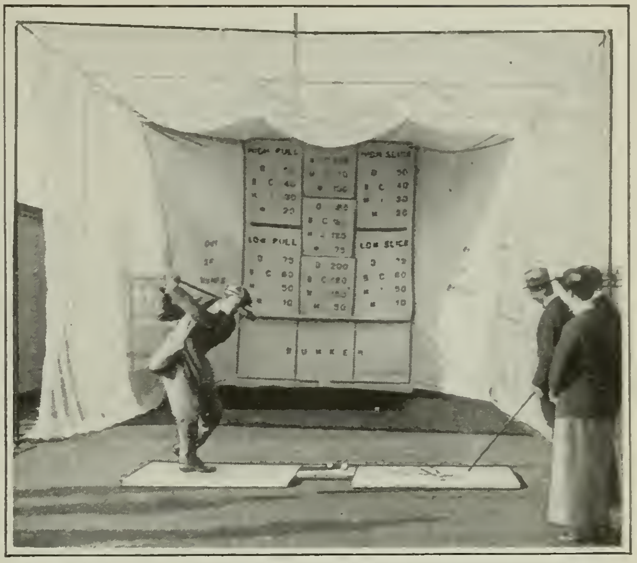
rounding sides, but equipped with a special device by means of which the blade can be brought at right angles to the handle, or at any angle desired. As a spade it may be used to start a hole; at right angles for lifting out dirt, or scraping it back; at a small angle it makes an excellent ditching-tool; and at an obtuse angle, with its sharp edge it makes the best of weed-cutting devices.

The adjustable device is simple, consisting merely of a case-hardened eye at the upper end of the blade, and having three flat surfaces for the pressure of a spring, placed in the ferrule and pressing upon the eye. At the upper end of the spring the ferrule is pierced by a set-screw which gives tension, thus holding the blade in any one of four positions.

The spade is here shown at its regular work

Playing Golf on the Roof

THE already familiar practice net of the golf stores has been turned to the use of finished players by a Boston hotel. On the roof has been set up the usual sort of net into which the player drives, but instead of the canvas back being merely to stop his ball from flying off the roof, it is painted to show what sort of shot he made. On the right are two sections, "low slice" and "high slice," and on the left two corresponding sections, "low pull" and "high pull." Numbers indicate the distance that would be gained by either, and whether the ball would go out of bounds before stopping. The central panel is dotted with numbers indicating the lenght of drive which would have resulted on a normal course. Wherever the ball strikes, the canvas shows the value of the drive, as to distance and direction. Below the charts is a space two feet high marked "bunker."



Francis Ouimet trying roof-garden golf on the top of a Boston Hotel

Sleep Outdoors in this Hotel

THE fresh-air habit has at last been recognized by a Boston hotel keeper, who, winter or summer, will let you sleep on his roof under a tent, if you have paid for a room down-stairs. Needless to say this hotel is becoming popular.

The roof of a hotel on which patrons may sleep summer or winter

Taking Photographs From a Skyrocket

AMONG the aids to the conduct of the war that have been proposed in Germany is the photography of the enemy's positions by the flight of rockets carrying cameras. The invention is less expensive and can be sent up closer to the enemy without provoking attack than a captive balloon, dirigible or aeroplane. Besides, it is not so dependent upon the wind as a kite.

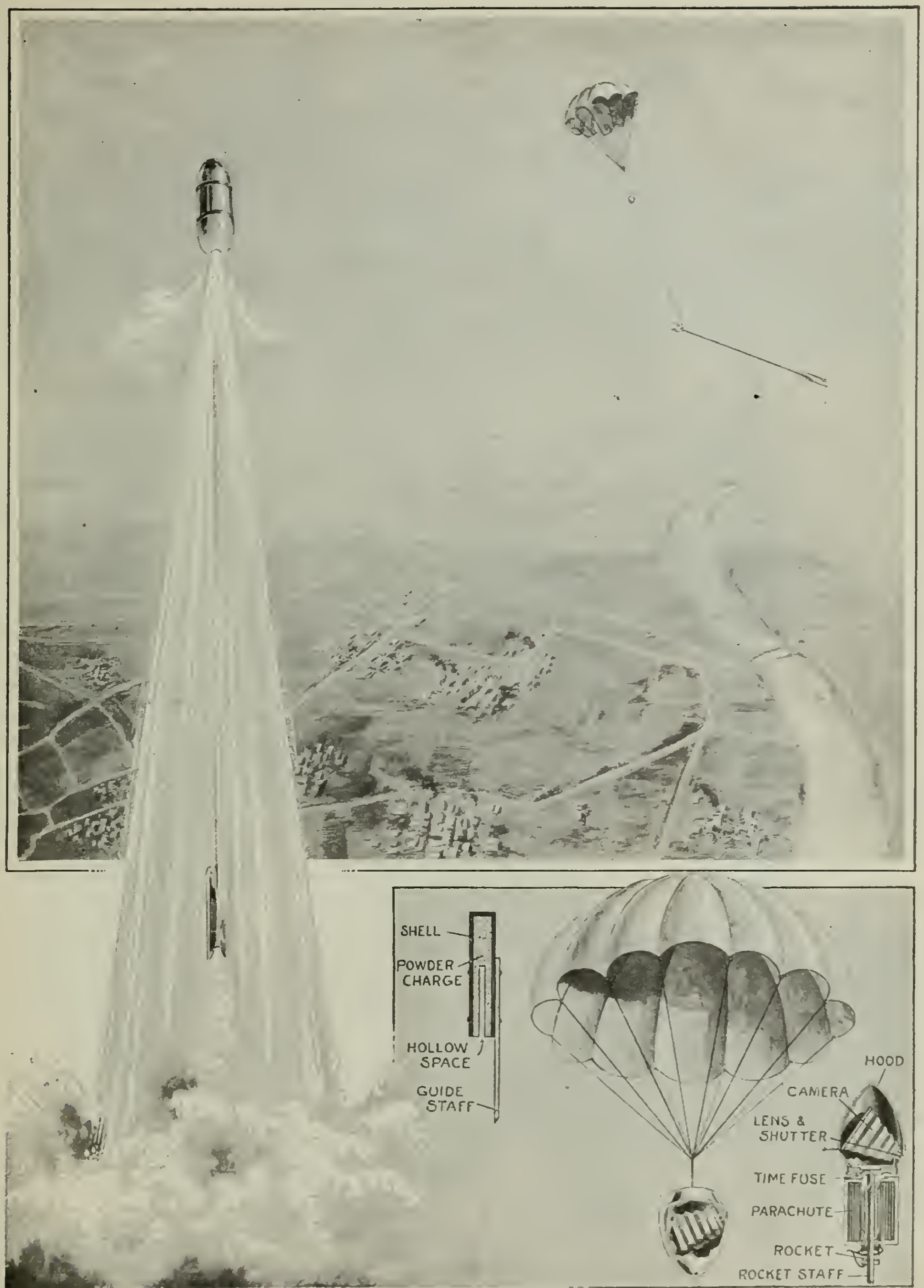
When the inventor, Alfred Maul, began his experiments fifteen years ago, he found, as he tells us in an article appearing in *Umschau*, that the ordinary rocket can hardly carry a considerable weight, and so he was obliged to devise one of greater strength.

His first invention was a shell closed above and open below containing a firmly compressed powder composition in which was a deep opening. Ignition developed a considerable volume of gas, which gas pressed down upon the atmospheric air, thus causing the rocket to rise. In a shot the initial velocity is the highest, whereas in the rocket the initial velocity is low but increases until the charge is burnt out. This occurs in about one and one-half to two and one-half seconds, but the rocket continues to rise, through the force generated, from six to nine seconds.

In his first camera experiments Mr. Maul used two small rockets combined. Here the rotary camera, which could take a picture about one and one-half inches square and had an oblique downward inclination, was in a hood above the rockets. At the sides of the rockets were two chambers containing parachutes of unequal size. The guide-staff had two vanes at its lower end, like an arrow, to prevent rotation and change of direction of the lens. At the highest point of the flight a time-fuse raised the shutter and threw out the smaller parachute. Just before landing, the larger parachute was opened. The double rocket could carry a load of over half a pound and rose about one thousand feet.

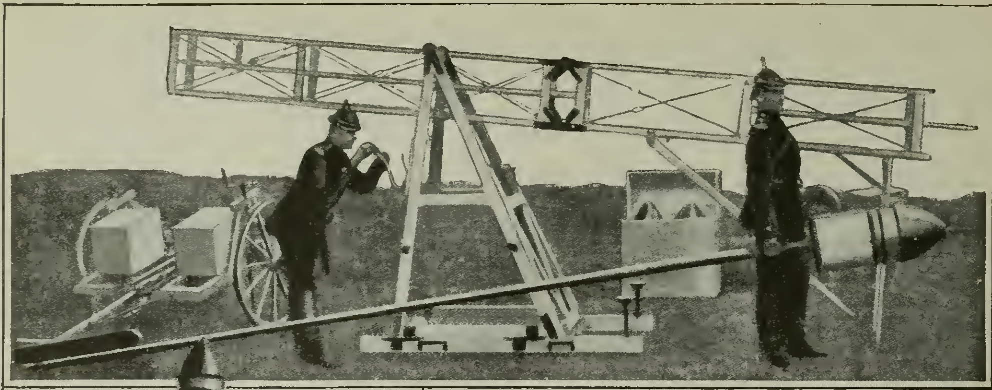
Failures accompanied successes in the tests. Rockets exploded, parachutes dropped at the wrong moment and much costly apparatus was destroyed, before the inventor saw the cause of his misfortunes, which was that the time taken for ascent depended on the density and moisture of the air. The exposure and release of the parachutes were, therefore, arranged independently of the period of ascent, by making the upper part of the hood resilient and equipping it with an electric contact device. When the rocket paused for a moment at its highest point of ascent, the contact opened the shutter and directly afterward threw out the first parachute. This proving successful, the photographic apparatus was enlarged to a diameter of eight and one-half inches; the plates were made four and three-quarters by four and three-quarters inches, the focal distance was also four and three-quarters inches. The length of the equipment was now over thirteen feet and the weight thirteen pounds. As the apparatus was still inclined to rotate on its axis corrective experiments were made, but the rocket proved unable to carry the weight of a special governing apparatus. Finally, a gyroscopic device was arranged which works automatically when the rocket

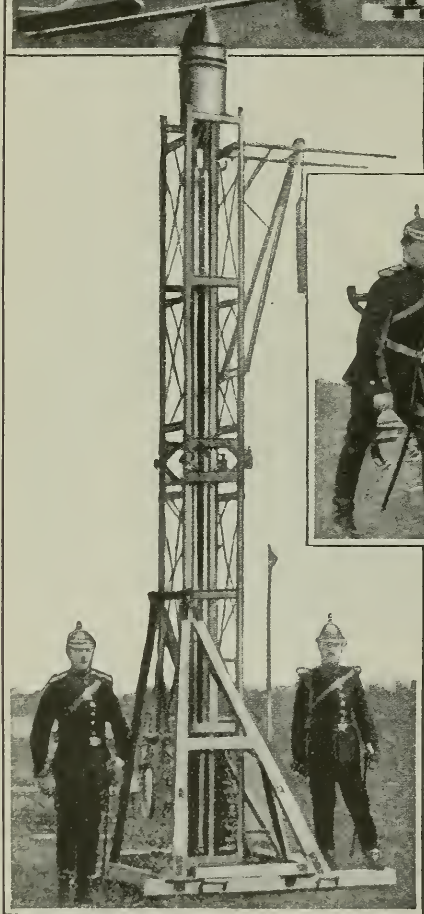
View of a German town taken with a rocket from a height of 1,550 feet

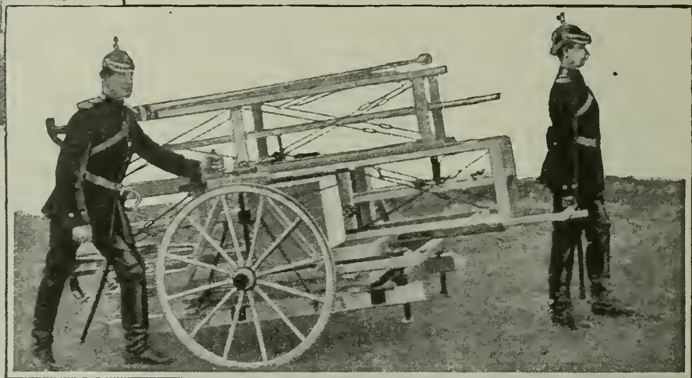


How the Skyrocket Camera Works

Ignited by an electric device, the rocket darts upward sixteen hundred feet. An electric contact opens the camera shutter and releases the parachute which returns the camera in safety







The apparatus needed to fire the skyrocket camera. Above, a view just as the rocket is about to be put in place. At the left, ready to be shot. Below, packed and ready to move away

rises and does not permit rotation.

The present apparatus can rise to a height of sixteen hundred feet. Its length is twenty feet, its weight about fifty-five pounds, and the pictures are seven and one-quarter inches square. Its parts are shown on the preceding page. The guide-staff about fifteen feet long is made in two united but easily separable parts, the upper being bolted to the rocket, the lower carrying the vanes, as shown.

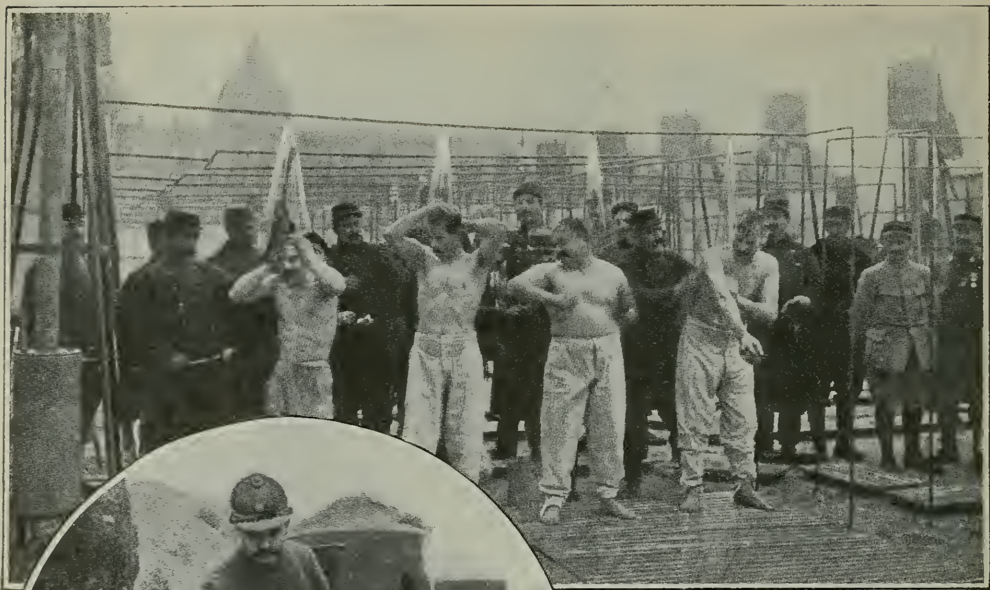
When ready for use the rocket is mounted on a collapsible, heavy frame carrying the sighting device and weighing about eight hundred and eighty pounds. The rocket is ignited by a distant electric device. The weight immediately runs down and the charge is fired, driving the rocket up one thousand, six hundred feet in eight seconds. When near the highest point of ascent the contact in the top of the hood opens the instantaneous shutter and releases the parachute. As the parachute opens, the rocket divides into two parts, connected by a thirty-two-foot belt. The hood and camera hang just under the parachute, while the container and staff swing about thirty-two feet below. The parachute, relieved of extra weight, lands the camera without jar in sixty seconds.

The Mascots of the Troops

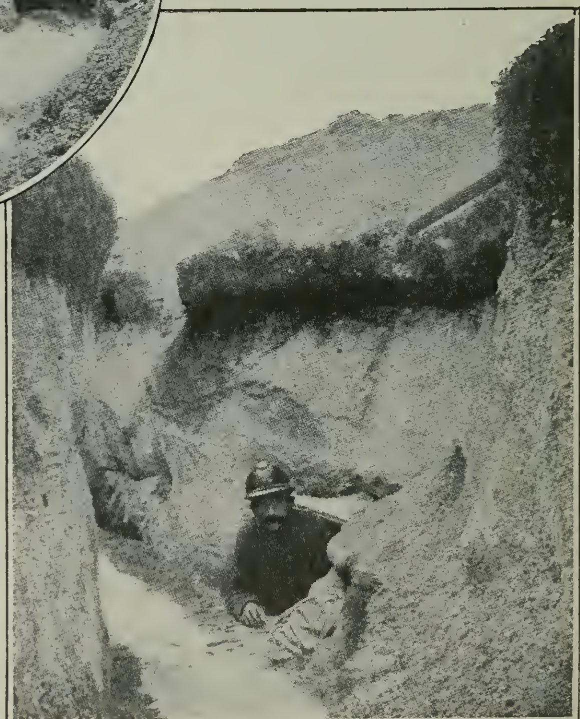
The French Military dogs are being put to more and more efficient work during the war. They are now being trained to mount the French parapets and give warning of the approach of the enemy. Here one is being trained

The British soldier who put the respirator-mask over the company's pet pig had a sense of humor. At the wheel of the launch is a mascot of British soldiers in Kamerun, the former German West African Colony. If mascots could bring good luck, every regiment and crew in the world would prosper, for each has its pet

Fighting Mud in the Trenches

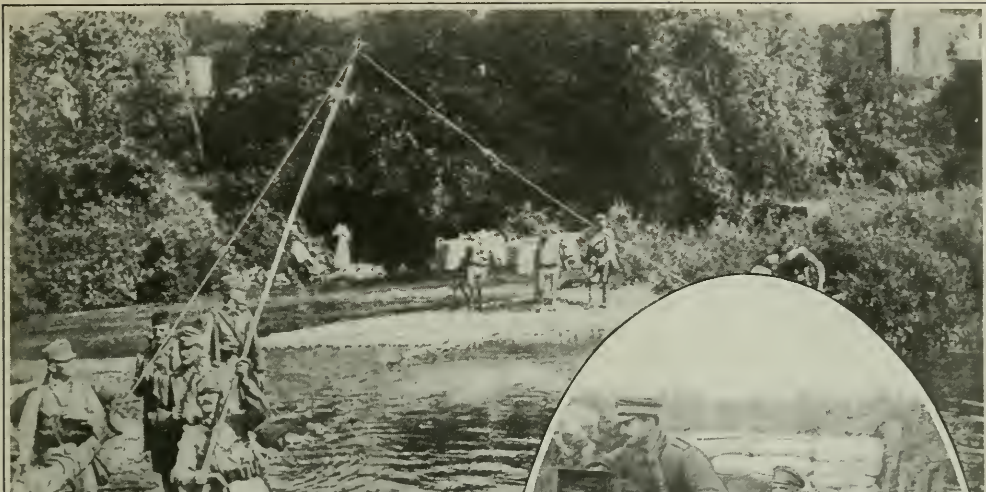


A large number of men can experience the luxury of a hot shower-bath by means of the arrangement shown above. The water passes through a heating apparatus before it reaches the spraying attachments



It is not easy to imagine men standing in trenches like this for three days and nights at a stretch, but that is what they did all through the long winter. Mud inundates the trenches on warm days and freezes in the cold weather. Long rubber boots, called "trench boots," were supplied to the men last winter and relieved the suffering to a great extent. Work in the trenches is not even confined to standing in the mud and fighting. In the illustration at the right is shown a sapper looking out from an air-hole. Many miles of tunneling have to be dug in order to gain desired positions and avoid the fire of the enemy. Underground mining, the digging of new trenches and building huts and caves for residence, give the soldier mud baths from head to foot

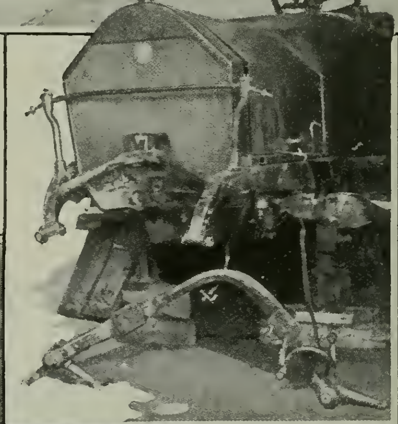
The Structural Side of War



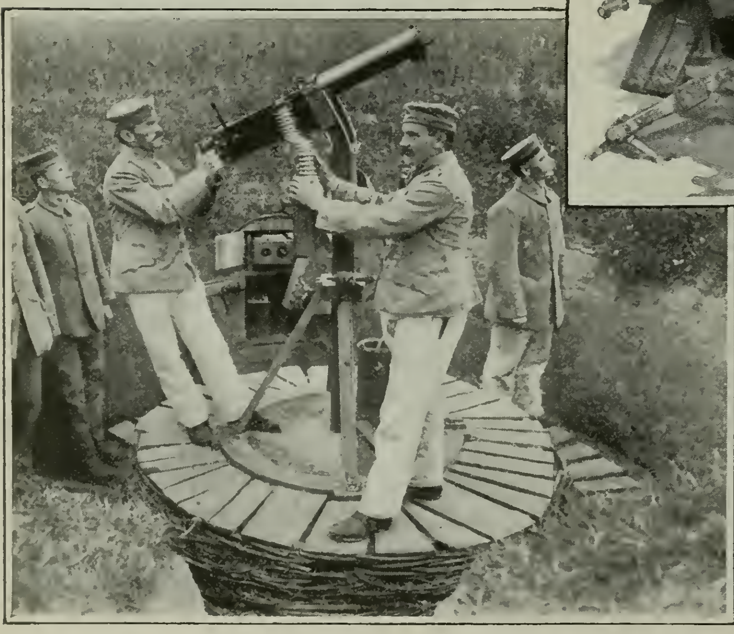
The Austrian soldiers above are stringing a telephone wire in the mountainous Isonzo district. In modern war, every part of an army must be connected with other parts and with the general staff by telephone. At the right, a model German trench and officers' shelter. The sticks prevent the earth from sliding in, and keep the floor dry. Below, Montenegrins are filling shells for their mountain artillery

Modern Machinery Resists Even War's Destruction

A German transport column removing the remains of a Russian aeroplane which was brought down by anti-aircraft guns near Lotzen. Although the aeroplane itself was irreparably damaged, the engine was again set up, this time on a German machine



Proof of the excellent quality of the material used in American automobiles was shown when a shell struck the front of an American motor car. Despite the enormous strain which axle and frame underwent, both being bent almost beyond recognition, there was not a crack in the metal



A Russian machine-gun, captured by the Germans during the summer drive, now serves as an anti-aircraft gun to keep Allied aeroplanes away from the town of Tirlancourt, France, which is now occupied by the invading troops. This type of gun is highly prized by both sides

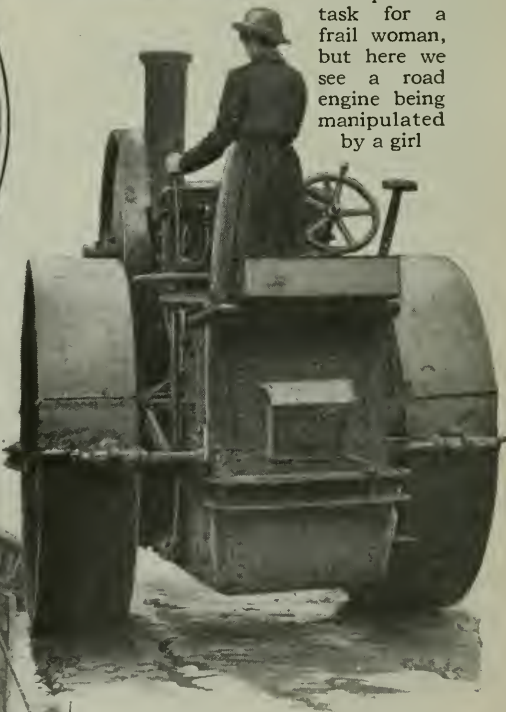
A submarine commander has but one means of judging the speed of the vessel to be attacked —by noting the size of the bow-wave thrown up by the intended victim. The correctness of the estimate means either a hit or a miss. The British have devised a clever method of confusing the German submarines. A huge bow-wave is painted on the sides of the ship, rendering it extremely difficult for the underwater craft to judge the speed accurately. In the insert is shown a heavy Austrian Skeda howitzer concealed with hay to make it invisible to the Russian air-scouts

English Women Doing their "Bit"

In the circle is a girl who is doing her part as a bricklayer. She does only the tasks that require no skilled labor; but that fact does not lessen the manual exertion required

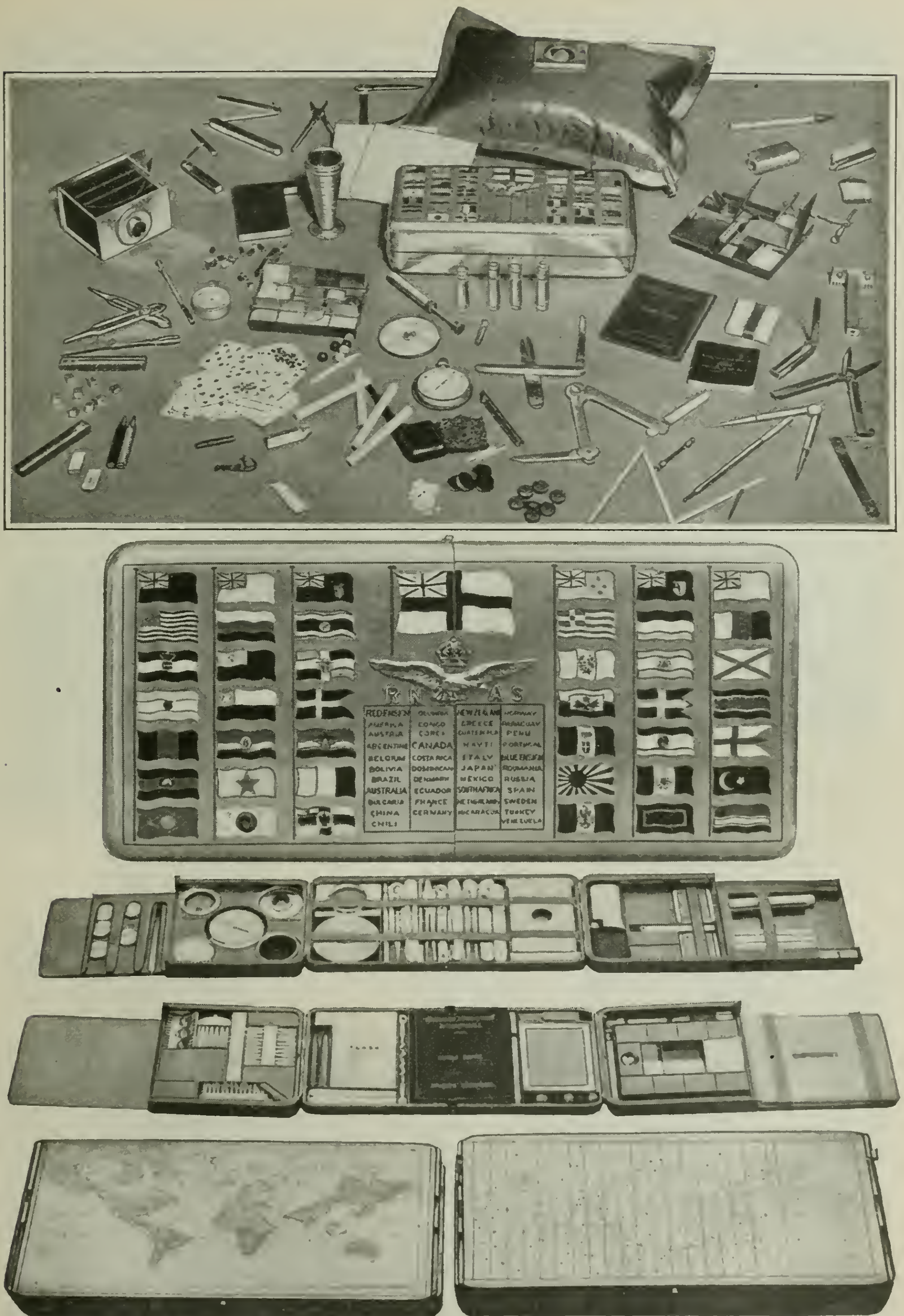
Another girl who is helping to keep the roads in repair in the country. The heavy work is done by men, but the girl may do much by merely filling up the many worn spots with crushed rock

Operating a large steam roller seems an impossible task for a frail woman, but here we see a road engine being manipulated by a girl



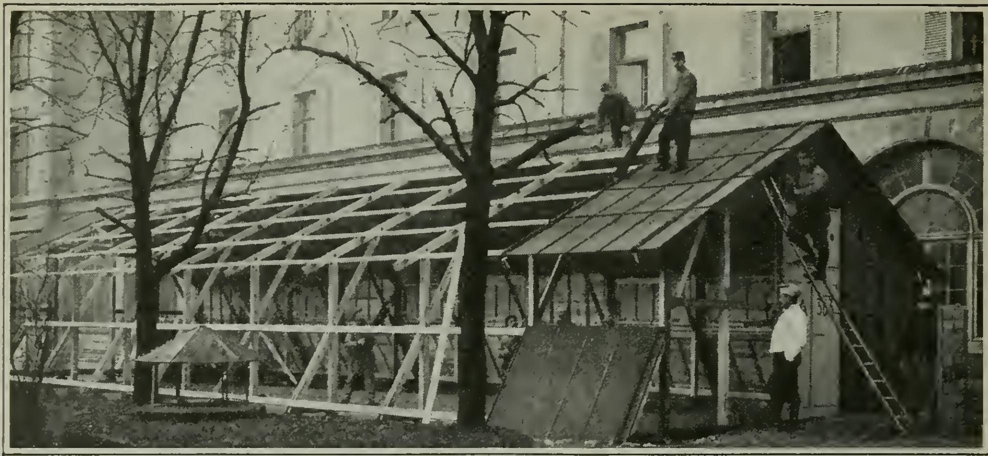
A modern ferrywoman. Among the men's tasks assumed by the British women is that of operating a rowboat ferry across a tidal river

All the Comforts of Home in an Airman's Kit Case

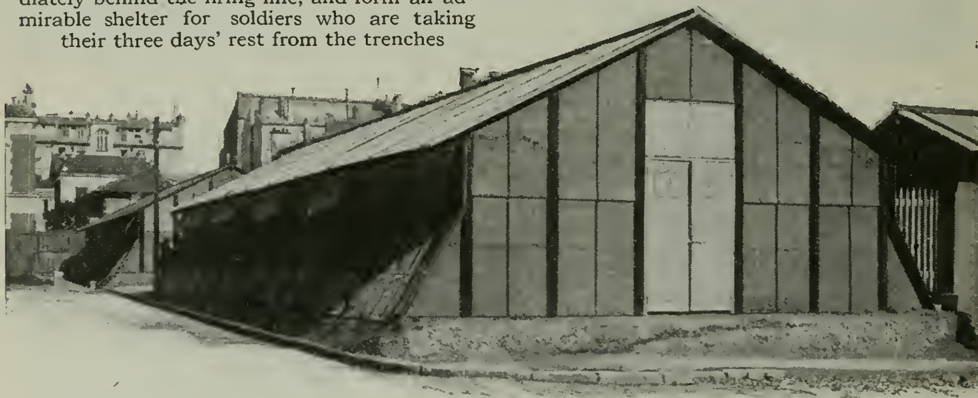


Every British aviator is furnished with a remarkably compact kit-case containing almost everything which can add to his comfort, from a pneumatic pillow to a pack of cards

Movable Barracks for the French



Constructing portable barracks for French troops. These houses may be quickly set up immediately behind the firing line, and form an admirable shelter for soldiers who are taking their three days' rest from the trenches



Credit for the invention of these portable houses is given to the commandant Adrian, who invented the helmets now used by the French troops, but these barracks resemble very closely the portable houses which are so familiar to all Americans

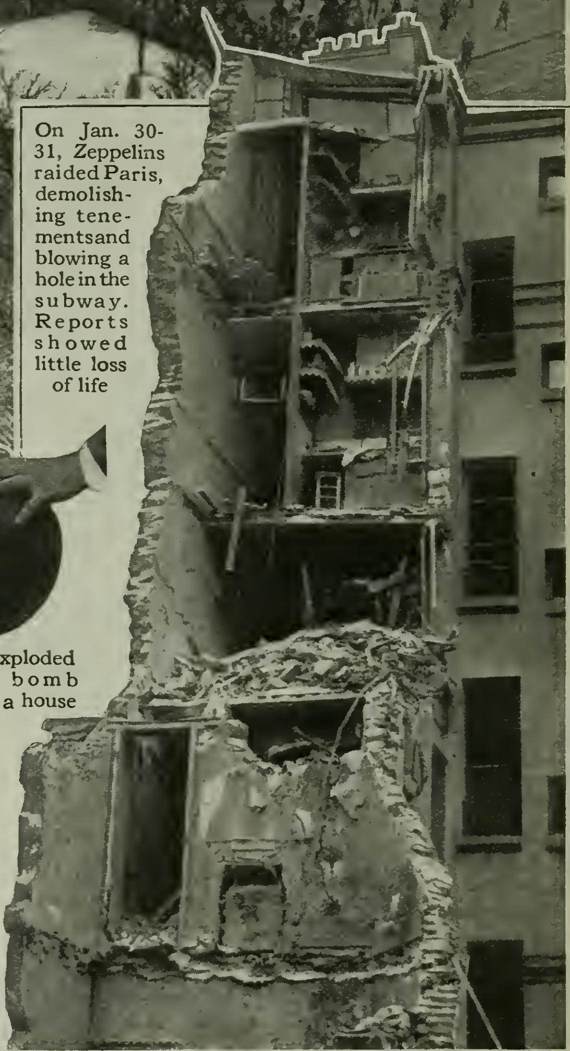
Making the Deadly Trench Torpedoes

The caps which cover the ends of the torpedoes of large caliber are heated at the forge as shown above, and then welded to the body of the projectile

A completed trench torpedo and its parts before assembling

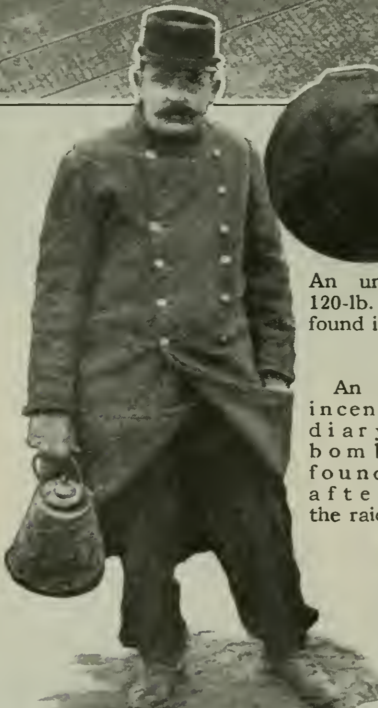
When they are finished, the projectiles are carefully tested with delicate instruments to verify the sizes and alinements. These clumsy looking bombs are thrown with amazing accuracy

The Paris Zeppelin Raids



On Jan. 30-31, Zeppelins raided Paris, demolishing tenements and blowing a hole in the subway. Reports showed little loss of life

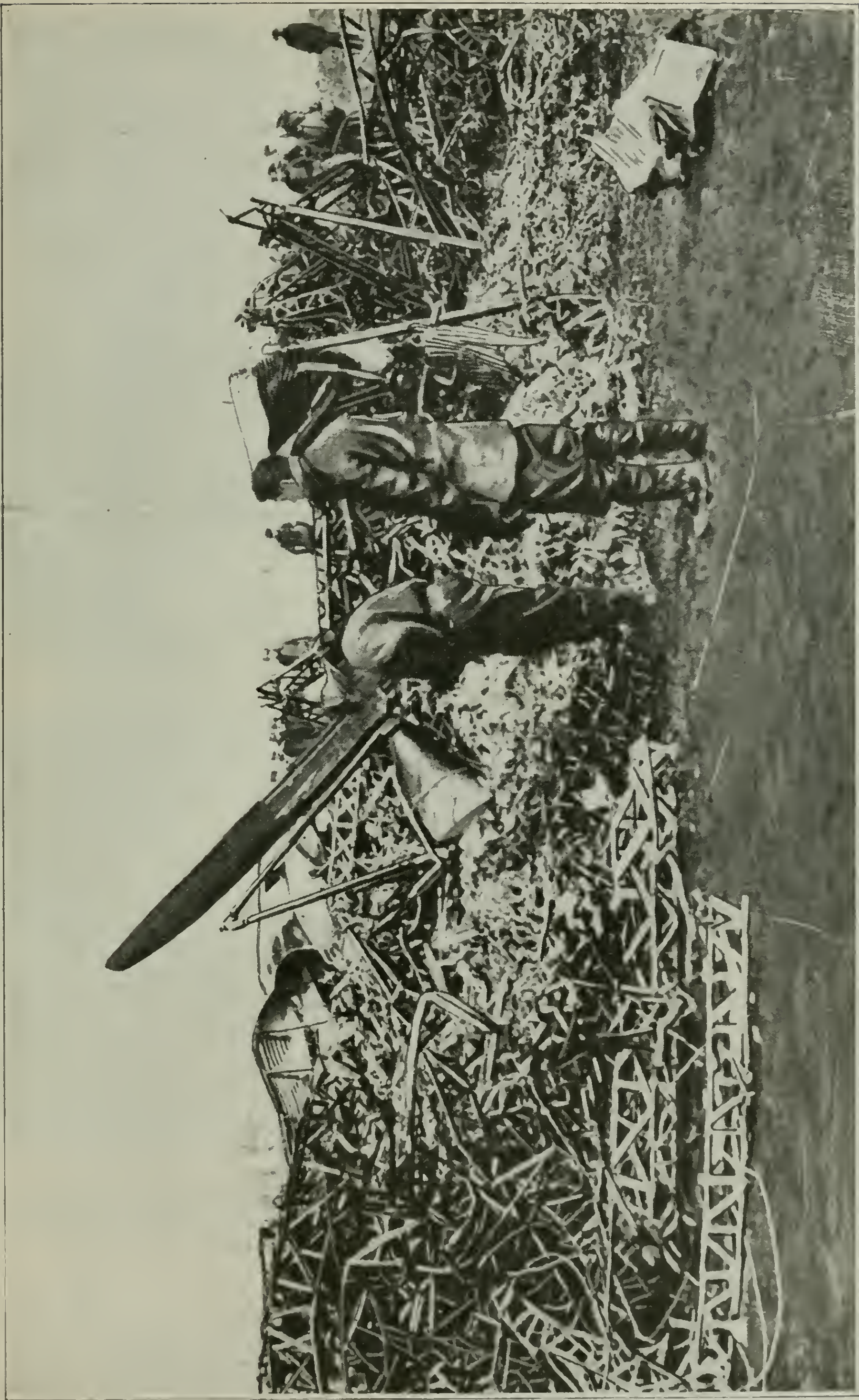
An unexploded 120-lb. bomb found in a house



An incendiary bomb found after the raid

Below, a German soldier resting in a French shell which had failed to explode

The Finish of a Zeppelin



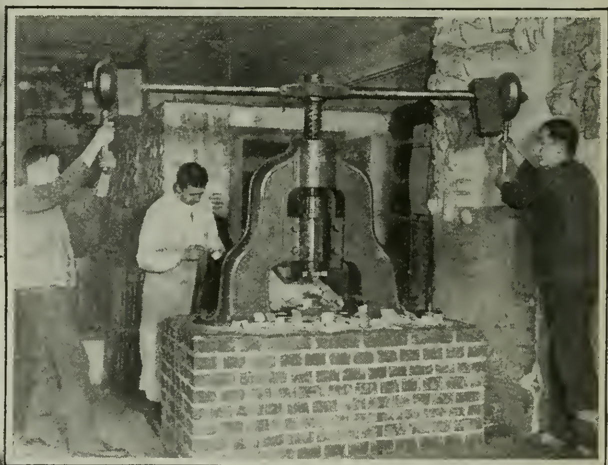
The wreck of the "L-77," the first Zeppelin brought down by gunfire. The airship was working above Revigny, near Bar-le-Duc, and was fired at and brought down at Brabant-le-Roi. Several important changes in design were revealed when the wreck was examined

The Booming Iron-Cross Industry

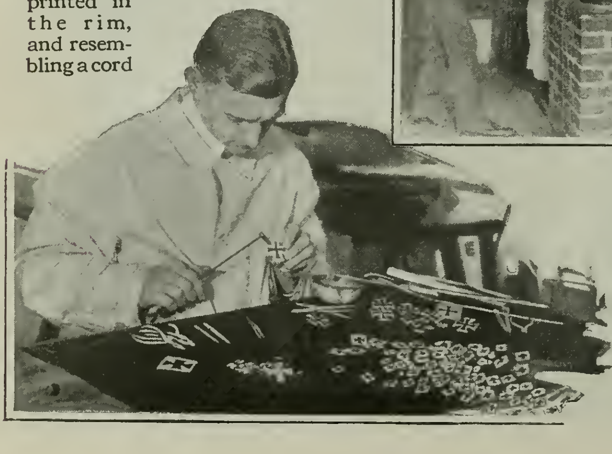
Every German soldier cherishes the hope that he may sometime win the Iron Cross. The generous bestowals of this reward have resulted in a distinct industry. The crosses are cast in multiple molds, in which the basic form of the cross is formed and the "W" with the imperial crown above and the date below is cast

At the right, the first step in finishing, where the engraver cuts the rough edges from the castings

The effect of the cross is greatly enhanced by a silver thread imprinted in the rim, and resembling a cord



The outline of the cross is stamped on squares of thin silver plate by subjecting the plate to great pressure in a screw-press

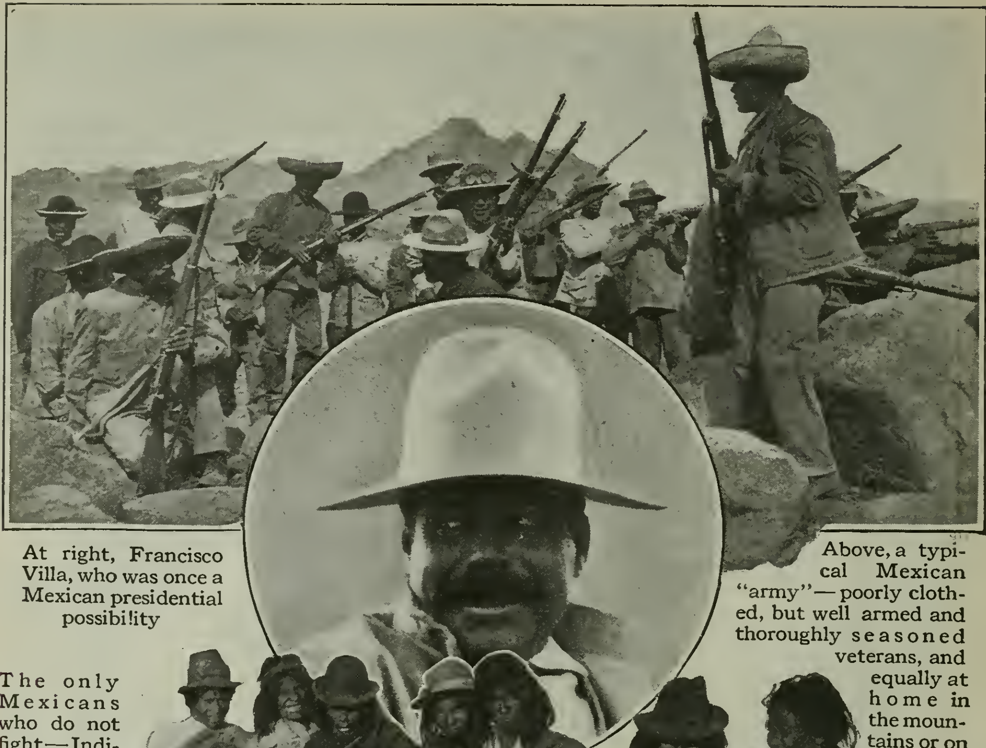


After the iron center is soldered to the silver rim, the cross is sawed out by hand, preparatory to the final polishing

Gas Is No Respecter of Persons

An infernal machine of the trenches. This small cylinder, when filled with the proper chemicals, will manufacture enough asphyxiating gas to kill hundreds of men. It is one of the many which are used by the Austrians in overcoming the enemy's forces before an attack

The children of towns on the firing line may meet gas at any moment on their way through the streets. Here are seen school children of Rheims lined up for the inspection of their gas helmets. So many gas attacks are launched in the immediate neighborhood of this unfortunate French city that no one is safe in the streets without a gas mask ready for immediate use. The school children are required by their teachers to carry a helmet, and if upon inspection the masks are found faulty or missing, the offending pupils are punished. Below is a French mother adjusting her daughter's gas mask before she leaves the home



At right, Francisco Villa, who was once a Mexican presidential possibility

Above, a typical Mexican "army"—poorly clothed, but well armed and thoroughly seasoned veterans, and equally at home in the mountains or on the desert

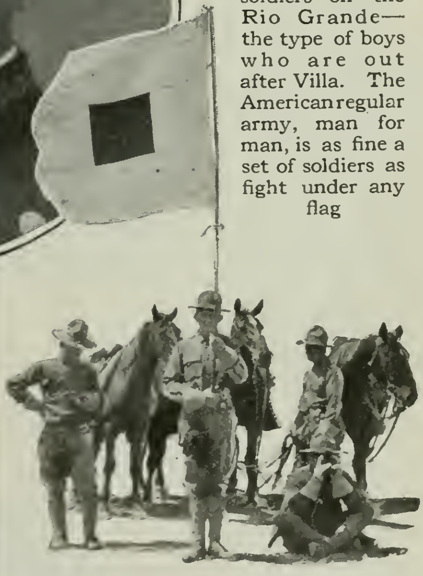
The only Mexicans who do not fight—Indians from the Sierra Madres. Most Mexicans are born outlaws, who see no reason why they should work when they can live by outlawry

American soldiers guarding food destined for Mexican refugees

And His American Pursuers

At the right, Gen. J. J. Pershing, leading the American Army which had orders to get Villa "dead or alive." His instructions were those General Funston received regarding Aguinaldo—and he is doing his work in the same thorough way

American soldiers on the Rio Grande—the type of boys who are out after Villa. The American regular army, man for man, is as fine a set of soldiers as fight under any flag



The wig-wag man is an indispensible member of the expedition

The signal corps, on whose field instruments the army will depend for communication. Below, a portion of the Thirteenth Cavalry on the march

One Tree Grows Through Another

IN a West Virginia forest nature has played an unusual prank upon two trees. One of them is a maple and the other an oak. Close inspection reveals the interesting fact that the oak tree has beyond doubt grown up through the maple. The oak being the more rugged of the two trees is causing the maple where its bifurcated trunk joins, a few feet above the ground, to split.


An oak tree growing through a maple

Asleep On the Sleepers

WHEN the first railways were built in China it was necessary, first to force the coolies to work upon them at the point of the bayonet, and later, to protect these coolies by force of arms from the outraged inhabitants of the countryside through which the railways ran. This feeling passed rapidly, however, as the Chinaman's philosophical disposition asserted itself. The accompanying photograph illustrates graphically the way in which the Celestial has taken the railway. The soporific individuals are section hands on the Shanghai-Nanking Railway, and because the little wooden pillows on which they and their ancestors have been resting their heads for a good many thousands of years were almost exactly similar—both in height, cross-section and hardness—to the eighty-pound "T" along which they were working, they were not long in adapting the convenient metals to the same purpose. There is one swift express which speeds over the straight and well-ballasted track between Shanghai and Nanking at the rate of sixty miles an hour, and in the first days that the "noon-day sleep" habit became popular it was no uncommon thing to have two or three decapitated coolies reported at headquarters every evening. This finally became so troublesome that orders were sent out prohibiting the practice absolutely, and holding the section bosses responsible for the men in their gangs, but even to this day, casualties from sleeping on the track still occur.


The Chinaman's pillow is a hard wooden bench, the size and shape of rails. So why shouldn't the coolies use these nice pillows the railroad laid down

Helpless United States

By Frederic Louis Huidekoper

The range of United States coast artillery as compared with that of guns mounted on British dreadnoughts of the "Queen Elizabeth" type

Although Mr. Huidekoper is not a professional soldier, he is an earnest and close student of military history, whose writings, notably his "Military Studies," have been consulted with profit even by staff officers. The following article is abstracted from his book, "The Military Unpreparedness of the United States," by permission of Messrs. Macmillan and Co., the publishers.—EDITOR.

ACCORDING to the latest statistics available, dated April 20, 1915, the authorized strength of the Regular Army—was 4,833 officers and 87,877 enlisted men, while that of the Philippine Scouts was 182 officers and 5,733 men, thus making a total of 5,015 officers and 93,610 men.

Notwithstanding the small size of the Regular forces in continental United States, the policy of the War Department to maintain the overseas garrisons at full war strength—a very sound policy since it will be almost impossible to reenforce them for some time after the outbreak of war and then only under the most favorable circumstances—must require a further reduction in them. As the Secretary of War very pertinently pointed out in his report for 1914:

"It will be necessary in the very near future to take from the United States and put into the Philippines thirteen companies of Coast Artillery, 1,950 men; in the Hawaiian Islands, three regiments of Infantry, one battalion of Field Artillery, and two companies of Coast Artillery, 6,380 men; and in the Panama Canal Zone, one regiment of Infantry, one squadron of Cavalry, one battalion of Field Artillery, one company of Engineers, and twelve companies of Coast Artillery, 4,774 men. . . . This will leave in the United States proper 12,610 Coast Artillery troops and 24,602 of the of the mobile army, the latter being then not much more than twice the size of the police force of the city of New York."

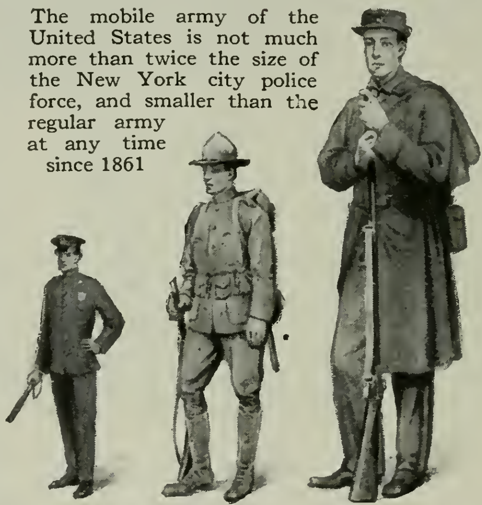
As the Coast Artillery must of necessity remain stationary in fortifications, the only force that can be transferred to repel attacks by an enemy seeking to land or penetrate within our borders is the Mobile Army, which will shortly be reduced to 24,602, as Mr. Garrison has stated.* It is an astounding proof of our unpreparedness at the present moment that such a force would be smaller than the actual strength of the Regular Army at any time since the close of 1861 — save in April, 1865, when it numbered only 22,310, but when we had more than a million volunteers who were Regulars in everything but name—notwithstanding that in those 53 years our population has increased from about 31,000,000 to 100,000,000.

We Have No Modern Howitzers and Not Enough Field Guns

On December 8, 1914, according to the

* Since this passage was written the Mexican situation has mitigated its force. The Mobile Army will be increased, probably permanently.—EDITOR.

testimony of Brigadier General Crozier, the Chief of Ordnance, the United States possessed only 658 three-inch field pieces, and even when the guns under construction and those provided for by the present appropriation have been finished, the number of guns of all calibers will not be more than 912. The minimum estimate of what would be needed has been placed at 323 batteries of four guns each, a total of 1,292 guns, while the maximum estimate, made by the late Chief of Staff, was 2,834, which is undoubtedly what would be required in a war against a great Power. On December 23, 1914, the Secretary of War acknowledged that we had only 634 completed modern field guns and howitzers altogether. The United States has nothing larger in caliber than the 6-inch howitzer, and only forty of those either in existence or appropriated for; yet every one knows that in the present European war great use is being made of heavier guns than these. The Chief of Ordnance also testified that, even when the design has been decided upon and the forgings delivered, the actual construction of a gun requires about four months; that a battery costs about $85,000; that if $2,100,000 were appropriated annually it would still require eight years before the United States would have 1,292 guns.



The mobile army of the United States is not much more than twice the size of the New York city police force, and smaller than the regular army at any time since 1861

In no other respects is the military unpreparedness of the United States so apparent as in the matter of reserve artillery ammunition. The minimum number of rounds per gun required in the German Army is 2,800, while our own Field Service Regulations for 1914 prescribe 1,856 rounds. Disregarding the other field pieces possessed by the American Army and assuming that the 568 three-inch guns were alone supplied with 1,856 rounds each, the number required would be no less than 1,054,208; yet the Chief of Ordnance confessed on December 8, 1914, that all the United States then had "was about 580,000 rounds for the Field Artillery, for the guns of all different calibers." If the 634 field guns of all calibers which the United States possessed in December, 1914, fired only 915 times each, they would more than exhaust the present reserve supply of field artillery ammunition amounting to 580,000 rounds, and it is a conservative estimate that two days of such firing as is a common occurrence in the battles of the present time, would suffice to consume the entire amount now on hand. The Chief of Ordnance stated that even if every source of supply were utilized, only "about 400,000 rounds" could be manufactured in the first six months; that only 130,000 rounds could be turned out each month thereafter; that a million rounds might be made in a year; that we need about a million and a quarter; and that "it takes over a year to get that much if we were to go at it with unlimited appropriations."* General Crozier had to confess that "no permanent ammunition trains have been provided," and that at the present rate of appropriation by Congress it would require eight years to complete 1,292 guns and their ammunition trains, and about four years to supply 1,800 rounds to the field guns of various calibers—with the exception of the 6-inch howitzers to which it was contemplated to give only 1,000 rounds—and then only on condition that the various plants throughout the country were kept "going night and day" in manufacturing artillery ammunition.

Plenty of Rifles, But Too Few Machine-Guns

After considerable experimentation the Ordnance Department has found it ad-

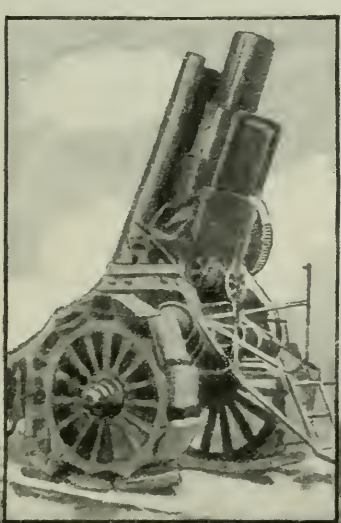
* Many American factories have engaged in the making of munitions for the Allies since this comment was made. We are probably in a better position now to meet our ammunition requirements.—EDITOR.

visable to discontinue the manufacture of the service model of machine-gun and has adopted the gun made by the Vickers Company of London as the better weapon. Of the old model—Gatling and Colt automatic guns—there were 1,380 in December, 1914, but many were obsolete and only 1,000 could be counted upon as serviceable. The former estimate of 1,801 machine-guns required by the Army has within the past year been cut down to 1,361, on the basis of four per regiment. This is manifestly far too low, as the French among others have increased the number of machine-guns per regiment to more than forty during the present war, owing to their great power of destruction. Only 125 machine-guns were manufactured for the American Army during the fiscal year ending June 30, 1914, and the supply of ammunition for them is fixed at 21,400 rounds per gun.

A more satisfactory condition is found in respect to infantry rifles, of which the United States possessed on June 30, 1914, slightly less than 700,000 of the most modern Springfield pattern, as well as between 300,000 and 400,000 of the old Krag-Jörgensen rifles. During the preceding year, 25,545 United States rifles, caliber .30, model of 1903 (or Springfield) were manufactured, which is at the rate of about 82 per working day, whereas that one small-arms factory has a capacity of 500 rifles per diem. The Chief of Ordnance declared that a reserve of 800,000 small-arms was desired, which would be sufficient to arm any force such as the country would be likely to need for the first months of war. It will, however, be necessary to increase the last appropriation—which was only $250,000—if the remaining 100,000 rifles are to be secured within several years.

Only Four Days' Supply of Ammunition For the Infantry

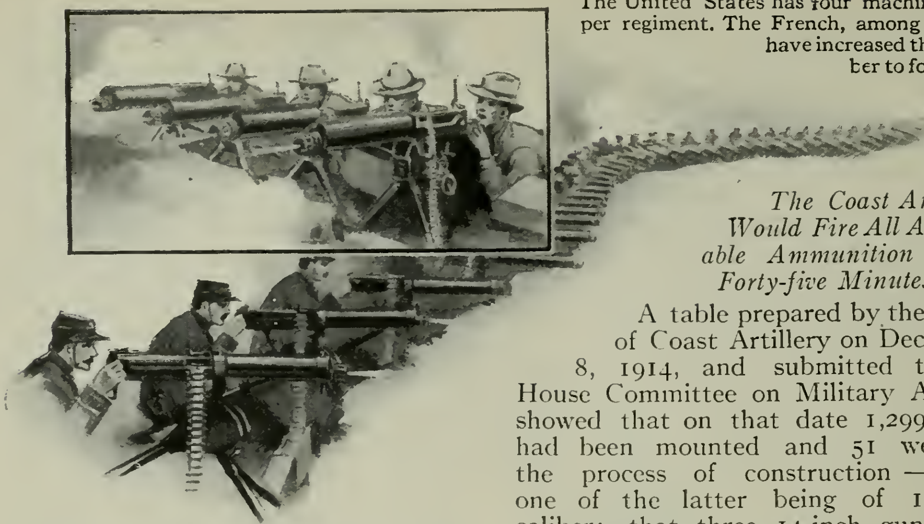
The reserve supply of small-arms ammunition in December, 1914, was only 195,000,000 rounds. Our Field Service Regulations prescribe 1,360 rounds for each infantryman—that is, 100 in his belt, 120 in the combat train which goes with the troops, 120 in the ammunition train which follows behind the supply trains, 340 rounds in the advance depot from which it can be sent forward to the troops, and 680 in the depot at the base of supplies. In other words, 195,000,000 would not be sufficient to supply an army of 145,522 infantrymen with 1,360 rounds each. The 1,360 rounds



The heaviest United States field piece is a pop-gun as compared with the German 42-centimeter, the largest mobile piece of artillery yet constructed

RESERVE AMMUNITION FOR ONLY TWO DAYS FIRING

THE UNITED STATES HAS NOTHING LARGER IN CALIBER THAN THE 6-INCH HOWITZER



The United States has four machine-guns per regiment. The French, among others, have increased the number to forty

prescribed for American infantrymen would, in all probability, be exhausted in four days' fighting.

The range of guns being one of the most important factors in war, the House of Representatives, by Resolution No. 698, adopted on January 14, 1915, called upon the Secretary of War for information in respect to our seacoast cannon. On the following day Mr. Garrison replied in a communication to the Speaker of the House, in which he stated:

(1) That there were no guns mounted in the fortifications of the United States proper of a caliber larger than 12 inches.

(2) That the range of the 12-inch guns mounted on the standard disappearing carriage was not more than 13,000 yards, but that the range of the 12-inch guns mounted on barbette carriages was approximately 18,000 yards.

(3) That the British dreadnoughts of the *Queen Elizabeth* type were equipped with 15-inch 45-caliber guns, and that their range was approximately 21,000 yards.

(4) That "It is true that the range of the guns just mentioned exceeds by over 4 miles the range of the guns as mounted in the defense of the United States proper, either on the Atlantic or Pacific coast; but it is not true that the range of those guns need remain thus restricted, since by a slight change in the mounting their range will be practically equal to that of the 15-inch 45-caliber guns above referred to."

It was admitted by our leading ordnance experts and military officials that such an augmented range could only be obtained at the expense of diminishing the weight of the projectile and hence its penetrating power. The net result is thus in favor of the heavier British guns.

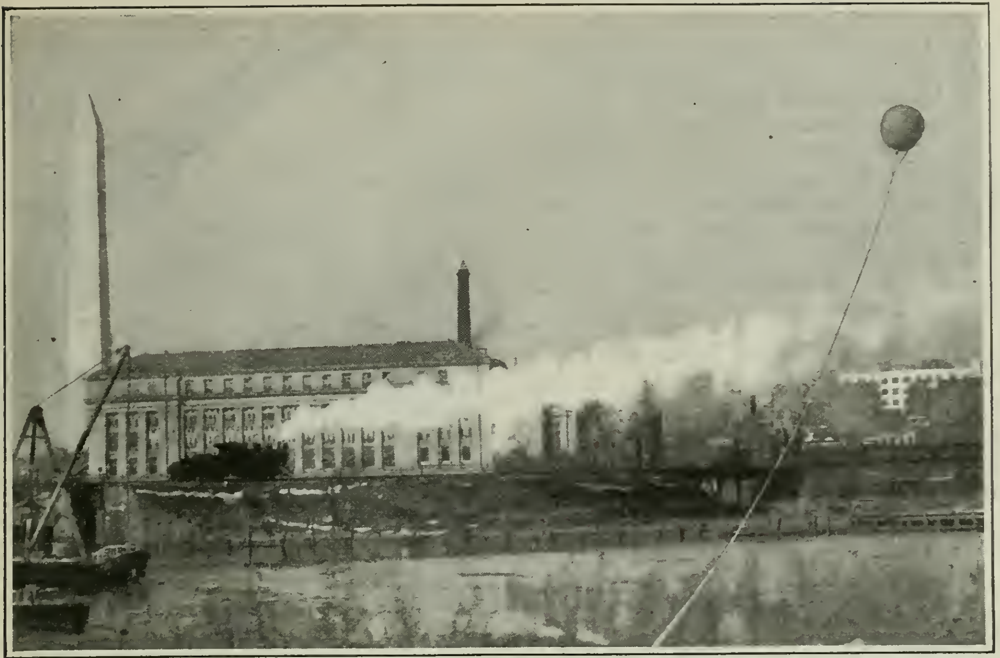
The Coast Artillery Would Fire All Available Ammunition in Forty-five Minutes

A table prepared by the Chief of Coast Artillery on December 8, 1914, and submitted to the House Committee on Military Affairs, showed that on that date 1,299 guns had been mounted and 51 were in the process of construction — only one of the latter being of 16-inch caliber; that three 14-inch guns had been mounted—that is, outside of the United States—and 21 appropriated for; that 433 modern 12-inch guns were in position and 11 under construction; while the remaining 863 already mounted and 18 appropriated for were old-fashioned 12-inch or calibers ranging down to 3-inch. Since high-powered guns have a life of only 240 rounds—or if used at the maximum, 100 rounds—it is therefore self-evident that the armament of our fortifications is sadly in need of being modernized.

On December 8, 1915, the Chief of Coast Artillery confessed to the House Committee on Military Affairs that:

"Of ammunition for continental United States we have now on hand and under manufacture 73 per cent of the allowance fixed by the National Coast Defense Board. That allowance for continental United States is the number of rounds that any given gun would fire at the maximum rate of firing in one hour."

Let the reader realize fully what this astounding revelation means. It means that the guns of the fortifications in the United States firing at the limit of their capacity would expend every bit of ammunition that they possess within 45 minutes. And the present Chief of Staff, General Scott, submitted to the same committee a statement showing that if the mortars were similarly fired they would exhaust the last round of ammunition in 30 minutes. What would happen if our fortifications were subjected to a gruelling bombardment?



A captive balloon raised above the site of the proposed power plant between the White House and Washington Monument to show how high the stacks would come

Captive Balloon Teaches a Lesson

TO demonstrate to the residents of Washington and particularly to the members of Congress, just how unsightly the effect of the contemplated new power plant chimneys really may be, the experiment was made of floating a captive balloon over the site to a height equivalent to that of the completed chimneys. The effect was startling, since the balloon, when it attained the height of the proposed chimneys, had soared to an almost unbelievable height. Inasmuch as the new power plant with its undesirable chimneys will have an effect upon the new City Park plan, many people who watched the balloon experiment made up their minds that the chimneys should never be. The question is now under discussion among interested residents.

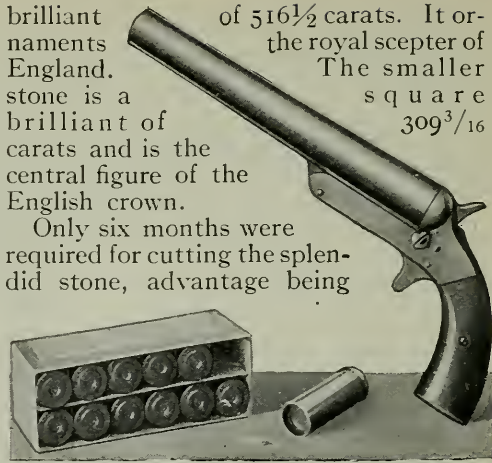
How Fast Is Your Train Moving?

A FAIRLY accurate computation of the speed of a moving train can be obtained by any keen-eared traveler with the aid of a watch equipped with a second hand. The wheels of a car produce a clacking in passing over the rail joints, the succession being divided into measures of as many beats as there are wheels on one side of the car. Furthermore, the traveler, due to his position, always hears one beat in each measure accented above the others. To determine the speed of the train, it is necessary only to count the accented beats for twenty seconds, the result being approximately the number of miles per hour of travel.

To explain this, let us say that fifty accented clicks are counted in the twenty seconds. Then the train is making about fifty miles per hour; for the fifty beats indicate that an equal number of rails have been passed over. The standard rail is thirty feet long. Hence fifteen hundred feet are being covered every one-third minute, or two hundred and seventy thousand feet per hour; which, divided by five thousand two hundred and eighty, gives fifty-one and one-seventh miles per hour as the actual speed. It will therefore be seen that the original count (number of beats in twenty seconds) comes close enough to serve the purpose.

Army Pistol Shoots Colors

A DECIDED novelty in the way of pistols has been perfected for use by the United States Signal Corps for the purpose of communicating at night. In appearance, the pistol resembles the old-fashioned dueling pistol except that it is lighter and smaller. Cartridges firing spurts of flame of various hues are used for ammunition, the color of the flame carrying a definite message to the distant lookout.



An army pistol which shoots colored light

A One-Pound Diamond

THE great diamond mines of the Transvaal have been revealing their age-long secrets for many generations, but the greatest surprise of all came on the twenty-fifth of January, 1905, when the Cullinan stone, afterward named *Star of Africa* by George V, was discovered. When the excited owners placed the colossal gem on the scales they found it weighed 621.2 grams, about one and one-third pounds. It was more than three times the size of any diamond ever found before or since, weighing 3,025¾ carats, and of the finest quality.

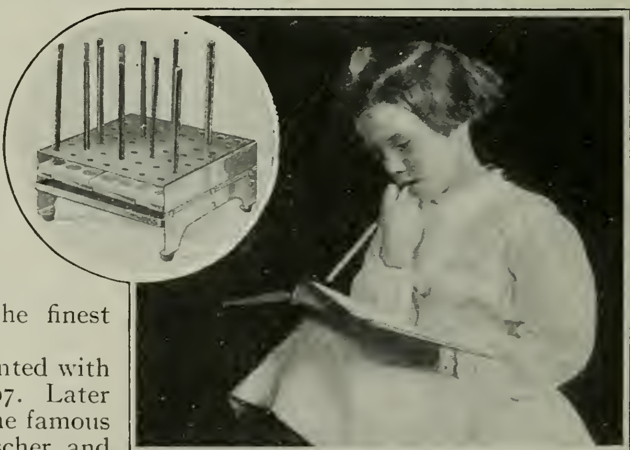
One and one-third pounds was the weight of the famous Cullinan Diamond. It was cut into two large gems and over a hundred smaller brilliants

King Edward VII was presented with the stone on his birthday in 1907. Later it was placed in the hands of the famous Amsterdam firm of I. J. Asscher and Company who cut it into two large stones and over a hundred smaller ones. The larger jewel has the exceptional number of seventy-four facets being a drop brilliant of 516½ carats. It ornaments the royal scepter of England. The smaller stone is a square brilliant of 309 3/16 carats and is the central figure of the English crown.

Only six months were required for cutting the splendid stone, advantage being taken of the planes of cleavage.

Disinfecting School Pencils

IT has long been recognized that the school pencil is a fruitful source of disease. The pencil points are usually given a bath by the child's placing it in his mouth to soften the lead. Then the pencil is passed on to another child, who does the same, thereby spreading all kinds of communicable diseases. The pencil is disinfected by a new system, through the action of formaldehyde gas upon the bacteria.



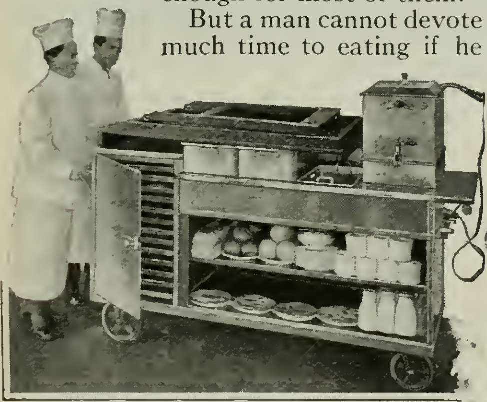
The lead-pencil of every child is a germ-carrier. Disinfect the pencil with formaldehyde gas, as shown by the picture in the circle, and the spread of disease in schools will be reduced

Serving Food on the Run

THE war has done many unexpected things in this country. It has touched the every-day facts of life in a degree unimagined prior to August 1, 1914. It has even affected the manner in which food is served. Since the war began, the Remington Arms and Ammunition Company has erected a plant at Bridgeport, Conn., which is more than a third of a mile long. This plant, with a capacity for eighteen thousand men, is working throughout the twenty-four hours in eight-hour shifts. As soon as a man leaves his machine, another takes his place. Men working for only eight hours a day, do not require, and, if they are working on piece, do not desire, a full hour for meals. A half-hour is long enough for most of them.

But a man cannot devote much time to eating if he must walk a third of a mile in search of food and then return to his place. So a "cafémobile" has been invented to meet his requirements. This, in fact, is a lunch counter on wheels. It is supplied with metal compartments for different kinds of food which should be warm when served, as well as for fruit, sandwiches, pies, etc. At different points throughout the factory provision has been made for attaching it to an electric circuit. By this means the soups, hash, potatoes, coffee, and meat can be heated readily.

Just before the lunch hour the squadron of "cafémobiles" sets out from the restaurant, each loaded with a supply of food. These are pushed by men in white caps, blouses and aprons. Each is trundled to a different place in the factory, previously assigned, and takes up a position near the electric connection. The folding counter is turned back and the oranges, apples, pies, sandwiches and milk set out in tempting array.



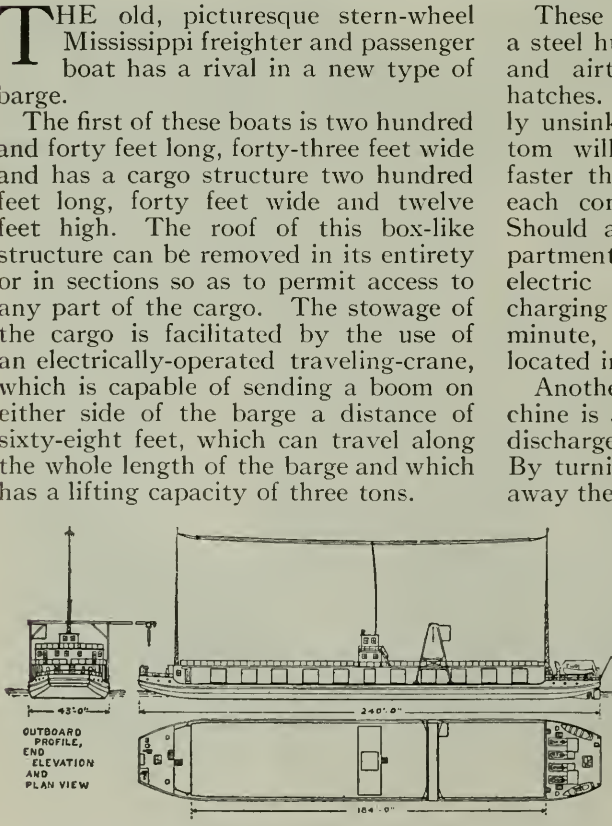
In turning out high-priced munitions every minute is precious for the men in the factories. So, a Bridgeport firm uses the "cafémobile"—a lunch-counter on wheels which saves the machinist on piece-work the time required to walk a third of a mile from his lathe to his food. By means of electric connections, foods are served hot

Exit the Mississippi Stern-Wheeler; Enter the Motor-Barge

Motor-barges equipped with traveling-cranes, wireless apparatus and other modern apparatus, are to supplant the romantic Mississippi stern-wheeler

THE old, picturesque stern-wheel Mississippi freighter and passenger boat has a rival in a new type of barge.

The first of these boats is two hundred and forty feet long, forty-three feet wide and has a cargo structure two hundred feet long, forty feet wide and twelve feet high. The roof of this box-like structure can be removed in its entirety or in sections so as to permit access to any part of the cargo. The stowage of the cargo is facilitated by the use of an electrically-operated traveling-crane, which is capable of sending a boom on either side of the barge a distance of sixty-eight feet, which can travel along the whole length of the barge and which has a lifting capacity of three tons.



Diagrams showing structural details of the motor-barges

These two-thousand-ton barges have a steel hull divided into four watertight and airtight compartments, with no hatches. Hence the boats are practically unsinkable. A puncture of the bottom will not permit water to enter faster than it will compress the air in each compartment to a given point. Should any accident puncture a compartment at any other place, powerful electric bilge-pumps, capable of discharging eight thousand gallons per minute, can be operated by a switch located in the pilot-house.

Another commendable emergency machine is a bow-pump, with suction and discharge at port and starboard at will. By turning a switch the pilot can suck away the water at one side and discharge it at the other with a resultant pull of twenty-five horsepower, which enables the vessel to turn from the dock against a forty-mile wind.

As the illustrations show, the living quarters, engine-rooms and pilot-house are entirely separate from the hull proper and the cargo spacing. Forward on the main deck are located the dining-room, the galley, and the large kitchen, which last is equipped with an electric stove, a dish washer, an ice plant and other necessary auxiliaries.

The engine-room, located aft, contains four eighty-horsepower engines which drive four screws fifty-one inches in diameter, so that the barge can travel at a speed of ten miles per hour in slack water, seven miles upstream and twelve miles when running with the current or downstream.

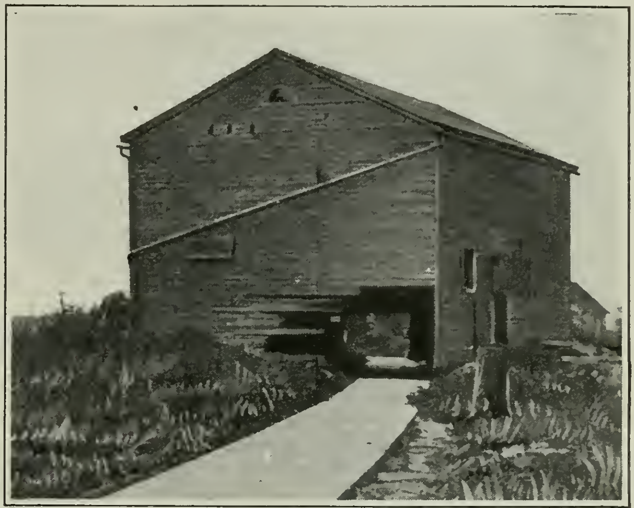
To facilitate the handling of these large cargo-carriers further, many recently invented marine appliances are installed, such as telephone service, wireless outfit, searchlights, and a system of indicators located in the pilot-house, by means of which the captain can almost instantly tell the condition prevailing in any part of his ship.

These barges can deliver freight at New Orleans five days after leaving St. Louis, a very much faster schedule than anything heretofore attained by the old type of stern-wheeler.

An equestrian milkman of Buenos Aires. If he gallops he may deliver butter

This Barn Bears a Lesson to Pacifists

THE well-known contrariness of the middle-western farmer was illustrated in an amusing way recently when an Illinois contractor requested a farmer to move his barn out of the right of way over which a concrete sidewalk was planned to be run. The farmer ignored the contractor's request. Then one bright morning the contractor smashed holes through each end of the barn and, despite the farmer's angry protests, the sidewalk was laid through it and on the way to its eventual destination.



© Alfred R. Wagstaff.

The owner of this barn refused to remove it when the landlord's contractor wanted to make a concrete path where it stood. Hence the result shown

"Quiere Leche Hoy?"

DOWN in Buenos Aires the apartment houses do not have dumbwaiters and the milkman does not come rattling and clanking across the cobblestones in front of your home at approximately four A.M. By that hour he is just about preparing to leave his hacienda with a full milk can strapped to either side of his horse. Arriving in the city he will make his rounds, stopping at his various customers to inquire *Quiere leche hoy?*—"Any milk today?" Some milk peddlers announce their presence as they canter along by loud shouts. But this practice is generally discouraged, as Buenos Aires is a quiet city, resenting vulgar hallooing in its orderly streets.

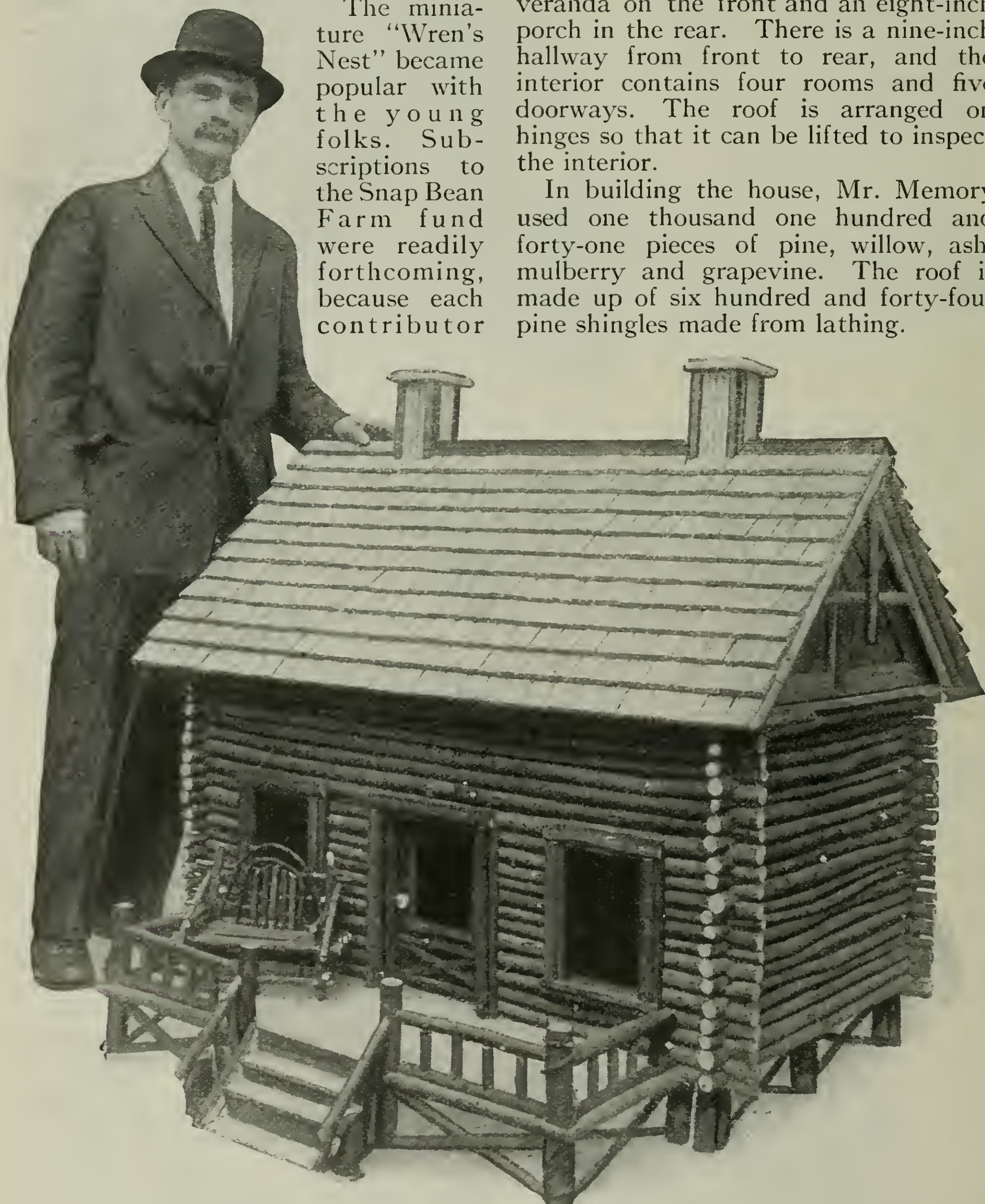
A Model of Joel Chandler Harris' Old Homestead

FOR the encouragement of a fund for the purchase of Snap Bean Farm, famous as the home of Joel Chandler Harris ("Uncle Remus"), a doll's house made to resemble the Harris home—"Wren's Nest"—has been built by Eli J. Memory, of Richmond, Va.

The miniature "Wren's Nest" became popular with the young folks. Subscriptions to the Snap Bean Farm fund were readily forthcoming, because each contributor had an opportunity to draw for the doll's house.

The little house required two arduous weeks for its construction. It is made of eighty tiny "logs" cut along the banks of Peachtree Creek near Atlanta. The structure is forty-five inches long, forty-three inches high and twenty-eight inches wide. It has a twelve-inch veranda on the front and an eight-inch porch in the rear. There is a nine-inch hallway from front to rear, and the interior contains four rooms and five doorways. The roof is arranged on hinges so that it can be lifted to inspect the interior.

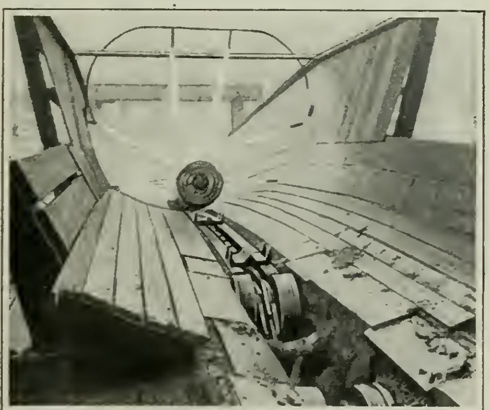
In building the house, Mr. Memory used one thousand one hundred and forty-one pieces of pine, willow, ash, mulberry and grapevine. The roof is made up of six hundred and forty-four pine shingles made from lathing.



To raise a fund for the purchase of Joel Chandler Harris' home, a doll's house, a replica of the Harris home, was made the prize in a lottery

Washing Logs for Safety

WASHING logs for safety before they go to the sawmill is the novel method employed in a lumber camp in the West. As the photograph shows, the logs are carried in a V-shaped trough upon steel rollers which convey them between jets of water of great force. These jets strike the surface of the logs, scouring them thoroughly on all sides. The result is that the bits of broken stone or other hard material that might cling to the rough bark are removed, and danger to life as well as damage to property is averted, for if a swiftly rotating saw hits a rock or nail in a log it is likely to explode like a bomb and send fragments of steel in every direction. The washing of the logs before they go to the saw is thus a safety measure well worth while.

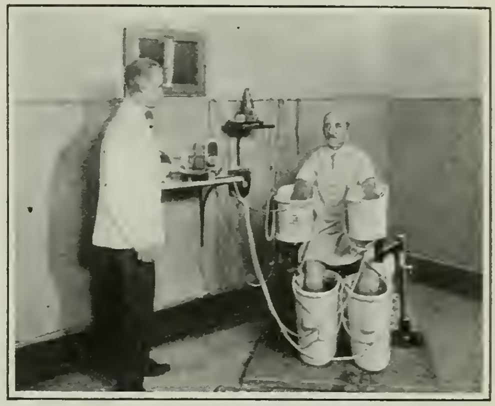


Jets of water scour the log and remove broken stones—a safety measure for sawmills

Twitching Muscles by Means of the Electric Current

IN the treatment of certain ills it is often desirable to introduce exercise, but in cases of prolonged illness, the muscular effort is often beyond the power of the patient. To overcome this inability to exercise, numerous devices have been invented to provide automatic exercise. One of these, much used in sanatoria, where natural methods instead of drugs are relied upon, is the "sinusoidal bath" with its many variations.

The bath is comparatively simple in its operation. The unit tubs and warm water provide electrical contacts; the sinusoidal apparatus is attached to an ordinary light socket. The sinusoidal current, which is painless in its application, will produce muscular contractions,

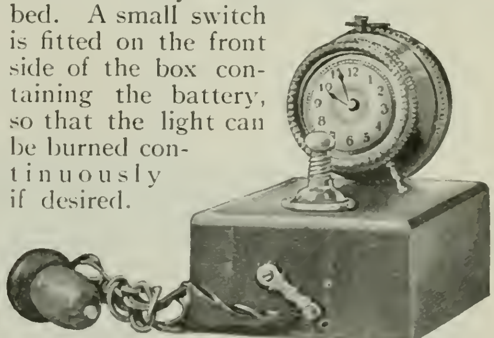


The man is taking a "sinusoidal bath." His arm and leg muscles are being twitched electrically to give them much-needed exercise

mild or violent at the will of the operator. The length of the contraction is regulated by a clock which breaks the current. The current may be applied in the four units simultaneously, but as a rule, the curative quality is best transmitted by alternate application. A treatment usually lasts from twelve to fifteen minutes.

An Electrically-Lighted Clock

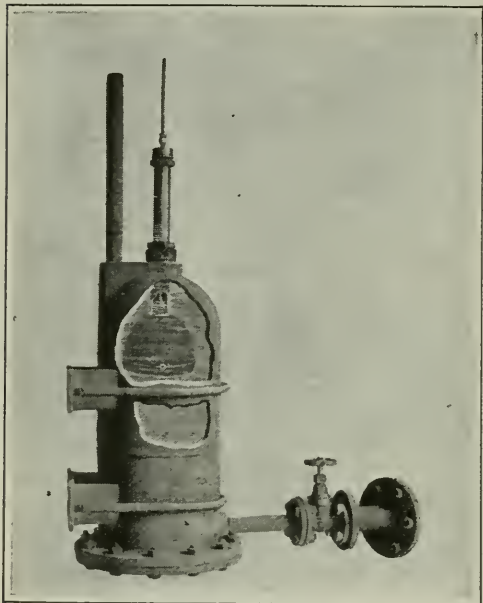
A NEW YORK manufacturer has recently brought out a compact electrically-lighted clock, provided with dry cells and a press button attached to the end of a cord long enough to reach from a nearby table or dresser to the bed. A small switch is fitted on the front side of the box containing the battery, so that the light can be burned continuously if desired.



The long cord runs from the clock to your bed. To find out the time without getting up, press the button at your end of the cord. The clock is illuminated at once

Making a Life-Saver of a Leak

WHEN a heavy sea is running, one of the glass-covered portholes in the bow of a steamer is often crushed in—an accident which, while seemingly unimportant, has resulted in the foundering of many a ship. Water rushes into the opening at the rate of many gallons a minute. Should the crew be occupied in other parts of the ship in clearing decks or battening down hatches, the broken port is likely to escape notice until enough water has entered to make the situation really serious.

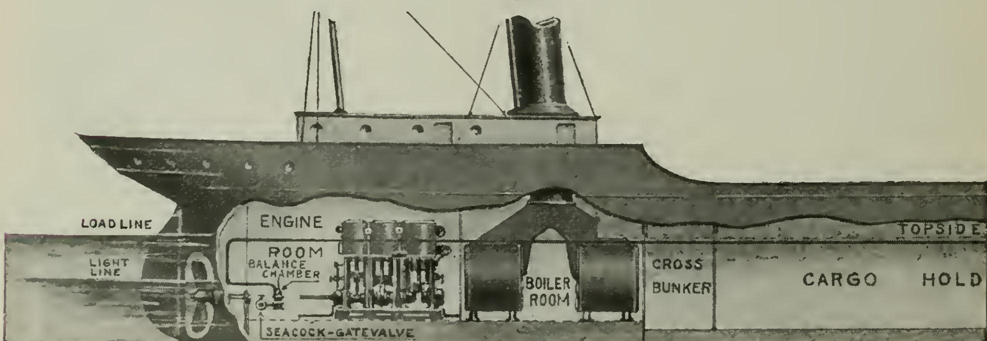


The water tank covers a hole in the ship's side. Part of the interior is shown so that the balancing-chamber can be seen. The small tube at the top leads to the mercury gage which tells whether the ship is listing or not

An automatic registering device with a dial in the chart room or captain's cabin has been installed on several freighters, to indicate within a fraction of an inch exactly how much water the vessel is drawing both forward and aft. The instrument has been applied to other uses, such as measuring the depth of rivers and the amount of oil and other liquids in tanks aboard ship and ashore. In all of these applications the principle of the device is the same.

The natural law which governs the operation of the "pneumercator," as the invention is called, is nearly as old as mechanics. Simply expressed, it is that the weight of liquids having the same cross-section is directly proportional to the depth.

Described in a few words, the device consists of a pressure-gage, which registers the weight of liquids in which it is sunk, and by means of a tube containing air indicates the pressure on a wall-gage. The apparatus is made up of three essential parts: a balancing-chamber, an indicator and a small pressure-pump. The balancing-chamber is connected by copper pipe line with the indicator, and the indicator is connected with the pump by means of another pipe line.

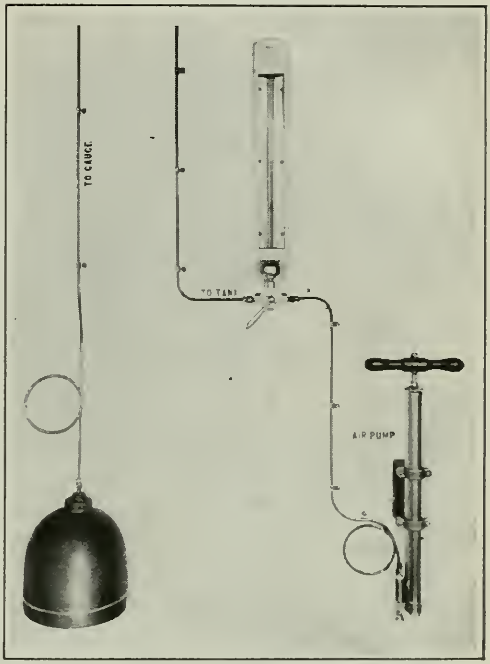


A cargo steamer equipped with two pneumercators. The balancing-chambers are contained in the tanks which are indicated in the bow and stern. Holes in the ship's side, which allow the tanks to be filled, are placed a few inches below water line when the ship is unloaded.

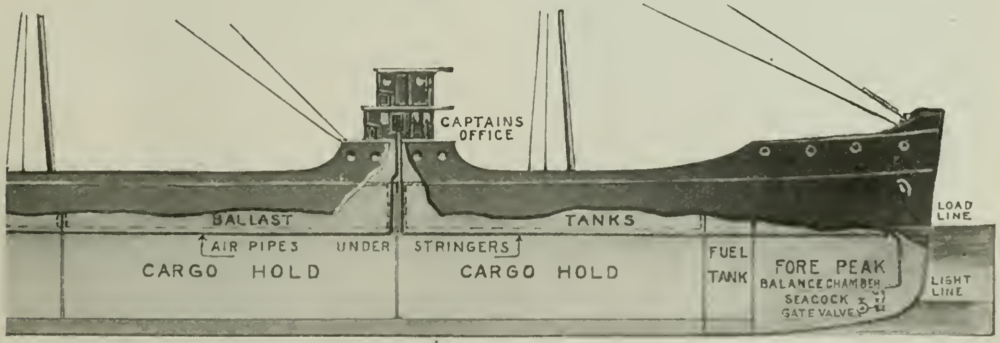
The balancing-chamber is a small metal bell with a tube at the top and a small hole in the side near the bottom. When the balancing-chamber is sunk, liquid is forced into the hole, the resultant pressure being transmitted through the pipe to the mercury indicator. The indicator resembles an old-style barometer, having a tall mercury column. As soon as the balancing-chamber has been sunk to the bottom of the tank the mercury column will rise no higher; it is then necessary to balance the system by means of compressed air. This is necessary to compensate for the loss of pressure transmitted due to the length of the copper tube. A valve at the bottom of the indicator is turned so that the balancing-chamber is in direct communication with the air-pump. A few strokes of the pump force out the liquid from the sunken chamber. Then the valve is turned back to its former position and the pressure is correctly registered on the dial by the mercury column. The accompanying drawings explain the system so clearly that further elucidation is hardly necessary.

With this device it is not only possible to determine correctly the amount of water or oil in the tank—and the calibration of the gage can be easily translated into gallons—but it can be employed for determining the tonnage of a vessel by the use of a balancing-chamber in the bow and another in the stern. Both of these chambers communicate through tubing to twin dials located in a convenient place.

Two of the accompanying diagrams illustrate the manner in which the apparatus is installed for determining a ship's draft. A one-inch hole is bored in the bow a few inches below the water line when the vessel is unloaded. If four equipments are installed instead of two—one on the port side and the other on the starboard side in the bow and the other two installed similarly in the stern, it is an easy matter by having the four gages side by side to tell whether the ship is



The bell-like object is contained in a small tank which communicates with a hole below the water line in a ship's side. The variations in water pressure are communicated to the gage. The purpose of the air-pump is to balance the system for accuracy



As the vessel sinks in the water, due to natural or accidental causes, the increased pressure is transmitted through copper tubing to indicators in the cabin's office, the chart-room or the engine-room, giving due warning to the officers of the ship properly trimmed or not. It is this system of installation which will give indication in the pilot-house or engine-room when the ship springs a leak. It is also possible to tell after the ship springs a leak whether the pumps are taking care of the inrush of water or not. By means of an electrical attachment to the mercury indicator, warning bells can be rung when a dangerous height has been reached by the mercury column, or, in other words, when the ship is listing in any quarter.

The possible uses of the pneumercator are almost limitless. It can be employed in oil fields, at hydroelectric plants, on warships, on gasoline engines and, in fact, any place where accurate pressure gages are necessary.

A pneumercator is installed on the U. S. S. *New York* for indicating the amount of oil in the auxiliary tanks.

A New Way of Driving a Bicycle with a Motor

ONE of the most ingenious motor attachments for bicycles yet placed on the market has recently appeared in England. The motor, which develops slightly over one horsepower, is attached to the luggage-rack; it weighs but sixteen pounds and occupies little space.

A new place for the bicycle motor

A V-shaped belt-rim is attached to the back wheel, and on this fits a friction-wheel, which is chain-driven from the motor. A lever operated from the handlebar lifts this wheel from the rim, and thus provides a free engine and clutch.

The motor is said to develop sufficient power to drive the machine at the rate of twenty miles an hour, although on a steep hill, the rider must help the motor by pedaling.

The makers assert that they can place this little machine on the American market at a cost of about fifty dollars. The expense of operating will probably be small, as the engine is designed to run nearly one hundred and fifty miles upon one gallon of gasoline.

This electric fixture can be easily attached to any bed

Reading in Bed Made Easy

AN electric light device which can be attached to any bed directly over one's head has recently been put on the market. A strip of brass is bent into nearly a circle at one end, the other end being bent in the opposite direction to form a large hook for hanging over the headboard.

An ordinary electric socket is fitted with a short threaded tube having a flange at its outer end. This tube passes through a longitudinal slot in the brass strip and is held in place by a spiral spring which presses against the flange and the inner surface of the curve. The length of the slot permits a wide angle of adjustment of the light. This simple device may be easily attached to a desk or any other piece of furniture where a light is needed.

Using Triggers to Launch Uncle Sam's Battle-ships

How Science Has Made the Launching of Dreadnoughts Mechanically Perfect

By Robert Howard Gordon

The battleship "Arizona" ready to be "fired" into the sea by her hydraulic triggers

THE launching of a great battleship involves the problem of releasing a ship from its ways without straining the shell. In the case of such great super-dreadnoughts as the *New York* and *Arizona*, the great length and enormous weight of steel necessitate unusual care in calculating the points where the strain can be relieved by additional ways. The "ways" are of two kinds, ground ways, which are immovable, and sliding ways, which move with the ship into the water.

Ground ways consist of longitudinal timbers on either side of the keel, placed about midway between the keel and the turn of the bilge or under surface of the vessel. The sliding ways are similar and rest upon the ground ways, with a thick coating of stearin or grease between them, to facilitate the sliding motion of the hull, as shown in Figure 1.

It was thought best in launching the *Arizona* to carry the ways as far forward as possible to gain additional length of sliding ways and consequently reduce the unit pressure. The extreme narrowness of the fore part of the shell necessitated the placing of three steel-plate slings under the ship, extending from side to side and lashed to the ship by heavy, wire rope as shown in Figure 2. The space between the slings and the hull of the boat was then filled with concrete, which gave the ship a temporarily increased width forward. The under portion of the shell, in the wake of the concrete, was greased with stearin, painted on hot, and the concrete was tied back to the slings.

The supporting structure for the aft portion of a ship must be removed before the launchings can take place (if the

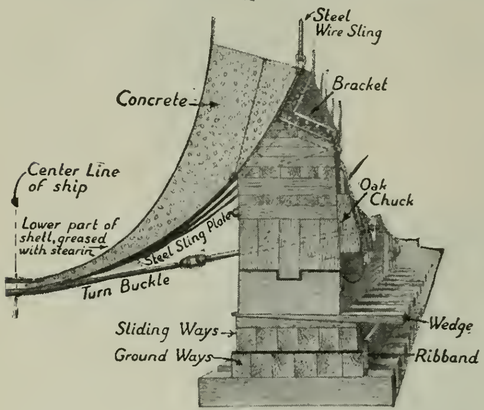


Fig. 1. Section through the fore part of the supporting structure, starboard side looking forward

stern dips into the water first), since the central portion of the hull has so much greater width. About six weeks before the *Arizona* was launched, the aft keel-blocks were removed and tumbling shores substituted. These consisted of blocks rounded off at their top, forward and bottom, after ends, thus allowing them to tumble when the ship started to move down the ways. This arrangement is illustrated in Figure 3.

The actual releasing of the ship was accomplished by means of two hydraulicly-operated triggers, one on either side of the shell and operated together. The trigger, shown in Figure 4, consists of special forged steel, the upper end engaging a cap set in the sliding ways, and the lower end bearing against a piston, sliding in a cylinder fastened to the ground ways. The cylinder contained a thirty per cent mixture of glycerin and water. When the signal was given, a releasing valve was turned,

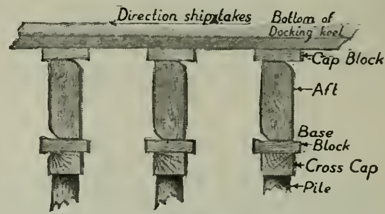


Fig. 3. Tumbling shores

allowing the glycerin in the hydraulic cylinder to escape. The pressure in the cylinder being removed, the trigger swung on its pivot, disengaging the cap and allowing the ship to move down into the water.

The effectiveness of this arrangement was proved in the launching of both the *New York* and *Arizona.* No appreciable strain was noticed anywhere, though very careful observations were taken.

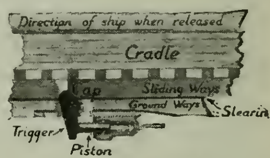


Fig. 4. The hydraulic trigger itself

Keeping Beverages Fresh

BY a new patent process grape juice, wines or beverages made from fruit juices can be so treated that they will not become turbid and will not form a sediment when stored. Also they are practically freed from any sort of bacteria.

The liquid, under regulated pressure and temperature, is passed through a finely divided mass of some material which will not dissolve or absorb moisture, such as corundum, garnet or quartz, and at the same time subjected to an electric current. If the liquid to be treated is acid, the crushed material it is passed over must be electro-negative; if the liquid is basic or neutral, the material, must be electro-positive. Alternating current is employed.

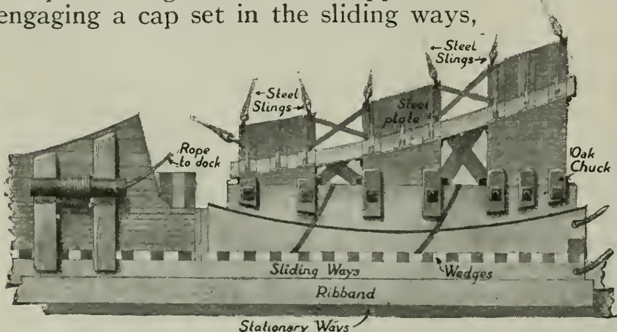
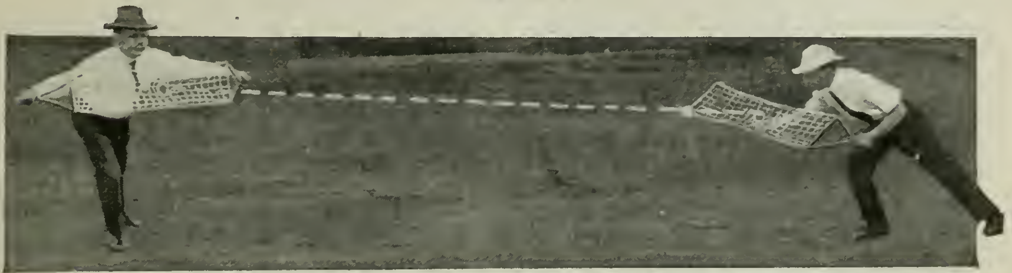


Fig. 2. View showing steel-plate slings under the narrow fore part of the vessel

Ten-Net—An Indoor-Outdoor Game



"Ten-net," the new game, in action. On the left, the net is extended immediately after the ball has been shot. On the right is the attitude of the player receiving the ball

IF "Ten-net," a novel game invented by Halvor Achershaug, of New York, meets with the popularity which is predicted by those who have played it, both indoor and outdoor sports will be forced to look to their laurels.

Many different games may be played with the nets patented by the inventor, ranging from a modified form of handball for indoor work to an exciting outdoor game somewhat resembling lacrosse.

At the right, a player about to shoot the ball into the air for a high "fly;" opening the arms throws it into the air with great force

A player receiving a ball from a high "fly." The net is held at an angle to catch the ball without having it bounce away

The nets are made of whipcord, fastened to two wooden handles in much the same manner that a hammock is slung between two posts. A triangular loop of resilient spring wire projects from each handle, and to this the edge of the net is securely bound.

In the center of the nét is a cradle-like arrangement which is also made of spring wire. This gives added strength to the point which stands the greatest shocks during the game.

In playing "Ten-net," the players use a tennis ball, and throw it back and forth, using the hand nets both in catching and throwing. When the ball comes speeding through the air, the player spreads his net, and allows the ball to hit it. At the moment of impact, the handles are quickly brought together, and the net breaks the force of the ball. A turn of the wrist, and the net is lowered, with the ball held securely inside.

In throwing the ball, the net is used as a sling. The net is relaxed, since the handles are held close together. To get the greatest speed and distance, the net is held behind the head, and is suddenly brought forward; at the same time, the hand grips are spread apart. The ball speeds away to an astonishing distance, where it is caught by another player, holding another outstretched net.

New York's Submarine Subway and How It Was Built

By Howard B. Gates

The author of this article is a Civil Engineer, who is connected with the Public Service Commission of New York city. His official duties were such that he was closely identified with the daring work that he so interestingly describes. Obviously, he writes from first-hand knowledge.—EDITOR.

A TWENTY-story building literally grows out of the ground over night; subways are built beneath our most congested streets and under rivers and we scarcely know they are there until they are ready for operation; our water supply is siphoned under rivers at great depths and runs through the very bowels of the earth in arteries hundreds of miles in length for our convenient use at faucet and hydrant; bridges spring from the opposite banks of our rivers and meet in the center within a fraction of an inch and we talk with our friends across the ocean and continent with perfect ease and understanding. Not only to the lay mind but to the technically trained as well, do these achievements become a source of wonder, the former accepting the result as sufficiently marvelous in itself, while the latter appreciating the underlying principles of science and laws of nature which contribute to their success, wonders at the ingenuity of their application. One of the most recent examples of these marvels of engineering is the "submarine" subway or Harlem River tubes built beneath the Harlem River to form the connecting link between the Boroughs of Manhattan and the Bronx subway systems now nearing completion.

The Harlem River at the point of this crossing is six hundred feet wide and varies in depth from twenty to twenty-six feet. In accordance with the requirements of the Secretary of War, the top of the structure was fixed at a depth which placed it an average of seven feet below the river bottom and made the lowest point in the structure about fifty-seven feet below water. To start the construction at the bulkhead lines was not practicable; hence the tubes were projected landwards, so that the total length of this special construction was one thousand and eighty feet.

The Four Tubes Floated Like Boats

Briefly, the method consisted in assembling the steel shell or form of the four tubes, in sections about two hundred and twenty feet in length upon timber supports above the water. With the ends sealed or partially closed, a section was launched and floated as a boat. Towing it to and anchoring it above its designed location, its tubes were filled with water under positive and accessible controls and gradually lowered into a previously dredged and prepared trench. As each section was lowered in turn, it was attached to the end of the previously placed section and encased in concrete. When all of the sections had been lowered and properly encased, with their ends closed by watertight walls or bulkheads, the water by which they had been sunk was pumped out, and a reinforced concrete lining was placed inside the steel shell to complete the structure.

The steel portion of the structure consists of four parallel tubes bolted together, with flat sides on their interior walls. Between the tubes are vertical diaphragm plates which are placed at intervals perpendicularly to the direction of the tracks and which extend to the rectangular limits of the structure.

Digging Trench for the Tubes in the Bottom of the River

The safe submerging of this light steel form and the temporary control and final location of it, comprise the most spectacular part of this great scheme. The trench into which the subway was to be located was formed by a "clam-shell" dredge. While the trench was being prepared, the structural steel tubes were in process of building over a slip about a mile away.

In launching each section nine flat-decked boats similar to canal barges, were uniformly distributed beneath the structure at low tide. As the tide rose the huge steel form was lifted clear of its supports; then tugs readily towed it out of the slip. Small valves in the bottom of these boats were simultaneously opened, the section slowly settling down into the water until it floated on its own surfaces as a boat. The flat boats were ballasted with stone to overcome the buoyancy of the wood of which they were constructed and were readily pulled from beneath the structure. After they had been pumped out, they were available for use on the next section.

The flotation of the structure was made possible by the watertight wooden bulkheads which completely closed the ends of the outside tubes and the lower half of the ends of the center tubes. These bulkheads and tubes presented something of the appearance of four large submarines tied together, their ends cut off and boarded up. As the same essential principles are involved in their submersion, they might be termed, the "Subway Submarines." Their weight or displacement when entirely equipped was about seven hundred and fifty tons.

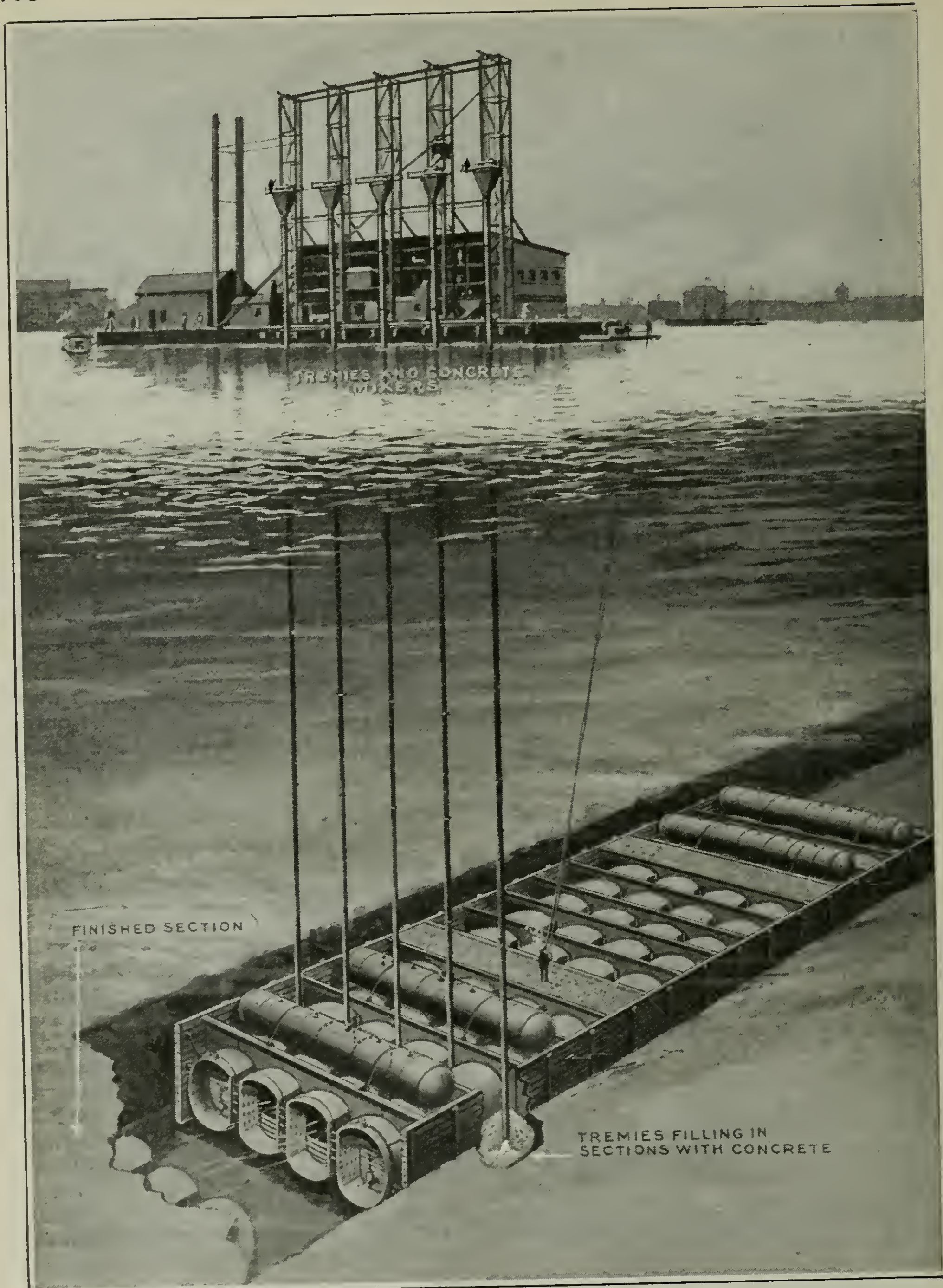
How the Tubes were Sunk

It is evident that, if the tubes are to be submerged, an enormous weight must be added to overcome the buoyancy that causes them to float. The admission of water suggests itself; but the scientist points out that this is a practical impossibility. Certainly it is a grave risk, to attempt to control and adjust the amount of water in so large a structure, especially where any tendency toward unequal settlement might cause the water to flow to the lowest points, and eventually plunge the whole structure to the bottom a hopeless wreck. It is a well-known principle in physics that the resulting buoyancy-effect of a floating body (in other words, the weight which the floating body will carry and remain floating) is theoretically equal to the weight of a volume of water of the same dimensions as the floating body, less the actual weight of the body. In the light of that principle the use of the four steel air cylinders illustrated in place upon the top of the tubes is at once apparent; they furnish the necessary suspension while the tubes are being filled with water.

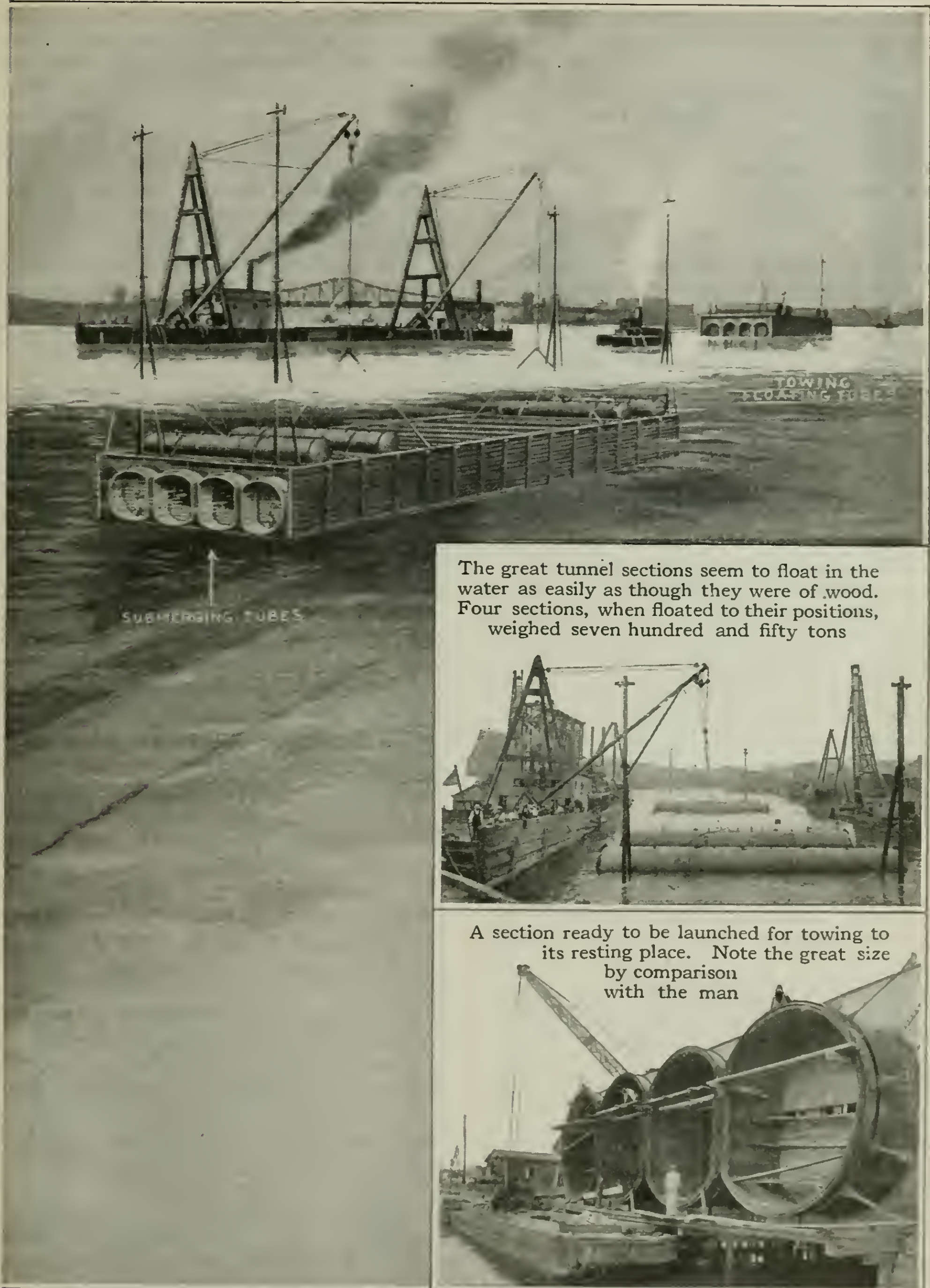
These cylinders, of light steel plate, were divided into three compartments (a small center one about fifteen feet long and two end ones about twenty-six feet long). Each compartment was fitted with separate valves for the admission of water and for the application of air pressure by which the water could be removed entirely from the cylinders, or from any compartment, or adjusted to any desired refinement. The cylinders had a combined floating effect seventy-six tons greater than the structure when submerged. Hence it was necessary to let in but nineteen tons of water to each of the cylinders to overcome their tendency to float. With the buoyancy-cylinders in place and four long steel location masts erected and carefully plumbed so that they were exactly over the center line at each end of the outer tubes, the section was ready to be towed into position. Approaching the site, the scene presented was essentially that shown at the extreme right in the illustration.

Filling the Tubes with Water to Sink Them

In order to fill the outside tubes with water (the first operation in lowering a section), twelve-inch submerged valves in each of the end bulkheads were opened simultaneously. With the excess floating effect of the buoyancy cylinders in mind, it will be appreciated that it was relatively unimportant how fast the tubes filled with water as long as they maintained an even keel. Slowly the section settled, as it filled with water, until it became submerged. Gradually it transferred its weight to the buoyancy cylinders and pulled them down into the water until only about two feet six inches of the cylinders were visible, a condition which followed shortly after that shown in the insert at the lower right-hand corner of the double-page illustration. Workmen standing upon



The four tubes of the new subway under the Harlem river in New York city are being put in place by floating them to a point above their destined position. The sections are then released from the barges which are carrying them half submerged and are dropped into place. Once in the trench which has been dug in the river bottom, concrete is sent down through



The great tunnel sections seem to float in the water as easily as though they were of wood. Four sections, when floated to their positions, weighed seven hundred and fifty tons

A section ready to be launched for towing to its resting place. Note the great size by comparison with the man

pipes to embed the tube sections solidly in the rock and to join the sections, one to the other. The work is done by divers where the elaborate mechanical system is inadequate, and at last compressed air forces the water out and the final joining is completed. This method requires less time and is less expensive than the use of a driving-shield each of the cylinders next simultaneously turned wheels which opened a three-inch water-valve in the bottom of the center compartment of each cyliner and by carefully observing the rate at which the cylinders became submerged and testing the subsequent load transferred to the derrick, the nineteen tons of water to overcome the buoyancy was admitted, filling the center compartment to about one-half its capacity. Then just enough more was let in to hold the section in position when lowered, against the action of the tidal currents in the river. This total excess load never amounted to more than a few tons, which the derricks readily sustained. The section was lowered, until one of the diaphragms at or near each end, rested upon temporary timber frames, in the shape of an inverted "U." By means of the location cables attached to the ends and sides, the section could be shifted north or south, east or west until the masts (which projected about ten feet above the water) indicated that the structure was in proper position. The control over this large steel structure was very complete; the section could be raised or lowered, shifted at will, or could even have been brought to the surface again if conditions had made it necessary.

How the Sunk Tubes Were Joined

Each section after the first, had a positive anchorage to the section previously placed; the ends were brought into perfect alinement by means of steel pins mounted on the end of one section, and guided into tapered holes in castings mounted in the same relative position on the other section. As the two sections were drawn together, the pins were started into the tapered holes and served to guide the ends to a positive junction, then a diver bolted them together. The complete operation from the time of opening the valves to admit the water to fill the tubes, to their final anchoring, required but three hours.

As soon as a section was placed, preparations were made to deposit the encasing concrete, the weight of which was necessary to keep the tubes from coming to the surface when their buoyancy would be restored in the unwatering, and the strength of which concrete, together with the reinforcing effect and waterproofing qualities of the steelwork, was to provide a safe working-chamber for the completion of the subway structure. The section, as far as described, might be considered to be a large box sunk in the bottom of the river, without top or bottom but having sides and ends, and divided by the diaphragms into a series of pockets which could be filled with concrete in any convenient order.

Pouring Concrete Through Pipes

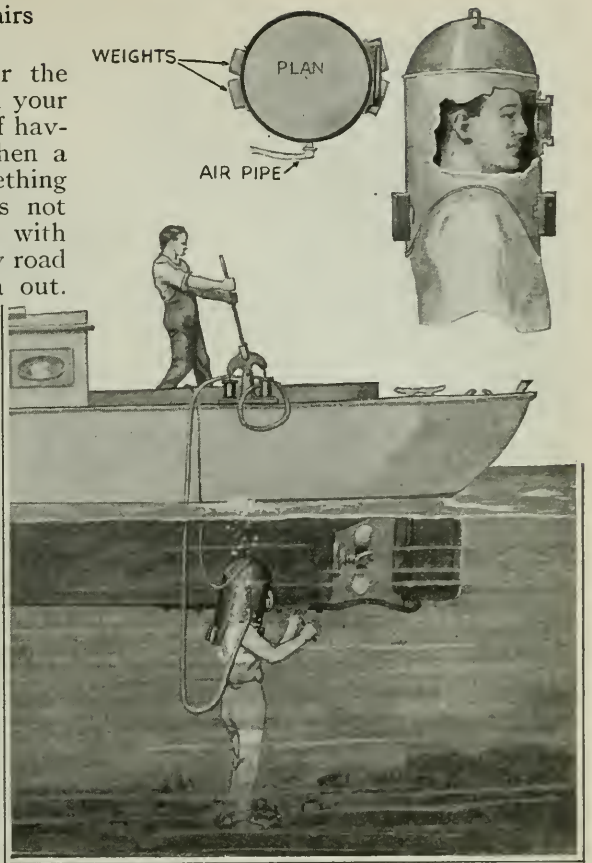
The tubes, being surrounded with water, the problem resolved itself into displacing this water with concrete and without the loss of the cement which would occur in dropping the concrete through even a much less depth of water. This was accomplished by what is technically known as the "tremie" method of depositing which involves the use of long pipes which are kept nearly full of concrete and which are raised a little as the concrete is poured in at the top. A nearly continuous flow is maintained. The concrete gradually displaces the water but does not mix with it. Each pocket required an average of twelve hours for its completion by this method.

When all of the pockets had been filled, except those over which the buoyancy cylinders had been placed, these cylinders having performed their functions, were disconnected by forcing the water out of them; they floated to the surface there to be reclaimed for use on the next section.

With all of the sections in place and encased and with the extreme ends of the series closed by the heavy wooden bulkheads previously mentioned, four small steel shafts or wells attached to the tubes before sinking, were opened and the water pumped out. It was then possible to get inside of these submerged passages beneath the river, assemble the concrete forms and place the lining, thus completing the structure. There were no leaks in the tubes except where some of the bolts in the interior walls had not been tightened sufficiently, and by tightening these bolts, the finished work was, figuratively speaking, "dry as a bone."

Making Your Own Boat Repairs Under Water

WERE you ever gliding over the smooth surface of a lake in your motor-boat with the satisfaction of having a perfectly working craft, when a sudden lurch told you that something had gone wrong? The feeling is not pleasant. It is only comparable with being stranded at night on a lonely road when your automobile has given out. In an automobile you are better off than in the motor-boat. Every kind of device has been thought of to help out the automobilist, but the yachtsman has been neglected. At last a device has been invented for the lover of boating which obviates the necessity even of towing the boat ashore to find out what damage has been sustained and what repairs are necessary.

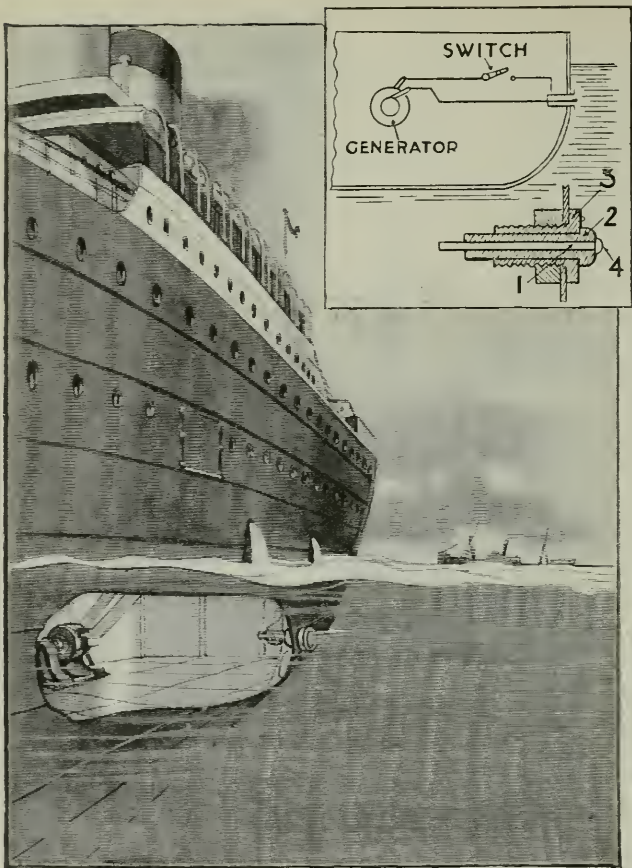


You do not have to be an experienced diver to use this hood. A metal helmet, bearing four weights, rests on the shoulders, and a hand-pump furnishes fresh air. All sorts of emergency repairs can be made under water with this device

The inventor of the device once found himself adrift with a broken rudder. Down through the clear water he could see the broken part. He had the proper tools for repairing it, but there was no way of reaching it. If only he could get down under the boat! The idea of a diving-helmet occurred to him then and there. After a series of experiments, the actual thing was produced.

This diving-helmet is of metal. Its lower edge fits snugly over the shoulders. Four adjustable weights, two in


In the middle picture is shown Rex Beach, the author, just emerging from the water after testing the diving-helmet. The other two illustrations were made off the Florida Keys by photographing under water. In case of accident, the diver can rise to the surface immediately by simply removing the hood



A submarine signaling apparatus that makes sounds under water by vaporizing the water and thus causing waves which transmit the sound

front and two in back, are fastened in place by metal strips. These weights overcome the buoyancy of the air in the hood and the natural buoyancy of the person wearing it. The buoyancy of the air in the hood tends to hold it in an upright position. Since the weights are suspended below the center of buoyancy of the body (which is in the chest), the shoulders are held firmly in the curved lower edge of the helmet.

Fresh air is supplied to the diver by means of a single tube which leads to a small hand-pump in the boat. The pressure of the pumped air not only prevents the water from entering the hood, but keeps a fresh supply passing through at all times. Since there is no suit to inflate, pressure of the air in the helmet is always sufficient to equalize the water pressure at the depth the diver is working and no more. As in the case of the regulation diving-suit, the amount of air is regulated by signals, but should any accident happen at the source of air, the diver simply lifts the helmet off his shoulders and quickly floats to the surface, an utter impossibility in the regulation suit.

A small glass window enables the diver to see the damaged part, in shallow water. With this simple appliance, a rope tangled in the propeller, a broken blade, a jammed rudder or hull punctures can be readily taken care of.

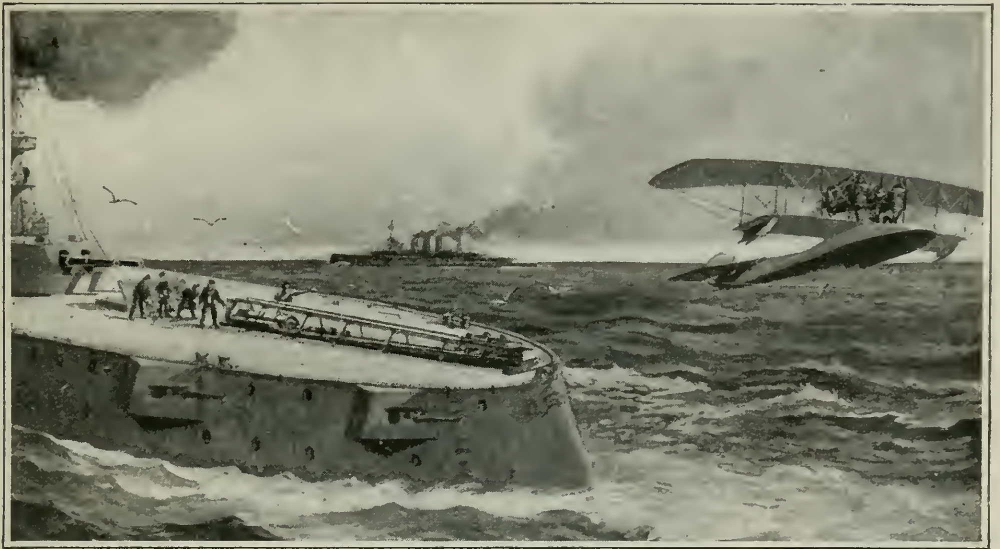
The accompanying illustrations were made by photographing the diver in twenty feet of water at Sea Gardens along the Florida Keys.

Submarine Signaling with Sound Waves

AN improvement has been made upon the usual bell and striker for use in submarine signaling. By means of a new device, recently patented by Theodore Bodde, waves may be transmitted much greater distances than heretofore. Also, the frequency or pitch of the sound waves is entirely under control. Another advantage lies in the relatively small size of the apparatus.

An electrode 1, centrally placed in the bushing 2, passes through the hull of the boat, the collar 3 holding the bushing in position. The electrode terminates externally in a sparking-knob 4. The bushing and the electrode are connected with the two brushes of an alternating current generator. A switch is inserted between one brush and the bushing for interrupting the circuit.

When the circuit is closed, the alternating current which is made to flow from the knob 4 to the collar 3, vaporizes some of the surrounding water. A powerful strain is exerted on the water, resulting in strong impulses being sent out. Signaling may be accomplished by opening and closing the switch.



By means of a trigger which moves but forty inches, an aeroplane can be catapulted into the air with a velocity equivalent to a run of forty feet on the ground. This new invention advances the use of aeroplanes at sea far beyond anything yet achieved

Catapulting Seaplanes from Battleships

A FEW years ago, when the thought of using aeroplanes in connection with battleships occurred to naval officers, the problem of launching was solved in a crude way by means of temporary inclined platforms built on the deck. Apart from the military objection to such a structure, the weather conditions had to be decidedly favorable in order to insure a successful start for a flight. At no time was it considered practicable to launch the flying machine while the ship was in motion. The machine ran down on the platform on the regulation wheels of a land machine; they were not real seaplanes.

It was apparent that the hydroaeroplane or seaplane would have to be carried temporarily upon a car or truck from which it could be detached at the right moment and allowed to rise of its own impulse by reason of the supporting pressure of the air due to the speed acquired in a short run. It was also clear that the car would have to be quickly accelerated to full speed within a run of something like forty feet. This rapidly gathered headway had to be insured without jerks or jars. To this end Captain Washington I. Chambers of our navy has devised a compressed-air catapult, the compressed air operating a piston which, in its turn, actuates a wire rope traveling over pulleys. A movement of but forty inches on the part of the piston is multiplied so as to draw the car forward forty feet.

To-day, the catapult has been so far perfected by the Bureau of Construction and Repair of the Navy Department that it has become a permanent feature aboard the aviation ship U. S. S. *North Carolina*. It is now possible to launch in flight the service seaplanes while the cruiser is steaming along at fair speed.

The seaplane's motor is set going before the catapulting process is started. In fact, the pilot does not give the signal for launching until his engine is working just right. The impulse air for working the piston is drawn right from the torpedo air-supply system, and the working pressure is something like three hundred pounds to the square inch. By means of a cleverly designed valve the air is admitted progressively to the cylinder, and in this way the desired maximum speed is reached from zero without shock.

In the future, our navy, when hundreds of miles from shore, will be able to send its seaplanes skyward with measurable indifference to the weather.

Burning Cars to Make Money

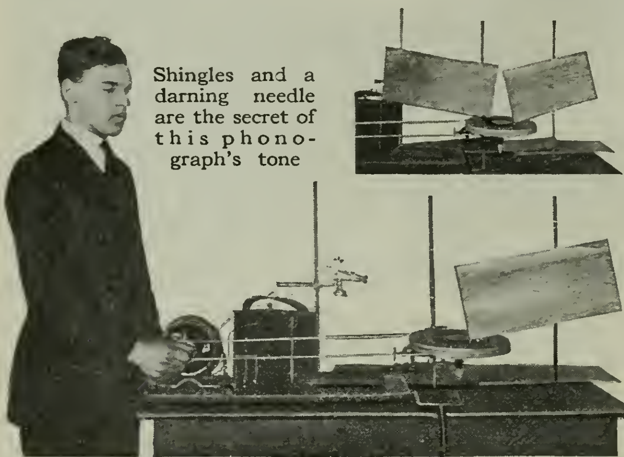
AFTER having carefully estimated the value of the wood in discarded railroad cars, balancing it against the cost of the labor necessary in retrieving it, the Pennsylvania Railroad came to the conclusion that it would be far more profitable to burn the old wooden cars entirely; then recover and sell the scrap iron remaining. By following this method of economy not only with cast-off cars, but with scrap material of all descriptions, the railroad company saved $2,000,000 in one year. Waste paper alone sold for $19,211, while old wheels, metals and wrought iron yielded more than $780,000.

By burning its old wooden cars a railroad company saves $2,000,000 a year in labor formerly spent to repair the cars. Before setting fire to the cars, all usable fixtures are removed. After the fire, the remaining scrap iron is sold

The Shingle-Phonograph

THE accompanying illustration shows a phonograph recently constructed by Harvey Smith, a student in the West Allis High School, West Allis, Wisconsin.

The reproducing part of the phonograph is nothing more pretentious than an ordinary shingle, with the point of a darning-needle securely fastened in one corner. A steel knitting-needle, clamped in a laboratory ring-stand, is thrust through a hole in the shingle to support it as it is carried over the record. The record is mounted upon a wooden turn-table constructed as follows:



Shingles and a darning needle are the secret of this phonograph's tone

A disk made of three-quarter-inch wood, with a groove in the edge is mounted on the hub and axle of an old bicycle-wheel, so that it can turn easily. This is connected with an ordinary battery-motor by means of a cord-belt. Pressure of the thumb and finger on the shaft of the motor regulates the speed of the disk. Records can be played backward simply by twisting the belt. The small illustration shows how two shingles may be used at the same time to play a duet on the same record. In like manner three or four shingles may be used.

Teaching Blind Men to Fence

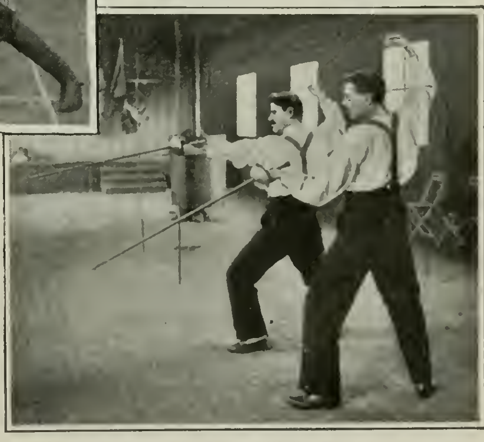
IN FRANCE, the only country where fencing can be said to flourish, a new system for teaching the use of the foil to blind men has sprung up. Its originator, Georges Dubois, has a method whereby the student is taught to rely upon the sense of touch only. In all fencing methods the sense of sight is not wholly relied upon. Professor Dubois emphasizes touch and eliminates sight altogether.

Soldiers, blinded in war, have now an opportunity of becoming skilled in the use of that ancient weapon, the small-sword. A blind man's one advantage is his ability to concentrate his attention without being distracted by seeing the action of others. This is of great value in modern fencing where a single "touch" anywhere on the body means that the bout is over. Intense alertness is requisite from the moment the fencer puts himself "on guard."

The white strips on the ground enable the student to assume his position

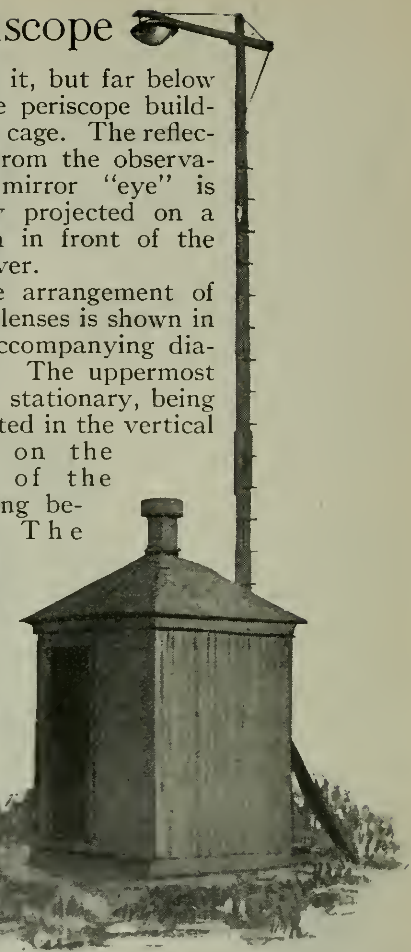
In the circle is shown Professor Dubois placing the pommel, or end of the handle, against the student's wrist. If the pommel is in the center of the wrist, the blade is in line with the arm. The blind students practice "binding," by twisting their blades over their opponent's and thrusting at the same time. This play is mainly for thrusting under the shoulder, accomplished by twisting the foil.

Making a successful thrust is the test of a blind man's training



Blind students are taught the feeling of an opponent's sword by means of iron rods

Out-Periscoping the Periscope



An observation apparatus with greater range than the periscope has been constructed by Joseph de Falco, of Vineland, N. J. With it, observations can be made by a submarine without the vessel endangering itself by coming so close to the surface as the present submarine periscope requires.

The "eye" of the new apparatus is an inverted semi-spherical mirror. This mirror is suspended from the end of a horizontal rod. The rod is attached to an adjustable mast, and is of the proper length to bring the mirror directly above a vertical, chimney-like tube in the roof of the house. The "eye" may be raised or lowered by means of a rope which passes up over pulleys attached to the horizontal arm and mast and then down into the hut where the end is within immediate reach of the observer.

In making observations, an image of all objects within a complete circle are reflected by the eye-like mirror. This image is magnified as it passes through a series of magnifying lenses directly beneath it, but far below in the periscope building or cage. The reflection from the observation mirror "eye" is finally projected on a screen in front of the observer.

The arrangement of these lenses is shown in the accompanying diagram. The uppermost one is stationary, being mounted in the vertical tube on the roof of the building below. The other lenses are all adjustaable and may be regulated according to the height of the mirror outside, the object being, of course, to focus the picture on the observation screen below.

The innocent-looking hut appears to be a shed with an electric light pole above it

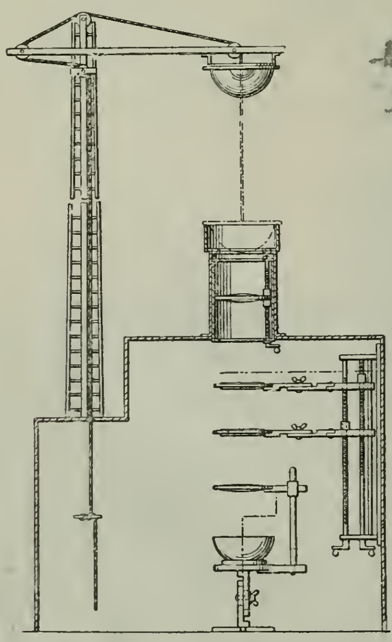


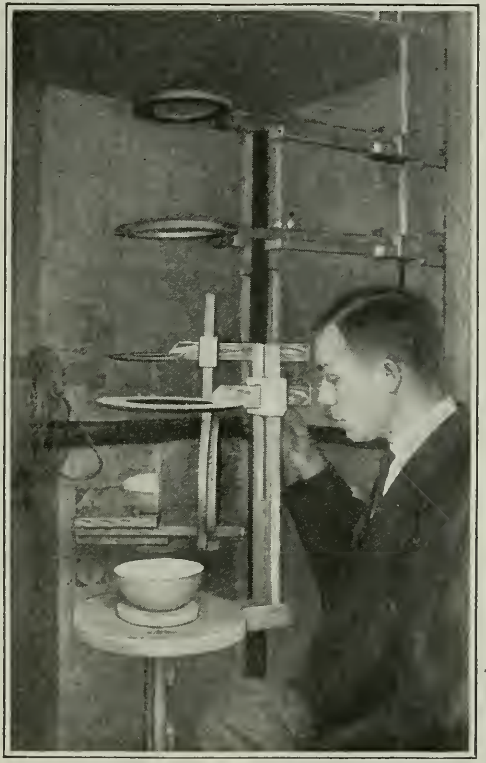
Diagram of construction of observation apparatus, showing the "eyes" and the lenses

This screen is, in reality, a semi-spherical shell with the concave surface uppermost. It is made of white enameled glass, so as to make a distinct image of the outside world. This observation apparatus rests on a table of suitable height for a man to sit comfortably and watch proceedings without incurring the risk of being seen and fired at. The picture thus obtained is in the nature of a bird's-eye view, since the mirror is located at a considerable height.

On the battle-fields of Europe a method

of taking observations is to hoist an officer to the top of an extension or telescopic mast or tower. There the view is excellent until a bullet or shell interrupts his work.

If in place of a human observer, the "eye" or semi-spherical mirror of the observation apparatus were substituted the securing of necessary observations would not be as costly to life, and the view obtained would be a more extensive one.



The observer sits safely inside the hut and watches what is going on in the semi-spherical mirror on the table

More Motion-Pictures in Color

NATURAL-color moving-pictures have so far achieved very little success, mechanical difficulties being the stumbling block which no inventors have yet been able to overcome successfully. One company has developed hand-tinting to a fairly satisfactory degree, although the results have not yet attained the necessary standard. The color effects are somewhat obvious. Another maker of colored moving-pictures placed his on the market before being commercially perfected. With this process it was necessary to run the film through the projecting machine at twice the normal speed, natural-color results being obtained by a revolving color disk which allowed red and green pictures to be flashed alternately on the screen. The same process took place when the picture was taken. The latest attempts at moving-picture color photography is suggested by an English inventor who proposes to expose alternate "frames" or pictures of a film through a shutter provided with a color filter. On one "frame" the colors in the photographed object which contain green will be registered on the next "frame;" various shades and tones of red will be separated out. When the positive film is printed from the negative strip it will be stained orange and green in alternation. Two positive films will be printed from the one negative and stained, then superposed and cemented together. Alternate frames are stained green and orange, and the two strips so arranged in assembling that when the film is ready for projection one green frame will be opposite an orange frame. The film will be run through the projection machine at normal speed, i. e., sixteen frames a second, and the resultant image on the screen, if the process works out as it is planned, will be lifelike in color. By a complication of the process, using three fundamental colors, instead of orange and green, finer gradations of color will be possible. The difficultues which beset this plan can be removed by adequate mechanical means. Coloring alternate frames red and green has not yet been successfully accomplished—at least on a commercial scale—although it probably could be done. The other difficulty is to secure positive film half the present thickness which would be sufficiently flexible and durable when two strips were cemented. The matter of superposing two film sections, so that the images exactly coincide—and this is absolutely necessary due to the immense magnification which takes place—is an important mechanical problem which must be thoroughly worked out.

Putting Speed in Telephone Directories

A SERIES of experiments were recently conducted by the New York Telephone Company to ascertain the quickness with which a telephone number could be found with the book printed in three different ways.

Testing the speed of telephone directories. Names in the arrangement adopted were found in 9.28 seconds as against 10.36 seconds in the old arrangement

Dr. J. W. Baird, Director of the psychological laboratory at Clarke University, Worcester, Massachusetts, was called in to supplement the work of the telephpne men by conducting other tests, using a variety of type arrangements. Dr. Baird made nearly four thousand experiments to determine the case and speed with which the average person could find a number on pages of the directory set up in various forms. Thirty-two men and women were selected as subjects for the tests. Care was taken that these individuals should represent radically different occupations and degrees of experience in the use of the directory

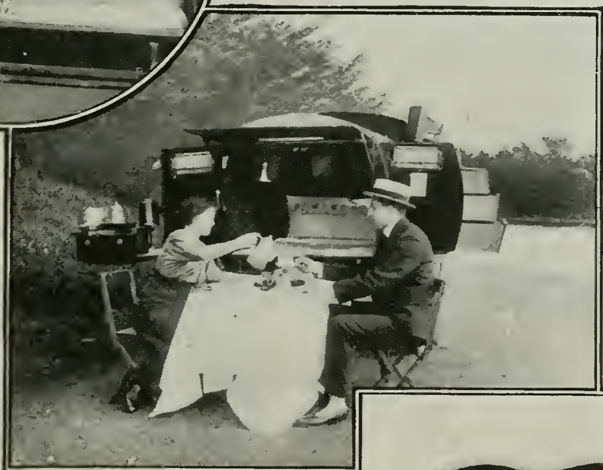
Pages with names beginning with the letters I and M and S were selected when tests showed that they varied sufficiently in difficulty to fulfill the purpose of the experiments.

Twelve pages were subjected to experiments, an I-page, an M-page, and an S-page, being printed in each of four different page arrangements and mounted on cardboard. Each page was placed in a separate "booklet." While the individual tested was looking up a number, the experimenters held stop-watches measuring the time elapsing from the opening of the booklet until the subject found and pronounced the number.

To find a telephone number in the old telephone directory, the pages of which were set in three-column measure, required an average time of 10.36 seconds. When the subscribers' names were printed in a four-column measure without indentation or leading, the finding time increased to 10.69 seconds. When the lines in the four-column page were set in "staggered" arrangement, i. e., in alternate indentation, the finding time was reduced to 10.14 seconds. When the type on the four-column page was made slightly higher and, moreover, narrower, taking eleven lines instead of twelve lines to the inch, the finding time was cut to 9.28 seconds. It was this arrangement of the page that was chosen, cutting 1.08 seconds from the 10.36 seconds required by the average subscriber to find a number in the old telephone book. This is a gain of more than ten per cent.

Converting an Automobile into an Apartment

YOU can go for an automobile tour now and carry your apartment with you in a neat-looking box-like contrivance which fits on the back of your automobile and which can be taken off or put on in fifteen minutes. The shell or case of the telescoping apartment is three feet and four inches long, as wide as the automobile, but not as high at the highest point as the automobile top. The roof of the "apartment" has a gentle slope.



There is very little left to desire in the way of an apartment if one has this sleeping, cooking and living telescope-automobile apartment

The apartment will fit on the back of your automobile and can be put on or taken off in fifteen minutes by an amateur

Into this small space are fitted a comfortable double bed in an electrically-lighted berth with a tempting bookshelf over the head of the bed; a complete cooking outfit, including a two-burner gasoline-stove; a table; a dressing-room attachment, with a shower bath equipment which includes a ten-gallon can and an attachment to the exhaust for heating water; storage room for a week's supply of food and linen; a dressing-table; a writing-desk; and other comforts to be had at home.

The automobile-telescope apartment is the invention of Gustav de Britteville of San Francisco, who uses it on business tours into the country.

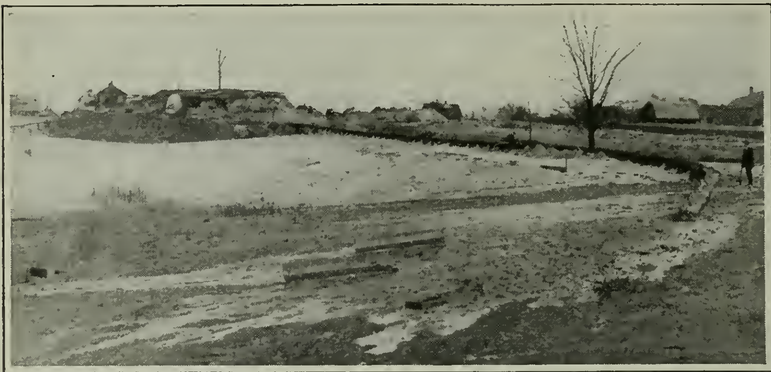
How To Make Spirit Photographs

PRINT from ordinary negatives in the usual manner on printing-out paper, then fix the prints in a solution of 1 oz. hyposulphite of soda and 8 ozs. of water, and wash them thoroughly. While still wet, immerse them in a saturated solution of bichloride of mercury until the image disappears; then wash thoroughly. Be very careful, as bichloride is very poisonous. Soak some clean blotting-paper in the hyposulphite of soda solution and allow it to dry.

To cause the spirit photograph to appear, cut a piece of blotting-paper the same size as the prepared print, and moisten it; then hold the apparently blank piece of paper in contact with it. The photograph will come out gradualy-clear and plain, and if washed thoroughlh ly will be permanent.

Making Money Out of Waste Land With a Stream of Water

As Henry Ford was laughed at when he claimed he would make a successful automobile, so Harlan K. Whitney, a civil engineer, caused much merriment when about two years ago he bought twenty acres of the most useless land on the outskirts of Battle Creek, Mich.



The new residence addition of Battle Creek, Mich., which was formerly a waste of marshes and ugly hills

The property was about evenly divided between rolling hills and squashy marshes. To-day the hills have been dumped into the marshes and leveled off, and soon Mr. Whitney will open his new addition of six blocks, which are less than three quarters of a mile from the business district, and only a block from a street-car line.

It is doubtful whether the power of hydraulics has ever before been used in the State of Michigan for this purpose. One hundred and twenty-five thousand yards of earth have been washed away, and about twenty acres graded. Some hills were twenty-five feet high.

The apparatus used was simple—so simple in fact, that it caused about as much ridicule as the suggestion that the land could be reclaimed. Two two-inch streams from an eight-inch well were pumped with a two-stage centrifugal pump. The water was carried sometimes as far as six hundred feet, sheet-iron sluices conveying away the used liquid with the sand and gravel driven before it. For a long time the water was turned back into the well, allowed to settle, then pumped over again.

His application of hydraulic mining principles to waste real estate is bound to change Mr. Whitney from an engineer of moderate means to a land owner of wealth. There will be at least one hundred lots in a most desirable location, whose total value should run close to one hundred thousand dollars. The cost was only nominal.

The reclaiming of many acres of useless land has been effected in many American cities, notably Washington and New York, and in many ways; but the use of hydraulic power for that purpose is an innovation.

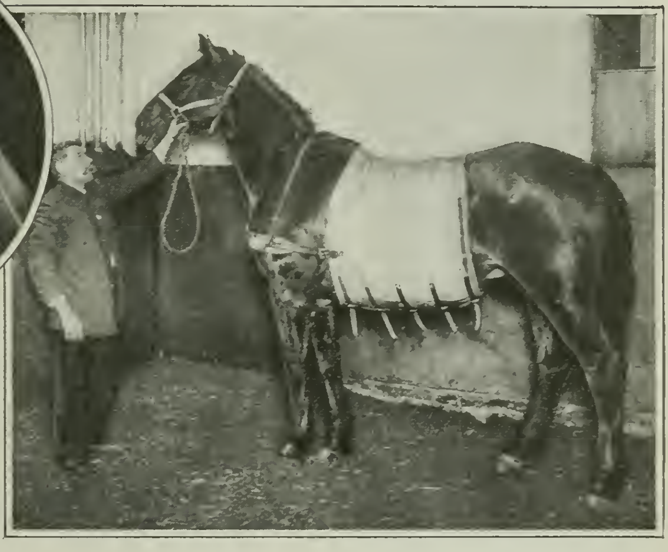
How the work was done. The hills were washed away with water which carried the mud formed down into the marshes

Purifying Iron in a Vacuum

An entirely new method of producing pure iron is reported to have been discovered by Trygve Yensen, an assistant in the engineering experiment station at the University of Illinois. This discovery was made during an investigation of the magnetic properties of iron and iron alloys. His method consists in melting electrically refined iron in a vacuum, which reduces the impurities far below any point which had been reached by any previous investigator. The magnetic properties of this vacuum-fused iron have proved to be remarkable.

The Modern "Horse Doctor" and How He Saves Money

By A. M. Jungmann



This terrier is suffering from a compound fracture of both hind legs. He fell from a fourth-story window. To the right is shown a sick horse. He developed pneumonia when a barge containing horses for the Allies was sunk in the Hudson

ONE million dollars is a fortune—at least it seems so to most of us. Yet animal surgery is saving one million dollars a year in New Orleans, a city of about three hundred and fifty thousand population. As New York has fourteen times as many inhabitants as New Orleans it is safe to assume that animal surgery means fourteen million dollars to New York every year.

"Oh, it's only a poor dumb animal!" is a wasteful expression of a wasteful thought. When the value of the poor dumb animal is considered in dollars and cents he immediately becomes important. Science has discovered that animals are worthy of attention because of themselves—or their economic value.

The good old-fashioned "hoss doctor" is disappearing and in his place we have the veterinary surgeon. The man who intends to devote his life to the health of animals is a man of scientific training who takes his profession as seriously as does the physician to human kind. You cannot hold yourself out as a veterinary surgeon any more than you can proclaim yourself a doctor or a lawyer without being one. In the Regent's Examinations veterinary science is classed with law, medicine, dentistry, etc. The United States has twenty-two veterinary colleges as against twelve ten years ago. There are between three and four hundred teachers and about three thousand pupils.

The American Society for the Prevention of Cruelty to Animals has been making an appeal for the protection and conservation of animals for years. Undoubtedly it has accomplished a great deal even when it has based its appeal on humanitarian motives. But in New Orleans, where the figures show that by adopting more efficient methods, the lives of its mules and horses are lengthened and the city is actually saving a million dollars a year, the Society has made a direct commercial appeal for the rational treatment of animals. Once the owners of large numbers of horses and mules were convinced that by better care they could get more work out of their animals they were only too glad to coöperate in every way with the agents of the Society.

The cat miscalculated the speed of an automobile. He almost got out of the way, but a paw and his tail didn't

According to the figures published by the Department of Agriculture there are about one hundred and ninety one million domestic animals in the United States and they are worth, roughly, six billion dollars. Is it any wonder that science has become interested in animals. There are approximately twenty-one million horses in the country, representing an investment of two billion, three hundred million dollars. The despised mule may not be so despised when you consider that he represents five hundred and sixty million dollars of our total wealth and that his kind numbers about four million five hundred thousand.

Purely as a question of national economy veterinary science should be encouraged.

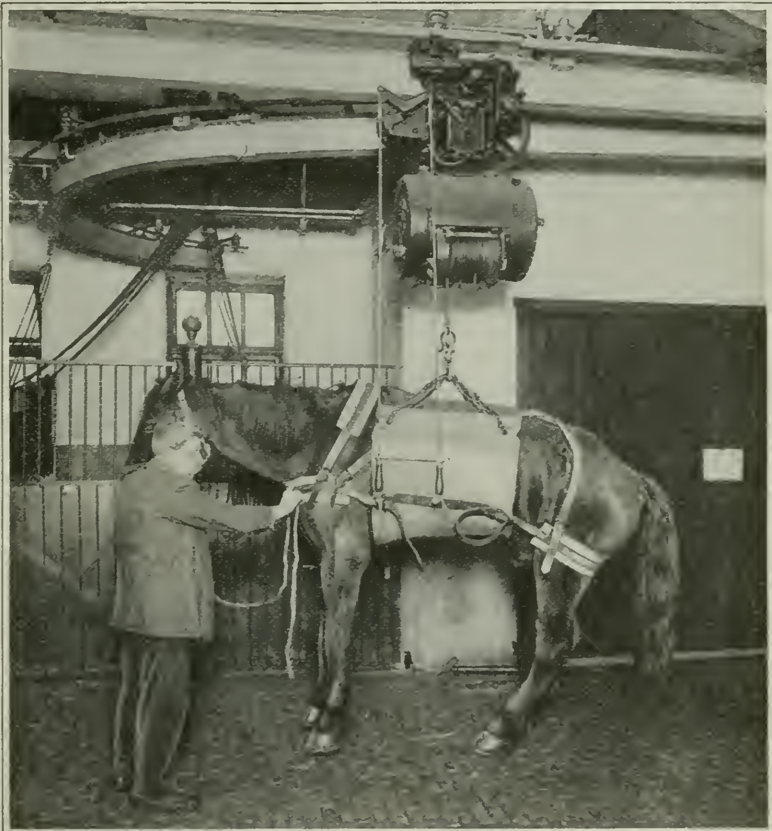
The successful veterinary must be, first of all, a good diagnostician; for his patients cannot help him by describing their symptoms. On the other hand, they cannot mislead him by withholding the truth, as human patients are prone to do. Another essential is a natural sympathy for animals. This is particularly necessary; unless the doctor can gain the confidence of his animal-patient it is exceedingly difficult for him to obtain satisfactory results.

Animals are subject to many of the diseases that afflict human beings, and besides these they suffer from a number peculiar to their own species. Horses are liable to pneumonia and unless very carefully treated the disease is likely to prove fatal. One of the most serious ills to which horses are subject is known as "azoturia," meaning to the lay owner and driver spinal trouble. The horse more likely to suffer from this

The horse sustained injuries to both fore legs. A few years ago he would have had to be killed, but now, thanks to this very modern method of treating animals, he will be as good as ever in a month's time. The use of a local anaesthetic prevents the horse from feeling any pain during the operation terrible malady than any other is the city work horse whose driver thinks he is doing the animal a kindness by overfeeding him on Saturdays, half-holidays and Sundays.

A horse suffering from azoturia will drop in the street and be unable to rise. His hind legs rendered useless, the animal loses control over his legs. Death may result in a few hours. At best the horse may live several days, suffering intensely. If a horse which has fallen in the street is hurried to a hospital he sometimes recovers. The disease is steadily increasing among city horses and is the cause of the greatest anxiety to veterinary surgeons. If horse owners would cut down their horses' feed during the days of rest or would see that the animals are exercised when full rations are fed there would be no danger. Every work day following a Saturday or Monday holiday the veterinary hospitals are crowded with unfortunate azoturia victims. Despite the progress of veterinary science, azoturia is as baffling to the veterinary to-day as it was twenty years ago.

The animal hospital is conducted in much the same way as if its patients were human beings. Everything about it is sanitary to the last degree. It is divided into accident wards and contagious wards; it has perfectly equipped operating rooms; and it requires a number of ambulances. In the model animal hospital maintained by the American Society for the Prevention of Cruelty to Animals in New York city, every possible provision is made for the care and comfort of the patients. The white-tiled wards are all thoroughly sanitary. The cat and dog wards have white cages in which the patients are kept.



The victim of a street accident. This horse cannot walk. So he is being conveyed from the ambulance to the operating table by means of a trolley. He is an unusually large horse but his feet just clear the floor. He is supported by the sling and a man keeps his hands on head and chest, both to reassure the horse and to prevent him from turning around

The Department of Health sends all rabid dogs which have bitten persons to this hospital. Here they are kept in a large ward by themselves. If, at the end of twelve days, they show no signs of rabies they may be returned to their owners; if they develop the disease they are humanely killed. When the small patients have recovered sufficiently to take exercise they are allowed the privilege of a specially designed roof-garden, but only for the number of hours prescribed by the doctor.

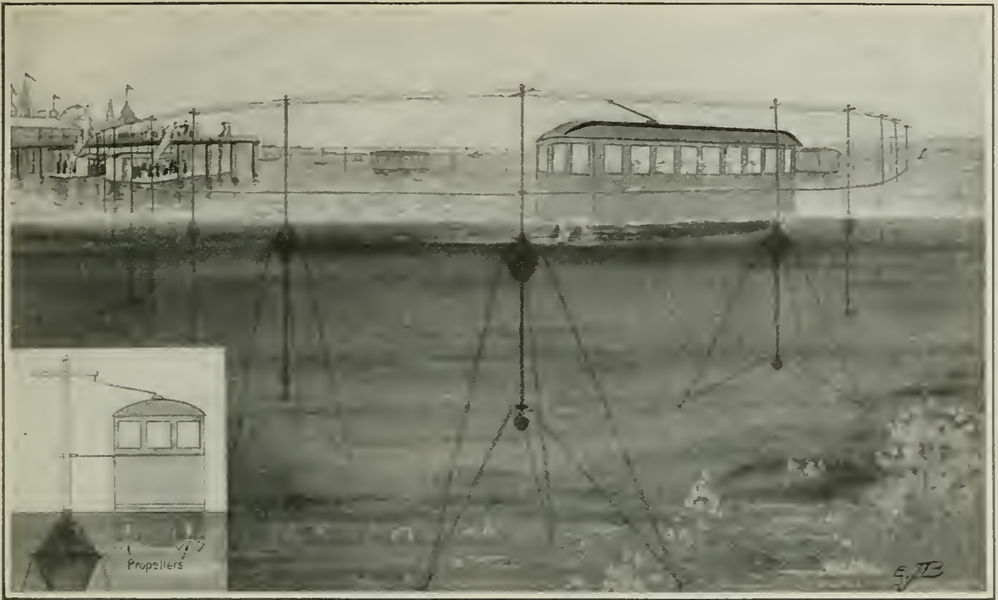
Because of their size and weight, the handling of wounded or sick horses has always presented a difficult problem. That problem has been most admirably solved in the hospital of the American Society. As soon as a horse has met with an accident in the street a policeman or the driver immediately sends for one of the A. S. P. C. A. ambulances. A big automobile ambulance responds, and the ambulance surgeon gives what aid he can. The running-board of the ambulance is drawn out. It is but the work of a minute to rope the horse's feet. At a given signal the ambulance attendants pull the ropes, thereby turning the horse over, so that he lands on the running-board. He is then firmly strapped to the board, and an electric motor inside the ambulance hauls the running-board back into place. While on his way to the hospital the horse is as comfortable as possible. When the ambulance reaches the hospital it is driven on a large elevator which takes it up to the top floor, where the operating room is situated. If the horse is unable to walk, a sling is passed around him while he is still attached to the running-board. The sling is then fastened to a trolley which leads into the operating room. He is laid upon the table without once having had to make the effort to stand.

When the animal's wounds have been dressed, he is trolleyed out of the operating room and into the ward and placed in one of the stalls. A horse which cannot stand is slung up and kept in the sling until he regains the use of his feet.

The operating table is fascinatingly ingenious. The horse is made to recline on a cushioned frame. Although perfectly comfortable he is so firmly strapped in the frame that he cannot hurt himself by kicking or struggling. The table can be raised or lowered by a lever, so that the surgeon may perform his work as easily and as expeditiously as possible.

Dr. T. S. Childs, the surgeon at the head of the hospital, has performed some remarkable operations on horses. One of his charges was a famous racer which had fractured the bone above the hoof. When the horse was placed on the operating table Dr. Childs found that the bone was so badly fractured that it had penetrated the skin; aside from being broken the animal's leg was badly lacerated by the bone. Part of the bone had to be removed, after which the leg was set. The leg was then placed in a plaster cast in which a small hole was left for draining the wound. The patient was supported in a sling but he appeared so unhappy that the doctor allowed him the liberty of a large box stall, one of the hospital's "private rooms." There he finally recovered. This horse was very intelligent and seemed to realize that everything was being done for his comfort. He took the best of care of

A view in one of the wards. The horse which the surgeon is dressing was seriously wounded by backing into a large steel hook which tore through the flesh of his tail and came out over his hip. He is a valuable cavalry horse and is the favorite mount of one of our colonels. Although his injuries were such that he had to submit to an operation, he will soon be back doing what he can for preparedness



The seventh heaven of a bather's delight is to be attained in this floating trolley-car—according to its inventor. The favorite recreation of letter-carriers is said to be walking. On the same principle city-dwellers presumably must bathe in trolley cars

his hoof, learned to hobble around on three legs and even acquired the trick of lying down and getting up without placing any weight on that leg. Four months in the hospital would be an expensive period for an ordinary horse. But this one was valued at $50,000.

Another remarkable case which Dr. Childs handled successfully was that of a horse which had broken three ribs. To-day that horse is back on the street.

These cases are mentioned only to give an idea of the work which is done in the field of veterinary science. Cats and dogs are brought to the hospital with rubber bands wantonly placed around their tails, legs or necks. The bands cut into the flesh and cause the animals to lose their tails and often their legs.

Cats seem to have a habit of swallowing needles. When a cat is brought to the hospital suffering with a cough Dr. Childs looks for a needle. In one instance he operated on a cat to remove what he thought was an ordinary needle. He found a hat-pin nine inches long. But the cat's life was saved. Dr. Childs has distinguished himself as much by his work among small animals, such as cats and dogs, as he has among horses.

The Trolley-Car Boat for Bathers

A FLOATING, electric passenger car service combining the pleasures of boating with the conveniences of trolleying is the daring proposal made in a recent patent. The trolley-boat is intended to enliven seashore bathing-resorts, as if they were not lively enough now. The cars used are similar to ordinary trolley cars, but, instead of being mounted on wheels, they have two oblong floats, pointed at their front ends for cutting through the water. At their rear ends are propellers.

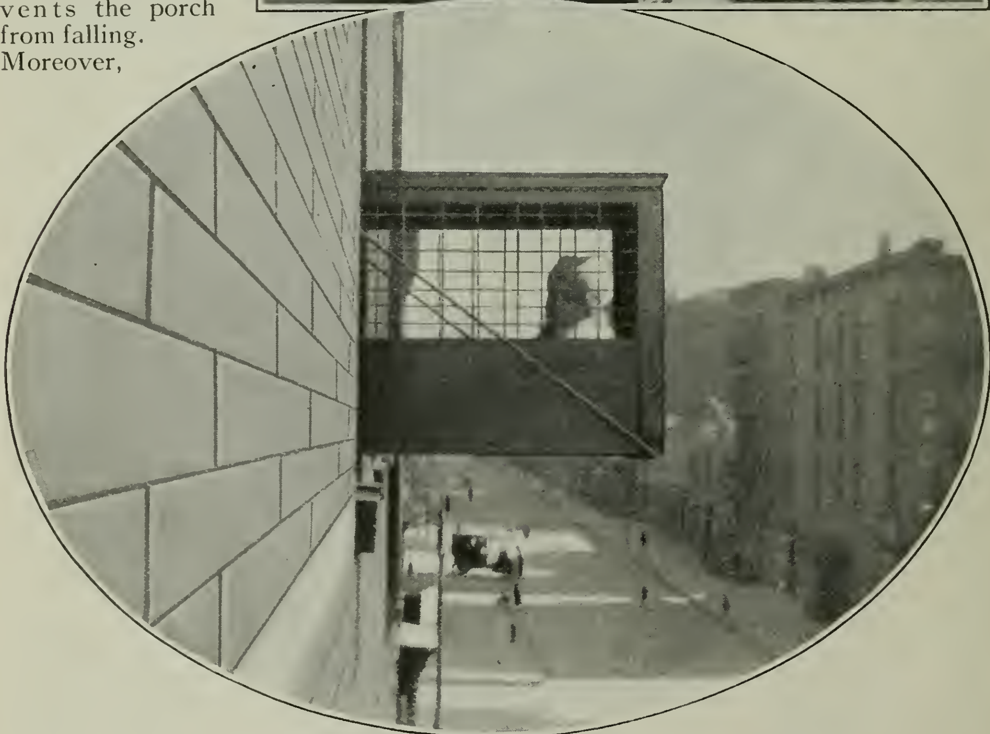
The current is supplied by conductors, supported by cross-beams attached to steel poles. Each pole has a weight at the bottom and a buoy in the middle, just submerged in the water. The whole structure is anchored to the sea bottom with chains. The weight maintains the vertical position of the pole; and the buoy, remaining at the same distance below the surface, makes it possible to run the cars at high or low tide.

The car is supplied with a regular trolley-pole, provided with three contact wheels, one pressing against the under surface, and one on either side of the conductor. On the tops of the poles are electric lamps for illumination at night.

Outdoors Yet Indoors

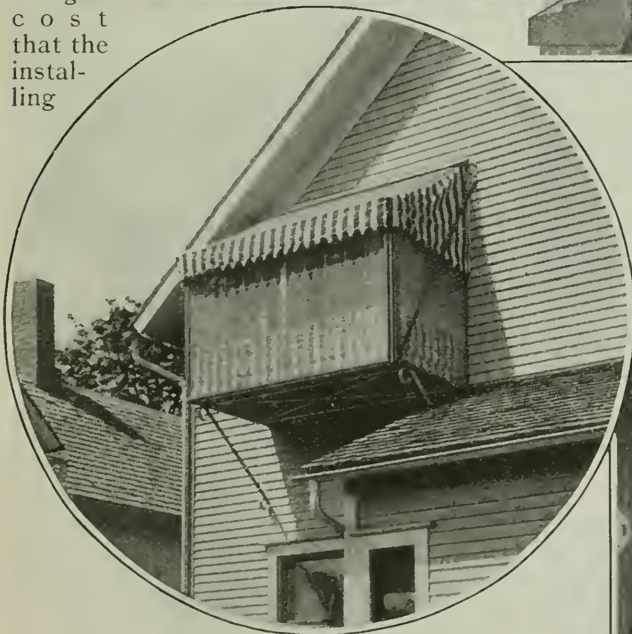
IN an effort to solve the fresh-air problem for city babies several enterprising inventors have devised arrangements whereby youthful Americans can be given all the fresh air they need and given it in perfect safety, at the same time allowing their busy young mothers plenty of time to do housework. As a result, manufacturers have already produced for the market tiny sleeping-porches which can be placed outside any window.

An iron brace capable of sustaining a weight of five hundred pounds prevents the porch from falling. Moreover, stout braces anchor the cage to the side walls in such a way that the strongest of winds are robbed of all danger. Another feature of the miniature sleep-



One hundred feet in the air—a sleeping-porch for babies ing-porch is that the baby cannot get out, nor can flies and mosquitoes come in. Into this tiny compartment rolls, if desired, a baby carriage so that the effort of the mother in taking the baby in and out is reduced to the minimum.

For grown-ups a similar sleeping-porch has been devised. Of course it is much larger, much more elaborate and more expensive. In order to diminish the high cost that the installing of a sleeping-porch usually entails, a western manufacturer has put on the market a hanging sleeping-porch to be suspended from stout iron straps lugged to the side of the building. The porch fits over the window of the bedroom and is provided with curtains which can be raised by cords from the bed. The porch has been so carefully designed that, when properly installed, one of them will sustain a weight of about a thousand pounds. This contrivance will not disfigure the appearance of any dwelling and is not expensive.



Above, the way the baby sleeping-porch is applied and used in a city flat. Below, another view of a similar device. At the left is a sleeping-porch, easily applied, in which a grown person can sleep in safety and unmolested comfort

Soldering-Iron Has New Principle

AN electric soldering-iron which heats the object to be soldered only at the actual point of contact, thereby doing away with much of the loss of heat

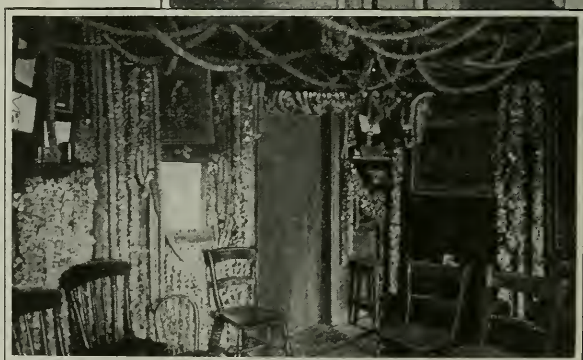
To obviate loss of heat by radiation, this soldering-iron has been invented. It heats the object to be soldered only at the point of direct contact

by radiation in the old-fashioned iron, has been put on the market for work of all kinds. The iron, which is made in various sizes, is connected with a step-down transformer.

Heat for soldering is generated by the resistance of carbon or carborundum contacts against which the object to be soldered is placed. The other contact, through which the current flows, is metal and will heat but slightly. No current is used until the object to be soldered is placed between the brass and the carbon contacts. It is said that with this new form of electric iron, soldering can be done in about half the usual time.

A Room Papered with Postage Stamps

WITHIN easy walking distance of the old cathedral town of Chichester, England, is the "Rising Sun," in North Bersted, a house of interest to all who collect stamps. This small inn contains a room every inch of which is covered with postage stamps. Ceiling, walls, doors, chairs, tables, picture frames, every part of the room, except the floor, is thickly covered, while from the ceiling hang long festoons and ropes, made of bundles of stamps for which there is no other place. Fully two million stamps are pasted up, and a million more hang in the festoons. Great bundles, one of which contains sixty thousand stamps, hang among the heavy loops.



Of all English inns the "Rising Sun" is the most curious. It has a room, every inch of which is covered with postage stamps—ceilings, doors, picture frames and tables. There are so many stamps that some have to be disposed of in long festoons and ropes, which hang from the ceiling

The Chair-Car—the Latest Development in Stagecoaches

MINNESOTA has returned to the good old days of the stagecoach, although those of the natives who can recall the romantic journeyings of the clattering vehicle would have some difficulty in recognizing the coach in its revised, 1916 edition. The cracking blacksnake whip, the plunging horses and the picturesquely cursing driver give way to the almost silent whirring of a gasoline motor. In place of the hard and crowded seats, there are soft leather chairs, with comfortable, springy backs and an arrangement of springs in their bases which absorbs all the shocks that the shock-absorbers of the vehicle itself overlook.

Gone also is the close confinement of the stuffy old coach, with its romance-nourishing darkness, where the young adventurer could hold hands in perfect safety with some fair passenger. For the new highway coach is brilliantly lighted by great round windows, not unlike the portholes of steamers. At night, incandescent bulbs shine in the ceiling.

This modernized stagecoach clips off the distance between Minneapolis and St. Paul over fine macadam roads. The fare is twenty cents, which lifts this particular highway coach from the despised jitney class.

The modern stagecoach looks like a ship

Inside, the seats are comfortable and there is plenty of light

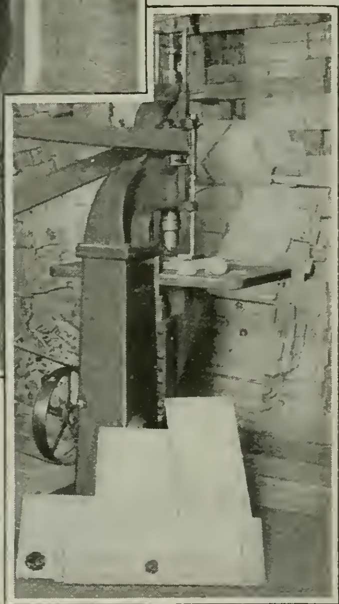
A soda-fountain table that is convenient and sanitary and handsome as well

A Sanitary Refreshment Table

An attractive and extremely durable restaurant table is made with heavy metal legs and four swinging stool seats of mahogany or oak finish. When unoccupied these stools are out of the way under the table.

The tops are noteworthy. They are pure white, of a solid material, made by melting crushed onyx at a temperature of two thousand six hundred degrees Fahrenheit. This material does not absorb or craze, is as easily washed as glass, is unaffected by acids, and strong enough to endure hard usage.

In addition to being a very compact and handy arrangement for ice cream parlors, especially in small stores, these tables can also be used outdoors, obviating the trouble of carrying chairs as well as tables.



A machine which cleans out knot-holes and then plugs them with a solid piece of wood

A Machine Which Plugs Knot-Holes

THE machine shown in the accompanying illustration is the invention of Merton J. Miller, a wooden-box manufacturer, of Los Angeles, California. Designed for the purpose of assisting in the plugging of knot-holes in box shook, it may be equipped successively with two different sizes of circular bit-like saws—one of which is used to eliminate the knot or reduce the knot-hole to a perfectly round hole, and the other of which, slightly larger, cuts the plugs used to close the holes.

The plugs are inserted in the shook by hand and fastened in place with crimper nails. Plugs are usually kept in stock, of various thicknesses, and as the lumber is cut up into shook the pieces containing loose knots or knot-holes are laid aside and later transferred to the boring machine. Box lumber is generally of rather inferior quality, and hence full of knots; and by the use of this machine a very great saving in lumber footage is made possible. The plugging of knot-holes in this way in a box factory that turns out ten thousand feet of box-lumber in a day can be done by one man working only three or four hours per day.

Earrings that Denote Widowhood

THAT India is a land of curious customs is confirmed by examining the accompanying illustration. This woman is a native of Garo, a province of Eastern Bengal. She is a widow; but instead of wearing black crêpe, she dons these ponderous earrings made of solid brass. Since her widowhood is perpetual, she is obliged to wear them the rest of her life. Each year another ring is added. The large number of rings would seem to indicate great age; but in India girls are married when only five or six years of age, and frequently are widowed at eight or ten.

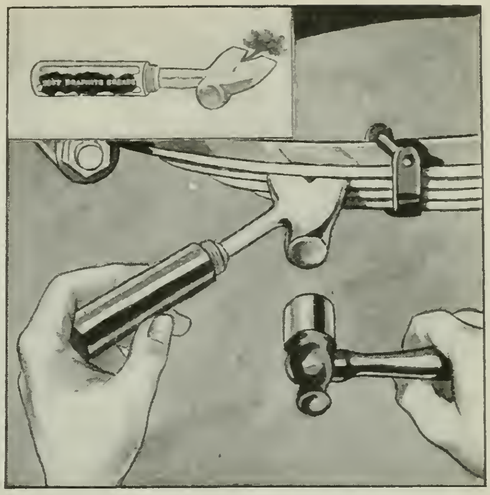
The constantly increasing weight of metal stretches the lobe of the ear, to which they are attached, in the extraordinary manner depicted. It is safe to say that no widow ever forgets the fact of her widowhood when wearing such a clumsy weight.

She is a widow. Her earrings are a badge of mourning

A Tomahawk Grease-Gun

COMBINING the advantages of a grease-gun with that of a spring-separating device, the tomahawk spring lubricator is a most interesting new tool. As the illustration shows, it is a small steel tomahawk, the hollow handle of which is filled with soft graphite lubricant. By a turn of the wrist, this lubricant is forced through a canal into the "edge" of the tomahawk, and thence between the leaves of the creaking spring.

The directions for this tool are the simplest: Hold the edge of the hatchet against the spring to be lubricated, strike a blow with a hammer on the striking butt and turn the handle with the left hand. A goodly quantity of lubricant is promptly forced between the spring leaves. Although the tool is particularly intended for small cars, it can be used on any sized spring on automobiles or trucks. All that is necessary is a heavier hammer and a stronger blow.



Here is a device that saves hours of time in greasing the leaves of automobile springs

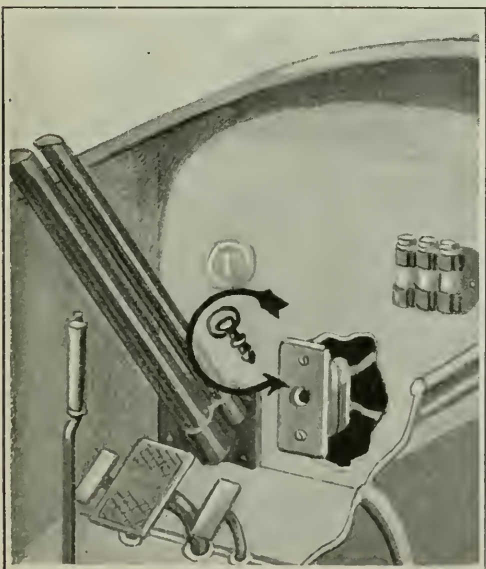
A Socket-Protecting Knot

AMONG the essentials required in the electrical element of factory operation is the convenience of the adaptable extension lamp. Considerable trouble is experienced in making plugs and sockets last more than a few weeks. Hence the scheme of putting a knot in their terminal wires, near the socket, before attaching to the cord. This serves for relieving strains and excessive bending of the wires, which in a short time break off, if left straight. Thus the life of the plug or socket is lengthened tenfold. This is a simple expedient, but it works.

Device Prevents Automobiles From Being Stolen

A NEW device intended for the safety of people who leave their automobiles standing on the street or in a public parking space fór long periods, has been invented. This is merely a switch which, when the plug is removed, grounds the magneto and prevents the engine from being started. When the plug is pushed in as far as it will go, the switch does not make contact; consequently the magneto is free from grounds. When the plug is pulled even part way out, the switch makes contact and the magneto is grounded, thus stopping the engine. This condition, of course, continues when the button is entirely removed.

No other type of plug could possibly be used to start the car. A ring on the plug can be attached to one's key-ring so that it will not be lost or misplaced.



This switch grounds the magneto and makes automobile thievery impossible

How a Second-Hand Automobile Made a Railroad Pay

THE Kansas, Southern and Gulf Railroad, a dream of the early 80's, was projected to traverse the wheat belt, connecting the Dakotas with the Gulf Coast. Work started at Blaine, Kans., and after twelve miles had been completed to Westmoreland, the county seat, the promoters could find no further sale for their bonds and had to abandon construction. For equipment they had two engines and two cars.

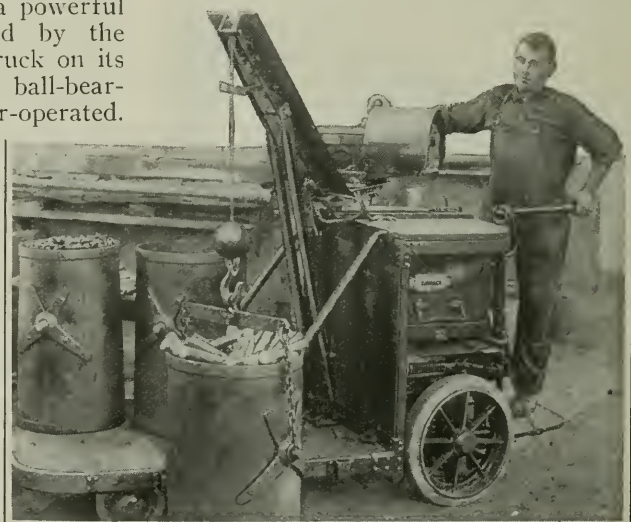
A second-hand automobile which made it possible to operate a bankrupt railroad profitably

The road never paid dividends, and even had to borrow money to pay interest on its bonds. About five years ago the engines wore out, and there was no money for repairs. The State took charge and appointed C. E. Morris as receiver. Morris traded the two locomotives for a reasonably good one and kept the trains going with some regularity. He also got a court order that let him raise the freight rates, and charge five cents a mile for passenger fares. But even this would not make the road pay expenses. About two years ago Morris disposed of the old engines and purchased a second-hand automobile. For the front wheels he substituted the trucks of a hand-car, and for the rear wheels two locomotive front wheels. The body had room for six passengers, besides the driver, and Morris built some miniature freight cars, by putting bodies on hand-cars. The road now has three freight cars, each with a capacity of two tons, and is not only giving satisfactory service, but is making money.

Lifting Made Easy

AN electric trailer-truck employed for shop and factory transportation has been equipped with a powerful and compact crane operated by the same energy that sends the truck on its way. The crane revolves on ball-bearings, and the hoist is motor-operated. The steel barrels loaded, have a weight of seven hundred pounds and the electric lifting arm will pick them up easily and lift them over the side of the truck. The platform of the truck itself accommodates three barrels. It is very hard to attempt to hand-truck barrels of such weight over perfectly smooth floors and over floors of uneven surface it is almost impossible.

The truck itself is also used for drawing trailers from one location in the factory to another, and with the addition of the new crane and lifting arm the trailers are easily loaded and emptied.



This truck runs around the shop and picks up and transports barrels and castings

The Screen Player's Make-Up

What the Camera Does to Your Face

By Horace A. Fuld

ANY textbook on light will tell you that white light is a composition of rays forming what is known as the spectrum, and ranging from violet and blue through green, yellow and orange to red. There are also rays and colors on each end of the spectrum, for instance, ultra-violet on the violet end, not visible to the human eye. The rainbow is a common example of the spectrum. When light strikes an object certain of these rays are absorbed. The unabsorbed are reflected, and the proportion of the reflected rays gives the object its color. Therefore light is a question of absorption and reflection. When light comes in contact with a brick all the red rays are reflected, which gives the eye the impression we call red. The corn flower, on the other hand, is blue because virtually all rays except blue and yellow are entirely absorbed. This, in brief, is the theory of color.

The ingredient common to every form of photographic film is a silver salt, in emulsion form, spread on a celluloid base. When white light is admitted through the shutter of the camera it strikes the iodide or bromide of silver and reduces it to a metallic state. Thus, in photographing a scene, light objects will be responsible for a chemical change in the salt, the extent of the change depending upon the brilliancy of the object.

The film is almost as sensitive to violet rays as it is to white light itself. Blue diminishes the sensitiveness but little. With the greens and the yellows we begin to notice a decided diminution. In other words the film is most sensitive to the violet end of the spectrum and least so to the reddish colors. This explains at once why red hair photographs black, for the film is almost entirely unaffected by these reddish rays.

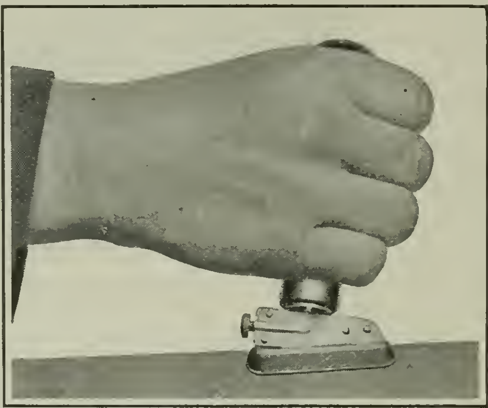
At left, J. Frank Glendon without make-up. Note the natural darkness of the skin. In middle, the same actor properly made up. Flesh tint lightens the tone of his face to the proper shade for motion-picture work. At right, the same make-up overdone, showing too much red on the face, eyes too heavily lined, eyebrows too black and too much red on the lips

Two more factors influence the use of colors in camera work. These are reflected light and intensity. When light strikes an object, so that some of it is absorbed while a portion is reflected to produce color, still another portion is reflected, without any change, as white light. This is known as reflected light. Illuminating the object enables us to photograph, as well as see it.

All these facts must be borne in mind by motion-picture actors. The colors that actors use in their make-ups differ. At one studio, for instance, red in varying shades is the favorite, with no special reason apparently; at another, blues are the subject of constant experiment. Theoretically the blues are the most sensitive, yet some companies insist that other colors be used. The net result of color on the film is gray, and provided the right tint is obtained, the color preference of the individual make-up specialists does not matter at all.

Browns are depended upon to make up Indians, Malays and other characters of dark skins; but a very little brown goes a long way, for brown is a combination of red, black and grey, evidently a dangerous and dark-colored combination.

For mulattos or negroes a darker shade of the same pigment is all that is required, although there are special preparations for the negro make-up. Of course, our knowledge of film color-value teaches us that other dark tints might be used instead of brown or black, but the use of the correct color has another advantage. It tells the usually ignorant "super" or "extra" what he is for the moment. There is a good deal in feeling the part, most actors tell us.



Any sort of cardboard box can be opened without breaking the contents if this handy knife is used

Occasionally an actor will be found with a peculiar skin, one that contains unusual pigments, and it invariably photographs very dark. The cure, in case of extreme darkness, may occasionally be accomplished in the developing room. Ghastly faces to accompany death scenes are obtained by a liberal application of white make-up.

Both facial make-ups and costumes are influenced by the color of the background. An experienced actor, called in to take part in a certain picture, will, before making up, carefully examine the color of the set in front of which he is to act. He does not want to make up, especially in the matter of clothing, too nearly the color of the set, for in that case he would not stand out from the background. Yet he has a still greater fear of dressing so as to create too sharp a contrast, for too great contrast is the despair of the man in the darkness who develops the film. If an actress wears a white shirt-waist against a black background, one of two things happens, either the film is over-exposed, or it is under-exposed. It takes much less time to develop the white than it does the black, and if both are shown in contrast in the same scene, one or the other will suffer. This theory of contrasts also holds for the colors. Reds and blues make a poor combination, either in the setting or in the actor's or actress's clothes, or in the facial make-up, for the blues develop faster than the reds. In fact, it is always better to use in one scene adjacent colors of the spectrum.

Occasionally you will notice an actor or actress with lips and cheeks to which the color has been too liberally applied. This is over-zealousness in an attempt to counteract the blue rays from the overhead lamps by means of which the studio scenes are lighted. As all lamps in common use give off a large percentage of blue rays, reds and yellows suffer in proportion, so that it becomes necessary to apply a color that will compensate this elimination.

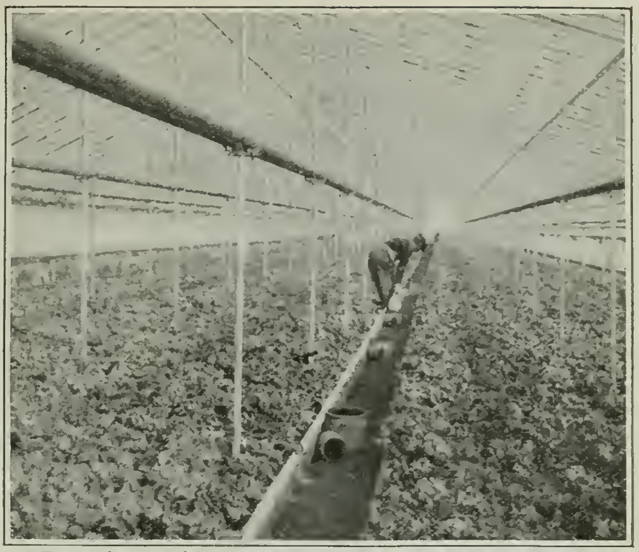
Novel Box-Opening Knife

A NOVEL knife for opening pasteboard boxes of groceries and in fact any sealed cartons without danger of cutting one's fingers or projecting the knife into the contents of the box, has been recently invented.

The knife is a short blade projecting centrally from an angular shoe, the sides of which are at right angles to each other, so as to form a channel adapted to run smoothly along the edge of a box while the blade slits its edge.

Poison Gas for American Pests

GAS that is far deadlier than the poison gases that are used on the battlefields of Europe is employed daily in America for purposes of stamping out pestilential beetles, moths, and vermin of all kinds. Hydrocyanic acid gas will kill a man if he inhales a single lungful. Yet its deadliness, when controlled by man and directed against his many small destructive enemies, is so desirable that the Department of Agriculture has issued an order requiring citrus crop growers in California to apply it to their plants to combat scale, the mealy bug and similar destroyers.


Preparing to rid a greenhouse of insect pests by means of deadly gas

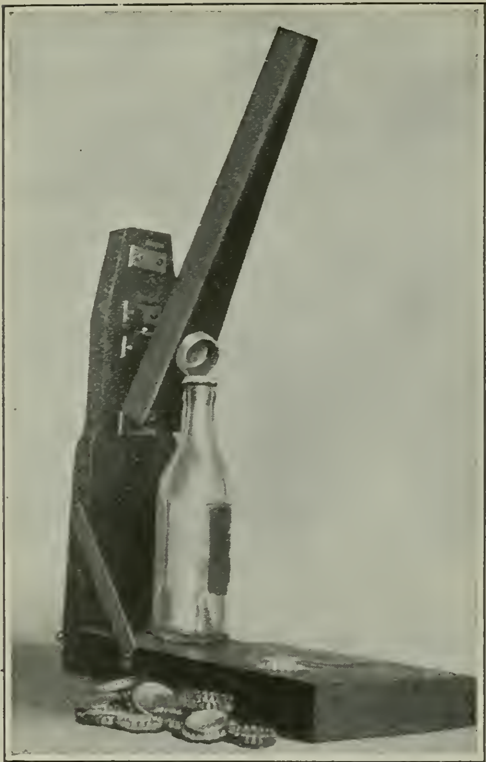
The gas is produced by dropping tablets or measured amounts of cyanide of sodium into sulphuric acid. The room in which the gas is generated is well sealed. Different plants require different amounts of the gas for thorough fumigation, the dose of sodium cyanide varying from five ten-thousandths to five thousandths of an ounce per cubic foot of air space. The former amount is sufficient to kill ordinary green flies; the latter will deal death to sow bugs.

A Fire-Fighting Trolley-Car

DULUTH has a fire-fighting trolley-car which is used for detached suburbs where poor roads or other barriers prevent ready response by motor or horse equipment to alarms of fire. The harbor of Duluth is formed by a narrow strip of land extending across the western end of Lake Superior. This strip of land, four hundred to six hundred feet in width, extends for a distance of seven miles from the Minnesota to the Wisconsin shore. About three miles of it, extending from the Duluth shore, is built up with summer houses and permanent residences of expensive construction. This suburb, Park Point, is so narrow that only one street is laid out, and on this street the track is laid.


A suburban fire department which finds an old street-car an efficient motor fire-engine

The city purchased a streetcar which had outlived its usefulness, but which was still in fairly good condition. After the seats were removed a hose-box was installed the whole length of the car and left open at both ends, so that no matter in which direction the car is going, it can carry the hose line from the hydrant to the place where the fire is located.



An easily operated machine for putting "crowns" on bottles

A Bottle-Sealing Machine for the Home

A SEATTLE inventor has patented a light, inexpensive bottling-machine, operated by hand, which may be folded into a compact form. It has a hand-lever with a metal device shaped like an inverted cup mounted near the fulcrum on the under side, so that a pressure of approximately three hundred and fifty pounds is exerted upon the metal caps used to seal the bottles. The lever may be hinged at four different heights to accommodate four different sizes of bottles, so that the bottle-sealer is very convenient for bottling fruit juices, cider or spring waters at home. The metal caps are obtainable at a very low price and are already crimped around the edge, but left flaring to fit over the rim of the neck.

The cup-shaped device on the under side of the lever presses the caps down and squeezes the flaring, crimped sides together, thus sealing the bottle air-tight, since the caps are lined with a cork pad. The machine is constructed of wood and measures about fourteen inches in height and the same in length when set up. It can be packed flat, since the base and upright bar fold together, and the lever is removable.

An Electric Fan Suspended by Its Own Wire

AN ingenious electric fan which may be used in any ordinary electric light socket is shown in the accompanying illustration. As the weight of the fan complete with its socket and guard is but slightly over two pounds, it may be suspended from any light-cord without injuring the connections.

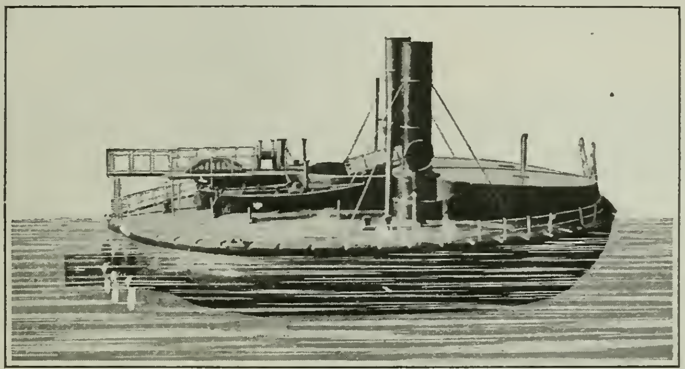
The five-inch fan is operated by a one hundred and ten-volt motor, suitable for either alternating or direct current. The blades run at high speed and throw an air current over a large area. It is said that this tiny fan has met with instant favor, as it saves the space and operating expense of the usual eight and ten-inch fans.

A fan which hangs in an ordinary lamp socket and cools a whole room

Ancient Battleship Ideas Revived

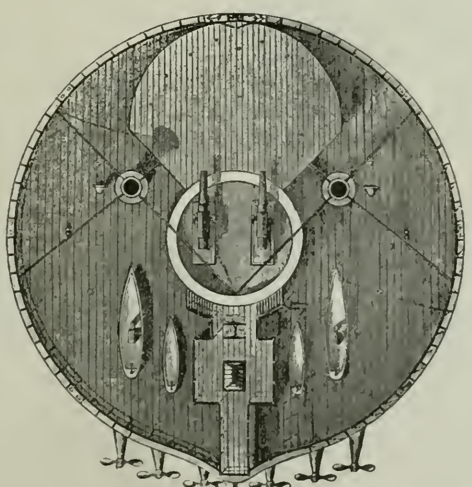
By Percival Hislam

MOST people imagine that the first armored ship was the "iron-cased frigate" *Gloire*, launched for the French navy in 1857; yet the Dutch built an armor-plated vessel nearly three hundred years earlier. That was in 1585, when Antwerp was besieged by the Spaniards. The Dutch took one of their biggest ships, cut her down and erected on the deck a battery with armored and sloping sides, within which they mounted eight of the heaviest guns the factories of the day could produce. The roof of the battery formed an armored breastwork for men armed with cross-bows and shot-guns, and there were gratings in the roof to provide ventilation for the battery below. A redrawn contemporary picture of the *Finis Belli*, as she was called, is reproduced herewith; and notwithstanding the lapse of time, she bears a striking resemblance to the *Merrimac* of the Civil War, which was designed and built on precisely the same principles.



The "Finis Belli," built in 1585, the first armored battleship, and precursor of the "Merrimac" and all armed ships

More than sixty years before the first dreadnought was designed, the famous American engineer Stevens laid down at Brooklyn an "armored battery" which had five gun-positions out of seven on the middle line. In order to save length, the other two guns were placed slightly *en échelon*—a system of mounting found in many British and German dreadnoughts to-day. The Stevens battery would have been able to fire all her guns on either broadside. Unfortunately, she was never completed, and after being on the stocks for over forty years was sold as scrap-iron.



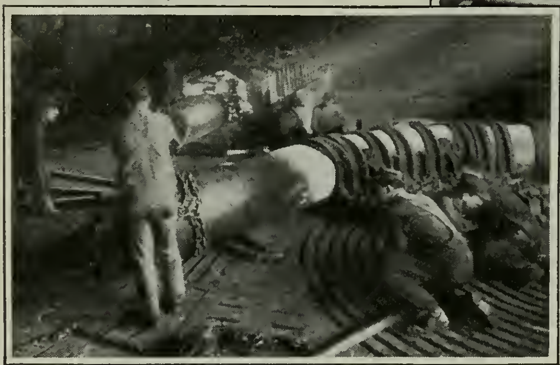
A circular warship of Russian design with six propellers. Two were built, but proved utterly unmanageable at sea

The other illustration depicts a remarkable type of ship built for the Russian Navy in the seventies. They were absolutely circular and fitted with six screws apiece, the armament consisting of two twelve-inch guns in a revolving barbette in the center. Two of these vessels were built, the *Vice-Admiral Popoff* (after the designer) and the *Novgorod*. They proved absolutely unmanageable in anything but a mill-pond, though the idea might have some practical use for coast defense.

Pipe Bending—A Growing Industry

THE growing use of bent pipes in various branches of engineering has called for a systematized method of bending, a process involving mathematical calculations of some difficulty.

Pipe-bends have a variety of applications, among which are the following: to provide flexibility and to compensate for contraction and expansion of steam-lines; to reduce the number of joints, and thereby losses, in pipe-lines; to avoid obstructions such as columns, pipes, etc.; to reduce friction in piping. The commonest use of pipe bends is in the construction of heaters and refrigerating plants. In the accompanying photographs, two large pipes in process of bending are shown. Heavy crane machinery is employed, and great pains are required in applying the heat correctly.



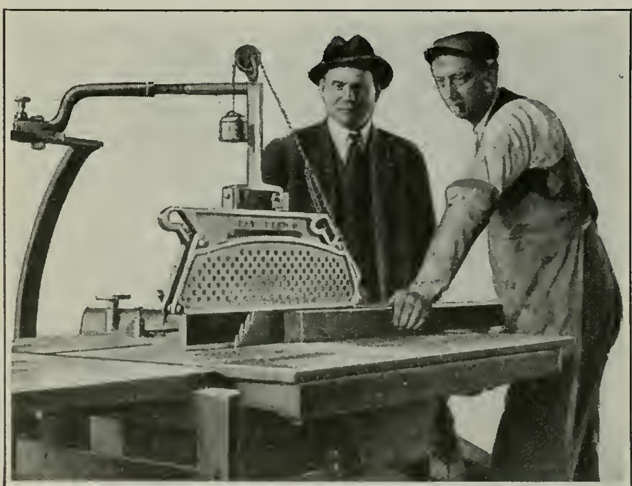
Pipe-bends are necessary to provide flexibility and to compensate for contraction and expansion of steam-lines; to reduce the number of joints, and thereby losses, in pipe-lines; to avoid obstructions such as columns, and to reduce friction in piping

A Saw-Guard Which Has a Clean Record

ALTHOUGH in use in various mills for the past three years, a saw-guard manufactured in Ohio has to its credit a record of no accidents of any kind. The guard is suspended from a bracket over the table and covers the saw completely.

When a board to be sawed is pushed against its lower front end, it automatically rises until the board is under it. When the board has passed through, the guard drops back in place. A small pulley against which the board is pushed, and an arrangement of levers causes the guard to be raised.

The value of this guard as a safety appliance cannot be over-estimated, since saws have always been a source of many accidents.



When a board to be sawed is pushed against its lower front end this guard rises, but when the board passes through, the guard drops

When Should Children Be Held Upside Down?

GREATER love for children hath no man than the one who discovered that the lives of many little children can be saved in certain emergencies, if they are held upside down.

Held upside down, the child's face is safe from the flames

When the clothing of children catches fire if a third of the child's flesh is burned, inclusive of its chest or head, it is very likely to die. Yet if the little one is held upside down immediately after its garments have caught fire, the child's life may be saved.

The three-year-old tomboy daughter of a United States Senator was playing a war game with some boys. They were gathered around a camp-fire when the wind carried an ember in her direction and set her clothes on fire. Corporal Hopkins, who had served in an emergency hospital, happened to be at hand.

He seized the little girl by her ankles and held her head down, not an instant too soon. The flames were just about to burn her bosom and curls. Flames have a tendency to rise and a child's face, hair, lungs, heart, and chest are the vital parts first endangered.

Another emergency which demands that the child be held upside down by its legs or feet, is when it swallows a fish-bone, a coin, or a piece of candy.

The coin tumbles out promptly

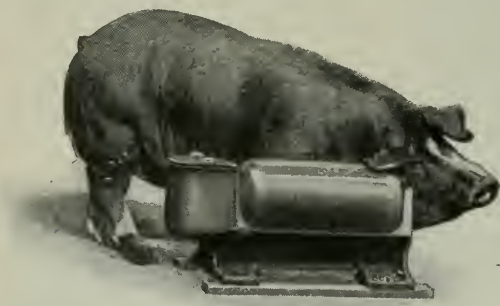
On the face of one hammer is a Maltese cross which is forced through the check when struck with the second hammer

Canceling Checks with a Hammer and Anvil

IN Cumberland County, Pennsylvania, one of the largest and wealthiest counties in the Keystone State, the Board of County Auditors still uses an ancient method of canceling all checks given in payment of bills by the county treasurer and by the treasurer of the Board of Poor Directors. The apparatus, shown in the accompanying photograph, generations old, is composed of a block of oak, fourteen inches high and ten in diameter, and two ordinary-looking hammers. On the face of one is a Maltese cross which is forced through the check when struck with the second hammer.

Hog-Power in the Hog-Pen

AN amusing sight can be witnessed on some of the large farms, where hogs in large quantities are raised, in the south and west. Large vertical galvanized-iron cylinders may be seen to revolve in the hog-pens, while the hogs, in numbers of ten or twelve at a time, trot busily around a cylinder, always in the same direction and sometimes at a speed nearly approaching a gallop. At first blush this procedure may seem like a recreation. But, the hogs are not playing at some new game; they are preparing their meal of ground grain, and the hog that is too lazy to trot and grind goes hungry.



The hog smears himself with an insecticide by rubbing against the roller

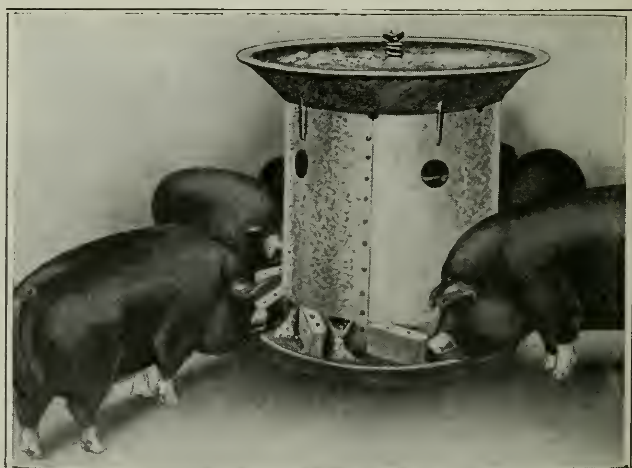
In the upper part of this revolving cylinder is a hopper or compartment into which the grain is poured. When the cylinder is revolved, a grinding mechanism chops the grain into fine particles suited to the palate of a well-bred hog. To secure this prepared grain the hogs must supply the motive power for grinding; and they supply it—with their snouts. A ring-like trough is attached to the bottom of the cylinder. Short wooden paddles project from the edge of the tank into the trough, and when pressure is applied to them they revolve the tank, grinding the grain, so that it flows in equal amounts into the spaces between the paddles. This grain feeder is virtually a "one-hog-power" machine as one energetic hog can revolve it.

Again, if you ever see a number of hogs pushing and jostling about a small device standing in the middle of a hog-pen, the object of their attentions may well be an apparatus which makes the hogs work to rid themselves of vermin, instead of forcing the farmer to spend weary hours spraying them with an insecticide.

The device consists of a steel roller set in a receptacle which is partially filled with an oily insecticide. The pigs find that when the vermin are troubling them, it is only necessary to rub against the roller, to end the trouble.

The appreciation of the hogs for these modern conveniences is absurdly comical in its actual working out, but these and similar hog inventions have done as much to make farming profitable in these modern days as many of the much more pretentious machines. The hog-pen takes up the slack end of the farm, and any devices which make them yet more independent of attention are vitally important. These appliances come the nearest to making hogs work of anything yet discovered.

Another apparatus by means of which the hogs apply insecticide to themselves and save time and trouble for the farmer



The hogs prepare their own meals by revolving the cylinder with their snouts. As the cylinder turns, it grinds the grain to feed the hogs. Lazy hogs go hungry

A Scientifically Designed Train-Announcing Megaphone

A GIGANTIC megaphone for announcing the arrival and departure of trains at the Pennsylvania Railroad's terminal in Washington, D. C., has been developed to such a degree of success that sounds emitted by it reach clearly to every corner of the huge station, despite the fact that the announcer is not required to raise his voice much higher than an ordinary conversational tone. The megaphone, which is mounted on a high wooden platform, is interesting, not only because of its gigantic proportions—for two men could crawl inside and hide comfortably—but also because it is the culmination, of a great many painstaking experiments.

A. M. Keppel, who is the designer, has tried out in the huge horn almost every applied principle of acoustics. A dozen horns of various sizes, shapes and groupings have been installed, improved and discarded. The present megaphone is considered to be the most satisfactory of all. Probably the most important discovery in connection with all of the devices tried was that a flat horn carries sound with fuller volume and less distortion than a round horn of the same general proportions. Accordingly, a huge flat megaphone was built and a number of smaller horns were secured within it, all being controlled by a single mouthpiece. As it now stands the horn contains no inner megaphones. Long iron wires have been attached, extending from near the mouthpiece to beyond the end of the horn. Their purpose is to prevent echoing, and to purify and clarify the sound. The giant megaphone measures ten feet four inches across the large opening and eight feet in length.

A megaphone which was built to carry sound without the waste of a single vibration

Wagon-Loader Resembles Gold-Dredge

A WAGON-LOADING machine has been brought out which in appearance and operation is a replica in miniature of the huge dredges used in California and Alaska for mining surface-gold. To a chain passing around two pulleys, one at either end of a steel frame, small steel scoops or buckets are attached at regular intervals. An electric motor supplies the power.

A loader which is built like a California gold-dredge and which can handle one cubic yard of crushed rock in a minute and a quarter

Why Can't We Make Diamonds

WE can. But they are so small that a microscope has to be used to see them. There is no chemical difference between the graphite in your pencil, the coal in the kitchen stove and the diamond. All are forms of carbon, and the diamond is but crystallized carbon. The Kohinoor that blazes in the diadem of a potentate was crystallized by nature from something like coal.

Molten iron will dissolve carbon, just as sugar is dissolved in water. Like water it chills and solidifies when it expands. A French physicist, Moissan, heated a crucible containing a mixture of pure iron and carbon to a temperature of seven thousand degrees Fahr. He dropped the white-hot crucible into cold water. The resulting contraction produced great pressure, and in that pressure diamonds were formed, not Kohinoors, but microscopic crystals, each of which cost about five times as much as a natural diamond of equal size. Sir William Crookes, the distinguished English chemist, obtained minute diamonds also by combining great heat with great pressure. He exploded cordite, to which carbon had been added, in a closed chamber. In other words he used a kind of cannon the mouth of which had been sealed. If we are to make big, salable diamonds we must have far more powerful mechanism at our disposal. Some day that mechanism will be provided, and the diamond factory of Niagara Falls will compete with the Kimberley Mines of South Africa.

A Lace Curtain Protection

IN the summer, when the windows are opened, the housewife may be annoyed by the fact that the lace curtains blow against the screens, and become rusty and dirty. This can be avoided by placing a small tack at each side of the window and tying a piece of white cord from one tack, across to the other. This will keep the curtains clean.

When a person sits near the window he may be bothered by the curtain blowing against him. Now, if another piece of string is placed exactly where the first piece was, and the curtain is placed between the two, it will be kept there; and both difficulties will be solved.

Eliminating Pottery Waste

POTTERY-MAKING has been, until recently, one of the few remaining industries where the skilled workman held absolute sway. And even with the most skilled of firemen, the variation in the degree of heat in the kilns was still so great that the loss in ruined pottery and "seconds" was immensely high.

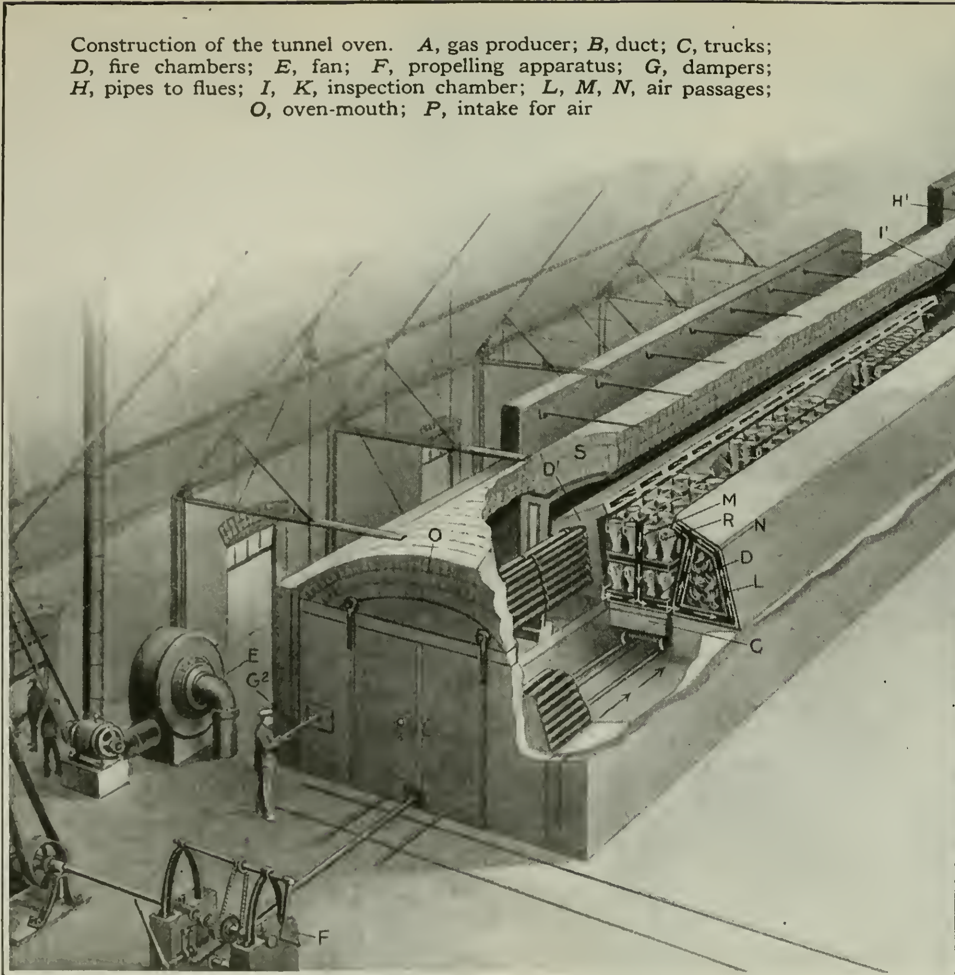
Not long ago an Englishman, Conrad Dressler, invented, for use in the glazing of wall tiles, a tunnel-kiln in which small carloads of material could be fired at once, and in which, by means of the generation of the heat from gas-producers, a saving in fuel up to eighty per cent could be affected. Not only this, but the temperature was kept so even that the wastage from ruined tiles and "seconds" was eliminated almost entirely, and the whole device could be controlled by unskilled workmen.

The oven has recently been applied to the kindred art of pottery-making, and in several large plants has taken the place of the old ovens, with vast saving to the company, though perhaps delivering a blow to that notable American industry, the five-and-ten-cent-store, where "seconds" delight the economical.

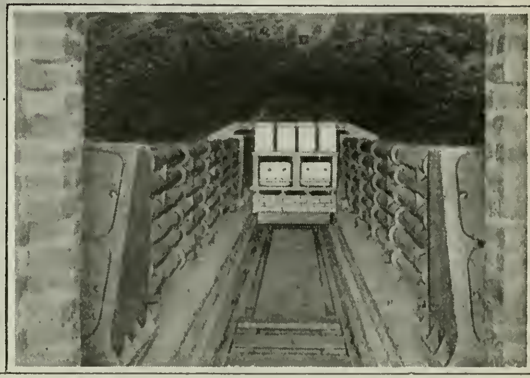
In pottery the clay bodies are changed in chemical and physical structure at a temperature varying from two thousand to twenty-five hundred degrees Fahrenheit, and to fall short of this temperature or to increase it unduly for any length of time, is to spoil the merchandise.

The gas from the producer enters the tunnel-kiln and is burnt, not among the wares to be baked, but in two long tubes running lengthwise of the tunnel, from which the fumes are carried off outside the kiln. The control of gas and air for its combustion is regulated automatically or at will, and is thoroughly even. The goods to be fired are put on the trucks, and propelled by a small motor, taking about one hour for the trip, not including the cooling in a heated chamber.

This kiln was first used in this country by a manufacturer of sanitary porcelain ware, and the scene reproduced here is from this American plant. The goods, in all cases, are placed on the shelves of trucks, which commence at two feet from the ground and rise to five feet for their trip through the long kiln.



Construction of the tunnel oven. *A*, gas producer; *B*, duct; *C*, trucks; *D*, fire chambers; *E*, fan; *F*, propelling apparatus; *G*, dampers; *H*, pipes to flues; *I*, *K*, inspection chamber; *L*, *M*, *N*, air passages; *O*, oven-mouth; *P*, intake for air



A Pottery Furnace built like a railroad terminal with real cars and tracks

A Fiendish Plant Which Thrives on Cattle

A PLANT grows in Persia, which kills by burying itself within an animal's nostrils or sides, the seeds there germinating and imbibing the moisture

A plant which fastens its claws into the nose or sides of cattle, kills them and feeds upon them

from the decaying body. No rain falls on the mountain plateaus of Persia during the whole summer. Vegetation is luxurious in the spring, when water in abundance runs down to the plains from the snow-covered mountain-chains and ridges. A merciless sun, and a dry desert atmosphere soon evaporate what moisture is not carefully stored by artificial means, and all plant life withers and dies, except desert thorns and some species of thistles.

During the spring the fat-tailed sheep and the camels enormously increase the fatty deposit in tail and hump. In two months' time bees store up honey enough for the rest of the year. All nature seems to labor overtime.

When the spring luxuriance of verdure is passing, our fiendish plant begins its deadly work. The fully developed seed pods, hidden under the withering foliage of brown and yellow leaves, fasten their tiger-like claws in the nostrils of a grazing camel, a wild ass, an antelope or a sheep; the animal tries to rid itself of the sharp prongs by rubbing, but the more it rubs the deeper it forces the claw-like tentacles into its tender, tortured skin. In many cases inflammation of the entire throat follows and the poor animal, unable to eat or drink, succumbs. That appears to have been the object of this fiendish plant, for it seems that only in the rich fertilizer of a decaying victim can it find enough nourishment for numerous offspring, which sprout from the hundreds of black seeds contained in its great, belly-like capsule. This is what the drivers of caravans say, and they hold the plant in fearsome awe, giving it many a bad name in their native tongue, such as "devil's flower," the "killer," and the like. The herds of breeding camels are left on the grazing grounds in a semi-wild condition, and wander over many miles to find sustenance.

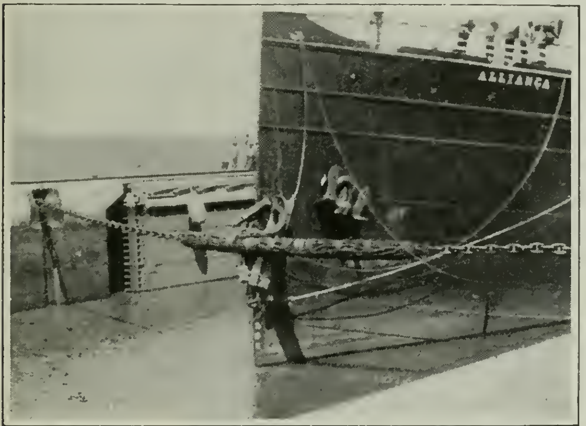
With a wheel on the front, a canoe can be handled easily by a woman or child

A Wheel-barrow for Canoes

A CANOE-BARROW, invented by a Philadelphia man, makes the transportation of a canoe on land an easy matter. Even a woman can take a canoe down to the water with the barrow. A wheel is attached to a simple metal frame that engages the gunwales and bang-plate of the canoe at one end. It may be attached to an empty or loaded canoe while resting in its natural position on the ground.

Panama's Locks Guarded by Chains

THE huge locks of the Panama Canal are guarded by massive chains stretched across the channel. No vessel can crash into the gates at any of the locks because of these fenders, placed seventy feet from each gate and near the surface of the water. When a boat is allowed to pass, the chains are lowered to the bottom of the canal. If the chains are struck by a boat, they gradually yield to the force, paying out to a certain distance which depends upon the violence of the impact.



Great chains act as fenders to keep ships from smashing into the locks at Panama

The mechanisms which regulate the chain-fenders are installed on either wall. A system of hydraulic cylinders is used for raising and lowering the chains. The action of the fender when struck by a boat is modified in part by the friction produced in the machinery, but mainly by the resistance produced by water flowing through valves.

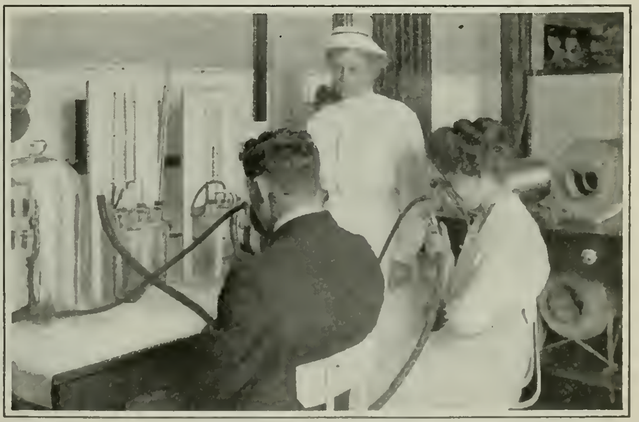
Satisfactory experiments were conducted last November under the direction of Henry Goldmark of New York. The *Cristobal*, laden with her cargo from New York, was run against a chain at various speeds and was brought to rest without injury. The distance traveled after striking the chain agreed, in each case, with the previous calculations.

Three-Quarters of Humanity Are Deficient in Lung-Capacity

RECORDS show that fully three-fourths of us are deficient in lung capacity. Regarding six as a normal standard, the average person is able to register only three or four units of pressure. In cases of asthma, the lung capacity is only one-sixth normal.

Bronchial affections such as asthma, hay fever and similar disorders are readily benefited by the therapeutic use of the vacuum breathing-apparatus. The mechanism is not complex in its operation, the chief end to be attained being the gradual increase of the breathing capacity of the patient.

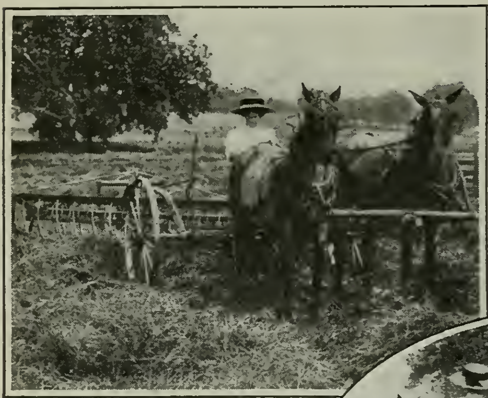
The patient places a rubber hood over his nose and mouth so that all air reaching him must be drawn through the rubber tubing. This tubing is connected with a glass containing water, which is permeated by air obtained through another, independent opening. The patient is forced to draw the air he breathes through the water, or against an approximate pressure of six pounds. This makes him breathe deeply and vigorously. Exhalation is made easy by the pull of a vacuum apparatus operated by motor, connected through a second tubing with the breathing hood. The lung energy expended is indicated on a mercurial register.

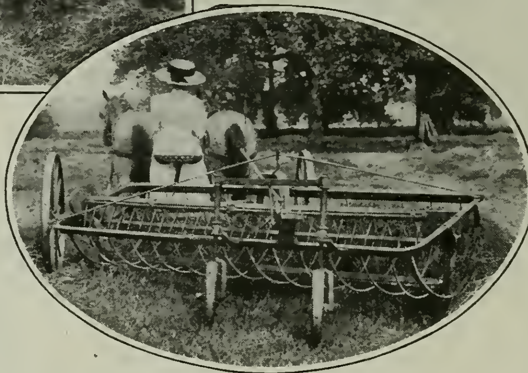


A vacuum breathing-apparatus to increase your lung power by drawing air through water

Maud Muller Up to Date

THE hay-rake has been vastly improved since Maud Muller's poetic hay-day. It is the ultra-modern machine that the lady in the accompanying picture is operating. Like a good rule it works both ways. As a rake it covers a wide path and delivers the hay in a row at one side. It has a rotating tooth-carrying frame, the rotation of which may be reversed at will. When reversed, it operates as a tedder, that is, it kicks the hay into the air, thus turning it over so that green hay will dry quickly.





Maud Muller now gathers the hay with a modern rake, which delivers it at one side in neat rows for loading

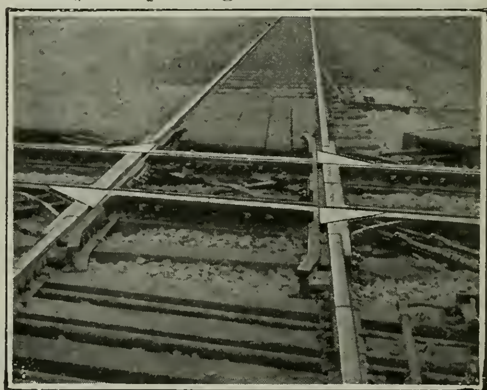
The angle of the teeth is automatically changed by reversing the rotating frame. In consequence, the teeth are always disposed at the proper angle when the machine is in operation. This makes the machine effective, however unskilled the operator may be.

The rotating frame is controlled by a somewhat intricate set of gears operated from a hand-lever within reach of the driver. It is a great help in haying time. Lewis E. Waterman, of Rockford, Illinois, invented the various improvements that distinguish it from other side-delivery rakes.

A Continuous Railway Crossing

A CONTINUOUS crossing has been invented that has very few parts and which makes the passage of every train perfectly smooth either way. It is composed of four steel triangles which slide back and forth by means of a lever thrown in the switching tower. In the illustration may be seen the four triangular blocks and also the rods which are used in operating them. When the blocks are set to make a continuous crossing from left to right and it is desired to clear the other track, a stroke of the lever will cause the blocks to move in a diagonal direction upward and outward. The slots are thus closed, making continuous rails for the trains. This system may be attached to the signal system so that it is always in the correct position.

The new device has been installed for test purposes by the Pennsylvania Railroad at Carrothers, Ohio, where sixty trains pass every day and the wear on the crossings is so great that new ones are necessary frequently. This crossing, however, has given excellent service for a number of months and may be permanently adopted. Trains of sleepers, ordinarily as noisy as trains of freight cars, pass over quietly without waking the passengers.



The jog is entirely eliminated by this new railway crossing

A Tree Which Serves as a Bridge

OUT near Marshfield, Oregon, in the celebrated Coos Bay region, a fallen forest tree is made to serve the useful purpose of a foot-bridge. The tree—an immense fir—grew handily enough by the side of a stream, to bridge which under ordinary circumstances would have cost considerable. Once the interested residents hit upon the idea, it was practically no trouble to fell the tree across the stream, trim away the branches and with an adz to flatten the upper surface of the fallen trunk. To make passage over this unusual bridge less hazardous, a hand rail was built through the simple expedient of boring holes in the log for the upright standards to which the fence-like railing was attached. The bridge gives complete satisfaction and attracts the interest of every newcomer in the vicinity.

A giant fir, felled to drop across the stream, furnished this excellent foot-bridge

The Ozark Float-Boat

AMONG the types of small craft that navigate North America's inland waters, one of the most peculiar is the Ozark Mountain float-boat. The swift, crooked and rocky streams of southern Missouri and northern Arkansas have known it for many decades, but at last it is beginning to disappear before the invasion of canoes and small power-boats. Under the management of a native "hill billy" the float-boat is as tractable as a family nag, but when a city man tries to ride it the craft sometimes behaves more like a broncho.

In appearance it is most primitive. "Something like a dug-out, something like a canoe, something like a flat-bottomed skiff," describes it—yet it is no more than a cousin to any of these. It is made of a few pieces of lumber held together with iron clamps, fashioned by the cross-roads blacksmith; in length is twenty feet or more; in width, not much wider amidships than two. It rarely has any seats and scarcely ever knows paint. The sides and ends taper like a canoe's, but the bottom is flat and the passenger, if he is careful, may stand up in it when he is casting for bass.

The craft is called a float-boat because its specialty is going down stream. When it has to be propelled against the current the native lays down his paddle and takes to poling.

The Ozark float-boat is rough, but it is as tractable as a family nag in the hands of an expert

A Medley of Puzzles

By Sam Loyd

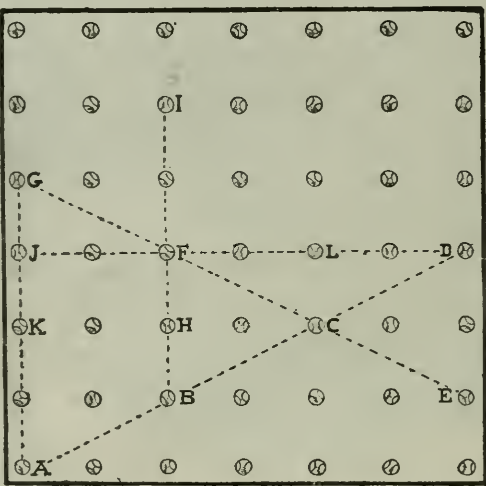
Fifteen Dollars in prizes will be awarded for the solutions of the puzzles appearing on these two pages. The first prize of Five Dollars will be awarded to the reader who sends in the best set of answers and writes the best letter of suggestion for the Puzzle Page. The letters of suggestion must not contain more than fifty words. Ten prizes of One Dollar each will be awarded to the ten readers who send the ten next best sets of answers and letters.

Answers to the May prizes will appear in the June issue. The names of winners of the prizes in the July issue. Answers and letters must be received before May 8th, addressed to Sam Loyd, care Popular Science Monthly, New York.

Play Ball

IN this field of 49 baseballs the puzzling proposition is to mark off all but 20 and to leave those 20 balls in such arrangement as to score the greatest possible number of rows, 4 balls to a row.

In the diagram it is shown how the balls, lettered from A to K—12 balls—are made to score 5 rows. Now see what is the highest score you can make with the full complement of 20.



How Large Is This Man's Lot?

"Talking about Poles" remarked McManus, "here's a study in Poles that would give Peary and Cook a pair of headaches.

"In building a fence around my square lot I find that if I put the poles two feet apart I will be shy 110 poles, whereas, if I plant them two yards apart, I will have 90 poles left over.

"Now can you tell me how many square feet there are in my lot?"

Children A-plenty

Farmer Smith and his wife say that the race suicide scare is of no account down their way, as they have 15 children, born at intervals of one year and a half.

Miss Pocahontas, the eldest of the children, who is reluctant about mentioning her age, admits she is seven times older than Captain John, Jr., the youngest of the brood.

Can you assist the census man in figuring out the age of Miss Pocahontas?

MARCH PRIZE WINNERS

The ten copies of the "Cyclopedia of Puzzles," offered for the best answers to the four March puzzles are awarded to the solvers given below, who not only solved all of the puzzles with absolute correctness, but gave analyses of the Kugelspiel problem, which proved to be the stumbling block for most of our contestants.

Ernest A. Hodgson, Dominion Observatory, Ottawa.

Nathaniel Ratner, 1804 Arthur Ave., Bronx, N. Y.

Fred A. Tracey, 59 White Street, Mt. Holly, N. J.

T. B. Ford, Chevy Chase, Md.

George S. Fuller, 506 Sears Bldg., Boston, Mass.

Chrystal McCue, Goodells, Mich.

Audley A. Baker, 808 Bell Ave., E. Carnegie, Pa.

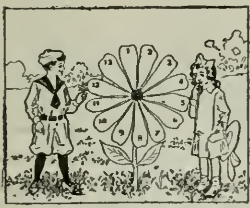
Earl F. Koke, 2121 N. Nevada Ave., Colorado Springs, Colo.

Wm. K. Bendrat, 616 W. 48th Street, Los Angeles, Calif.

J. A. Fairchild, Mt. Olive, Ill.

A Daisy Game

Here is a version of the "One I love two I love" Daisy Game which involves a neat little puzzle. You see the young people take turns in plucking the petals, the victorious player taking the last petal and leaving the "Old Maid" stump with his or her opponent. The player has a choice of removing one or two of the petals at each play, provided the two are side by side. For example, the first player might take petal 13, or 1 and 2, but not 2 and 13, since they are not together.



The game may be played with small buttons or other markers laid upon the petals until all are covered. If your opponent started by covering 1 and 2, what would be your play to make sure of a win?

While You Wait

O'Sullivan, the cobbler, who shoes his customers "While you wait," says he can repair five pairs of men's boots in the same time that it takes to fix six pairs of women's shoes, and that it takes the same time to overhaul five pairs for the children as it does three pairs for the women, so he charges according to the time consumed.

The other day he took in $6.60 and reshod three men, four women and two children. Can you tell how much he charges to repair a pair of children's shoes?

Reversing Magic Squares

"Let us have a little talk about magic squares," said the schoolmistress. "The arrangement of numbers in the form of squares, so that they will add up the same amount in every column, as well as in the two diagonals, is without doubt the oldest of mathematical puzzles. It was held in great veneration by the Egyptians; and the Pythagoreans, to add more efficiency and virtue to the magic square, dedicated it to the then known seven planets.

6	1	8
7	5	3
2	9	4

"Here we have the simplest form of the magic square, this being capable of extension ad infinitum. Now, since there is nothing new to be presented about magic squares let us take a contrary view of the magic square principle and imagine an arrangement of figures in square form that will not give two like totals in the 8 rows. Juggle the figures about in any manner you wish to bring about the 8 different totals, but do not disturb the center 5.

"There is another little puzzle suggested by the lines forming the squares.

"I want you to show how the diagram of 9 little squares may be constructed of 4 separate continuous lines of similar length, which means that no lines must cross. There you have two puzzles to work out."

APRIL ISSUE PRIZES

The Editor has decided that it is not fair to award the prizes of the Puzzle Page on a basis of the date of mailing the answers because readers do not all receive their copies at the same time. Therefore the prizes for answers to the puzzles in the April issue will be awarded in accordance with the rules stated on the opposite page governing the prize offer for the letters and answers to puzzles in this issue. Answers to the April puzzles must be received not later than May 8th.

The answers to the April puzzles will appear in the June issue. The names of the successful April contestants will appear in the July issue.

Blasting for Good Roads

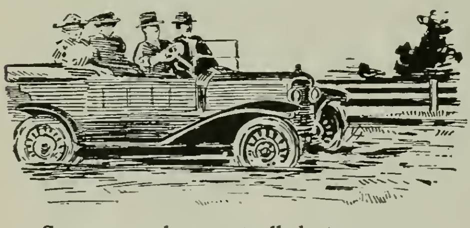
By J. H. Squires, M.S., Ph.D.

SOME corrective must be found for the present poor condition of roads that are already oppressive and promise to become intolerable.

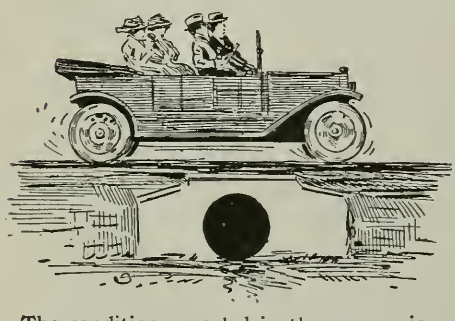
As for the work of building or improving roads, the advent of dynamite into this field is reducing both time and labor to a minimum. For clearing a right of way by removing stumps and boulders, removing outcrops, getting rid of high sides and digging ditches—for proper drainage is the best of good roads insurance—it has been demonstrated that the highest point of efficiency is reached through the use of explosives.

Also for cutting away hillsides or bluffs and lowering grades—operations which heretofore have in many instances seemed prohibitive because of the labor required—this modern short-cut to the easy haul is destined to bring about a radical change in our roads.

For both the construction and maintenance of good roads, it approaches the ideal, since it reduces time, labor, and expense, and produces results that make for permanency.



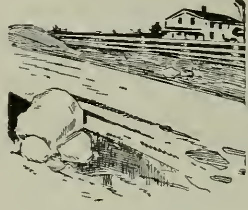
Swamps and uncontrolled streams are hard on vehicles



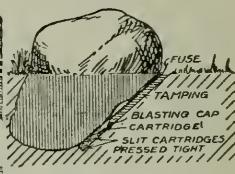
The condition revealed in the upper picture corrected by a blasted ditch and a good culvert

Bad drainage is the greatest enemy of good roads. Excess of water, more quickly than anything else, destroys a road. Relief is through drainage. Drain-

Plan of loading preparatory to blasting a ditch through a swamp



Boulder in ditch flooding a road



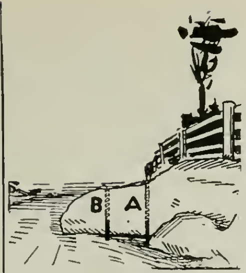
Proper method of placing and loading a boulder for smoke-hole shot

age ditches were formerly dug by hand labor; the cost was high and the work progressed slowly. Many are already more or less familiar with ditch blasting methods and the results that are obtained. In the rougher sections of the country, especially in the swamp and flooded areas, the use of dynamite for ditching cannot be too highly recommended. It does the work quicker, better, and cheaper. It permits good drainage at a low cost where any other method now known would mean poorer drainage and a great increase in cost. This applies to all types of ditches.

Excepting in some prairie regions, all road improving is attended with much stumping in or along the right of way. Most stumping on highway construction is now done by hand. The work is slow and expensive; the stumps are heavy and difficult to handle and are therefore simply rolled to the side of the road, where they remain as eye-sores for years. These stumps can be blasted out at small cost.

There is now much pick and bar work in removing boulders and ledges from the road. A careful study of conditions

A common obstruction



Fire "B" before "A"

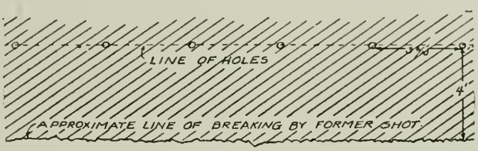
The rock broken up

The clear road

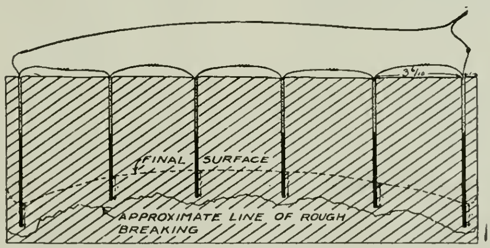
has failed to reveal a case where the use of explosives will not hasten the work and decrease the cost.

The old method of making cuts in hard ground by hand digging, using road plows for loosening the clay, is not at all satisfactory. It is slow, arduous, and expensive. Well placed blasts will either loosen or throw down this hard ground so that it can be easily loaded into wagons or carts, or can be removed by drag or wheel-scrapers. The object sought is the saving of time and expense.

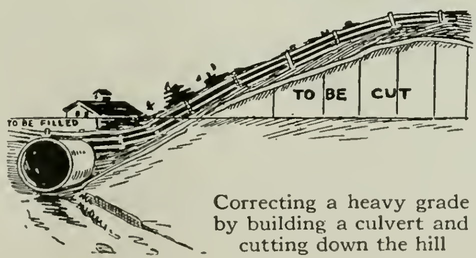
When road improvement necessitates the widening of cuts, the work is too often done with picks. The hard ground is loosened and torn down by hand digging, and then carted away. Material saving in time and money may be effected by throwing down the banks by blasts, after which the loosened soil may be moved with scrapers or by wagons. The exact nature of the loading will depend on the depth of the cut and the nature of the ground to be moved.



Plan of appropriate loading for cut work



Elevation of approximate loading for cut work



Correcting a heavy grade by building a culvert and cutting down the hill

The high side in a road which is caused by a boulder or hard bank on one side, or by the washing away of earth on the other side, is now too often left as an impediment to progress. Light blasts are proving effective for loosening this material so that it can be removed by a drag scraper or road machine.

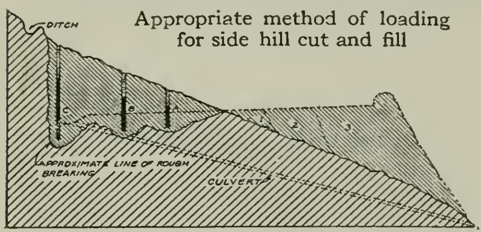
The stumps, boulders and ledges in the side ditches are now largely neglected. This causes bad drainage. Their removal can be successfully accomplished only when explosives are used.

Old water breaks or "thank you marms" are also attacked by explosives, as blasting is most effective in getting rid of these.

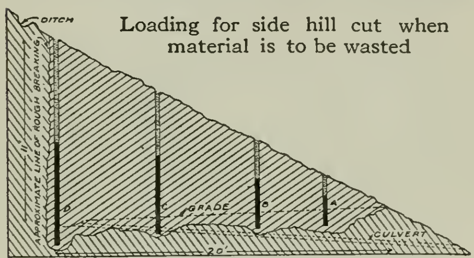
Many of our hill roads are now troubled with short, dangerous curves where skidding and collisions are always to be expected. Too little attention is given to correcting the conditions. The new dynamite method of relief is to shoot off the point of the cliff if the road passes around the outside point, or to widen the side hill cut if the curve points into the hill. The bank may be shot away by heavy charges that will blow all of the soil down the hill, or the ground may be loosened and removed by scrapers or road machines.

Much interest is now being shown in tree planting along private and public roads. These trees must usually be planted where the conditions are not favorable to them. Where such adverse conditions are encountered, better results in the growth of the trees are obtained when each hole is blasted.

In heavy road construction the steam

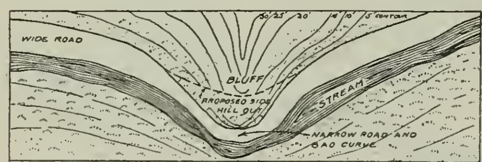


Appropriate method of loading for side hill cut and fill



Loading for side hill cut when material is to be wasted

shovel is playing an important part. Light tractor rigs are employed. These dig slowly and with difficulty in hard ground. On actual count it was found that under such condition the dipper was not filled more than one time out of



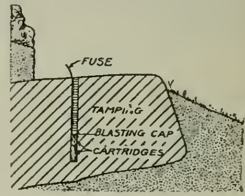
A common road trouble and the remedy

five. This slowed up the work. Blasting ahead of the shovel will loosen the ground so that it can work to capacity.

The demand for hard surfaced roads creates a need for millions of tons of crushed stone. This is blasted out of the quarries. In some sections remote from operating quarries, the stone is obtained by blasting hard boulders out of the fields. Occasionally a rock cut affords an excellent source for stone, and gives the additional advantage of cheapening the cost of construction by making use of the most expensive material to excavate.

When crooked or shallow streams are paralleled or crossed it is often cheaper to correct the stream than to elevate the road to a sufficient height to keep it out of trouble.

A great part of the filling up of stream courses is caused by logs and other floating material forming rafts and sand bars in the channels. Another fruitful source of trouble is from outcrops of rock which divert or impede the normal flow of the current. Overhanging stumps and trees along the banks lend still further obstruction. Sharp bends in the course of the stream check the current and cause trouble by forming sand bars.

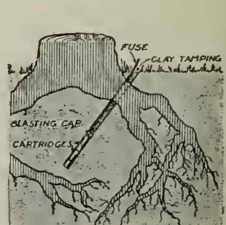


Loading a rock-ledge outcrop

Any and all of these troubles may be overcome quickly and at reasonable cost by the use of dynamite for shooting out the rafts and logs, and blasting a sufficient channel through the confining rock. A well-placed blast will cause the overhanging stumps to vacate immediately.

Cutting off sharp turns in the channel will take a little more time and should be well done in the beginning. Locate the line of the new cut-off and blast a ditch that will at all times carry a part of the flow. When this is done and the rafts and logs are out of the way above and below, all there is left to do is to wait for heavy rains to flood the streams. The increased velocity of flow will cause the water to cut and wear away at the bottom of the channel as well as at the sides. From time to time it will be best to go over the stream and make sure that no new obstruction is being formed.

A good use for blast-holes

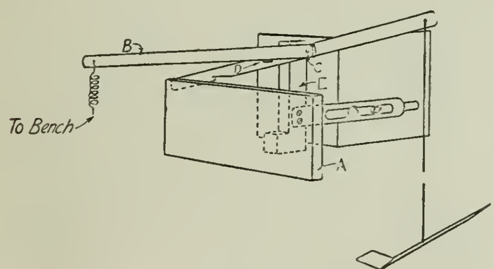


Loading top-rotted stump

Small blasted ditches have been scoured out by the current until they are now carrying the entire flow of large streams. With a little help now and then any stream with a fair fall can be made to do wonders in making itself a permanent and suitable course.

Sometimes roads must parallel streams for considerable distances, where the lay of the land is such that the road must be immediately alongside the stream. Correction lies in deepening the stream by blasting, and then constructing a small side ditch next to the bank to handle the water from above.

The field of usefulness of explosives in road building is rapidly widening and will in a short time include many classes of work now done entirely by hand labor, as the cost will be materially reduced.

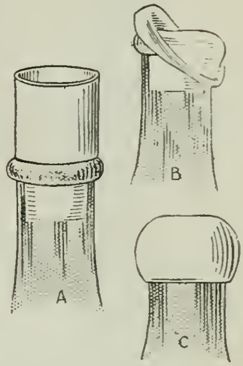


Construction of a bench shear for cutting copper strips. This device is easily operated by a foot treadle

Making a Bench Shear

THE illustration shows a shear that was made for cutting strips of copper, ½ in. wide and ⅙ in. thick. The jaw *A*, is made deep to be gripped in the wire at the bench. The moving jaw is connected to a treadle on the floor. The rod *B*, which brings the moving jaw back to place, pivots at *C*, and rests on the pin *D*. It is worked by a spring which is fastened to the top of the bench. The guide *E*, which is fastened to the stationary jaw, keeps the two cutting edges of the jaws together. The stop is made adjustable, as shown. The jaws should be made from tool-steel. The writer made the stationary jaw out of cast-iron, which has cut several hundred pieces and is still in good condition.—C. Anderson.

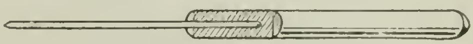
An Improved Bottle Stopper



A BOTTLE stopper especially suited to the use of travelers, is shown in the illustration. It consists of a single piece of soft red rubber, having two parts, a base and a hood. The base is in the form of a regular stopper, and its upper edge is extended as a short tube, as shown at *A*, in the illustration. After inserting the stopper in the bottle, the top part is pulled down over the rim, as at *B*, forming a tight hood over the mouth of the bottle, as at *C*. This stopper is especially good for benzine, alcohol and other volatile or inflammable liquids, or for acids and the like.

New Automobile Alarm Calls for Help

THE recent starting of an automobile at an exhibition of motor cars by wireless power, suggested to an inventor a new application of the wireless principle. The instrument includes the installation of a wireless sending apparatus, with a radius of only a few hundred yards, and a small receiving instrument, such as are used now without the need of aerial wires. When the owner of the car leaves it unprotected for a time, he switches on the "wireless" and walks away. Any interference with the ignition system is at once "wirelessed" to the owner, who carries the receiving instrument in his pocket. The buzzing of his receiver sends him scurrying to his car.



A fine drill made from a needle

A Drill Made from a Needle

SMALL drills for watchmakers can be made from needles which are tempered, filed at one end to the usual shape of a drill point, and fitted at the other end with a small brass or copper handle.

Mechanical Tops

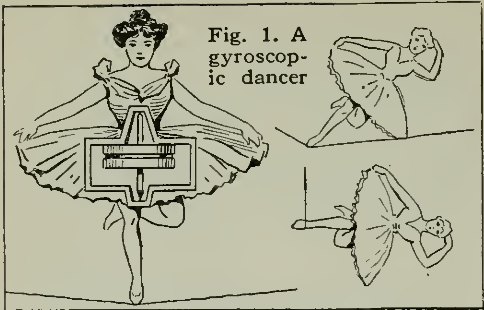


Fig. 1. A gyroscopic dancer

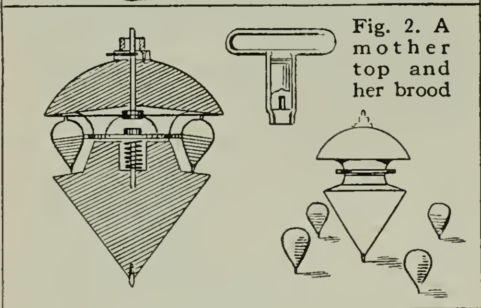


Fig. 2. A mother top and her brood

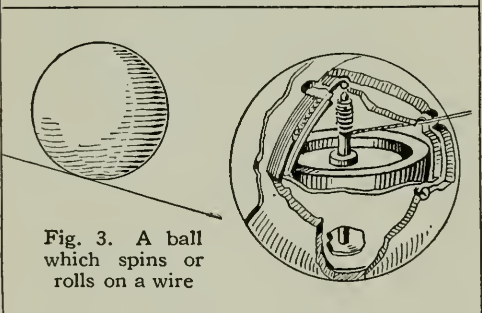


Fig. 3. A ball which spins or rolls on a wire

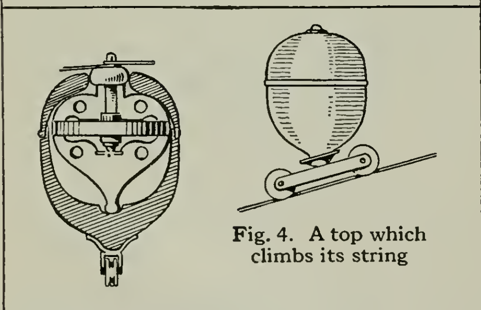


Fig. 4. A top which climbs its string

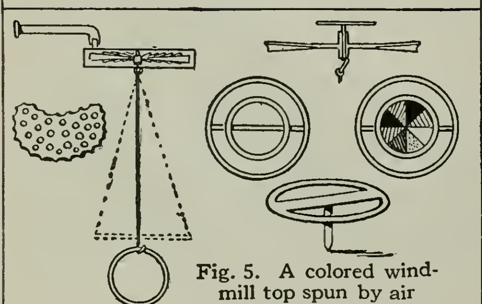


Fig. 5. A colored windmill top spun by air

SPINNING-TOPS, like toy soldiers and other necessities of boyhood, have existed for many years. Recently, the old standby made from a spool with a peg pushed through the center, has succumbed to more scientific devices. The principle of the gyroscope is frequently used. The little ballet dancer, Fig. 1, can spin on her foot, her arm or her head, because of the gyroscope mechanism which is concealed inside it.

A toy which resembles an old hen and her brood of chickens, consists of one large top having several lateral cavities with small tops mounted in them, Fig. 2. When the big top is spun, a disk attached to its shaft rotates also, and the outside of this disk, touching each of the small tops, causes them to spin.

Jugglers and acrobats have a ball which will balance on a wire, resist all efforts to roll it, or roll in only one direction, Fig. 3. The gyroscope principle is involved in this toy.

Another top for balancing on a wire has an egg-shaped case with a removable cap, Fig. 4. The mechanism, enclosed within this case, spins in a tiny depression. The case is mounted on a miniature truck of two wheels.

The principle that a whirling body tends to rotate about its shortest axis is demonstrated in a toy consisting primarily of a blow-mill encased in a circular tin box, Fig. 5. Attached to the axis of the fan is a long cord terminating in a hook. When the fan is rotated, the cord becomes rapidly twisted. A ring suspended from the hook will rotate in a horizontal position.

Variations from the simple ring may be used, one being a ring having a concentric disk of primary colors. Rapid rotation tends to resolve the colors into white. The opposite phenomenon may be illustrated by means of irregular pieces of white cardboard with holes punched in them; they tend to break up white light into colors.

One of the newest ideas in toys is a real musical top, Fig. 6. A hollow cone has a vertical shaft projecting beyond the upper rim and having a central hole in which a nail may be inserted for

Which Puzzle

spinning. The cord is wound around the shaft, and after being quickly withdrawn, the nail should also be lifted out. The music is made by short tubes in the sides, placed at right angles to the diameter of the cone. Tiny reeds attached to their inner ends are vibrated when the top is spun.

A game in which tops are pitted against each other for speed, requires the use of a top having a depression in its upper surface for a fan, Fig. 7. The air-currents created by rotating the top revolve the fan. Numerals on the rim of the cavity indicate the movement of the fan.

For those who like to solve puzzles, the art of spinning a top must also be acquired if they wish to solve the puzzle-top, Fig. 8. A central, circular tube constitutes the body of the top. From it project radially four tubular arms. Four balls are free to move in these arms but they must pass through the central part. The trick is to spin the top with a ball in each arm.

The chameleon top, Fig. 9, has a semicircular depression in its upper face in which are held, by means of a screen, several cubes having different colors on their surfaces. Rapid rotation of the top forces the cubes outward and diverse color combinations are presented.

A "flying" top, Fig. 10, has two propeller blades pivoted on its sides. When the top is not being spun, two coiled springs hold the blades inside the body, but the centrifugal force exerted in rotation forces them out through the lateral slots. The top literally rises from the table, the degree of upward movement depending upon the force expended in setting the toy in motion.

A very novel effect is obtained with a top having an auxiliary wheel, Fig. 11. The body is in the form of a globe very much flattened on the upper and lower sides. The auxiliary wheel is simply a disk painted with the primary colors, and having a central pin. When the top is in motion, the wheel is laid on the spinning-surface, its edge touching the top and its axis pointing inward toward the spinning-point. It will then rotate with the top, producing a peculiar, fascinating effect.

Fig. 6. A real musical top

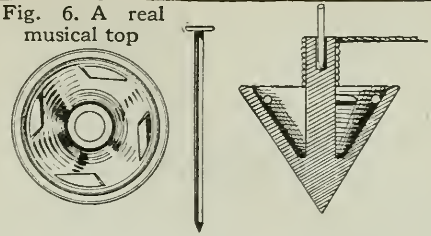


Fig. 7. A speed-recording top with which contests are held

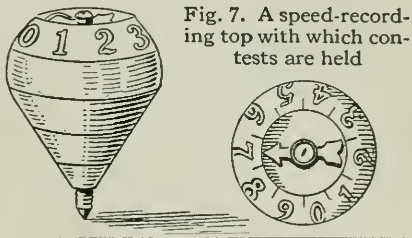
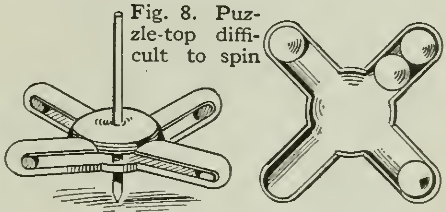


Fig. 8. Puzzle-top difficult to spin



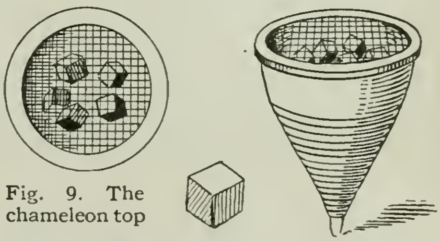


Fig. 9. The chameleon top

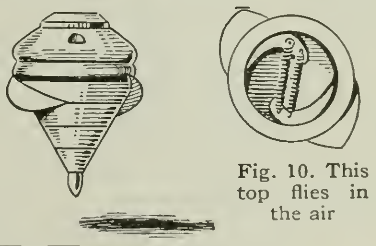
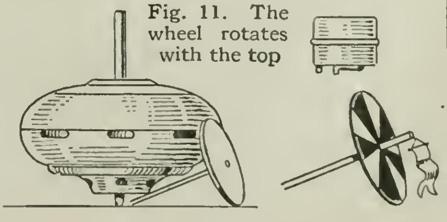


Fig. 10. This top flies in the air

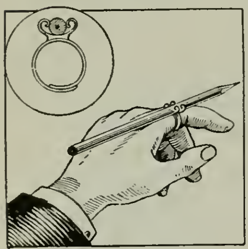
Fig. 11. The wheel rotates with the top



Little Inventions to Make Life Easy

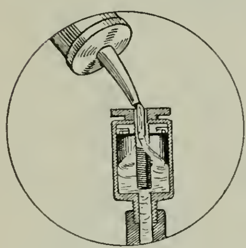
Why Weren't They Thought of Before?

Finger-Ring to Be Used as a Pencil-Holder



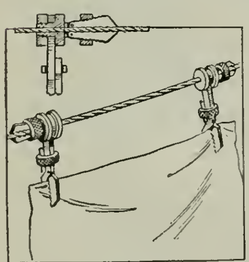
A V-SHAPED spring clip is attached to a finger-ring, and is used to hold a pencil in a convenient place so that the user will not have to search for a mislaid pencil constantly and yet leaves the hand free.

This Grease-Cup Keeps Your Hands Clean



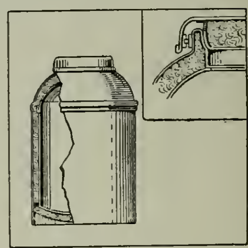
TO obviate the necessity of removing the grease cup when it is desired to fill it with grease, an inventor has inserted in the cup a washer which acts as a plunger to force out the grease. This washer runs on a screw-threaded stem, which is operated by a thumb-screw in the head of the cup.

A Clothes-Pin with a Sandow Grip



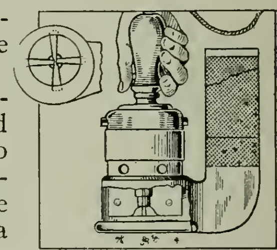
A clothes-pin has been patented with a grip sufficiently firm to resist the strongest wind. On the wire or rope used for drying the clothes, is attached a ring which projects downward, and terminates in two short arms similar to the blades of a pair of scissors, but having corrugated surfaces for gripping the clothes. Above the pivot the outer surfaces of the arms are also corrugated to engage a ring nut, which can be tightened when fastening the pin on the clothes.

Keeping the Heat Out of Milk-Cans



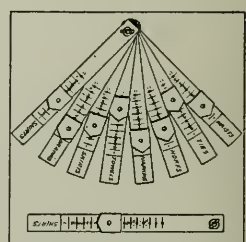
A MILK-CAN especially designed to keep out heat is the latest improvement in dairy appliances. It consists in reality of two cans, one within the other. The space between them is filled with felt, ground cork or other heat-insulating material.

An Electric Whirlpool to Suck Flies to Their Doom



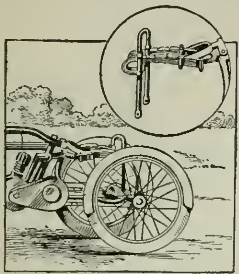
THE latest fly-killing engine is a small motor encased in a handle with a cord which attaches to an ordinary electric socket. The motor operates a miniature electric fan placed eccentrically in the open end of the handle. Air is sucked in and swirled around the circumference of the casing and forced out through a bent tube ending in a screened trap. Insects coming within reach of the "deadly wind" are sucked in and killed.

Counting Up on Steel Fingers



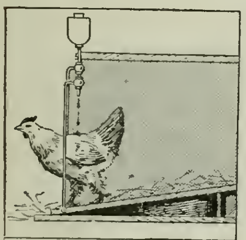
AN improvement on the old method of counting on one's fingers is a new device having several strips of steel pivoted at one end. At the "finger tips," are written the names of the various articles which are usually sent to the laundry, such as "shirts," "handkerchiefs," and "collars." On each "finger" is mounted a slide which may be quickly moved to register the number of pieces.

Converting a Motor-Cycle Into a Tricycle



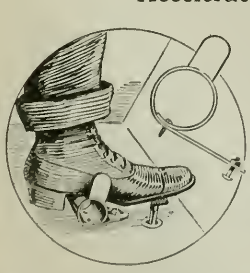
A MOTOR-cycle may be easily transformed into a motor-tricycle, by the use of a patented axle which is attached by lugs to the lower end of the frame. On the upper end of the frame is bolted a spring, to which are attached two uprights for the axle. By this means the substitute axle is securely fixed to the motor-cycle frame. A belt-drive from the engine transmits the power to the two rear wheels.

Rough on the Hen—But Useful



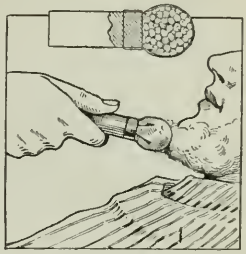
IN order that the poultry breeder may identify the hens which have a propensity to enter the nest to set needlessly, a valve containing ink or liquid dye is placed at the opening of the nest. When a hen enters the box containing the nest, a trap-floor drops, pulling a string which opens the valve, thus allowing some of the marking fluid to fall on the hen's back.

To Keep Your Foot Always on the Accelerator-Pedal



TO provide a safe and comfortable rest for an automobile driver's foot so that he may keep his foot in the proper position near the accelerator-pedal, a rest has been invented, which consists of a tubular piece of metal to be bolted to the floor at the desired spot. On one side of the rest is attached an upright piece of metal, which acts as a guide to prevent the foot from slipping in an emergency. The rest fits directly under the arch of the shoe.

A Single-Service Shaving Brush

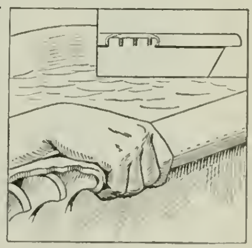


A SANITARY shaving brush which may be thrown away after having been used once is made of a pad of sponge or antiseptic cotton covered with a flexible material such as gauze or cheesecloth. This brush is impregnated with a sufficient quantity of powdered soap to lather the face. The brush is adapted to be made in large quantities at a very low cost, so that it may be thrown away after every shave.

Adjusting the Big Shoe-Stand to the Little Boy

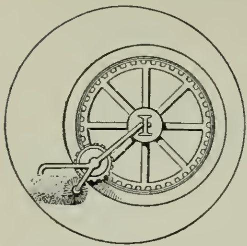
TO enable small children to have their shoes polished without difficulty, an inventor has made a pair of substitute foot rests for a polishing stand. These rests may be easily attached to the stand, and are so designed that they will accommodate any size of child's shoe. A pair of heel and toe clamps are attached to the shoe plate and are connected by means of a coiled spring.

Finger-Holds for Your Slippery Bath-Tub



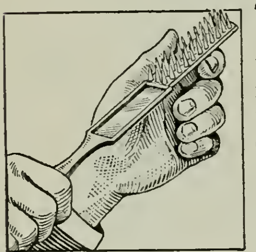
SOME difficulty is often experienced, especially by invalids, aged people and children, in seating themselves in the modern enamel or porcelain bath tubs. The surfaces are naturally slippery, and this difficulty is increased by the presence of water and soap. An inventor who must have slipped has provided gripping surfaces under the rolled edges of the tub, so that the bather may easily change his position.

Brushing Away the Tacks



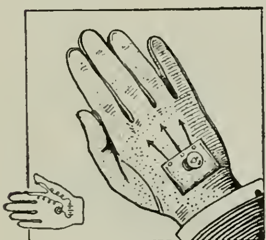
A REVOLVING brush has been devised for sweeping aside small objects likely to puncture an automobile tire. Attached to the axle is a framework, holding the brush and two gear-wheels. The small gear-wheel engages with cogs on the rim of the automobile wheel; and the large gear-wheel operates the brush, thus rotating the brush in an opposite direction to that of the moving tire.

This Toothbrush Can Be Used Only Once



THE bristles of this novel toothbrush are made of some material which becomes soluble upon application of water. After having been used once, the toothbrush is useless, and a new one must be provided. A suggested composition of the bristles is a mixture of antiseptic formaldehyde tooth powder, paper pulp and an adhesive of an antiseptic or sanitary nature.

A Lamp for the Motorist's Glove

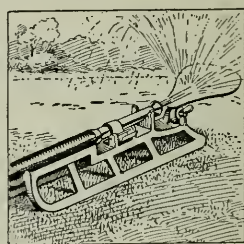


EXTENDING the arm to one side as a warning to drivers behind is well-enough in the daytime. At night some other expedient is necessary. To overcome this difficulty a new device has been patented consisting of a glove with a small electric light fitted into the back near the wrist. The contact points are on the index finger and the thumb so they can easily be brought together. The wires pass through the glove between the inner and outer layers.

Keeping the Cow's Tail Out of the Milk Pail

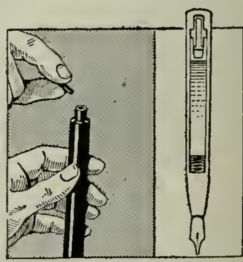
TO prevent a cow from switching her tail while being milked, a large, heavy clip is made of some metal, preferably iron or steel. On the inside of each block of metal, forming the faces of the clip, is a groove which receives the tail comfortably. A suitable spring holds the two faces of the clip tightly together. With the heavy clip on the end of her tail, the cow is unable to switch it freely.

A Sled for Lawn-Sprinklers



AN arrangement for holding the nozzle of a hose used in spraying consists of a sled-like framework with two upright pieces having grooves for the reception of the nozzle. Over one groove or notch is a clamp for securely fastening the hose. Just in front of the mouth of the nozzle is pivoted a spoon-like spreader or deflector. A thumb-screw makes it possible to adjust this part at any desired angle.

Does This Solve the Refilling Problem for Fountain Pens?



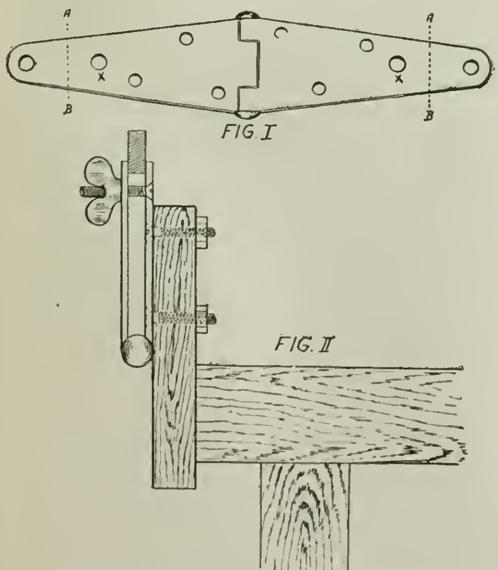
IN order that a solid ink may be used in a fountain-pen, and in order that the ink may be renewed without soiling the fingers, a small receptacle is made to screw into the upper end of the barrel. When the cap protecting this upper end is removed, a pellet or stick of solid ink is dropped into the receptacle, and the other end of the barrel is filled with water.

For Practical Workers

Using a Hinge for a Vise

A SERVICEABLE and durable vise may be made with a few simple tools, at a very small cost. Procure an 8 or 10-in. strap hinge and cut it off along the lines marked *A-B* in Fig. *I*. Fasten the hinge, with two small bolts to your workbench or on to a board, which may in turn be fastened to the bench, as in Fig. *II*. Secure another bolt of ¼-in. diameter, 2½ ins. long, and thread it for a distance of 2¼ ins. Insert it through the holes *X*, *X*, which should be drilled before the hinge is fastened to the bench. See Fig. *I*. Put on a winged nut and your vise is complete.

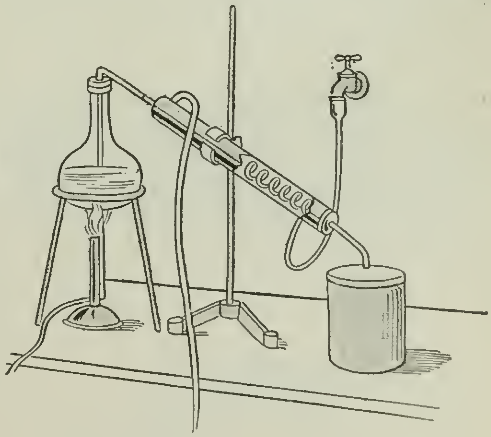
Any hinge may be made to serve as a clamp in the same way, by putting a small bolt through two of the holes and tightening up the winged nut with a wrench.—H. W. Lueddecke.



A strong hinge makes a good vise if adjusted in this fashion

How to Make a Distilling Apparatus

EVERY chemical laboratory requires a good, distilling apparatus for obtaining pure chemicals. The one here described is inexpensive and easily made. A piece of brass or copper tubing 20 ins. long, with a diameter of 2 ins. and a thickness of about 1/16 in., is fitted with 2 rubber stoppers 1⅞ ins. in diameter, having a center hole of ¼ in. Two holes 5/16 in. in diameter, are drilled 2 ins. from each end, and 2 brass tubes 1½ ins. by 5/16 in. are carefully soldered into them. One of these tubes is for supplying water to the large tube, which acts as a water-jacket, and the other is for discharging the water.

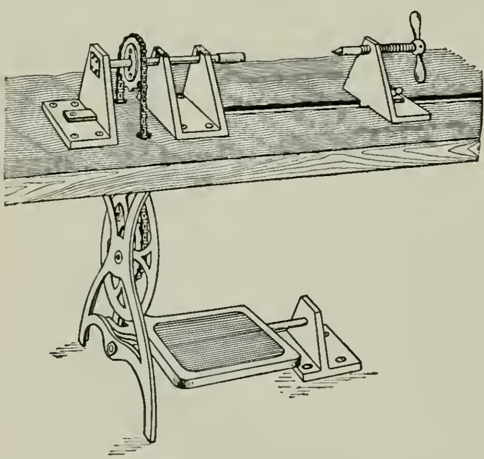


Running water and simple laboratory equipment serve to make this still

The inner tube is made of glass stock ¼ in. in diameter and 40 ins. long. By means of a Bunsen burner with a wing tip, the glass tubing can be bent into the shape indicated in the illustration, having 10 curves, each 1¼ ins. long. Heat the tubing until it is cherry-red and then carefully bend it into the proper shape, but wait till it is cool before making the next curve. Care should be taken to have the curves uniform for fitting into the metal tube. One end is now fitted into a rubber stopper, which supports it in the water-jacket. The other end should be smeared with vaseline and inserted in the other stopper, and that in turn in the outer tube. Each of the short side tubes should be fitted with a length of rubber tubing, one being attached to the water-faucet and the other to the drainage pipe. Chemicals of all kinds, including mercury, may be purified by means of this apparatus.—Samuel Cohen.

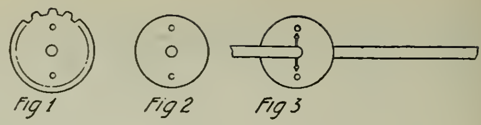
Making a Handy Power-Bench

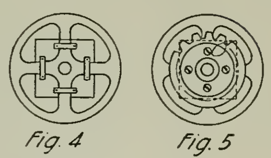
EVERY workshop should include a power-machine like the one shown in the illustration. It can be used as a wood-turning lathe, for running an emery-wheel, and, in fact, for many other



This arrangement of a power-bench can be made on an old sewing-machine body

necessary operations. Procure a chain and two bicycle sprocket wheels, a steel rod, ranging from ¼ in. to ½ in. in diameter and 1 ft. long, one side of a sewing-machine stand, with the wheel and





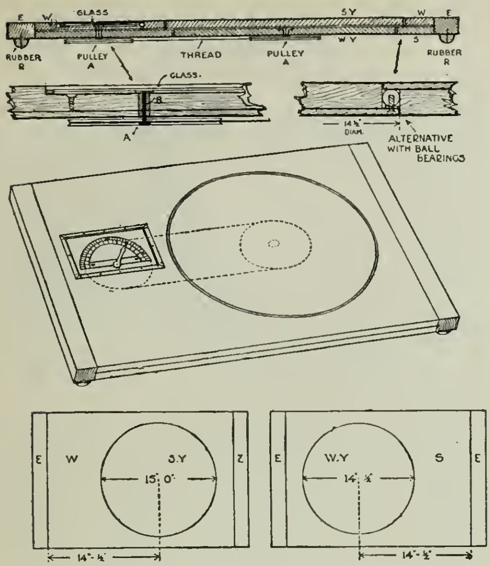
Lathe construction details of the power-bench

treadle, a piece of galvanized sheet iron, 1 ft. sq., but not too thick, a thumb-bolt, and a clamp from an old emery-wheel.

Screw four supports to the top of the bench, as shown in the illustration. The one to the extreme left has a hole drilled near the top and a short piece of tubing fitted into it to receive the shaft. Screw a piece of iron on the back to act as a stop for the shaft. Make grooves in the tops of the two middle supports and, after inserting tubing, screw galvanized strips over the tops to secure the shaft. Drill a hole in the support represented at the right. Make it a size smaller than the thumb-bolt, which should be filed to a point, and insert the bolt. In placing these supports and drilling the holes, care must be taken to keep the shaft perfectly level and in a straight line with the thumb-bolt.

Make a slit in the bench exactly parallel with the line of the shaft. Drill a hole in the base of the right support and insert a bolt to pass down through the slit. Make two holes in the bench at the proper place to let the chains run through, and drill a hole in the shaft directly above. Place the part shown in Fig. 1 on that shown in Fig. 2, and both on the part shown in Fig. 3. Bolt them together, place them on the shaft, pass a nail or wire through the shaft, and solder it to them. At the end of the shaft a number of different forms of chucks may be used.

Fasten a small board to the sewing-machine wheel by means of strips as shown in Fig. 4. Then attach the gear, Fig. 5. A stick connecting the treadle with the wheel and a support for the treadle must also be adjusted before the machine is complete. When finished, anyone may be proud of this little power-machine.—Harry B. Durlin.



A revolving drawing-board of this design can be made by an amateur

Construction of a Revolving Drawing-Board

A DRAWING-BOARD that revolves will be of interest to many amateur draftsmen. The following dimensions may be altered according to the materials that the builder has on hand. Procure a board, ½ in. by 18 ins. by 24 ins., of any soft wood. By measuring down from the top of the board 9 ins. and in from the side 16½ ins., establish a point and describe a circle of 15 ins. diameter.

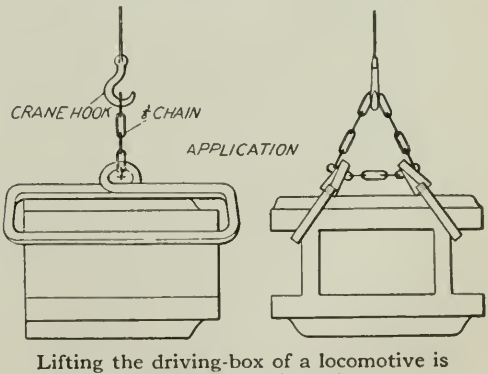
Prepare another board of the same dimensions, with a circle of 14½ ins. diameter. By means of a band saw, remove the disk within the circle of each board. Glue the two boards, *W* and *S* together, the centers of the two circles coinciding. The two disks, *SY* and *WY*, should be similarly glued together. Glue two rectangular strips of hardwood *E*, 1 in. by 2 ins. by 18 ins., on the ends of the rectangular boards to prevent warping.

Make two pulleys *A*, 4 ins. in diameter, with a V-shaped edge. Attach one pulley to the bottom of the circular board. Measure from the left side of the rectangular board 5¾ ins. in on the center line and drill a ¼-inch hole. Into this hole, force a piece of brass tubing, ¾ in. long, and having an inside diameter of ⅛ in. In the top board, make a rectangular opening, 6¼ ins. by 3⅝ ins. by ¼ in., so that the small hole just made will be at the middle of the lower long side, as shown in the diagram. At this point, fasten a protractor.

A short piece of steel rod, ⅛ in. in diameter, must be threaded at one end. Attach a needle or pointer, such as a clock-hand, to the other end and place the rod in the brass tubing. Fasten the other pulley to the under, threaded end by means of nuts. Pass a thread around the two pulleys and tie it securely. Rubber tacks should be driven into the bottom of the board at the four corners. The dial may be kept clean by means of a piece of glass, 6¼ ins. by 3⅝ ins. By adjusting the index finger, the revolving board, with its drawing, can be set at any angle which may be desired.—H. ALEXANDERSON.

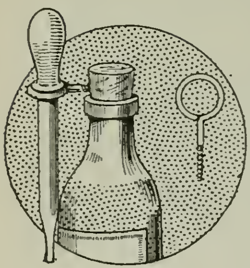
The Construction and Use of a Safe Driving-Box Lifter

THE device illustrated is for lifting driving-boxes with a traveling crane, for use with planers, boring-mills, drill-presses and the like. It is made from two forgings and a ⅜-in. chain. The two rectangular links are made from ¾-in. iron. The ring is made first, then the rectangle, and lastly the two are welded. They slip over the driving-box as shown. As soon as the crane-hook is hoisted, the two links are drawn together. An accident is practically impossible. The size of the link can be made to fit any driving-box, though it can be used for any box it will go over. The only exception is when the box is too small.—JOSEPH K. LONG.



Lifting the driving-box of a locomotive is simplified by this device

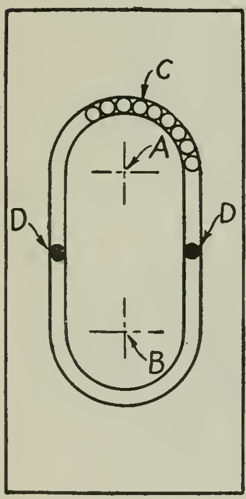
A Pipette Attached to a Bottle



A SMALL pipette may be suspended from the cork stopper of a bottle, by means of an ordinary eye-bolt whose diameter is slightly larger than the diameter of the dropper. The arrangement is clearly depicted in the illustration.

If the bottle is shorter than the pipette, a rubber band may be attached to the pipette, forming a flange to engage the ring of the eye-bolt. This device is especially useful in hospitals and homes, where sanitary measures should be observed.—P. F. QUINN.

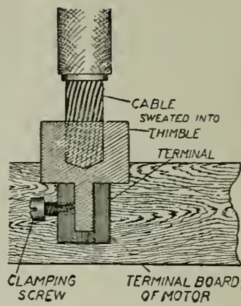
Making Dies of Difficult Outline



IN making a die for punching out plates of an unusual outline, such as the one shown in the diagram, the following method may be employed to advantage:

Lay out the figure carefully, drill the holes *C* and knock out the plug. Replace the plug and secure it by means of two pins, *D*, *D*. Bolt the plug to the face-plate, parallels being placed between the face-plate and die so that the plug can be driven towards the face-plate and dropped out. Locate the point *A* which is the center of a circle whose circumference coincides with the outline of the end of the figure. The plug should now be removed and the half-circle bored out and clearance given to it. Next, remove the die from the face-plate and replace the plug with the pins. Fasten the plug to the face-plate, locate the point *B* and bore out the semicircle, as before. Finish the two flat sides between the semicircles with an end mill in a milling machine.

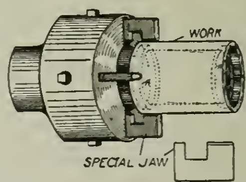
How to Fit Cables Into Small Terminal Holes



IN installing an A. C. induction motor, it sometimes happens that the holes in the terminals on the terminal board are too small to receive the ends of the cable. Instead of the common but unsatisfactory method of cutting strands of wire off the cable to make a fit, the following method is suggested:

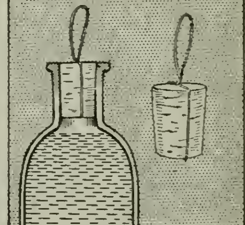
Make some brass thimbles and sweat them on the cable ends, as shown. The thimbles are made from a round brass rod large enough for boring a hole to fit the end of the cable. The other end is turned down to fit the hole in the terminal block.—H. HUNTER.

A Set of Jaws for Counter-Boring and Facing



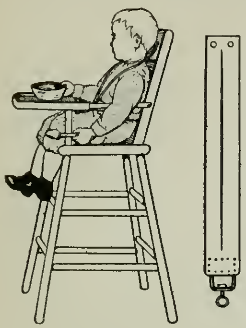
THE diagram shows a special set of jaws made for use on the lathe-chuck when counterboring and facing the inner ends of castings, such as that shown in the illustration. The jaws being cut away allows plenty of room for facing the ends. The cutter used is a lathe-tool set in the tool-post.—C. ANDERSON.

No Corkscrew Needed



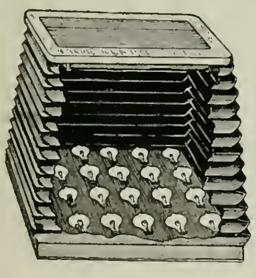
IF manufacturers would loop a piece of strong cord, the length depending upon the size of the stopper, around the cork before inserting it in the neck of the bottle, they would greatly help their patrons. This would do away with corkscrews and would save time.—WM. ED. FINKERNAGEL.

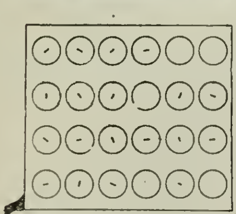
How to Keep the Baby in His High-Chair



TO prevent a baby from standing up in his high-chair, try this: Remove the leather handle from an old razor strop. Cut a slit in the center from end to end, leaving about an inch at each end uncut. Fasten one end of the strop to the inside of the back of the chair, with 2 screws, 3/8 in. in diameter. Hook the other end up under the feeding shelf. The slotted belt rests comfortably on the baby's shoulders and he is perfectly safe.—BERNARD SPIVAK.

A Substitute for a Condenser when Making Enlargements

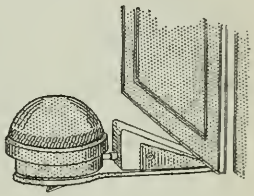




FOR enlarging photographs under artificial light by the projection process a good condenser, of diameter sufficient to cover the negative used, is necessary to insure even distribution of light on the print. The object of the condenser is, of course, to distribute the light more evenly to each and every corner of the negative. A good substitute for a condenser—lenses suitable for large negatives are expensive—is a lamp-board mounting a number of miniature tungsten bulbs so that the light is distributed fairly evenly over the whole surface of the negative, instead of being concentrated at a single spot, which is the case when a single lamp is used without a condenser. The board should be slightly larger than the negative to be enlarged, and should mount as many lamps as it is possible to squeeze into the surface. If 6-volt lamps are used, 18 or 19 can be connected in series, to be used on the house-lighting circuit.

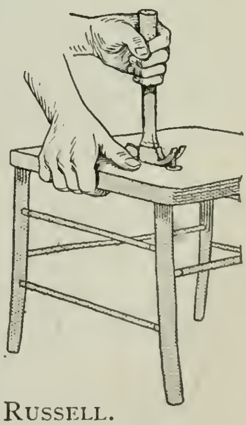
The lamp-board should be mounted well away from the negative at the free end of a bellows, so that the board can be kept in constant movement while the print is being made. This helps to distribute the light more perfectly. Excellent results can be obtained with this simple apparatus.—E. F. HALLOCK.

A Wedge as a Burglar-Alarm



AN excellent burglar alarm for the home or for use when traveling is seen in the illustration. It consists of a wedge, which is placed in the interior of the bedroom under the door. It carries several small points or claws on the under side, which grip on to the floor, making it impossible to open the door even by the hardest pressure. Besides, a bell rings when the device is pushed upon, for the wedge part slides back slightly upon the base, actuating a rod which sets off the bell mechanism. For use in hotels when traveling, the little device is one of the most practical, and, being small, it can be stowed in any baggage. No key is needed to wind up the bell. The bell itself is turned about by means of its milled edge as will be seen in the illustration.—F. P. MANN.

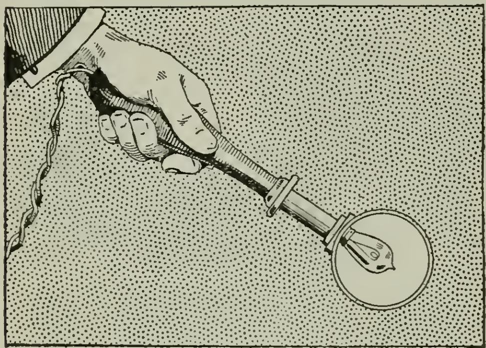
An Easy Way to Remove a Broken Chair-Leg



IT IS sometimes difficult when repairing chairs and other household furniture to remove a broken end from the base, except by boring. If a screw-nail is driven into the broken end and then a claw-hammer applied, the broken end may be removed very easily.—JEFFERSON RUSSELL.

An Improved Darkroom Lamp

A METHOD of darkroom illumination is shown in the accompanying illustration. The negative may be examined thoroughly during the process of development without unduly exposing the plate. A two-candle-power incandescent lamp is attached to a handle and enclosed by a hemispherical reflector, closed at the front with a disk



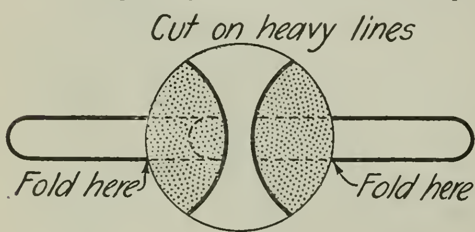
A two candle-power ruby lamp allows close examination of negatives during the process of development

of dark ruby glass. The lamp is held near the plate and all the light is thrown downward so that the eyes receive only the light reflected from the plate.

Only a small section of the plate is exposed to the light at any time. When the lamp is not being used for this purpose, it may be laid face down on the table or suspended so as to light the darkroom.—GEORGE YASTE.

How to Send Coins by Mail

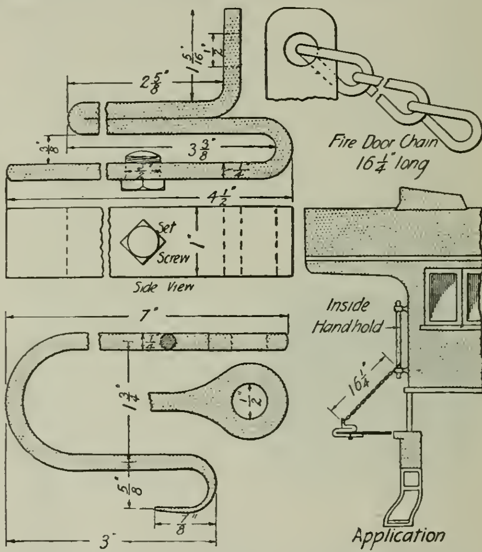
LAY the coin on a sheet of paper and describe a circle around it. Then with a knife, cut through the paper along the heavy lines, as indicated in the diagram. The coin may then be slipped underneath the central slip and the two flaps may be folded over the top.



A piece of stiff paper cut as indicated will hold a coin securely for mailing

A Locomotive Apron Lifter

THE device shown in the illustration is for holding up the apron between an engine and its tender, while coupling or uncoupling the tender. The apron is generally hinged to the cab brackets and is a mean thing to handle. This appliance is simply a small clamp which slips in over the edge of the apron and has a small chain with a hook on the other end which is fastened on hooks around the cab handhold. The details are clearly shown in the diagram. Note the small set-screw, which is tightened after the device is put on the apron, to prevent accidents.—J. K. LONG.



The "apron" between locomotive and tender will be held up safely with this device during coupling

Uncoupling Pipes

THE threads on steam, water, and gas-pipes are usually coated with white lead or paint when the pipes are coupled together; old pipes that have been put together in this manner are usually hard to uncouple. If the juncture is heated, the paint or lead will soften and the pipes can be taken apart very readily.

When two pipes rust together, pour a little oil on the exposed threads and allow the oil to soak in for a few minutes. Then heat to make the oil penetrate. The pipes may then be taken apart easily.—F. M. DEFENDORF.

How to Build and Sail a Small Boat

By Stillman Taylor

THE average boy will find it comparatively easy to build a thoroughly satisfactory sailboat, and no difficulty will be experienced if the simple instructions which follow are well understood before undertaking the work. A boat of this flat-bottom or "sharpie" model, is the easiest of all sailing craft to construct, it will be found safe and stable and will show a fair amount of speed with a reasonable spread of sail. It is, moreover, essentially a boy's boat, suitable for use on rivers and lakes, and because of the flat bottom, it draws but little water, and is upon this account a very desirable boat for use at the seashore, for it may be pulled up on the sandy beach.

The cost of building will naturally vary somewhat—depending upon the locality and the kind of fittings used. The finished hull may be built for $10, and if the mast is rounded out by the builder, and the sail is stitched by mother or sister on the sewing-machine, the total cost may be kept within $20. A completely rigged boat of this type will cost not less than $75 if made by a boat-builder.

In beginning the work, first cut out the stem as shown in Fig. 3. Oak or ash is the best material for this part of the craft, but cypress may be used. As may be noted in the diagram, the stem is rabbeted out on a bevel to receive the sideboards.

The sideboards may next be marked to the shape and dimensions shown in Fig. 2, and then carefully sawed out with a rip saw.

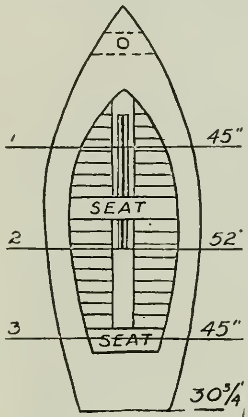


Fig. 1. Deck plan

The molds, which give the correct width and shape of the boat, are merely used to keep the sides in shape while putting in the ribs and flooring. These are removed when this part of the work has been completed, hence they may be made from any odd pieces of old lumber found about the house—packing boxes, etc. Three molds are required, the dimensions being shown in Fig. 4.

The stern or transom is best made of oak or ash, but cypress or cedar will answer very well. This is first drawn to shape and sawed out to the shape and dimensions shown in Fig. 5.

Having gotten out these pieces, the

Material Required for Hull

2 pcs.	Cypress	$\frac{3}{4}$ in. x 18 in. x 15 ft	Sideboards
2 pcs.	Cypress	$\frac{7}{8}$ in. x 2 in. x 15 ft	Floor-stringers
2 pcs.	Cypress	$\frac{7}{8}$ in. x $\frac{7}{8}$ in. x 14 ft	Seat-risings
1 pc.	Cypress	$1\frac{1}{8}$ in. x 9 in. x 12 ft	Seats
1 pc.	Cypress	$\frac{7}{8}$ in. x 15 in. x 8 ft	Sides centerboard trunk
1 pc.	Cypress	$\frac{7}{8}$ in. x 3 in. x 12 ft	Deck beams and knees
1 pc.	Cypress	$\frac{7}{8}$ in. x 2 in. x 30 in	Centerboard posts
4 pcs.	Cypress	$\frac{7}{8}$ in. x 3 in. x 18 ft	Decks
1 pc.	Oak or Ash	6 in. x 6 in. x 18 in	Mast blocks
2 pcs.	Oak or Ash	$\frac{7}{8}$ in. x $\frac{7}{8}$ in. x 15 ft	Ribs
1 pc.	Oak or Ash	$\frac{7}{8}$ in. x 13 in. x 31 in	Stern transom
1 pc.	Oak or Ash	$\frac{1}{4}$ in. x 5 in. x 12 ft	Cockpit coaming
1 pc.	Oak or Ash	$\frac{1}{4}$ in. x $3\frac{1}{2}$ in. x 46 in	Top centerboard trunk
2 pcs.	Oak or Ash	2 in. Half-Round Molding	Fenderwales
2 pcs.	Oak or Ash	$\frac{1}{2}$ in. Quarter-Round Molding	To cover tacked edge on coaming
1 pc.	Georgia pine	$\frac{7}{8}$ in. x 6 in. x 15 ft	Outside keel or shoe
1 pc.	Georgia pine	1 in. x 7 in. x 7 ft	Centerboard
1 pc.	Georgia pine	$\frac{7}{8}$ in. x 8 in. x 4 ft	Rudder
5 pcs.	Cedar or white pine	$\frac{7}{8}$ in. x 6 in. x 16 ft	Flooring-boards
5 yds.	No. 8 or 10 ounce Canvas		Deck covering

work of setting up the hull may begin. First nail the sideboards to the beveled scarf or rabbet in the stem, by a double row of nails. Galvanized cut boat-nails should be used, and a hole must first be bored before the nail is driven home. This must likewise be done in

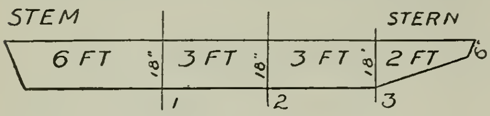


Fig. 2. Sideboards

fastening all parts together—otherwise splitting is likely to spoil the work.

Now place mold *A*, 5 feet from the stem (see deck plan Fig. 1), and after bending the sideboards around it, secure firmly in position, by tacking a batten across the sideboards at top and bottom. In doing this, merely drive the nails partly in, so that they may be easily removed later on. Place mold *B*, 3 ft. from mold *A*, fasten and set up mold *C* in the indicated position. Owing to the somewhat abrupt bend of the sides at this point on to the stern, a rope strap may be twisted around the sideboards like a tourniquet, to force the sideboards tightly up against and at right angles with the molds. Clamps may, of course, be used, if at hand.

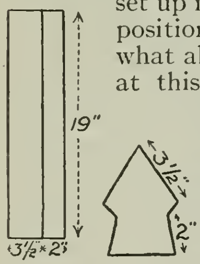


Fig. 3. Stem

The transom is now placed between the sideboards—outside flush with edges of sideboards—and fastened in place by nailing the sides to it.

The floor-stringers are now to be nailed along the inside bottom edge of each sideboard. To make the stringers follow the bend near the stern, make several slight saw-cuts across, so that the stringer may be sprung to follow the curve of the sides.

We are now ready to put in the oak ribs, and these must be nailed solidly to the sideboards. Space the ribs about 18 ins. apart, and nail with galvanized boat-nails, through the sideboards. Clench the ends on the inside of the rib.

The hull is now ready for the flooring. Turn the hull upside down, and if the sideboards and stringers are not perfectly straight across the edges, plane off until the flooring fits well when laid across the bottom. This detail is an important one, for if a tight joint is not made here, the boat is likely to leak. The floor-boards are now laid across and nailed solidly to the edge of both stringers and sideboards. Begin at the bow and finish at the stern, letting the last floor-board extend beyond the transom about ½ in. and neatly round off the edge.

To prevent any possibility of leakage, it is a good plan to lay a strand or two of candle-wicking along the edge, before nailing the flooring in place. The floor boards must be planed so that the edges

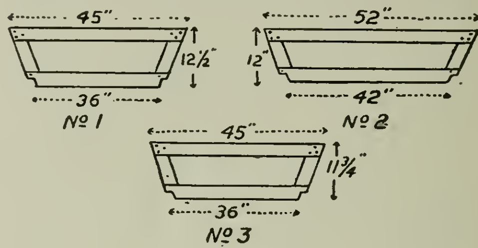


Fig. 4. Molds

are perfectly square and smooth, that each may fit the other as tightly as possible. If this is done, and cedar or white pine lumber free from knots or defects is used, the bottom will quickly swell water-tight. Calking is never satisfactory in flat-bottomed boats, for it is almost impossible to keep it from falling out of the seams. It is unnecessary if the flooring is laid as directed.

After the bottom is on, nail the ⅞ by 6-in. strip of Georgia pine (do not use North Carolina pine, which is an inferior wood), in the center of the outside. This forms the outside keel or shoe and should run from stem to stern. Fasten by nailing from the outside, and clench the nails on the inside, setting in the heads well below the surface. This should also be done throughout the boat, so that putty may be filled in to make a good finish.

The boat may now be turned right side up and the seats and seat-risings put in. The risings are simply ⅞ by ⅞ in. strips, screwed to the ribs the seats resting upon them.

The molds may now be removed.

In the place occupied by them put in a rib, in the same manner you have fastened in the others.

The work of making the centerboard may now be started, which is shown in Fig. 6. First cut the slot in the exact center of the floor, and through the outside keel. Make this slot 2 ins. wide. At each end, put in a post. Nail this post solidly to the flooring and to the keel. The sides of the centerboard trunk are best made of a single board; if two are used, calk the seam.

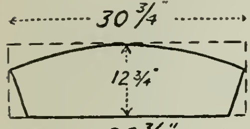


Fig. 5. Transom

The sides are shaped as shown and nailed to the posts. Lay two or three strands of candle-wicking at the junction of flooring and trunk. Finish by nailing a 1-in. quarter-round molding to cover the joint, first laying in a strand or two of candle-wicking. For the centerboard, two pieces of Georgia pine are doweled together as shown in diagram. Galvanized or plain iron rods about ¼ in. in diameter are all right for fresh water, but brass is more durable in salt water. In boring the dowel holes, make them the same size as the dowels, and take particular care to bore the holes straight, otherwise the board will not be true. In the lower left-hand corner of the centerboard, make a 4½-in. slot. Bore a hole through the trunk and hang the board by driving an oak pin flush with the outside of the trunk. Near the after-end of the top edge of the board, drive a staple or screw-eye, and fasten a galvanized iron rod in the eye, so that the centerboard may be raised and lowered. The top of the trunk is finished with a ¼ by 3½-in. oak piece, in which a hole is bored to allow the rod to project through. Screw this in place on the edges, using brass screws.

The deck beams may now be put in, and while many boats are made with a flat deck, it is best to form a "crown" by curving the beams 1½ or 2 in. in the center. For the fore deck, put in three deck beams, running them across and screwing solidly to the ribs. Two beams should be put in to support the stern deck also. To support the side decks, knees should be put in to rest upon each seat, and in between. The deck details are shown in Fig. 8.

The deck is laid in strips, running fore and aft (lengthwise of the boat). Begin by laying the first strip from stem to coaming line; then fit the others as shown in diagram. When ready to lay the side decks, put a few strands of candle-wicking along the top edge of

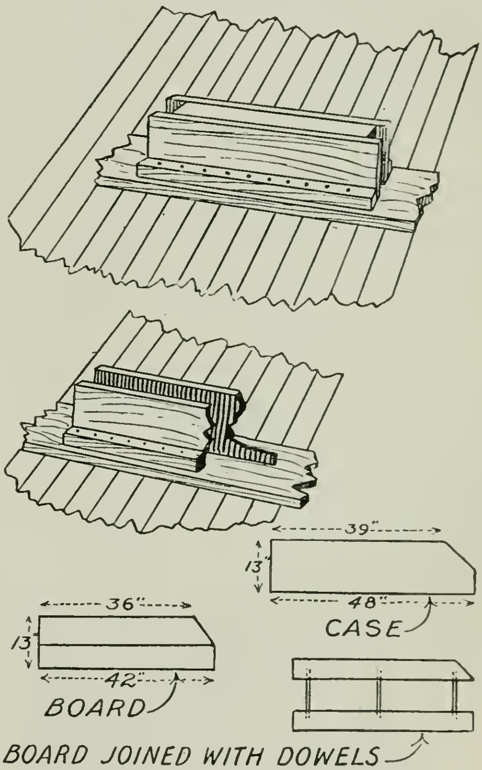


Fig. 6. Centerboard construction

sideboards, and nail the deck solidly to the sides. Screw firmly to the deck beams, countersinking the heads of all screws and nails.

Now that the boat is decked, cut out the inside curve for the coaming of the cockpit. The coaming will not require steaming, if ¼-in. oak is used. Simply bring the forward ends together to form a Λ. A butt-block shaped to fit, is now screwed firmly in place to make a solid joint.

If the deck is carefully laid with tight joints and kept well painted, it will be water-tight, but the usual practice is to cover the decks with canvas. The canvas may be laid in glue or wet paint, the former being by far the better method. Procure a can of soft, black marine glue and brush it on the deck with an old stubby paint

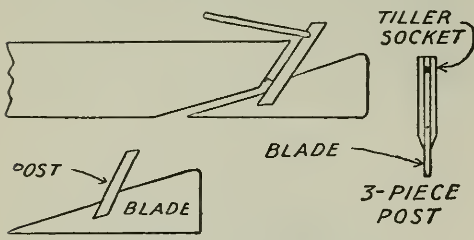


Fig. 7. Rudder details

brush. The glue comes in the form of a thick paste, and will be found too stiff to brush evenly, but spread it as evenly as possible. Now lay the fitted canvas in place and with a moderately hot flat iron, iron the canvas until the melted glue sweats through to the surface. Now pull the edges of the canvas over the sides and tack to the edge of sideboards with copper tacks, spaced close together. Tack the inside edge of canvas neatly to the lower edge of coaming. It is better to use a one-piece deck covering, but it may be pieced by lapping one edge over another about an inch, and gluing in place. Do not use tacks anywhere on the deck.

The row of tacks on the outside edge is covered by screwing on the 2-in. half-round molding which forms a fender-wale. Taper this at bow and stern to make a neat appearance. The tacked inside edge is similarly covered by screwing a ½-in. quarter-round molding around the coaming. On the outside of the coaming, about 18 ins. aft of the middle seat, screw an oar-lock block (made of oak or ash), to both the coaming and the deck.

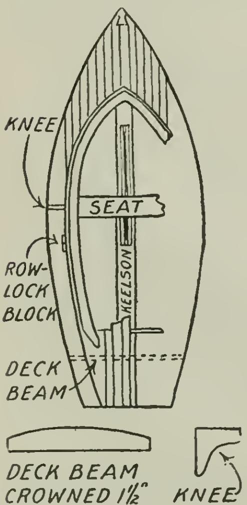


Fig. 8. Detail of decking

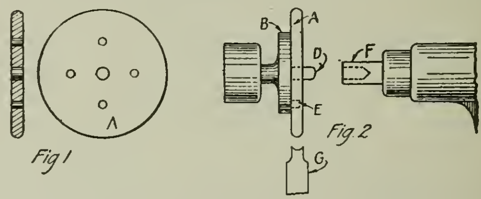
Several types of rudders may be used, but the outside transom form of rudder is preferable to the form using a rubber port. Such a rudder is easily made as shown in Fig. 7.

(*To be concluded*)

Rounding Washers in a Speed Lathe

ROUNDING the edges of washers in large quantities may be accomplished on a speed lathe, by means of an arrangement such as shown in the diagrams. The washer *A*, Fig. 1, is floated on two pins placed on the face of the piece *B*, Fig. 2, which is made to fit into the headstock spindle. The central hole in the washer must fit snugly over the pin *D*. The pin *E* engages with one of the four other holes, but it need not fit tightly.

Fastened in a socket held in the tailstock spindle, is a piece of copper *F*, Fig. 2, being drilled out to clear the pin



Fitting for rounding washers on a lathe

D. When the washer is in position, the copper end is brought into contact with it, keeping it in place.

The tool *G* is used in actually rounding the edges of the washer. Every washer is put on and taken off without stopping the machine. Care must be taken that no chips get between the washers and the face of the arbor, since this will make a bevel on one side and ruin the work.—C. ANDERSON.

Improving Automobile Springs

MANY lightly-built cars of the Ford class will ride more easily if the body springs are taken apart and sent to a polishing shop to be polished off. Here they are first given a rough brushing with a coarse carborundum wheel, after which they are polished to a bright luster, greased, and colored. After this treatment, the springs should be kept lubricated, and they will be found to work very smoothly.—R. W. TILLOTSON.

Boring a Hole in Glass

WHILE the Wimshurst static machine is one of the most easily constructed mechanisms of its kind, no doubt a good many amateurs are prevented from constructing it through the mistaken notion that the glass plates are difficult to drill. This is by no means the case, provided one has access to a lathe. The difficult part is not in cutting the disk, since any good glazier can do that; but in cutting the hole in the center, for fitting the hub on the machine.

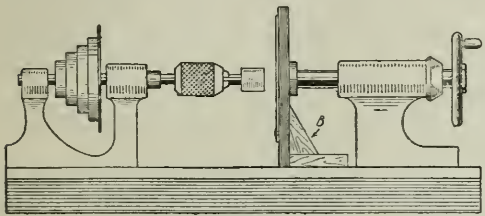


Fig. 1

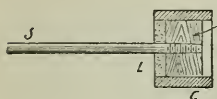


Fig. 2

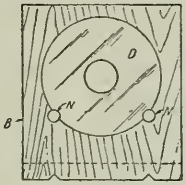


Fig 3

Arrangement for boring hole in glass by means of a lathe

Excellent results can be obtained with the following scheme: Into a piece of copper tube *C*, Fig. 2, the size of the hole wanted in the glass, drive a block of wood *W*. This must be a driving fit. Then screw a 5/16-in. wood screw *S* exactly in the center of the wood block, as shown, and cut off the head. In order to hold the screw in place, it is advisable to tin the shank of the screw and the edge of the copper tube, and fill it with solder, as shown at *L*, Fig. 2. This is our boring tool. Next, make a bracket (*B*, Fig. 1), that will slide on the lathe-bed plate. This may be made of wood. Place a center in the chuck and slide the bracket *B* against it, so as to mark the exact center. Remove the bracket from the lathe, and with a pair of dividers, draw a circle the size of the plates which are to be bored.

Drive two nails on this circumference, as shown at *N*, *N*, Fig. 3. Now replace the bracket in the lathe, and place the boring tool in the chuck as shown in Fig. 1. Place the glass plate on the nails *N*, *N*. If all this has been carefully done, the plate will be perfectly centered. Now move the bracket so that the glass plate just touches the boring tool, and exert a gentle pressure with the tailstock.

The cutting is done by applying oil and emery. Since the copper is very soft, the emery becomes embedded in the tube and thus forms an excellent cutter. A rather slow speed is desirable. The best way to apply the emery is to put it in an oil-can with a rather large opening and squirt it into the cut.

It is well to relieve the pressure from time to time to allow the emery to work into the cut. By this means a very clean hole can be cut, and the result will well repay the trouble involved in the making.—E. C. MEILLORET.

Making Shrinkers

IN making the part shown in the illustration, much time, as well as steel, may be saved by shrinking on the piece *A*. Make the shrinkers from a piece of extra-heavy 1-in. pipe, having the required outside diameter. The use of pipe obviates the cost of making shrinkers, and a 1-in. drill just cleans out the hole. Cut the pipes into the required lengths, leaving a little extra for facing, and then drill them. When a long pipe is drilled and then cut up, a burr is left at each end, which is difficult to remove.

In Fig. 1 is shown a device, which is very handy for shrinking a piece to be located at some special point. A piece of steel, which has been drilled out and hardened for use in hammering on the shrinkers, is shown in Fig. 2. It will not crack or splinter like an ordinary piece of pipe.—C. ANDERSON.

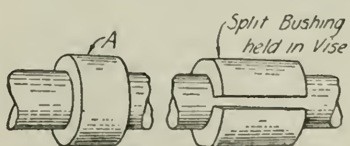
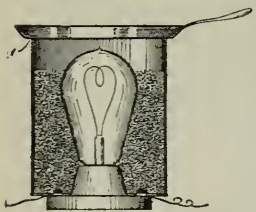


Fig 1

Fig 2

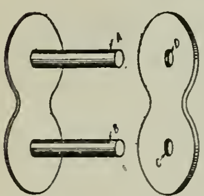
Device for shrinking a piece of piping into place on a shaft

Frying Eggs by Means of an Incandescent Bulb



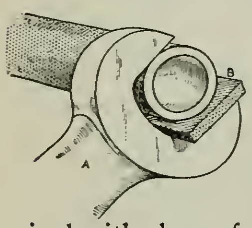
An ordinary incandescent bulb, together with some sand and a tin can, can be used for frying eggs to suit the taste of the most critical. Procure a can large enough so that a space of ¼ in. will remain between its sides and the bulb at its widest part. Cut a hole in the bottom of the can to fit an electric socket. Screw in the bulb and fill the can with sand as shown. Place the pan on the top of the can and be sure it fits tightly. Turn on the current; in a very few minutes sufficient heat will be generated to cook the eggs. If left longer, the sand and glass will become almost red-hot.—Wm. Harrier.

An Easy Way to Punch Holes in Clock-Spring Steel



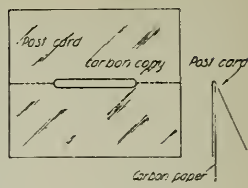
The diagram represents an instrument that will be found handy for punching holes in spring-steel, such as a clock-spring. It consists of a link from an automobile chain, one pin of which *A* is filed flat like the end of a punch. By placing the steel spring over the hole *D* and entering the pin *B* in hole *C*, a sharp blow with a hammer over *A* will cut a clean hole through the spring. Being of steel, the pins *A* and *B* may easily be hardened.—M. F. Vandersdale.

An Improvised Pipe-Wrench



A pipe-wrench can be improvised from a solid wrench *A* and a coarse, sharp file. The file *B* is placed in the lower jaw and raised with slugs of metal, if necessary, until the desired grip is obtained on the pipe between the upper jaw and the file surface. This expedient will prove of value in an emergency.

A Carbon-Copy Postal Card

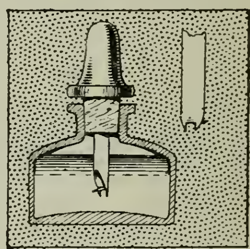


A postal card, similar to the regular double card used for a return message, may be used for making a carbon copy. The carbon is slipped between the two folds of the card in writing; then the copy is torn off along the central perforated line.

For this purpose a comparatively thin card is required.

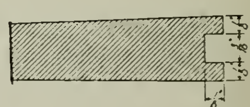
This scheme is especially valuable to clubs and business houses who have to send out hundreds of short communications.—F. P. Mann.

Improving a Drawing-Ink Bottle



The quill, usually attached to the stopper of a drawing-ink bottle, necessitates several dips into the ink before a sufficient quantity is obtained for transferring to an instrument. By slitting the quill on both sides of the point and standing it on the point, with a heavy object bearing down on the stopper, the tip becomes horizontal, forming a small cup, which will retain a large quantity of ink.—C. Nielsen.

Hints to the Mortor-Cyclist



The appearance of old and rusted cylinder heads can be greatly improved by applying ordinary stove polish with a small brush.

Bent crank-hangers can be straightened by putting a piece of one-inch pipe over the end of the hanger and exerting a little pressure.

A wrench for the bolts in the crank case can be made by grinding or filing a screwdriver bit into the desired shape, as shown in the diagram. The bit is then placed in the brace and used like a socket-wrench.—E. H. Dodge.

A Bow-Drill for the Work-Shop

THE bow-drill about to be described will be found a most useful addition to the average amateur's workbench, and although the size of the drills somewhat restrict its field of usefulness, it will be found invaluable in the construction of certain classes of apparatus.

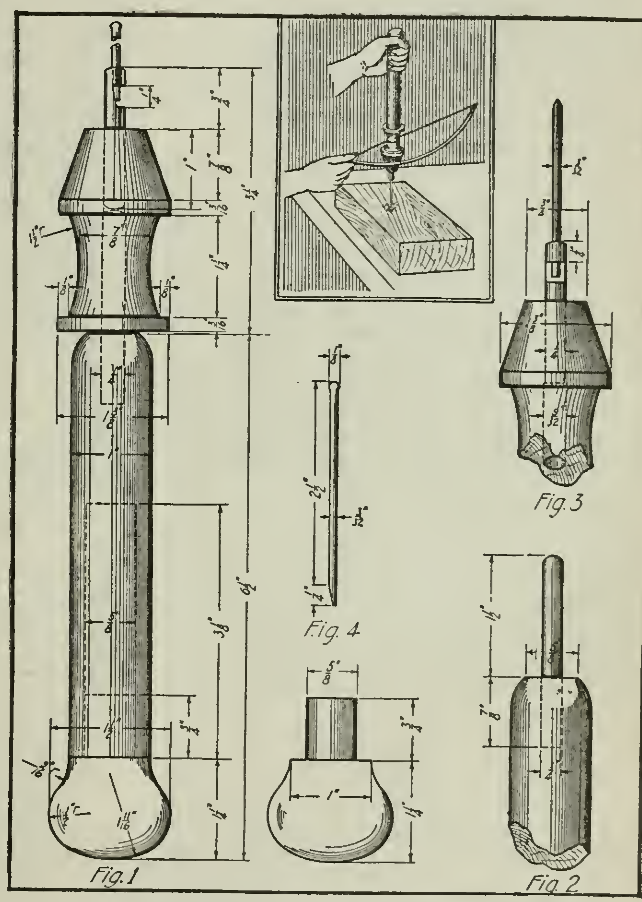
The handle should be turned first, preferably from good ash stock. It is perfectly straight in diameter and 5¼ inches long. One end tapers in to ¾ inch. A ⅝-inch hole should be bored in the other end 3⅛ inches deep; this serves as a magazine for the drills.

The next step is to turn the knob or breast-piece. This is 2 inches long and 1½ inches at the widest point. One end is rounded off as shown in the diagram, while a shank ¾ inch long and ⅝ inch in diameter is turned on the other end. This fits the magazine and serves as a stop for it and as a breast-piece for the drill.

The next step is turning the spool, the dimensions of which are given in Figs. 1 and 3 of the diagram.

The chuck is next made. This is of iron or soft steel ¼ inch in diameter and 1¾ inches long. A slot ¼ inch long is filed in one side ¼ inch from the end; the upper side being filed 11/64 inches deep, while the lower side is filed 5/64 inch deep. A hole is next bored endways into this slot slightly larger than 3/32 inch; the other end is embedded into the end of the spool for one inch of its length and should not turn. A 9/32-inch hole should be bored in the other end of the spool up to the end of the chuck. This should be done before the chuck is put in so that the spindle will bear directly on the end of the chuck. This reduces the friction.

The next step is to embed the steel spindle in the handle. This had best be of steel, ¼ inch in diameter and 2⅜ inches long. One end should be slightly rounded, while the other is tightly embedded in the handle for ⅞ inch of its length. The spool on this spindle should rotate freely.



Construction details of a bow-drill adapted for actual workshop use

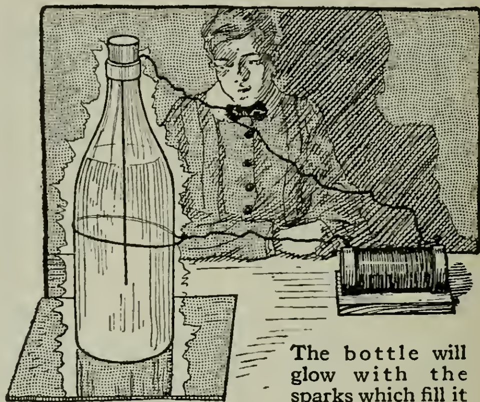
The drills are next made and are easily and cheaply constructed from the ribs of an old-fashioned umbrella. These ribs are of the finest spring steel. To make the point, cut the wire to the desired length, say about 3 inches, as this is long enough for average work.

Then heat the tip to a cherry red and hit it a sharp blow with a hammer to flatten it slightly, and quickly dip into cold water. This gives about the proper degree of hardness. The necessary clearance was given when it was flattened, and the point is then ground down until the flat side is very nearly a half-round and the narrow side tapers to a point at an angle of 30 degrees. The other end is filed off slightly on a long angle, as shown in Fig. 4. This slides up upon the slot in the chuck and prevents the drill from turning.

The bow is made of some limber wood, such as elm or hickory, and is trimmed down so that when bent it will give the desired tension to the string. This depends on the wood used and should be sufficient to keep the cord from slipping when twisted once around the spool. The bow used with the drill described was 2½ feet long, ¾ inch wide and ¼ inch thick. The cord should be of leather attached to one end and about 6 inches above the other end, which was left for a handle.

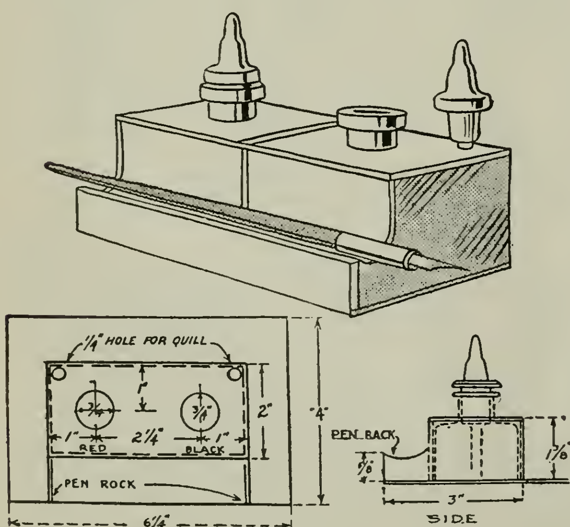
The chuck described here is expressly made for the wire drills, but if the maker has any other drills that bore with a backward and forward motion, he could use any design of chuck he wishes in order to accommodate the drills.

This bow-drill, if the points are well ground, will quickly bore wood or iron and if supplied with turpentine will even bore glass. When needed, the drills can be made longer, but when the length is over 6 inches care must be taken or they will bend when pressure is exerted on the handle. To rotate the drill, the bowstring is twisted once around the spool and the bow is then pushed rapidly backward and forward at right angles to the handle.—Rae McGooch.


The bottle will glow with the sparks which fill it

The Luminous Bottle

To perform this experiment, fill a big bottle nearly full of water and run a wire from one terminal of a spark coil to the inside of the bottle. Set the bottle on a plate of glass to insulate it from the table. Then run a wire from the other terminal and tie it securely around the bottle about half way up. When the spark-gap is started, little sparks are given off from the wire to form a fine network all about the bottle.—F. M. Kimble.



An attractive non-upsetting ink bottle stand

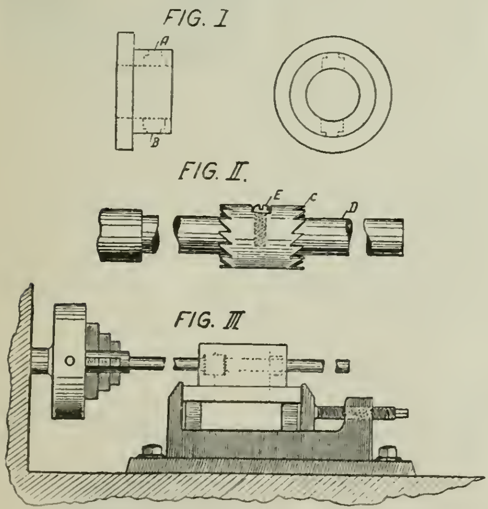
Non-Upsetting Holder for Drawing Inks

An ink stand that will not upset, owing to the broad base secured, can be made according to the dimensions given in the diagram. The base should be cut first and the sides fitted afterwards. Cigar box wood will do. The two end pieces should protrude in front of the bottles and the upper surfaces should be whittled out for pens.

Inside Counter-Boring in a Miller

THE problem of securing the counter-bore shown in Fig. *I*, may be solved by means of a cutter *C*, shown in Fig. *II*. This cutter is made for left and right, for use in a milling machine running only in one direction. It is a snug fit on the shank *D*, one end of which is held in the chuck, as shown in Fig. *III*. The small diameter of the shank is a few thousandths of an inch smaller than the hole, which is drilled through the sides of the work, shown at *A*, Fig. *I*.

The method of holding the work is shown in Fig. *III*. After being placed in the vise, it is lined up with the end of the shank, which is held in the chuck. The cutter is then placed between the sides and the table moved inward. This runs the cutter on to the shank to which it is fastened by means of the screw *E*.—C. Anderson.

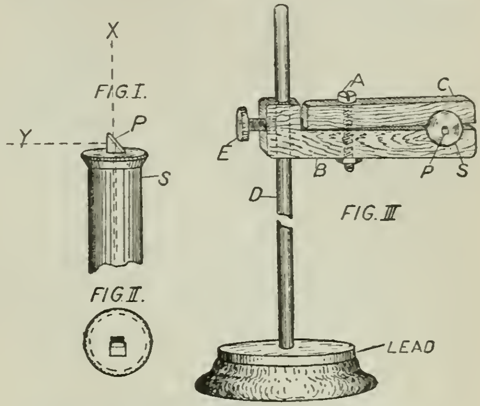


A solution to the problem of getting the counter-bore shown in Fig. I

How to Improve a Pocket Spectroscope

SMALL direct-vision spectroscopes are very popular with many amateur experimenters and are comparatively inexpensive. The utility of an instrument of this type can be greatly increased by a few simple improvements which can be made by anyone who is handy with tools.

The most important addition is that of a comparison prism, whereby light from two sources can be viewed simultaneously and the spectra compared. This is shown in Fig. *I*. A small right-angled prism *P*, with ¼-inch sides, is fixed at the slit end of the spectroscope

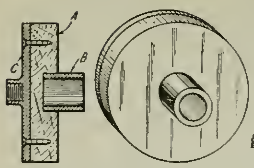


A comparison prism can be added to a pocket spectroscope with little difficulty

S, the position being carefully adjusted so that exactly one-half of the narrow slit is obscured, as shown in Fig. *II*. Strong isinglass cement, or an alcoholic solution of shellac, may be used as an adhesive and will be entirely satisfactory, if the instrument is carefully handled. Light proceeding from a source *X* immediately in front of the spectroscope, will pass directly through the uncovered half of the slit; while light coming from the side, as at *Y*, and entering the prism, will be refracted at right angles to its former direction and made to pass through the covered half of the slit. In this way two spectra can be seen, one above the other, and compared.

It is a great convenience to fasten the spectroscope to a stand, thus leaving both hands free. A simple stand that can be constructed without difficulty, is shown in Fig. *III*. The spectroscope *S* is gripped between two wooden blocks *B* and *C*, hollowed out at one end. A gentle grip is all that is needed. This can be secured by the use of a small brass bolt *A*, passing loosely through large holes in both blocks. The lower block *B* is perforated at the end to slide up and down a rod *D*, fixed upright in the center of a wooden base. A thumb-screw *E*, serves to hold the block at any desired height. To make the stand steady, the base should be weighted with lead.—H. J. Gray.

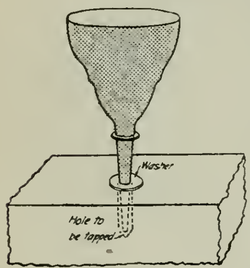
A Lathe Polishing Kink



TO polish small round boxes, napkin rings, and the like, after they have been taken from the lathe, take a board, *A*, and with an expansion bit bore a hole the size of the object to be polished, *B*, and place it in this hole so that part of it projects.

Screw the board to the face-plate, *C* and put it on the lathe. The edges of the board may be turned down with a chisel and the object given its final smoothing and polishing without gripping it in metal.—R. F. CUMMINGS.

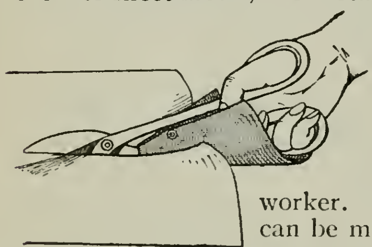
Tapping Blind Holes



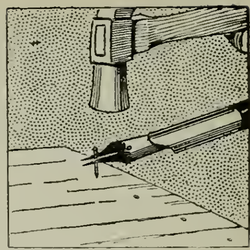
BEFORE tapping blind holes, much time and trouble can be eliminated by first making sure that the holes have been drilled to the right depth. This is done by placing a leather washer on the spout of an oil-can so that the end will just touch the bottom of the hole, the washer resting on the face of the work.—C. H. ANDERSON.

How to Cut Metal and Not Cut Yourself

WHEN making a long cut in a strip of sheet metal, the metal is likely to bend up behind the shears and cut the hand of the worker. A guard can be made from a rectangular piece of sheet metal. Cut off the two corners of one end and bore two holes as shown in the diagram. Bend the smaller end along a longitudinal line through the middle. Fasten to the bottom handle of the shears by means of a small bolt. —J. LIEBMAN.

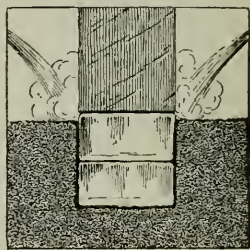


Handling Small Brads



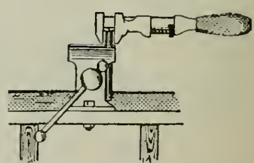
AN ordinary pen greatly facilitates the handling of small brads or pins. The brad should be placed between the blades of the nib and then hammered in part way, after which the pen may be removed.—JOSEPH BRAFF.

Using Ice to Lower Heavy Stones



THE placing of finishing stones, weighing several tons, is often difficult because spikes cannot be used, owing to the position of the stone in the building. The stone can be easily lifted to the desired level with ropes, but it cannot be lowered with them, since they would wedge in the sides. By placing several cakes of ice in the hole, the stone can be lowered on to them, directly above the opening. Streams of hot water will melt the ice and let the stone sink into place easily.—A. J. COWEN.

An Emergency Pipe-Cutter



PIPES of brass or other soft metal can be threaded with a lock-nut of the proper size. A lock-nut is cut at opposite places across the threads, the two threaded halves thus formed comprising a very crude pipe-cutter. The pipe should be held by a vise and the nut gripped with a monkey-wrench.—C. A. FAIMAN.

Whistle on Engine of Motor-Boat

A WHISTLE in place of the pet-cock or priming cock, of a twin cylinder marine engine will be of use in signaling from a motor-boat.

Experimental Electricity

Practical Hints for the Amateur

Wireless Communication

Damping in Radio Circuits

By John Vincent

THE subject of damping and "logarithmic decrement" of current and voltage in radio telegraph senders and receivers is often looked upon, by the wireless experimenter, with a certain degree of awe. This is usually because many of the textbooks and articles treat the matter as though it were very complicated and hard to understand; the fact is indeed the contrary, and the matter of damping is not at all difficult to grasp. There is no need of making use of long mathematical expressions to figure out how much damping exists in any circuit, and what damping itself means.

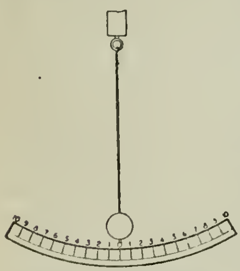


Fig. 1. Pendulum with circular scale

In the first place, it must be understood that in speaking of the damping of an alternating current one refers merely to the rate at which the current oscillations die away. If the oscillations die away fast the damping is said to be high, or if, on the contrary, the oscillations persist a long time before fading out, the damping is feeble. A pendulum having a freely pivoted joint at the top, and swinging through the air, will vibrate back and forth many times before coming to rest; its oscillations, which are, of course, mechanical, are then feebly damped. But if the same pendulum is immersed in water it will stop swinging much sooner, because the friction of the water offers resistance to its motion; in this condition the damping is higher. If the pendulum is lowered into a tank of heavy oil or molasses the friction will be greater still, and the oscillations will die out very quickly; thus the mechanical system becomes highly damped.

If we arrange the pendulum with a circular scale and pointer, as shown in Fig. 1, it becomes a simple matter to measure its period and damping. To find its period it is only necessary to draw the bob to one end of the scale and let it go, counting the number of complete swings it makes in one minute. The length of time taken for one complete swing from left to right and back, measured in seconds, is equal to sixty divided by the number of swings in one minute; this division gives the time period of the pendulum. For instance, if the bob is swung out to the left and let go at the beginning of the minute of timing, and if it swings back to the left side thirty-six times and is at the right-hand end when the minute is up, the period will be 60 divided by 36.5, or 1.64 seconds. By lengthening the cord or rod a little, the period could be made exactly 2 seconds, or by shortening it, 1 second. For the illustration of damping measurement given below it is useful to make the pendulum about 39 ins. long, which will make the period about 2 seconds. The cord may be lengthened or shortened, as required, until, by a number of successive measurements, it is shown that the time of making one complete swing is two seconds. To measure the damping it is not necessary to have the period any specific length of time, but the plotting of oscillation curves of the pendulum is made easier if some simple number is chosen.

This plotting of the oscillation is an interesting and useful preliminary to the determination of the damping of the pendulum. Suppose that the period has been adjusted to 2 seconds, and that the scale along which the pendulum-bob swings has been marked off into 10 equal parts on each side of the middle or zero position. Let the bob be drawn to the left and held at the tenth division;

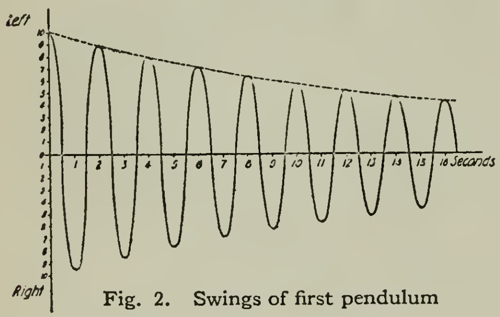


Fig. 2. Swings of first pendulum

if it is released it will reach the lowest point (zero) in exactly ½ second and will swing out to the right side. At the end of 1 second it will reach the end of the swing to the right and will be on the point of returning. At the end of 1½ seconds the bob will be again opposite the zero point, and at the end of 2 seconds it will be at the end of its first complete period and about to swing to the right in beginning the second period. The important thing to note is that although the bob started at 10 on its scale, it did not swing so far to the right but instead commenced to return at the point indicated by about 9.5 on the scale. At the end of the first complete period it swung out only about as far as 9 on the left; at the next complete period it swung only a little beyond 8. If one watches the extreme reach at the end of each swing very carefully, it becomes possible to make a table of the successive turning points. For a certain pendulum these may be as follows:

Time in Seconds	*Position of Bob*
0 (start)	10 left
0.5	0
1	9.5 right
1.5	0
2 (end of first period)	9.0 left
2.5	0
3	8.6 right
3.5	0
4 (end of second period)	8.1 left
6 (end of third period)	7.3 left
8 (end of fourth period)	6.6 left

and so on. At the end of each half second the bob would be at zero, and at the ends of the fifth, sixth and later periods, at the following values of the scale to the left: 5.9; 5.3; 4.8; 4.3; 3.9; 3.5; 3.1; 2.8; 2.5; 2.3; 2.0; etc. By drawing a horizontal line to represent time in seconds and by dividing the space above and below it into ten equal zones, above for swings to the left and below for swings to the right, the diagram of Fig. 2 may be drawn by measuring off the points given in the table (or those measured from your own pendulum). This diagram represents the actual movements of the suspended weight, and by drawing a broken line through the highest points one can get a good idea of how fast the swings die away, or, in other words, of how great the damping is.

The most interesting thing about the figures determined by the above experiment is that the ratio of the successive measurements or amplitudes of swing remains a constant quantity. This may be proved by taking the ratios of the swings at the ends of each period; the first ratio is $10/9 = 1.1$. The second is $9/8.1 = 1.1$. The third, $8.1/7.3 = 1.1$. Likewise, all the others may be found to be equal to 1.1, since it is a law of nature that all simple free oscillations in any vibrating system (whether mechanical or electrical) will die away or be damped out at such a rate that the ratio of their successive maximum amplitudes remains constant. This ratio of amplitudes is a measure of the damping, and is called the damping factor. The larger the ratio the higher the damping.

Suppose that the wind friction of the pendulum shown in Fig. 1 is increased by fastening to it, near the bottom, a fairly large piece of cardboard, in such a way that it will act as a brake. The swings of the pendulum will die away much faster than before; that is, the damping will be increased on account of the increased frictional resistance of the fan. On such a more strongly damped pendulum (assuming that the oscillation is started by letting the pendulum begin from the point 10), the successive maximum swings to the left (at the ends of the first, second, third and later periods), may be as follows: 8.0 (end of 1st); 6.4 (end of 2nd); 5.1 (end of 3rd); 4.1; 3.3; 2.6; 2.1, etc. It is seen at once that now the swings decrease much more rapidly. This is even more vivid when Fig. 3, which shows the motions of the second pendulum, is inspected; the rapid fall of the broken line along the top, which indicates the damping, should be noted especially. The constant ratio or damping factor, whose value is an indication of the damping, may be found as before by dividing the first maximum amplitude by the second, the second by the third, etc. This gives us: 10 / 8 = 8 / 6.4 = 6.4 = 5.1 = etc. = 1.25. Since this ratio is larger than before the brake was added to the pendulum, we have an arithmetical proof that the damping is larger.

So far we have considered only the "damping" of the oscillation system; what is the "logarithmic decrement?" Nothing more nor less than the natural logarithm of the constant ratio which has just been figured out. These logarithms, or special numbers, for several different ratios, are given in the following table:

Ratio	*Logarithm*
1	0.00
1.05	0.05
1.11	0.10
1.16	0.15
1.22	0.20
1.25	0.22
1.28	0.25
1.35	0.30

By looking up the ratio 1.1, which was that of the first pendulum, in the table it is seen that the logarithmic decrement of that arrangement was a trifle under 0.1 per period; similarly, for the second pendulum (which had a damping factor of 1.25), the decrement is found to be 0.22 per complete period.

Although the examples just given are purely mechanical, damping in electric circuits is of the same character. Let us consider the circuit of Fig. 4, which has connected in series a condenser *C*,

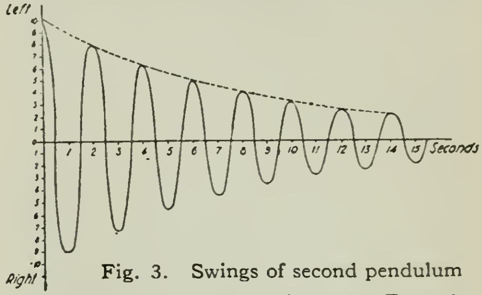


Fig. 3. Swings of second pendulum

an inductance *L*, a resistance *R* and a special current indicator *I*. This indicator is of the sort which will show the amount and direction of the current flowing through the circuit at any instant, as would a Braun-tube oscillograph. If *C* is charged to a certain potential and then is allowed to discharge through the oscillation circuit by the sudden closing of switch *S*, the result will be a free oscillating current through *L*, *I* and *R*. As was shown in the March article of this series, the frequency and time period of this free oscillation can be figured out from a simple rule, if one knows the inductance and capacity of the circuit. The thing important to this discussion is not the period of frequency, however, but the rate at which the free oscillation dies away. If the oscillograph *I* is arranged to make an actual photograph of the oscillation current-effects (which is entirely feasible, even on very high frequencies), the result will be a curve of the sort shown in Figs. 2 and 3; if the capacity and inductance, or either of them, are increased, the time period will be lengthened and the curves will spread out more along the horizontal line. If the voltage applied to the condenser before the switch *S* is closed is made larger, the current flowing will be increased and the highest and lowest

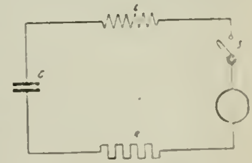


Fig. 4. Oscillograph Circuit

points (the maxima) of the curves will be farther from the zero line. If the resistance in the circuit is increased, there will be fewer oscillations before the current dies away to a small value; that is, the damping will be increased. These three electrical effects correspond in the mechanical case, to changing the length of the pendulum string, pulling it farther from zero before releasing it, and putting on the fan to increase the wind-resistance.

If an oscillogram made in this way,

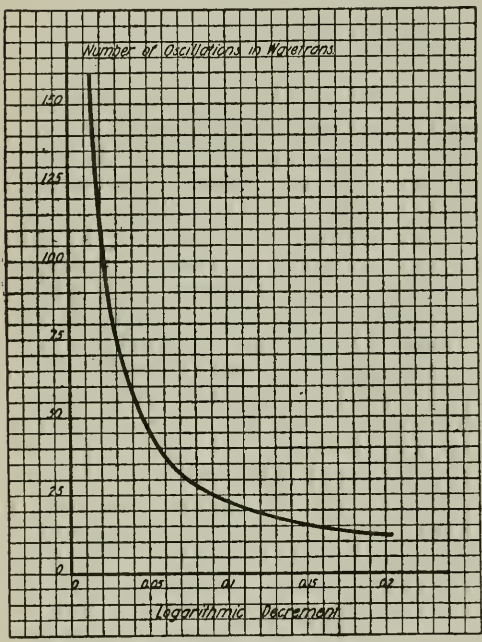


Fig. 5. Oscillation for various decrements

showing the free oscillatory discharge in such a circuit as indicated by Fig. 4, is measured with a pair of dividers, it is found that the ratio of the maximum amplitudes remains constant. Just as with the pendulum, the logarithm of this ratio may be taken and thus the logarithmic decrement of the circuit determined. If the ratio (or damping factor) is found to be 1.05, the table above shows the decrement to be 0.05 per period. If the ratio is made as large as 1.28 by increasing the resistance, the decrement is increased to 0.25 per period. The numerical range of decrement values for circuits used in radio telegraphy is very much the same as that of mechanical vibrating systems; the electrical oscillations in an ordinary spark sender for radio will die away at about the same rate as the mechanical oscillations of a springy steel rod held in a vise. There is a variation of decrement values in wireless transmitters from about 0.03 to about 0.5 per period; the present laws of the United States require that the logarithmic decrement shall be 0.2 or less, since otherwise there are so few oscillations in a wave-train that tuning is not of very great value.

If every time it was desired to measure the damping of a circuit one had to set up a high-frequency oscillograph and make a photograph of the free oscillation, and then measure the amplitudes of the current maxima from that and finally compute the ratio and the logarithm, there would be very few such measurements made. It happens that since the damping in any circuit depends upon the effective capacity, inductance and resistance of that circuit, one may compute the decrement directly from known values of those quantities. The rule is not complicated; it merely states that the logarithmic decrement of any simple circuit may be found by the following four steps: (1) Divide the effective capacity, in farads, by the effective inductance, in henrys; (2) take the square root of this result; (3) multiply this root by the effective resistance in ohms; and (4) multiply this product by 3.14; the answer is the logarithmic decrement, per complete period, of the circuit in question.

This rule for computing decrement may be applied to a simple circuit, for example that of Fig. 4. Let us assume that the effective capacity is 0.001 microfarad, which equals 0.000000001 farad; the inductance may be 0.01 millihenry, which is 0.00001 henry; and the resistance we may assume as 3 ohms total. Following out the rule, the first step gives 0.0001 as a preliminary result; the square root of this is 0.01; multiplied by 3 this becomes 0.03; and multiplying again by 3.14, the logarithmic decrement is found to be 0.095 or a trifle under 0.1 per complete period. It is often difficult to measure the three quantities resistance, capacity and inductance in an oscillating circuit in such a way as to get their true effective values. The relation expressed by this rule is used often to determine the resistance when the damping, inductance and capacity are known; to do this, the damping must be measured in some other way. The method most utilized depends upon the fact that feebly damped circuits give much sharper tuning than those which are highly damped. In a later article this will be explained more fully, and various examples of tuning measurements will be given; for the present it will be sufficient to point out that the sharpness of tuning depends upon the amount of energy that may be accumulated in an oscillating circuit by resonance. Every wave of a wave-train adds its share to the energy being stored, hence it becomes almost obvious that the more waves there are in a train, the more energy will be stored. It is apparent from the pendulum experiments that the feebler the damping of an oscillating system, the more oscillations it will complete before it comes to rest. Since the waves in a wave-train correspond to the number of complete current oscillations in the antenna as a result of the spark generating that wave-train, it is seen that the less damped the antenna current, the more waves per train. Thus the less the damping, the sharper the tuning.

Fig. 5 is a curve which shows the number of complete oscillations in a wave-train of any normal decrement before the amplitude is reduced to ten per cent of its original value. By looking up the decrement along the horizontal line, then tracing upward until the curve is intersected directly over the assumed decrement value, and then following the horizontal line to the scale at the left, the various desired values may be found. Thus, for decrement 0.2 there are only 12 complete oscillations before the amplitude has fallen off nine-tenths, while for decrement 0.02 there are about 112 oscillations. As the decrement grows smaller the number of oscillations rises rapidly; for zero decrement the number would be infinite—the oscillations would be completely sustained and would not die away until the circuit was opened.

A National Wireless Association

THE National Amateur Wireless Association, headed by Guglielmo Marconi, inventor of wireless telegraphy, has entered the field of radio communication for the expressed purpose of promoting group, or co-operative, working among amateurs. The organization is a comprehensive one, aiming to direct and standardize radio experiment throughout the United States by arranging with each member for progressive courses of study and later through grouping the most promising radio enthusiasts with active co-workers and guiding the experiments along productive lines. The development of radio engineers from sincere investigators who are hampered by facilities for higher training is to be promoted by a series of specially designed experiments, supplemented by a monthly bulletin service.

Military wireless signaling is a branch of instruction to be given a prominent place in the program. Arrangements have been made for amateur clubs throughout the country to affiliate with military organizations as accredited members and officers of signal corps. This branch of training is under the direction of Major William H. Elliott, Adjutant-General of the Junior American Guard and one of the vice presidents of the Association. Several signal corps batallions have already been formed and are training to serve in the proposed third line of defense for the nation. Summer camps have been secured and field maneuvers will be featured in the vacation months.

From the New York headquarters of the Association, announcement is made that every amateur who is properly endorsed may secure membership as an individual. According to abilities and geographical location, members are entered for eligibility in some existing local club, state or inter-state association, and when these have secured recognition, a representative is appointed to the National Council with a voice in the management of the governing body.

In the unusual growth in popularity of wireless lies a possible source of benefit to the nation. Every skilled amateur could render great service to his country in time of war.

An Automatic Pressure-Gage Alarm

AN ordinary pressure-gage may be easily equipped with a simple home-made contact device, which will serve as an automatic alarm, giving the attendant an audible signal, when the pressure has exceeded or dropped be-

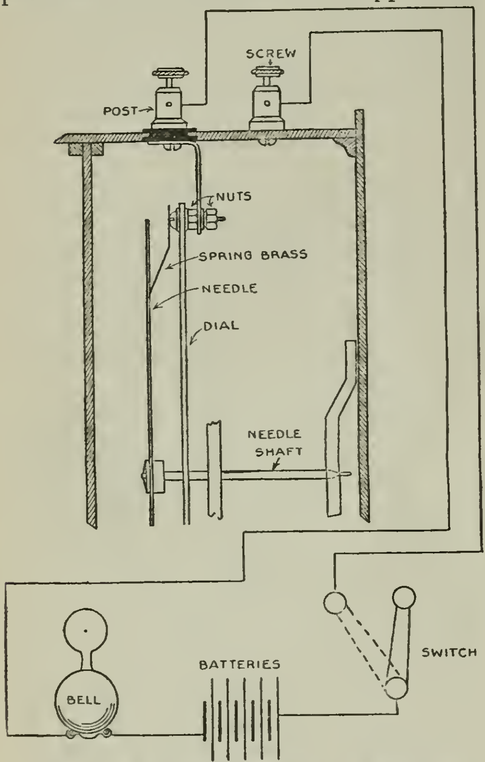


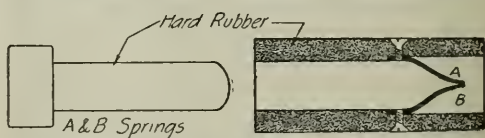
Diagram of connections for making an audible pressure-gage alarm

low a previously determined value. This device may be arranged as follows: Carefully remove the glass front of the gage and also the needle from its spindle. Then, on the under side and at the outer end of the pointed end of the needle, fasten a very light piece of spring brass, which is to brush over the contact to be mounted on the face of the dial. This contact is fastened on the face (of dial) in such a position that the spring on the end of the needle is in perfect contact with it, when the needle indicates a pressure corresponding to the value at which the alarm is to be given. It is, of course, to be insulated from the dial, and in turn, connected to a binding post, mounted on the outside of the frame, or containing case, of the pressure-gage and properly insulated from it. A second binding post is mounted on the case itself, and electrically connected with it. These two posts form the contact device, and are connected in series with the bell battery and a small single-pole switch. In remounting the needle on its shaft, great care must be exercised to see that it occupies the same position on the face of the dial that it did before. A little error may prove of great damage, in case it should indicate a pound or so less than is really the actual pressure. The spring of brass, on the outer end of the needle, should be very light and flexible, and so adjusted that it will move over the contact on the face of the dial with the minimum friction. It would, no doubt, be best to fasten a small piece of platinum on the points that touch or coincide with each other, to prevent trouble due to corrosion and arcing.

A diagrammatic sketch of the entire device, including the electrical connections, is presented herewith. One or more additional contacts may be mounted on the dial, at various spaces showing different pressures, etc. These contacts may also be put in circuit with bells, buzzers, and the like with different tones.—WM. WARNECKE, JR.

Fools Automobile Thieves

PROBABLY the simplest way to disappoint the automobile thief is by means of an inconspicuous lock which short-circuits the ignition system. Two springs should be installed in the walls of a rubber tube. When a rubber plug



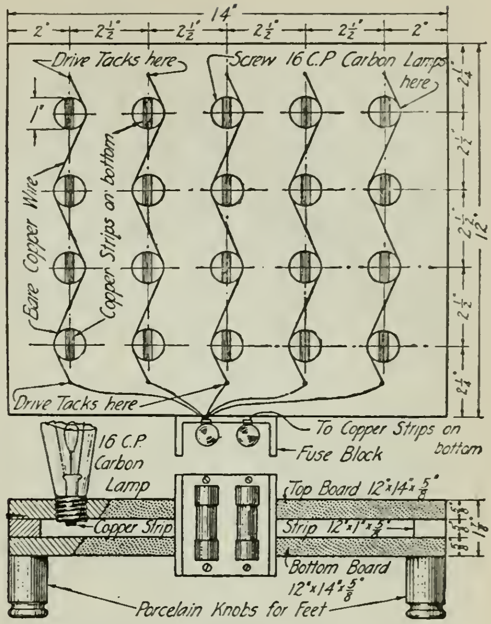
A short-circuit of the ignition system is the safest guard against automobile thieves

is inserted, the springs are forced apart and the current will go to the spark-plugs as usual. Withdrawing the plug allows the springs to come within sparking distance of each other, and the circuit is temporarily put out of order. One spring should be connected to the terminal of the magneto and the other to the automobile frame.

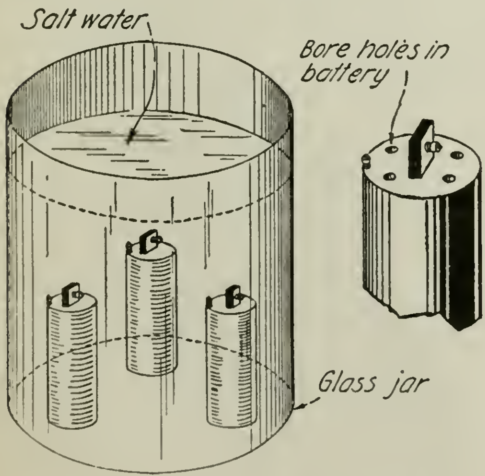
Lamp Resistance for Charging Storage Batteries

A LAMP bank resistance for reducing current in charging storage batteries, while wasteful of energy, is cheap in construction and is often useful in power houses or in those few places were electric current is abnormally cheap. The lamps are inserted in holes bored in a soft pine plank, making contact on the lower side with strips of copper or brass that are fastened by tacks. Contact with the other lamp terminals—the threaded bushings—is made by winding clean copper wire in a zigzag fashion between the lamps' bases, as indicated in the diagram. The wire should be wound about each lamp base several times to secure adequate contact, and soldered, if possible. A fuse block should be provided and the connections made as shown.

Old lamps are best, as their resistance is lower than new ones. If the polarity of the current is not known it can be found by placing one wire of the circuit in a tumblerful of water with a wire from the lamp bank opposite. Only a couple of lamps should be used in this test. By noting the bubbles that arise from the two wires, the polarity can be determined by marking the wire from which most bubbles rise. This is the negative side. Storage batteries will be ruined if the connections are not correctly made.



A simply arranged lamp bank for reducing voltage when charging storage batteries



Method of recharging dry batteries by immersing them in salt water

Recharging Worn-out Dry Batteries

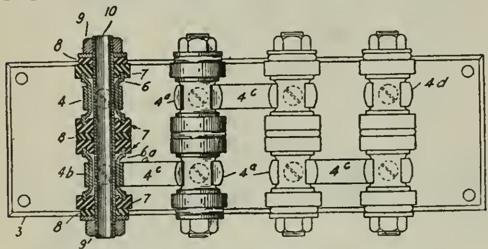
DRY batteries are made of dampened carbon cobalt. That all batteries have not the same life is due to the fact that they are dry from use, or leakage from evaporation through the top. Cheap batteries do not contain the quality of carbon found in high-grade batteries; hence it is useless to recharge cheap ones. A good high-grade battery will recharge three times before it is worthless.

Take six worn out batteries, drill four holes in the top of each through the tar covering (a red hot nail or a small drill will do), so that the black carbon can be seen. Fill a pail with water, so that it will be about one inch higher than the tops of the batteries. Dissolve three good handfuls of common table salt in the water. Do not use sal-ammoniac. Place the batteries in the pail in a standing position. Leave them for eight hours, stirring the salt water about twice during that time.

After removing the batteries, stand them upside down to let what water will run out (about two hours). Then seal them with a hot soldering iron; connect them, and they are ready for use. This can be done three times.—T. F. Busch.

Tubular Quenched Gap

A PATENT for a novel form of quenched spark-gap is No. 1,132-589, issued in 1915 to F. H. Kröger. In the illustration is shown one of the diagrams forming part of this patent. The gap units are made up in groups of two sparking spaces connected in series, and each unit slips into a pair of clips much as does an ordinary cartridge fuse. This gives complete interchangeability and makes it possible to substitute new gaps for any which happen to break down,

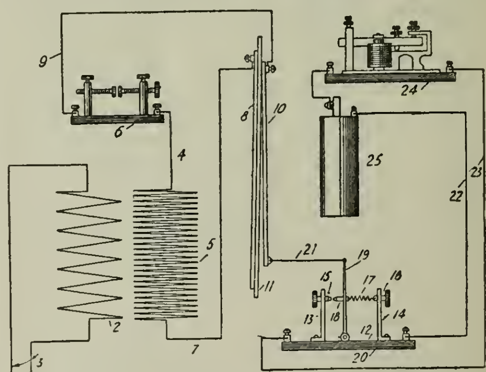


Interchangeable gap units for a tubular quenched gap

without disturbing the sections which remain in useful condition. As may be seen from the illustration, each unit has as its most important parts the central tube 10 and two shorter cylinders 6 and 6a, which slip over the inner tube with a small space between them and which have their ends expanded to a considerably larger diameter than their central portions. The outer tubes are supported by the grooved insulating disks 7, which serve also to hold them concentric with the inner cylinder 10. Between the end supports and at the extremes of the units are placed soft rubber washers 8, and the entire structure is clamped between washers and the nuts 9, so as to form a rigid, airtight assembly. The spark passes between the inner cylindrical surface of the cylinder 6 and the upper, outer and parallel surface of 10, and, after the current traverses tube 10 to its lower portion, it passes from the lower outer surface of 10 to the inner and parallel surface of 6a. The current is then led to the second unit through clip 4c, and jumps two more gaps. As many gaps may be placed in series as needed. The spacing between sparking surfaces remains constant regardless of the pressure on the gaskets.

An Unusual Recording Receiver

IT has been known for many years that a wireless telegraph power transformer connected directly to lighting of power lines would often set up, in those supply circuits, very severe disturbances. Unless proper protective measures are resorted to, it sometimes happens that the operation of a wireless telegraph transmitter thus connected will cause sparking, insulation breakdowns and other troubles at some distance from the sending station. In a plan disclosed in U. S. patent No. 1,143,799, issued during 1915 to R. B. Avery, these line disturbances are made use of to record or make evident the operation of a wireless transmitter. Referring to the figure, it is seen that the primary 2 of a step-up transformer 1 is connected to the alternating current power lines 3. One terminal of the secondary coil 5 is led to the adjustable spark-gap 6 through wire 4, and the circuit passes thence through wire 9 to



System for recording messages received by power lines

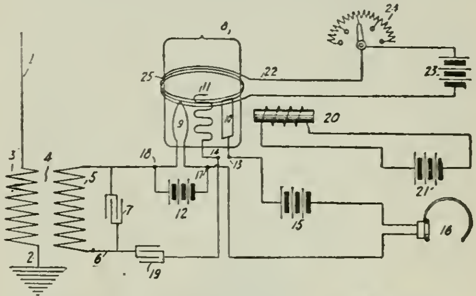
the swinging plate of a special condenser, 10. The other plate of this instrument, 8, connects through 7 with the secondary coil and is separated from 10 by the insulating sheet 11. The pivoted sheet 10 is mechanically connected through 21 to the contact apparatus 12, which comprises a lever 19, moving and fixed contacts 18 and 15, and an adjusting spring 17, as shown. When this contact is closed, current flows from battery 25 through the local lines 22, 23, and the sounder or recorder 24 is operated.

In using this receiver, the spark-gap 6 is opened just beyond the point where sparks will pass from the normal operation of step-up transformer 1. When surges are set up in the lines 3 by the operation of the distant wireless transmitter, the impulses serve to increase the potential of the secondary 5 and a series of sparks passes across 6. This results in a stronger charge being placed upon condenser 8, 11, 10 and the plates are therefore attracted more strongly than before. By the ensuing motion of 21 and 19 the contacts 18 and 15 are brought together, the local current flows and the sounder or recorder is operated. As soon as the key of the sending station is opened, sparks cease to pass across 6, plate 10 swings back to its normal position, and the sounder circuit opens. Thus, it becomes possible to observe the transmission of wireless messages from a station in the vicinity without using an antenna or detector in the usual way. It is not always necessary for the instruments described to be connected with the power line supplying the wireless station, for often the inductive effects are sufficiently strong to operate such an apparatus located at a considerable distance from the signaling plant.

Magnetic Adjustment of Audion

A UNITED STATES patent issued in 1915 to B. Graves, No. 1,138,652, shows an interesting method of controlling electromagnetically the action of an audion receiver. The diagram of that patent is reproduced, in which the usual complete receiving-circuits are shown. The new features are the coil of wire 25 wound about the bulb and connected to battery 23 through regulating resistance 24, and the electromagnet 20, which is supplied with current from battery 21. By varying the position and strength of the magnet 20, and by altering the intensity and direction of current through the coil 25, the patentee has found it possible to increase the sensitiveness of his audions. The matter of magnetic control of such receivers is of considerable experimental interest, and it is doubtless well worth while to try this method.

The consensus of opinion on the matter, however, so far as there is any agreement, seems to be that any effects which can be produced magnetically may also be secured by variation of filament current, plate circuit potential and tube vacuum. Occasionally it is not found possible to get the best response from a given bulb by any of the ordinary adjustments, and in these instances full sensitiveness is sometimes secured by applying a properly-disposed



Increasing the sensitiveness of the audion with an electromagnet

magnetic field. The inventor of the method shown, states that by its use he has secured better results than from a simple magnetic field set up by a permanent magnet. It is probable that the independent control of magnet position and field intensity makes it possible to secure the best conditions more easily.

Learning the Code

AMATEURS learning the Continental code will find it a great help to practise sending and receiving words which necessitate the use of letters frequently misunderstood or forgotten. The prime essential in learning the code is to forget how each letter looks on the code chart and learn to recognize the letters by *sound*. Such letters as F, L, Y, Q, X, and others have a peculiar rhythmic sound which soon becomes familiar and easily recognized. The following words are helpful in code practice: fizz, fall, calf, fix, lax, liquor lacquer, buzzer, squall.

Telephone Receivers

FOR long distance receiving, a good pair of head telephones is always a profitable investment. If the telephones are insensitive, it is useless to expect to hear distant stations.

An Electromagnetic Rectifier and a Polarized Relay

By R. E. Ryberg

The Rectifier

THE storage battery has become a necessity in the laboratory of the experimenter and wireless amateur. The problem then becomes one of supplying an efficient means of rectifying the alternating current in the house-lighting mains in order to charge these batteries. They could easily be charged

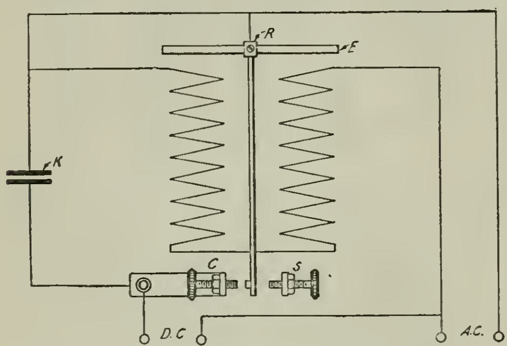


Fig. 1. Wiring diagram for large condenser

by a small direct-current generator, but not every experimenter has one at his disposal. Almost everyone has an electrolytic rectifier for this purpose, but this rectifier, besides wasting current, is a source of constant trouble and requires frequent cleaning. Therefore, the experimenter will welcome any device the operation of which will scarcely affect the meter.

Many experimenters have a polarized ringer about their shops, and this will answer very well. If the keeper or permanent magnet is weak it may require re-magnetizing.

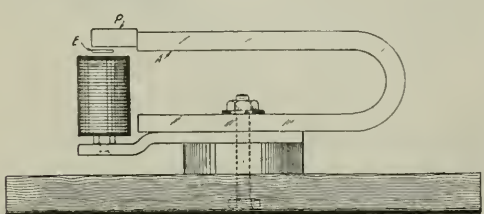


Fig. 2. Mounting of the polarized relay

The resistance of the coils is from 1,000 to 1,600 ohms, so it is readily seen that they will consume very little current,—about .06 ampere to .11 ampere on the 110 volt supply.

The clapper rod should be cut as short as possible, and bent outward to engage the permanent contact and stopper. The coils must now be mounted on a suitable hardwood base together with the stationary members, of which there are two, one being used as a contact and the other as a stopper. Platinum or silver contacts should be soldered to the permanent contact and the corresponding side of the clapper rod.

A condenser *K*, of large capacity, say ½ mfd. to 2 mfds. should be shunted across the contacts to reduce sparking. By adjusting the contact *C*, and the stopper *S*, Fig. 1, this device will work nicely. The wiring diagram is shown. In making the connection with the moving element, it should be soldered up on the clapper rod or the armature. Care must be taken to permit the clapper rod to swing freely. The connection should not be made on the armature support as the current should not pass through the bearing *R*. This arrangement uses one alternation of the cycle only; but the experimenter, by placing additional contacts, may take advantage of the complete cycle.

The Polarized Relay

The same instrument can be used as a polarized relay with only a few changes.

A polarized relay is a most useful instrument for the experimenter. It is the only relay that can be used in multiplex telegraphy and the best relay to use in conjunction with selenium cells and coherers. The reader will realize a few of its many uses. The instrument shown in the illustration, when used as a relay, will operate successfully on .5 milliampere.

One of the changes mentioned was the use of a powerful magneto magnet in place of the keeper or permanent magnet which is ordinarily used. The method of mounting is shown schematically in Fig. 2. In using the magnet it must be mounted so that the lower surface *A* of the upper pole is above or level with the top of the armature *E*, so that the lines of force will penetrate the armature. A pole piece *P* can be used to extend the pole of the magnet. If used, it must be located over the center of the armature. It can be about ½″ square by ¾″ long. Its use can be determined by trial, since it does not always improve the operation of the instrument.

The magneto magnet can be obtained second hand for about 50 cents at a motor-cycle repair shop or a garage. If weak it can be re-magnetized for almost nothing. For a polarized relay of over 1,000 ohms resistance a few cents spent in obtaining a powerful permanent magnet will be an excellent investment, as the commercial instrument of this resistance is beyond the means of the average experimenter.

When used as a relay, it is unnecessary for the clapper rod to swing very far, so that the armature *E* may be lowered to close proximity with the ends of the magnet cores by means of two adjusting nuts. The distance can easily be determined by experiment. When used as a rectifier this distance need not be as small and can be adjusted accordingly. The bearing-screw *R*, Fig. 1, should be adjusted to prevent any undue play of the armature, but on the other hand, it must not be made tight enough to bind.

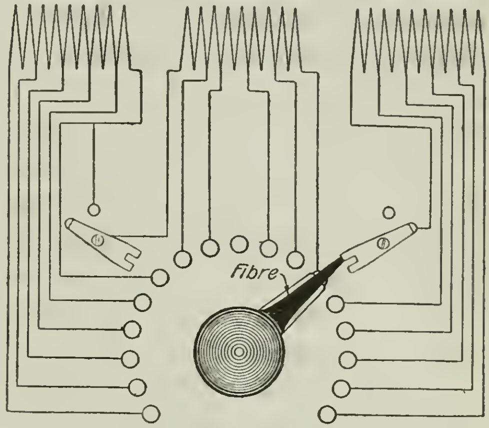
Inexpensive Stranded Aerial Wire

T is a well-known fact that stranded wire is preferred for aerials to solid wire, but it is not used much by amateurs since the cost is high. An inexpensive stranded wire may be made, however, as follows:

Find the length of aerial wire needed and then cut five pieces of No. 20 bare copper wire that length. Lay them together and about every two feet twist the strands twice. The resulting wire is of low resistance, high tensile strength and proves very satisfactory.

Automatic Dead-End Switch

THE multiple-point switch, shown in the illustration, is equipped with small auxiliary switches to cut off the wire not in use on loose-coupler primaries or loading-coils. Most dead-end switches must be opened or closed inde-



Wiring diagram of a multiple-point switch

pendently, but this one is operated by the movement of the multiple-point switch itself. It cuts off the primary in steps, immediately after you cut in less coil than the amount where each break occurs. Thus no switches are forgotten. The diagram explains its construction, and dimensions are not given, since they will vary somewhat, according to the specific needs of the maker.

Avoiding Grounding in Running Metal Molding from Chandelier Outlets

TO run metal molding from outlets from which chandeliers are hung, and avoid grounding, the following method is suggested. Cut away the canopy as shown in Figure 2, and apply insulation between the canopy and separable, metal outlet box. This produces a neat appearance and is inexpensive.—JOSEPH FISHER.

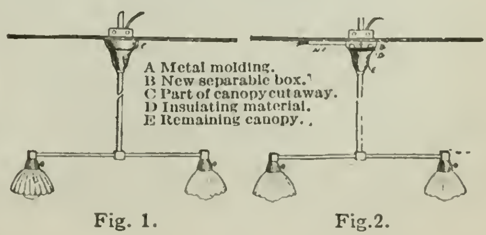


Fig. 1. Fig.2.

Money Prizes for Radio Articles

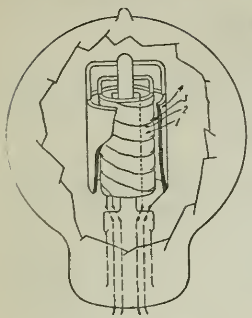
We want you to tell our readers how you have overcome your wireless troubles. Every radio operator, amateur or professional, has encountered difficulties in building or using his apparatus. Many different people are bothered by the very same problems day after day. It will help you to learn how others worked to get successful results, and it will help others to learn how you succeeded.

For the two best articles describing how you overcame troubles in building, operating, adjusting or repairing any radio instrument or group of instruments, we offer first and second prizes of $25.00 *and* $15.00 *respectively. The prizes will be awarded to the two writers whose articles, in the opinion of the Editors, will prove most helpful to the readers of the magazine. The Judges of the Contest, who will be the Editors of the* POPULAR SCIENCE MONTHLY, *will select the prize-winning manuscripts from those which conform with the following conditions:*

CONDITIONS OF PRIZE CONTEST

1. *Manuscripts must be typewritten, and on one side of the paper only.*
2. *Illustrations must be on sheets separate from the manuscripts.*
3. *Articles must be addressed to the Radio Prize Contest,* POPULAR SCIENCE MONTHLY, 239 *Fourth Avenue, New York, and must reach that address before June* 15, 1916, *in order to be considered.*
4. *Manuscripts which do not win prizes may be purchased for publication, at the option of the Editors and at the usual liberal rates.*
5. *The decision of the Judges, which will be announced in the August,* 1916, *issue, is to be final.*
6. *Each manuscript must be accompanied by a letter containing criticisms and suggestions as to the wireless section of the* POPULAR SCIENCE MONTHLY. *The merit of these letters will not be considered in awarding the prizes, but their suggestions will be taken as indications of what types of articles are of the most value to our readers.*
7. *If contestants wish to have their manuscripts returned, they should send postage for that purpose.*
8. *Articles should not exceed* 2,000 *words in length. If you cannot present your information in an article of that length, write several articles, each on a different phase of the subject, and each independent.*

Audion of Increased Sensitiveness



New Audion Bulb

IN the attempts to increase the sensitiveness of audion detectors and amplifiers, there have been devised many internal arrangements of the three usual elements (grid, plate and filament). In some, the spacing of the conductors is changed, and in others the forms of the electrode are radically different from those usually encountered. A type of tube shown in the diagram, was patented by A. McL. Nicolson in 1915. It is illustrated in the diagram accompanying specification No. 1,130,009. This instrument contains within its evacuated bulb two concentric cylindrical electrodes, of which the inner 1 corresponds to the grid and the outer 4, to the plate of the ordinary audion. The filament 2 is wound spirally around the inner electrode in a groove 3, but is, of course, insulated from the surface supporting it. The construction shown is said to show increased efficiency because the filament is placed close to the input electrode 1 and because this electrode is of large surface; these two conditions co-operate to set up a strong electrostatic field between the filament and the grid or its equivalent, and this has been found to make for increased amplification.

Constructing a Variable Condenser

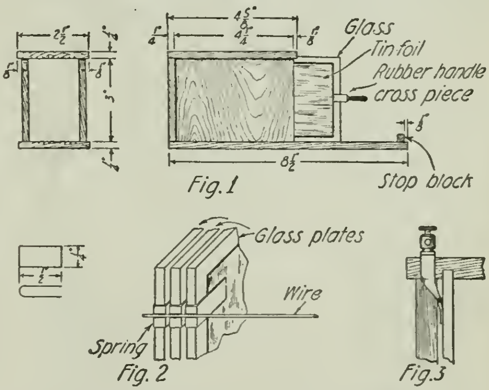
A VARIABLE condenser, cheap and easily made, requires the following materials: tinfoil, 2 ft. of ¼-in. ash or oak, and 9 plates of glass, such as old photographic negatives. The plates should be 3¼ ins. by 4¼ ins.

Cut 18 rectangles, 3¾ ins. by 2¾ ins., of tinfoil. Shellac them at the center of both sides of the glass plates. Care must be taken that the foil forms an even coating on the glass. Next, construct a box of 5 sides, having the following dimensions:

Top.........4⅝ ins. by 2½ ins.
Bottom.......8½ ins. by 2½ ins.
Sides..........4¼ ins. by 3 ins.
Back..........2¼ ins. by 3 ins.

Before assembling the box, make 9 cuts lengthwise across the top and bottom, 3/16 in. apart and ⅛ in. deep. The first groove on the top and also on the bottom should be made ½ in. from the edge. These grooves will be the correct width to hold the plates firmly in place, if made with a rip-saw. The 2nd, 4th, 6th and 8th grooves from either side must be somewhat wider than the others so as to allow the plates to slide along easily. The top and bottom of the box are glued and nailed to the sides, as shown in Fig. 1.

The back is put on after clips have been fastened to the 1st, 3rd, 5th, 7th and 9th plates and a wire soldered across them, as shown in Fig. 2. The



A variable condenser can be made with old photographic plates and tinfoil. These diagrams show construction details and the necessary connections

second, 4th, 6th and 8th plates are also to be connected together in the same way.

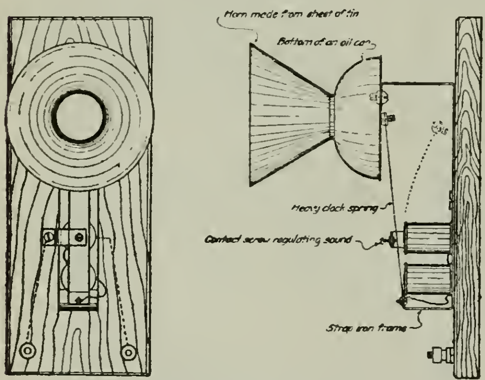
A wooden stop-block, measuring ¼ in. by ½ in. by 2 ins., must now be made and fastened ⅛ in. from the edge of the end of the bottom, as shown in Fig. 1. A handle of hard rubber should be fastened to a cross-piece, measuring ¼ in. by ½ in. by 2 ins., and having 4 grooves like the ones first made, but ⅜ in. apart. The first should be 7/16 in. from the end.

The terminals should be made of spring-brass less than 1/32 in. thick and bent as shown in Fig. 3. One touches the tinfoil of the first plate: the other touches the foil of the eight plate, as shown.—W. E. FINKERNAGEL.

How to Make an Electric Horn

ANYBODY having a little mechanical ability can make a very satisfactory electric horn from a couple of coils and a few odds and ends.

In the accompanying diagram, the electromagnets and horn are fastened to a continuous piece of band iron, which in turn is screwed to a wooden base. On the end of the band iron over the electromagnets is fastened a piece of heavy clock-spring. This serves as a vibrator or armature. At the free end of the spring a hole is drilled, through which is screwed a heavy stove bolt, which acts as a striker. A small strip of strap iron is screwed into the base, bent over the vibrator, and drilled to hold a set-screw, which is merely a small bolt with a nut on both sides of the iron. This is the interrupter. It also controls the pitch of the horn.



A practical electric horn which was made from odds and ends

The mouth of the horn is cut from a piece of tin and soldered to the bottom part of an old machine-oil can, the flexible base acting as a diaphragm when set in vibration by the striker.

The electricity runs through this horn in exactly the same circuit as in a door-bell. When connected up and the button is pressed, the vibrator is drawn to the coils and the circuit broken by the interrupter, causing the striker to move back and forth. The less room given for movement by the interrupter, the higher the pitch of the horn.

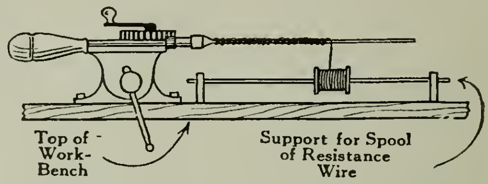
The vibrator, being made from a spring, lends still more force to the vibrations.

This horn may be worked on the house-lighting circuit by connecting in series with an incandescent light, or it may be run by batteries.

It can be used for many purposes, being especially good for a burglar alarm.—Ed. Gettins.

Making Coils of Resistance Wire for a Small Electric Stove

RESISTANCE wire may be easily wound in coils for a small electric stove by means of a hand drill. Place



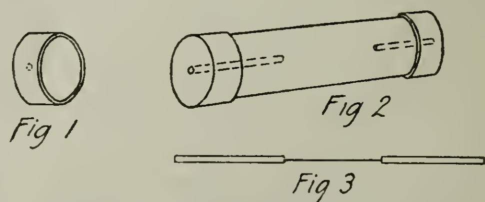
Resistance coils can be wound evenly by means of a hand drill fastened securely in a vise during winding

the drill in a horizontal position between the jaws of a small vise. Insert a rod of about ⅛-in. diameter in the chuck of the drill; an old curtain rod will do. Make a support for the spool, as shown in the illustration. Then, by turning the handle of the drill with the left hand and guiding the wire with the right hand, the wire will come off very easily without becoming tangled.

With about 18 ft. of No. 30 nichrome wire, a small electric stove will consume practically 100 watts of electrical energy.—Frank Hiemer, Jr.

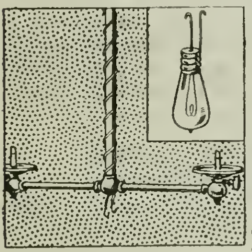
Repairing a Burnt-Out Fuse

A BURNT-OUT fuse may be easily repaired with the aid of a little solder. Substitute for the old fuse wire a new one of the same capacity. Solder a length of copper wire to each end of the fuse wire (Fig. 3), and after cleaning



A burnt-out fuse can be made as good as new at very small cost the brass ferrules around the hole (Fig. 1), apply a small amount of solder to each. Assemble the fuse by slipping the copper wire through the hole; then apply solder and mend with a hot iron. Fit the fuse in the fiber and in the hole in the opposite brass ferrule. Tin in the same way as before and cut the copper wires flush with the brass end, as in Fig. 2. The fuse will then be found to be as serviceable as before.

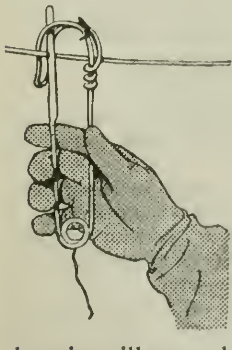
Substituting a Flashlight for a Door-Bell



WHEN there is sickness in the house, it is often necessary to avoid all noise as far as possible. At such times the door-bell is a source of great annoyance. To overcome this difficulty, disconnect the wires from the bell and run them down the gas or electric fixtures. Leave the ends bare and bend them into hooks, as shown in the diagram. Secure a flash-light bulb and solder two wires to it, bent as shown. The flashlight can then be connected with the push-button at the door by simply hooking it on to the wires.

This arrangement is also of great service to anyone who is deaf. If wires are arranged in every room, the flash-light can be attached in whichever room the deaf person happens to be. Thus a bell is not needed.—J. E. Noble.

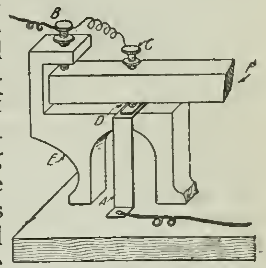
Telephone-Line Test-Clips Easily Made



ANY telephone man can make a pair of line test-clips for ten cents. Buy two large safety-pins and cut ¼ in. off the point of each. Solder a piece of No. 6 copper wire, 1½ ins. long to the part from which the point was cut so that it will pass between the wires at the open end of the pin.

File a small groove in the copper in which the line wire may rest. Then simply solder the test cord to the loop at the other end of the pin.

Changing a Telegraph Sounder Into a Relay



A TELEGRAPH sounder can easily be changed into a relay by adding a small piece of copper as shown in the accompanying diagram. A piece of sheet copper is bent as shown and placed under the screw *C*, but previous to this, a piece of thin mica is placed between screw *C* and stand *E* at *D*. A piece of small wire is coiled and carried from the screw *B* to the screw *C*, to insure a good contact.

The two telegraph wires are attached to the regular binding posts and the relay wires are connected with screw *B* and copper *A*. When the magnet's base is drawn down, the arm *F* completes the circuit in *B* and *A*.—Wm. Harrier.

A Current Reverser for Small Motors

A DOUBLE-POLE, double-throw switch, if connected according to the accompanying diagram, will reverse the direction of a direct-current motor. Disconnect the wires on the motor that are connected to the binding posts, brushes and field. Connect binding post No. 1 of the switch and No. 6 post to one end of the field. Connect the other field terminal to posts No. 2. and No. 5. One brush is connected to one binding post of the motor and No. 3 post of the switch. The other brush is connected to No. 4 post. The batteries are inserted between one of the binding posts on the motor and No. 3 post of the switch.

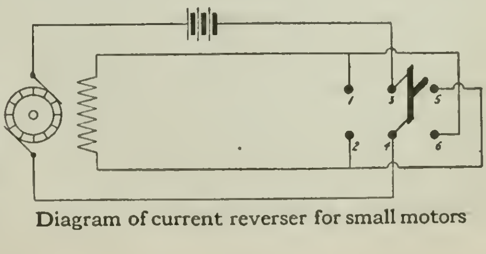


Diagram of current reverser for small motors

What Radio Readers Want to Know

Receiving Tuner; Sending Condenser

L. J. T., St. Louis, Mo., inquires:

Q. 1. Some confusion exists in my mind regarding the designs for receiving tuners. Take for example the following: For a receiving tuner to be adjustable to wavelengths from 175 to 4,000 meters, is it preferable to construct two separate tuners or may two small-sized tuners be joined together (in the primary and secondary windings) to receive the longer wavelengths? Also, what is the most desirable size for the cylinder and the size of the wire in the primary and secondary? Is single cotton-covered wire better than enamel wire? In addition, approximately how many taps are required on the secondary winding?

A. 1. A receiving tuner of this range is practical provided the precaution is taken to fit it with dead-end eliminating switches. If the dead-end losses are to be wholly eliminated, you are advised to construct two separate tuners. Assuming that the smaller tuner is to be used for amateur work it may have the following dimensions: The primary winding is $3\frac{1}{2}$ ins. in diameter by 2 ins. in length covered with from 80 to 85 turns of No. 28 D.S.C. wire. The secondary winding is 3 ins. in diameter by 2 ins. in length covered with No. 30 D.S.C. wire. The secondary winding is equally divided between the taps of a three-point switch, while the primary winding may be fitted with a slider. Connected to an aerial of the dimensions found at the usual amateur station, the following described receiving tuner will permit adjustments in both the antenna and detector circuits to a wavelength of 4,000 meters. The primary winding is 4 ins. outside diameter by 7 ins. in length and is wound closely with No. 24 S.S.C. wire. The secondary winding is $3\frac{1}{2}$ ins. in diameter by 6 ins. in length wound closely with No. 30 S.S.C. wire. The turns of the latter winding should be equally divided between the points of a ten-point switch. The primary windings may be fitted with a slider or preferably two 10-point switches, one of which takes in a single turn at a time and the second one connects in a number of turns in groups.

The secondary winding must be shunted by a condenser of small capacity; one of .0005 microfarad capacity will permit the reception of wavelengths in the vicinity of 4,000 meters.

If you are familiar with the construction of dead-end switches the windings of the long wavelength tuner may in this manner be broken up into groups and a small portion used for the reception of amateur signals, though the efficiency will probably not be so high as when two different tuners are used.

Q. 2. Please give the dimensions for a condenser to be connected to a 1-k.w. transformer regardless of the 200-meter wave.

A. 2. The proper capacity of the condenser depends upon the secondary voltage of the transformer and the frequency in cycles per second. Lacking this data we can not advise. If the potential of the transformer is 20,000 volts at a frequency of 60 cycles, it is customary to fit it with a condenser having a capacity varying from 0.012 mfd. to 0.018 mfd. A single plate of glass $\frac{1}{8}$ in. in thickness with other dimensions 14 ins. by 14 ins. covered with foil 12 ins. by 12 ins. will have a capacity of 0.002 mfd. Nine of these plates, connected in parallel, will total 0.018 mfd. If as assumed, the potential of the transformer is 20,000 volts, a series-parallel connection for the plates is required, that is to say, 18 of these plates must be connected in parallel in each bank and the two banks connected in series.

The Use of Loading-Coils

E. C. T., Beaumont, Texas, inquires:

Q. 1. Approximately what is the wavelength adjustment possible with a double-slide tuning-coil 18 ins. in length, 3 $\frac{1}{2}$ ins. in diameter, wound with No. 22 S.C.C. wire?

A. 1. Connected to the average amateur aerial this coil should permit adjustments to stations employing wavelengths as great as 3000 or 3,500 meters.

Q. 2. Would I secure better results if the coil were wound with bare wire?

A. 2. Not necessarily, since either bare or insulated wire may be employed. This coil is too large for the maximum degree of efficiency at wavelengths lying between 200 and 1,000 meters. For the ordinary aerial a single coil of wire, 6 ins. in length by 3 ins. in diameter wound with No. 26 S.S.C. wire, will be sufficient for the lower value of wavelength.

Q. 3. Will a pancake loading-coil increase the wavelength of the above tuning-coil?

A. 3. Yes, but we see no need for it.

Q. 4. How is the loading-coil to be connected to the tuning-coil?

A. 4. It should be connected in series with sliding-contact connected to the aerial wires.

Ground Connection

P. V. D., Warwick, N. D., inquires:

Q. What form of earth connection is considered desirable where the sub-soil consists of hard and very dry clay?

A. If by digging to a depth of several feet moist earth cannot be reached, you are advised to install what is known as a "surface ground." For your purposes this artificial earth connection may consist of several long copper wires spread out radially from the base of the mast and the greater portion placed directly underneath the flat top portion of the aerial. There should be at least as much wire in this "ground" as there is in your antenna.

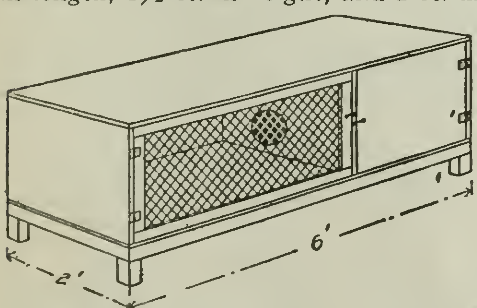
The Home Workbench

How to Build a Rabbit Hutch

RAISING rabbits near a large community is a profitable industry, and it is an enterprise that many schoolboys in America have embarked upon, with returns in money that are indeed out of proportion to the small amount of time and energy necessary for the proper care of the little animals.

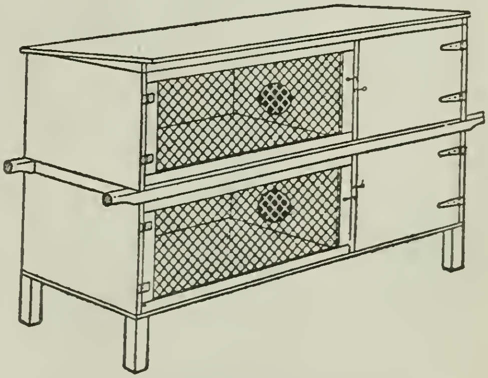
The construction of clean, comfortable homes for rabbits, as recommended by the Department of Agriculture, is as follows:

The hutches, as they are called, should be built of good, sound lumber, and should have tight floors, providing at least 12 sq. ft. of floor space. The best plan for building hutches in quantity is that used in building sectional bookcases. The bottom section has short, stout legs, while the others are placed upon it until the desired height is reached. A convenient size for an outdoor hutch is one measuring 6 ft. in length, 1½ ft. in height, and 2 ft. in



The proper dimensions of a rabbit hutch are six by two by one and a half feet

width. The top, bottom, ends and one side should be enclosed, while the open side is fitted with two doors on hinges. The space should be partitioned, so that one-third comprises the sleeping quarters, while the remaining two-thirds serve as exercising space. A hole, large enough to admit the passage of a full-grown rabbit's body, is cut in the partition. Of the two doors which enclose the two rooms of the "apartment," one is of



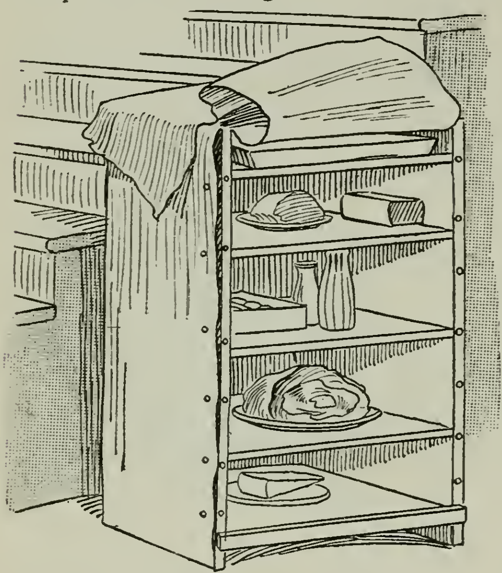
A portable hutch, with two stories, which can be carried about by two boys

wood, and the other of wire mesh similar to that used in enclosing poultry runways. The screen door should be provided with a sliding wood cover, as a protection against severe cold weather.

Outdoor hutches, which are desirable for most of the climates found in America, are best, and should be fitted with sloping roofs and made otherwise watertight. Holes for ventilation should be bored in the side walls near the ceiling. Several layers of waterproof paint should be applied.

Rabbits thrive on a diversity of vegetable foods. The most important fact to bear in mind in feeding is that a sudden change of diet is often disastrous. The best grain for rabbits is oats, although this dietary monotony may be broken occasionally by corn-meal, barley, or other grain. Hay is necessary to the rabbit's health. During the winter, green foods are required together with grain. Two meals a day, except for suckling stock, when three should be given, is the best schedule.

The Belgian hare is ready for the market at the age of four months, although some breeders sell at the age of ten to twelve weeks, aiming to have their stock weigh about five and one-half pounds at that age.



The pan on the top shelf keeps the duck curtain wet and the evaporation of the water cools the whole box

How to Make an Iceless Cooler

On farms where ice is scarce, the device illustrated is of great utility. It consists of a box of convenient size, with shelves at various distances apart. In the drawing, the upper shelf is about 3 ins. from the top of the box, which is about 12 ins. by 18 ins. square. The bottom shelf is 13 ins. above the floor, the second shelf 12 ins. above that, the third 11 ins. higher, and so on. A pan of water is placed on the top shelf.

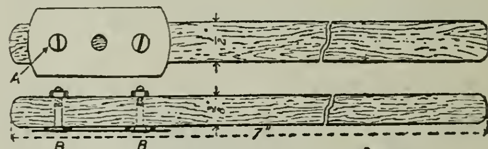
The box should be placed where there is more or less movement of air, to encourage an evaporation of the water which keeps a heavy duck curtain wet all the time. This curtain completely envelops the box. It is tacked on two sides and on the back, but left loose in the front. Only two lengths need be used, one starting near the floor on one side, extending loosely over the box and down on the other side; the other extending from the floor behind to the top and fastening at the sides, but left loose above and down at the front. The front should have buttonholes to go over pegs at the side.

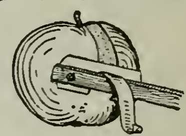
When the pan is filled with water, the duck should rest in it, so that the water will flow by capillary attraction to the floor. Very little of it should actually reach the floor, because most of it should be evaporated by the air. This method will actually keep the temperature inside the box considerably cooler than that outside. This cooler is easily made and the cost is reduced to a minimum.—Dr. L. K. Hirshberg.

A Vegetable Peeler Made from a Razor Blade

An old safety-razor blade can be used for peeling vegetables by attaching it to a wooden handle, as shown in the illustration. The handle should be 7 ins. by 3/8 in. by 1/2 in., and should be sand-papered to a smooth finish. Attach the blade by means of two bolts *A*, 1/8 in. by 1/2 in., having flat heads. Place a washer *B* on each bolt, between the blade and handle.

If a drill is at hand, a strip of iron or brass may be substituted for the wooden handle. Many uses can be found for this handy knife.—J. E. Noble.

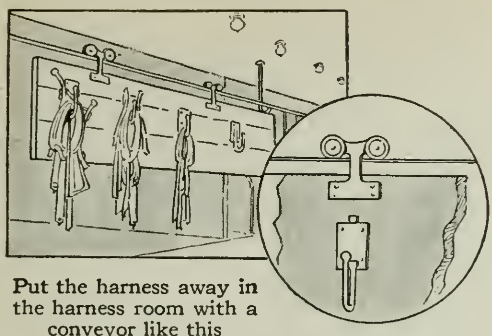




If the razor blade is properly adjusted the fruit may be peeled quickly and without useless waste

Soldering German Silver

German silver cannot be soldered with lead without showing a difference in color. The following formula obviates this difficulty: Silver, 1 part; brass, 1 part; zinc, 1 part. Melt in the ladle, stir, pour into the mold and cool. The flux for the foregoing is borax powder.—T. F. Busch.



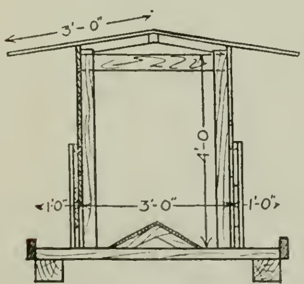
Put the harness away in the harness room with a conveyor like this

A Harness Carrier

FARMERS generally have difficulty in keeping their harness in repair and in the proper place. Hanging it up on an old hook about the stable is not in accordance with present day efficiency methods. On a certain Iowa farm a noteworthy system of caring for the harnesses is practiced. The harness carrier runs over the litter carrier track of the barn and into the harness room near the stable. The carrier is made of three planks cleated together with boards. There are four hooks on each side of the carrier for hanging the heavy work harnesses. The litter carrier track runs behind all the horses, so the only additional track that is needed, is that which runs into the harness room.

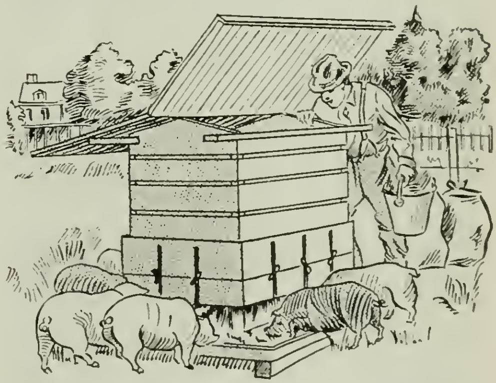
An Ear-Corn Feeder for Hogs

A SELF-FEEDER for hogs, which will hold approximately 20 bushels of ear-corn, is easily made. The crib has a base 3′ by 4′ and is 4′ high. It is built on a solid frame of 2″ lumber and covered with 6″ crib siding for the walls, and ship-lap for the roof. The siding should be spaced 1″ apart for ventilation. Surrounding the base is a trough 1′ wide with a fender on its outer edge made of lumber 2″ by 4″.



The corn is deflected into the trough by a pyramidal arrangement in the crib, as shown in the cut. Its flow is further regulated by an adjustable slide held in place by bolts with winged nuts. The trough is sheltered somewhat by the overhanging roof, made from boards 3′ long. One section of the roof should be hinged for filling. The feeder should be built on skids or runners so that it may be hauled about the lots to any desired location. It may be painted and set in a high, well-drained spot or on a concrete platform. The lumber list follows:

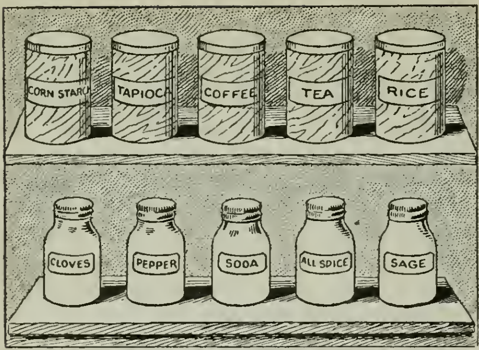
2 pcs. 4″ x 4″ x 7′ runners
6 pcs. 2″ x 10″ x 5′ floors
2 pcs. 2″ x 4″ x 6′ trough-fender, sides
2 pcs. 2″ x 4″ x 5′ trough-fender, ends
6 pcs. 2″ x 4″ x 4′ studding
4 pcs. 2″ x 4″ x 6′ plates
50′ ship-lap for cover, 3′ lengths
50′ (lin.) 1″ x 4″ cleats
80′ 1″ x 6″ crib siding
30′ 1″ x 12″ slide
2 12″ strap-hinges
10 bolts, with winged nuts



The hogs can get at the trough but not into the interior of this ear-corn feeder

A Hint for Draftsmen

TO remove ink from ruling pens and lettering pens dip them in a solution of ammonium hydroxide, or, as it is more popularly called, ammonia water. A strong solution will cause old ink as well as any kinds of waterproof ink to be easily wiped off with a cloth. I have used ammonia for a long time for this purpose and it does not seem to have any injurious effects on the pens. Ammonia also cleans ordinary steel pens equally well.—L. G. HASKELL.



An attractive grocery set which can be made by any housewife

Making a Cheap Grocery Set of Your Own

THE storing of staple groceries in the pantry is now giving way to placing them on open shelves in the kitchen. But an array of paper sacks and open boxes with their covers at all angles, is unsightly. Special sets of containers, made of glass, pottery or china, are rather expensive, but no housewife need be without a set. A dozen glass fruit-jars, quarts and pints, are very neat, require no labels and speak for themselves when the supply is low.

Ordinary tin coffee-cans make a fine set, when covered with varnished wall paper and labeled with ink. Pasteboard coffee-cartons, with hinged, tin pour-out spouts in the lids, are also available. Cocoa, mustard or baking-powder cans, when washed and painted, make excellent receptacles for spices. Even screw-top olive-bottles may be used to good advantage.—AVIS G. VESTAL.

Non-Irritating Skin Cleanser

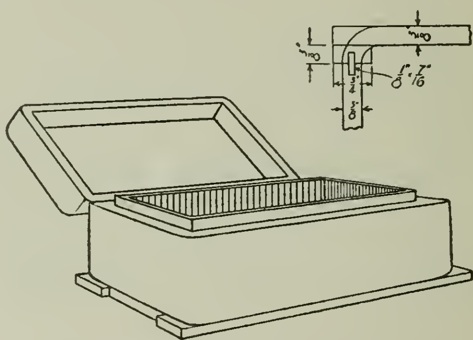
MECHANICS' hands, while not ordinarily tender, can in time be injured by the continued use of soaps and cleansers which contain caustics, sand or even pumice. An effective cleanser which can be substituted for these more dangerous ones consists of pure white soap dissolved in hot lemon juice. When cooled, the mixture will have the consistency of ordinary soft soap, and while it can be safely used on the most delicate skin, it will thoroughly remove all grease and dirt.

How to Make a Glove-Box

THIS glove-box is best made from some fancy wood such as walnut or mahogany. If these cannot be procured, a fine box may be made from red gum-wood, which has a large, close grain and takes a fine finish.

The sides are fastened together by means of small grooves and tongues. The small pieces 3/8" x 3/4" x 3 1/2" should be fastened to the long side pieces by means of the rub joint. The glue should be hot. Rub the small block up and down on the side until it sticks firmly. Clamps are not necessary.

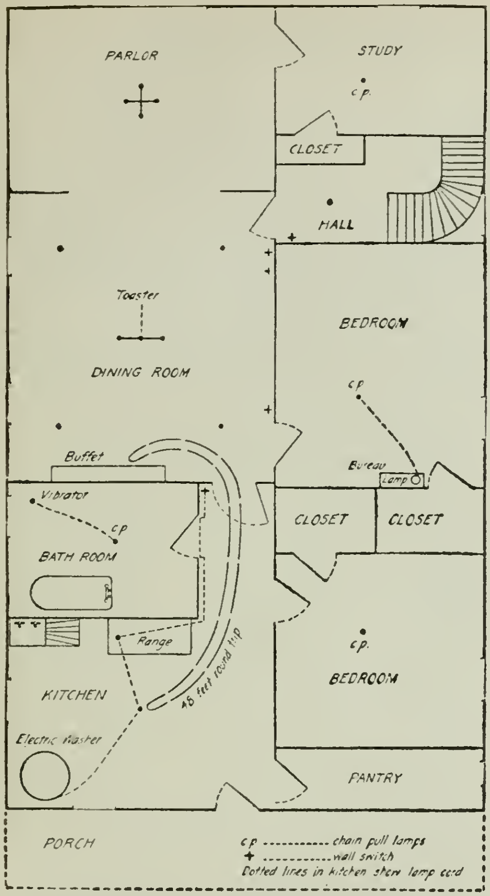
After the sides have been fastened together, the corners should be rounded off. Take the surplus off with the chisel and gouge and finish with the half-round file. The inside of the box should then be sandpapered. Now fasten on the top and the bottom. Round off the top and sandpaper the entire box.



A glove-box made by hand from fine wood

With a sharp-pointed marking-gage, mark a line around the box 3" from the bottom. Saw off the cover, using great care to follow the line. True up the edges with a sharp plane and fasten on the cover with narrow hinges.

To finish the box, give it a coat of linseed oil. After rubbing this dry, apply a coat of white shellac. Smooth this off by rubbing with linseed oil and pumice stone. Then apply a second coat of shellac. Smooth this off with oil and rotten-stone, and apply the final coat of shellac, and polish.



Floor plan of the apartment showing the rearranged lighting system

Making Over the Lighting System

THOUSANDS of apartments in every city are wired and lighted in the most thoughtless manner possible. One husband, with a practical turn of mind, studied the situation, and in a few hours made a very convenient arrangement. The expense he had to bear himself, but all of the changes can be undone and the material removed to another apartment.

All of the lamps in the flat were sixteen candlepower carbon bulbs, giving relatively little light at a high cost for current consumption. Except in the dining room and parlor there was but a single lamp in a central ceiling fixture and set so high as to be difficult to reach. All of the lamps were of clear glass, hence glaring. The clothes closets had no lights and were so located that the single north windows could not possibly illuminate them. Moreover, the electric apparatus for which attachment was needed, could not be used without having each time to unscrew a solitary lamp and leave the room in blackness.

For the entire flat he purchased tungsten lamps of higher candlepower, thus securing more light for less current consumption. The reduction in monthly bills quickly compensated for the new lamps. The four small ceiling bulbs in the dining room were chosen of frosted glass; most of the other lamps have frosted tips. The four parlor bulbs he dipped in an amber solution to soften the light.

The central dining room fixture held three lamps. Two were sufficient for dining purposes and he removed the center one to permit morning attachment of the electric toaster.

A Safe Swing for the Baby

IN an Illinois town a clever mother has made for her "toddler" a swing from which he cannot easily fall. The wicker hood of an old baby carriage, shaped like half a muskmelon, is suspended by ropes from a low tree limb. If he tires of swinging he can fall asleep comfortably in the hollow of the basket, without danger.—AVIS G. VESTAL.

The baby swings in the hood of a discarded baby carriage

An Improved Match-Striker

TACK a piece of fly-screen over sandpaper of the same size. This will not wear out as readily as sandpaper alone.

Building a Bungalow—II.

By George M. Petersen

(*Concluded from the April Number of the Popular Science Monthly*)

HOW often we hear the expression "You should see my bungalow—the plan was original with me and we think it ideal in every way." Perhaps the plan was "original," so far as the speaker is concerned, but in reality the writer has never seen a really original bungalow that was a success. The fact of the matter is that every conceivable plan, that is worthy of the name, was discovered years ago and the so-called "new ideas" are only alterations or changes made in these old lay-outs. Of course there are new elevations that are original, and some of them are really pleasing, but on the whole they are only an assembled product combining the attractive features in several houses which the designer has seen.

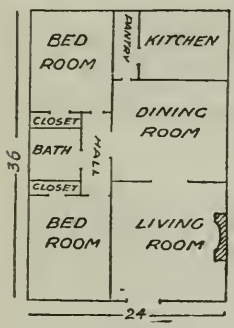


Fig. 1

The writer's experience in designing of residences has been wide. When he first started in he would feel highly elated over some new feature which he had conceived and installed in someone's plans, only to find out, sometimes months or years afterwards, that the idea had been used by someone else perhaps years before. It was rather discouraging, but was really unavoidable as the old saying that "there is nothing new under the sun" holds especially true in house design. There are numerous features in connection with modern appliances and conveniences that are either new or are worked up in such shape that they are really practical, but so far as the design itself is concerned it is the same old story under a new title. It therefore behooves the designer of houses not to say that the design was original with him as it is really an untruth.

So far as bungalow designs are concerned, the writer has never had the pleasure of seeing one yet that could not be directly traced back to one of the twenty used as the illustrations for this article, although it may be that there are one or two studies that have been omitted. It makes no difference how large or expensive the bungalow or house is, it must follow some general plan and these general plans are termed "plan studies" on account of the fact that the designer looks over his "studies," selects one that he thinks will be suitable to the arrangement he has in mind; and, with the study as a foundation, he designs the wonderful plan which people look over and remark how wonderful his plans are. His arrangement may be clever, his lighting arrangement may be nearly perfect, his heating plans may be exceptionally well arranged, his ventilating scheme may be well-nigh perfect and the whole may make a very pleasing, attractive and nearly perfect home, but when it is traced down it will be found that the living room can be found in so-and-so's house, the dining room in someone else's dwelling, the chamber arrangement may be brought down from the old Colonial days, while the fire-

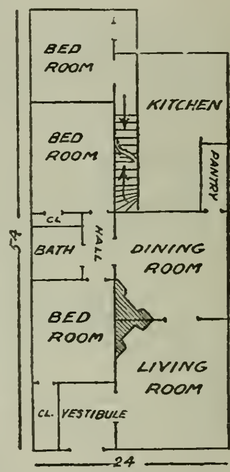


Fig. 3

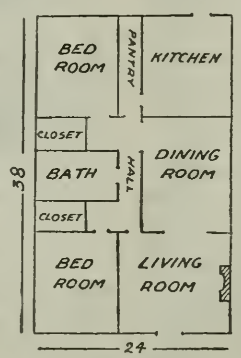


Fig. 2

places may be copied from the old masterpieces of the Old Country; the panel-work may be a relic of old England, while the exterior of the house may have been adapted from the Swiss chalet or some other type of architecture. To sum up the whole proposition, it may be said that the designer is a designer of details only and that only so far as their location and size are concerned.

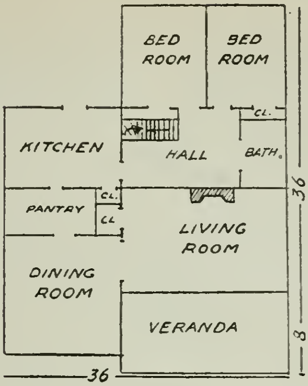


Fig. 4

With the thousand of different bungalow plans in use throughout the country, there is probably not one which cannot be traced, directly or indirectly, back to one of the general layouts or plan studies shown in the drawings submitted herewith. Of course the partitions may be shifted a few inches this way or that, the ceilings may be raised or lowered a few inches, the plan may be reversed so that the bedrooms come on the opposite side of the house, the fireplaces may be put into different locations in the rooms, the veranda may be shortened or lengthened, a pantry may be added or a pantry may be omitted, and other changes may be made that are too numerous to mention, but the plan is still the same as one of those shown.

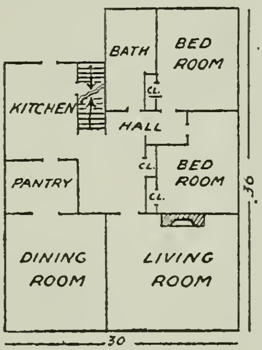


Fig. 5

In Figure 1 is shown a very common study from which some very plain but interesting layouts can be worked up with little difficulty, as the study is exceptionally valuable for the narrower type of city bungalows. This is one of the two-bedroom layouts which are so popular at the present time.

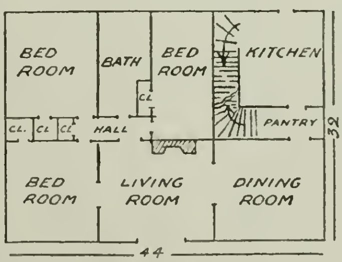


Fig. 6

Figure 2 shows a study which is very similar to that shown in Figure 1, the principal difference being in the location of the pantry and in the center hall arrangement which allows a person to get into any room in the house from any room in the house without passing through a third room. This study also places the kitchen in the corner of the rear of the house so that it has two sides completely exposed to assist in lighting and ventilating that important room. While this study closely resembles that shown in Figure 1 and may be termed a plan drawn from that study, it is nevertheless a study in itself, and a valuable one at that.

Figure 3 shows a study which treats with three bedrooms, a vestibuled front entrance, interior stairway to attic and cellar, and a fireplace chimney, which is so placed that a fireplace may be built in both the living room and dining room and still be connected to the same chimney, thereby saving a good many dollars for the owner. It will also be noticed that the amount of hall room, usually called "waste space," is exceptionally small. The third bedroom, the one off the kitchen, may be used as a maid's room, sewing room or just as a spare bedroom. By placing a door between this room and the one ahead of it the room may be brought into almost direct connection with the bathroom so that the trip through the kitchen can be avoided. This third room, when connected with a door, can be used, together with the room adjoining it, for the owner's suite—one room being used for a sleeping room and the other for a dressing room. When this arrangement is used, the third bedroom may be equipped with three windows on either side so that the effect is a great deal like that of a sleeping porch.

Figure 4 illustrates a type of house which is very desirable, but which is rather uncommon. The great advantage in this type of bungalow lies in the arrangement of the sleeping rooms. It will be noted by the reader that the bathroom and the two sleeping rooms are at the rear of the house so that a person may use them with perfect freedom while visitors are being entertained in the living rooms. Again, a person may be in ill health or may be tired out so that he must retire before the regular time; in this case the arrangement of the sleeping rooms also is advantageous as by closing the door connecting the living room and rear hall the noise from the former is practically eliminated before reaching the bedrooms. The stairs to the attic and basement may also lead from this small hall, so that in the event of a billiard room being furnished in either place it will readily be reached without taking visitors through the kitchen. Take it all in all and the study shown in this figure is really worth actual study by anyone who is contemplating the erection of a bungalow for a home.

Figure 5 is a study of a bungalow along the same general lines as those in Figure 4, but is a little cheaper house to build. The bathroom is, perhaps, in a little better location because of its being further removed from the living rooms and kitchen. There is also a disadvantage in the location of the bathroom due to the fact that the servant must come past all the sleeping rooms to reach it, whereas in Figure 4 the bath is directly opposite the kitchen door. This study also permits of a smaller house and for that reason is cheaper to build than is the one in Figure 4, as already stated.

Figure 6 is a study of a three bedroom, rear bedroom bungalow in which the least possible space has been consumed for the hall. The great disadvantage of this plan lies in the inability of a person getting from the kitchen to the bathroom without going through the living rooms. Aside from this one point and that of the location of the stairs, the study is a good one, since the three bedroom doors are all about an equal distance from the bathroom door.

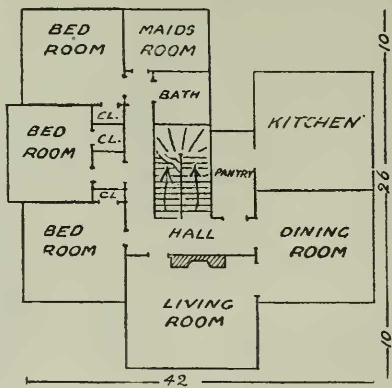


Fig. 7

Figure 7 gives us a study of a bungalow having four bedrooms, and this study strongly suggests two houses connected together on account of the sleeping portion of the house being built in a wing at the side of the living and service portions of the building. This arrangement is good for the size of the house, but there are better and more appropriate types of architecture for a four bedroom house than a bungalow, although this study is shown here as it is used to some extent.

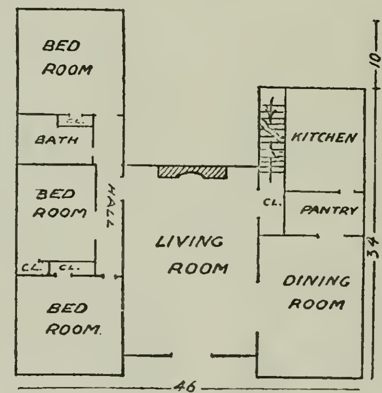


Fig. 8

Figure 8 is a very desirable type of bungalow, especially adapted to a warm climate where a conventional garden may be kept in the court. The ventilation of this type of house is also very good and the cost of erecting a house of this size and design are not as great as would be imagined. This type makes an ideal summer home, as the large living room is very comfortable on the cool summer evenings when the family desires to gather together indoors instead of on the broad, roomy veranda. Another feature of this study lies in the fact that the sleeping wing of the house may be extended back as far as is desired in order to obtain as many bedrooms as may be necessary. The dining room and kitchen may also be dropped back and a library or den placed in the location now occupied by the dining room. If it is desirable to leave the dining room at the front of the house on account of the view or for any other reason, the den may be placed in the space occupied by the pantry and the pantry may be moved to the rear or some other location.

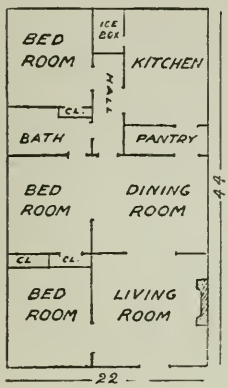


Fig. 9

In Figure 9 we have a study of a three bedroom bungalow which, while not the most artistic study shown in this article, is a very compact arrangement and a reasonable plan to build from. Every line is straight and economy is the principal feature. By making the house a trifle wider and running a hall down through the center so that all bedrooms would enter on to it and thereby be in direct communication with the bathroom,. the arrangement would be greatly improved.

Figure 10 shows a very simple bungalow and is the cheapest study shown. It is the aim, from the viewpoint of economy, to keep any type of house as nearly square as possible and to meet this the study shown in this figure was worked up. The one great drawback to this particular study lies in its only having one bedroom, but that disadvantage can be readily overcome by working up a plan from the study and putting in as many bedrooms as may be desired, always remembering to keep the house as nearly square as possible, provided the lot on which it is to be erected is wide enough to allow for it.

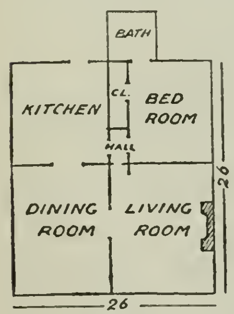


Fig. 10

In Figure 11 is shown a study which has unlimited possibilities at the hands of a clever designer. This study allows the kitchen to be well ventilated from three sides, which is a very good feature. The stairs going up to the billiard room in the attic are just off the living room and extremely handy when visitors are to be entertained in this manner. The cellar stairs go down from the kitchen and are right under the stairs going up into the attic, thereby saving floor space. The bedrooms and bathroom being at the rear of the house give the plan the desirable features mentioned under Figure 4.

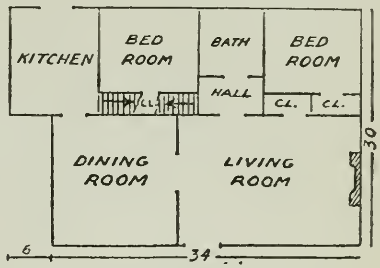


Fig. 11

Figure 12 shows a study which strongly resembles that shown in Figure 11, excepting that the bedroom is the room that is ventilated from three sides instead of the kitchen. The stairway to the second floor and the arrangement of the bathroom directly off the living room should also be noticed. The more the designer thinks over this study the more ideas will be obtained from it, since the study lends itself readily to a great many different arrangements which are pleasing and economical. The entrance into the living room from the side of the house instead of from the front in the conventional manner is greatly appreciated, especially in a summer home that faces a lake or other body of water. In a case of this kind it is always advisable and desirable to place the entrance on the side of the house opposite to that from which the prevailing wind is. This placing of the door will be greatly appreciated when the wind is blowing a heavy rainstorm ahead of it and driving the water through every possible opening, so that it is not only impossible to use the door but it is almost impossible

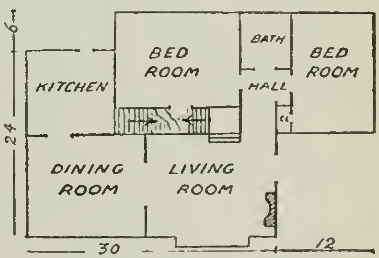


Fig. 12

to keep the rain from driving in around it.

Figure 13 shows another study which is especially desirable for summer use on account of the great wide living room which extends clear across the front of the building. In this study the living room and dining room are combined so that the cost is greatly reduced by omitting the one room and at the same time the most desirable view obtainable from the house may be secured while at meals, as well as when lounging in the living room after a tramp or a swim.

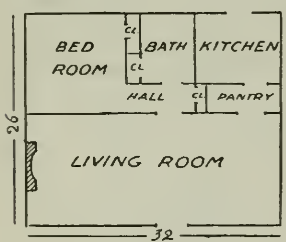


Fig. 13

Figure 14 has a strong tendency toward the general plan of Figure 13, but is considerably different when closely examined. In the first place the study shows two bedrooms and in the second, this study has a dining room which was omitted from the study in Figure 13. The resemblance lies in the large living room across the front and the arrangement of the kitchen, bathroom and rear bedroom. The dining room and the second bedroom are merely inserted between the living room and bedroom of Figure 13 and we thereby obtain another study with which to work.

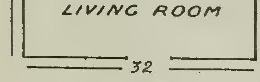


Fig. 14

Figure 15 shows a really clever study of a wide and shallow bungalow—one of those that make a very grand impression from the road but which have little depth when closely examined. As will be noticed by looking over the drawing, the three bedrooms and bath, instead of being placed at the rear of the house as in the studies shown in Figures 4, 5, 6, 11, 12 and 13, are placed at one end of the house. This arrangement allows the living rooms to be entirely separated from the sleeping rooms by closing the doors, as has been already explained, and also allows of perfect ventilation of the living room and dining room. The bathroom is in the handiest possible location for all of the rooms, and the three bedrooms are all of good size. The stairs may go up or down from the little hall between the dining room and kitchen and may go in the opposite direction from the other end. The most desirable arrangement, under the usual conditions, would be to have the cellar stairs lead down from the little hall, while the attic stairs lead up from the wall end of the partition and enter the dining room. A door may also lead up the stairs from the kitchen, if this is a desirable arrangement.

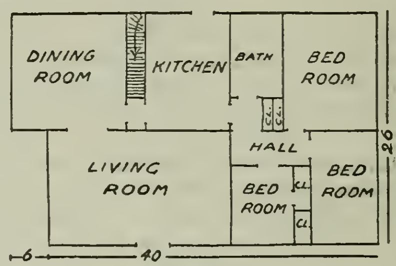


Fig. 15

The object of showing these arrangements or "studies" is to get the prospective builder into a habit of looking over plans and considering where they are weak and where strong and also to impress upon his mind that his opinion may be just as good as that of the average architect, so far as designing is concerned, at any rate.

The remarks about assembling various details into one plan are also given with a view to helping the prospective builder take notice of little arrangements, elevations, fixtures, color schemes and the other numerous details which go to make the completed building. By making notes on the things that "look good," at the time they are seen, a house which will contain just what you desire in almost every respect will result as you have seen these things actually finished and you do not have to guess what it will look like or take someone's word for it.

Keep the bungalow along conservative lines, and the ultimate effect will be refined rather than freakish.

The Popular Science Monthly for July

Are mine fields a real defense against submarines? Ships are being torpedoed every day in the mined English Channel and in harbors seemingly impregnable because of the extensive mine fields that guard the entrance. Could this happen in New York Harbor?

The Mine That Hears

One of the most prominent of our engineers has invented a system to destroy instantly any submarine which might attempt to penetrate into our harbors. He describes this wonderful invention in the July POPULAR SCIENCE MONTHLY.

How to Camp

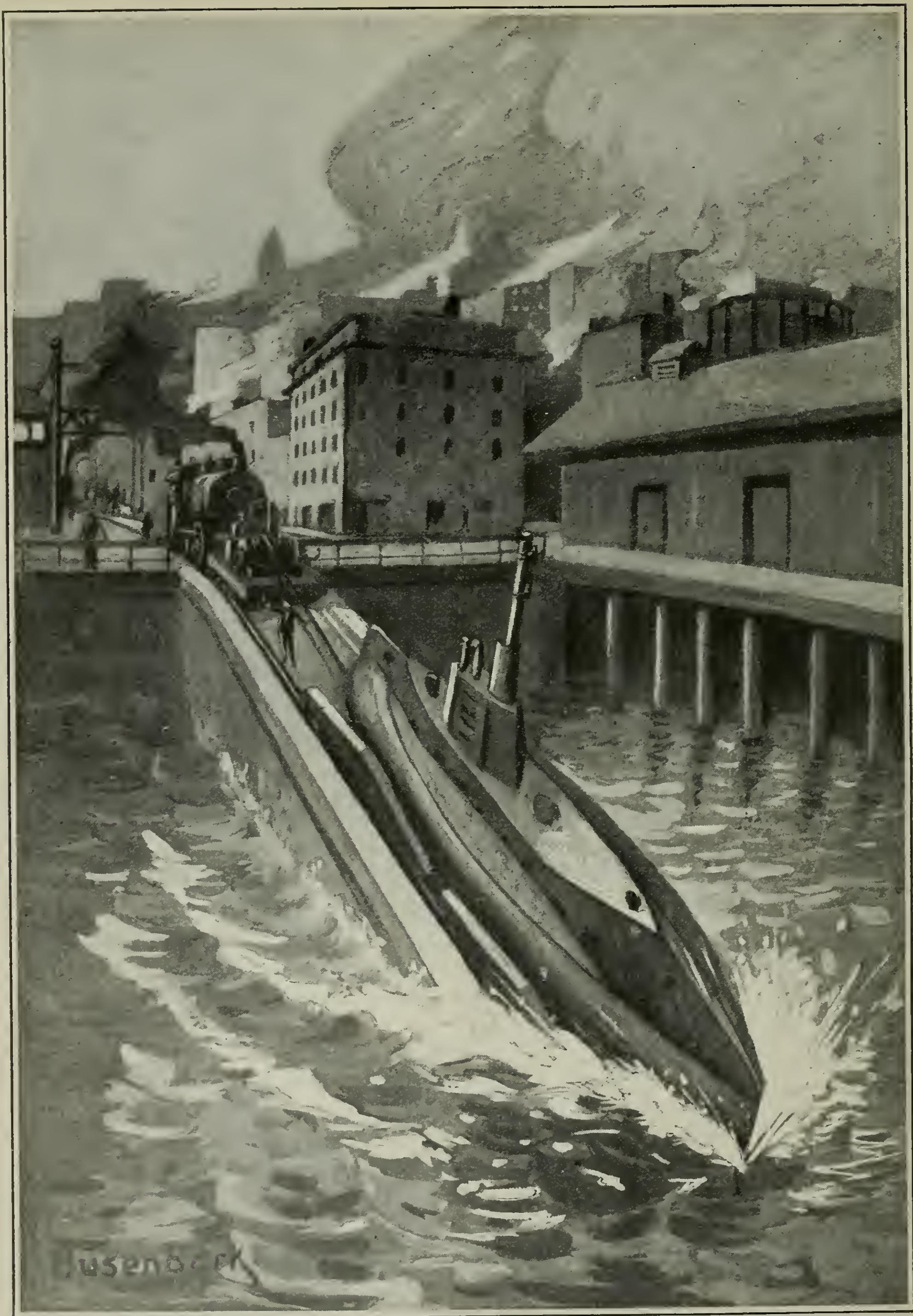
Are you going camping this summer? Next month will appear an article on this subject which will give new ideas to even the most seasoned camper.

What Sailors Don't Know About Sailing

Most yachtsmen think that they know how to sail a boat. They don't. Professor H. A. Everett, of Johns Hopkins University has analyzed the science of sailing a boat, and shows in the July issue just why most men handle their boats badly.

The Voice Typewriter; Talk and It Writes

Other features are: "Automobile Repair Kinks," "A Typewriter That Obeys the Human Voice," "A New Armor Protection for Ships," and—but why continue? There are three hundred more.



Simon Lake, the submarine inventor, suggests that we could mobilize two-hundred-ton submarines by rail. "The railway tracks would be continued down under the water as a submarine railway at such points as the government might desire. It would be necessary only to back the truck and submarine down into the water until the submarine floated"

Popular Science Monthly

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Undersea Fighting of the Future

I.—Mobilizing Submarines on Rails

By Simon Lake

Under the general title "Undersea Fighting of the Future," we publish two articles, by two distinguished engineers, in which the possibilities of the submarine are set forth in a way which shows that we have only begun to learn the use of the most powerful naval weapon thus far developed. Mr. Lake's article deals with the mobilization of submarines for defense; Mr. Chandler's with a highly ingenious method of engaging and destroying submarines under water.

Simon Lake came prominently before the public notice about fifteen years ago as the inventor of a submarine on wheels—a craft which could not only navigate under water but which could also travel on the bottom of a waterway. He acted as advisor on submarines to the German and Russian governments.—EDITOR.

I FIRMLY believe the destiny of the submarine is to stop all future maritime wars between countries. A tremendous power for destruction, the submarine is in itself useless for purposes of invasion. The moment the submarine becomes visible it becomes vulnerable. Its function, therefore, is to lie in wait and attack unawares. All students of warfare must now admit that it is manifestly impossible to send an army across the sea with big guns and troops and to land them, if submarines are on watch. I believe all engineering experts must also admit that when the proper motive power for submarines is evolved, a motive power which will give the submarine the speed of a surface ship, then merchantmen cannot carry on commerce on the high seas except by mutual agreement equitable to all nations. And I believe this will hasten the day when each country will consent to agreements to "do unto others as they would be done by."

Simon Lake. the author of the article on this page, is the inventor of the "even-keel submergence type" of under-water craft which has in recent years been introduced by most of the navies of the world

If, in time of national differences, it were possible for each country to encircle itself with a zone ten miles in width, to pass which would be sure death, it would not be long before quarreling countries would make up their differences. If our country had sufficient submarines to protect its coast line and to establish such a similar zone, an offensive war would be rendered unnecessary.

Last year Congress made an appropriation calling for 25-knot submarines, to cost not more than $1,500,000 each. I saw this reported in the newspapers and I immediately wired the Department that it was impossible to secure 25-knot boats for less than about two-and-a-quarter million dollars each, and I later advised that it would then probably take several years to develop a suitable engine. The largest submarine engine of which I know is one of 1300 horsepower, completed in Italy for one of the large German boats just at the beginning of the war.

As it would probably require about 10,000 horsepower to attain twenty-five knots, Congress hardly realized how stupendous was the problem of producing at a single step a boat capable of traveling nearly twice as fast as the best underwater vessel of the day. No wonder there were no bidders for a 25-knot boat.

While it was impossible, even with unlimited money, in the present condition of internal combustion engineering, to develop a 25-knot submarine boat quickly, it is possible to get quickly a large number of 50-knot submarine boats of small size, which for the same expenditure would prove many times more effective in warding off an attack than the larger boats. I refer to what I call "amphibious submarines;" that is, submarines of about two hundred tons displacement, which could be hauled on special railway trucks from one point of the country to another at a speed of fifty knots per hour, with crews, stores, equipment, all on board. The railway tracks would be continued down under the water as a submarine railway at such points as the Government might desire. It would be necessary only to back the truck and submarine down into the water until the submarine floated. Her commander would only need to give the bell and she would be off. Such boats could probably be built for three hundred thousand dollars each to make ten knots on the surface and about eight submerged. It would be possible to get six or eight such boats for the cost of one twenty-five-knot boat and cover six to eight times as much territory. A torpedo fired from a small, inexpensive boat is just as effective as one fired from a large, expensive boat. The small boats could make the trip from New York to San Francisco in four days, New York to Boston in five hours, New York to New Orleans in thirty-six hours, in perfect safety, while a modern large submarine, under war conditions, could probably not make the trip at all, except as a slow-going surface boat, liable to capture or destruction. One hundred of these amphibious submarines could be quickly turned out by the various shipyards throughout the country, and it would also be possible to get engines quickly for them; the power required permits of using sizes of engines that have already been developed by several concerns. Such a system of coast protection would enable the quick mobilization of a large number of submarines at any threatened locality, for harbor or coast defense purposes. Of course it would be advisable to have a large number of submarines for off-shore work or to patrol the coast where distances between ports or harbors would be too great for the smaller craft.

Many disadvantages accompany the use of the storage battery. It is very heavy for the horsepower energy it carries. It is also bulky, so that only sufficient energy may be carried to propel modern submarines at about eleven knots per hour for one hour, about eight knots per hour for three hours, or at about five knots per hour for twenty hours. This means that when the energy is exhausted the submarine must ascend to the surface or secure surface connection in order to obtain air to enable her engine to be run to recharge her batteries. This is likely to prove her undoing, as the noise of her internal cumbustion engines in charging, can, with a proper receiver, be heard many miles, and would direct an enemy surface boat or submarine to her. Therefore, before the submarine can become invulnerable, she must become capable of operating without sound. If it were possible to produce some sort of primary battery whereby energy-producing material could be put into the battery like coal into a furnace, it would be ideal for submarine torpedo-boat use, and the submarine would then become invincible.

Undersea Fighting of the Future

II.—Battling with Telephones

By Edward F. Chandler

The author of this article has conducted extensive researches in the art of submarine radio transmission, applying the results to defensive and offensive means of warfare. The system of submarine navigation described in this article is the result of conclusive tests.—EDITOR.

IF the war has taught us anything it has taught us that the submarine must be reckoned with both as an annihilator of battleships and as a destroyer of commerce. Of the dozens of instrumentalities invented for killing on a wholesale scale it is the most terrible. And yet how crude is this new weapon! Compared with what it can be made it is what the blunderbuss of old is to the modern rifle.


Edward F. Chandler, whose most important work thus far probably is the development of a submarine range-finding system and its application to the detection and destruction of hostile submarines

Consider for a moment how a submarine boat is handled. The commander plows along at the surface much as he would on any ship. In the offing he sees a pillar of smoke. Friend or foe? He must investigate. Changing his course, he steers for that cloud on the horizon. In fifteen minutes he has approached near enough to discover that the smoke is pouring from the funnels of a hostile collier. She flies the naval ensign of her country, and she is convoyed by a torpedo-boat destroyer. The submarine commander gives an order. Water surges into tanks in the submarine's hold. The craft sinks until only her periscope projects from the water. Heading for the collier the submarine arrives within half a mile of its prey. The commander takes the bearings of the collier by compass and orders complete submergence. In another minute the craft is completely under the surface. A sharp command, and a puff of compressed air starts a torpedo from one of the launching-tubes. In less than a minute it has reached the collier. There is a dull explosion. Fifteen minutes later a cargo of four thousand tons of coal lies at the bottom of the sea, and a hundred brave men have perished miserably.

Why the Submarine Is Crude

It seems very simple, very certain, this torpedoing of a ship from a safe place under the water. But for all that it is unscientific and haphazard. The submarine commander sees nothing below the surface; that is why he must take aim before he submerges. To strike, the target must be large and very near; otherwise he would surely miss. Suppose that you were told to shoot blindfolded at a mark one hundred yards away and that you were given two minutes to locate the target before your eyes were covered. You would be exactly in the position of a submarine commander about to torpedo a hostile ship. Is it any wonder that torpedoes must be fired at close range? Is it not obvious that the submarine could be made still more terrible if the submarine commander could locate his quarry accurately in the inky blackness in which he is immersed?

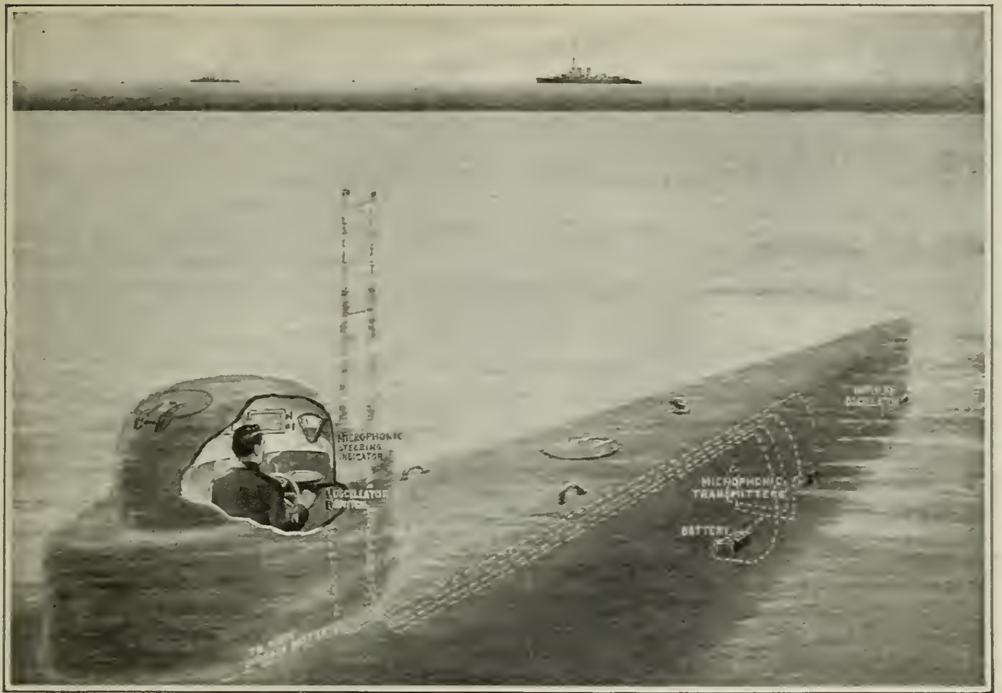
To use lights under water is hopeless. Even millions of candlepower would not reveal the presence of a ship a mile off to a submerged underwater craft. But suppose that the commander of a sub-

Although the submarine is blind after it dives it can be made to hear with the aid of microphones. If two hostile submarines were equipped so that they could hear each other there is no reason why they should not fight under water. Torpedoes would be the weapons used—torpedoes directed solely by the sound emanating from the craft to be destroyed

marine could locate his prey by sound; suppose that he could hear a ship and locate her by sound more accurately, for example, than a blind man can locate the position of a ticking clock in a room? Might not that solve the problem?

With this thought in mind, I have worked out a method of utilizing microphones—a method which is a modification and extension of that which I described in the Popular Science Monthly for October, 1915. Those who read that article will remember that I showed how it was possible to make a torpedo guide itself toward the beating propellers of a ship with the aid of microphones—"electrical ears," as I call them. A microphone is found in every telephone transmitter. It is an instrument for intensifying feeble sounds, or for transmitting sounds, and it is based on the principle that the transition between loosely joined electric conductors decreases in proportion as they are pressed together. The conductors form part of a circuit through which a current is passing, and the variations in pressure due to sound waves in the vicinity of the conductors produce variations of resistance, and hence fluctuations of the current, so that the sounds are reproduced in a telephone receiver. In the modern telephone the transmitter is essentially a microphone, the pressure of the sound waves being communicated to the conductors by means of a diaphragm.

In a torpedo of the type I described in the Popular Science Monthly, the microphones are mounted in pairs on both sides of the nose. So long as the sound of the hostile ship's beating propellers, traveling through water far more readily than sounds travel through air, affect all microphones with equal intensity, the torpedo rushes on straight to its mark. But if the vessel should change its course, the vibrations of the propellers would no longer strike the two pairs of microphones with equal force; one pair would be more affected than the other—the pair directly ex-



In order that a submerged submarine may direct its course accurately toward a hostile ship it may be provided with microphones on its port and starboard bows. The difference in the volume of sound received by the two microphones indicates the course to be pursued. The sound can be converted into movements of a finger playing over a dial

posed to the vibrations. At once electrical circuits are closed and automatic mechanism started which swings the rudders of the torpedo and points the nose of the torpedo toward its mark. As soon as the microphones on both sides are restored to electrical equilibrium, in other words as soon as they hear with equal clearness, the torpedo keeps on a straightaway course.

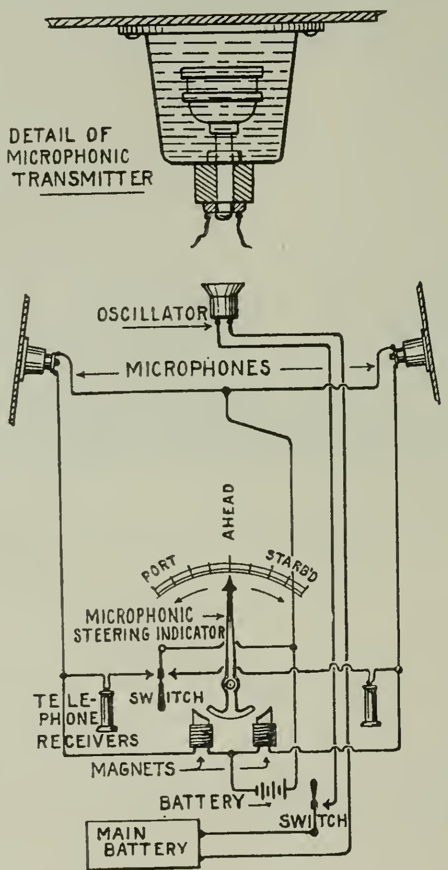
It is evident that the same principle can be applied to submarine boats traveling under water, with the difference that since the submarine is manned by intelligent human beings, the microphones can be made merely to indicate the course to be pursued, leaving to the commander the task of steering a true course. As in the case of the sound-controlled torpedo, the submarine is provided with microphones on its port and starboard bows. Telephone ear-pieces are provided which enable the submarine commander to listen to the sounds gathered by the microphones. If the submarine is not pointed head on toward the ship to be destroyed the microphone on the off side will hear less than the other, and the difference in the volume of sound received by the two microphone detectors will be noted at once in the telephone receivers. The commander changes his course until he hears equally well with both ear-pieces.

Seeing Sounds on a Dial

While it is perfectly feasible to direct a submarine by telephone it is much more effective to convert the microphone vibrations into visual signals. As a result the commander of a submarine has only to watch a finger move over a dial in order to know what course he should steer. In a sense he sees the sound which the microphone detectors hear. The accompanying diagram sets forth the essential principles of this conversion of the microphone vibrations into visual signals so clearly that an extended description seems hardly necessary.

While a visual steering indicator is

primarily depended upon to guide the submarine on its deadly errand, telephones are connected with the microphones, to be used when the occasion arises. With their aid the commander learns a new language. He realizes the meaning of strange grindings, hums, moans, blows, murmurs and vibrations —the many tongues of the sea. If we but knew it the water of the ocean is a veritable Babel; it is a great reservoir of sound, the recipient of ten thousand different vibrations, ranging from the grinding of pebbles to the pounding of steamship engines. Just as a woodsman learns the meaning of the weird soughing of wind in tree tops, the "woof" of a bear, the patter of deer's feet and the call of quail, so a submarine commander can distinguish one underwater sound from another and interpret it correctly. A tramp steamer can be microphonically distinguished from a *Mauretania,* a torpedo-boat from a superdreadnought, and above all a subsurface craft from a surface craft. Thus the character of an unseen ship miles away can be ascertained.



A diagram showing the Chandler system of converting sounds heard through a microphone into visible signals

But apart from listening to passing ships, the telephones will be required to receive messages from an admiral on a battleship five miles away. Both warships and merchantmen are equipped with submarine signaling devices — devices which send forth either bell sounds or rhythmic vibrations. It is easy to see how useful they can be made to telegraph orders to a submarine under water five miles or more away.

Under Water Echoes and How They Are Applied

In the foregoing account of my invention I have assumed that the vessel to be attacked with the aid of the microphonic steering-indicator is in motion—that its engines are giving audible sounds and that its propellers are churning up water noisily. But suppose the vessel to be attacked is at anchor—what then? Is not the submarine commander helpless?

The difficulty is easily overcome if we can make the submarine produce a characteristic sound and if we can have that sound echoed back from the ship to be sunk and picked up by the submarine's own microphones. Fortunately Professor Fessenden has provided an instrument ideally suited for the purpose. Called an oscillator, it may be regarded as a kind of underwater klaxon horn, the diaphragm of which is electrically vibrated to emit a characteristic bleat. By means of a switch, located near the hand of the submarine commander, the oscillator can be turned on or off.

The oscillator will be of use not only to locate a ship at rest but to save the submarine in a nerve-racking emergency. Imagine the commander of a U-boat bent on the destruction of a ship entering a harbor and traveling along at the surface with only his periscope exposed. A fast armed motorboat looms up—a type of craft which has proved to be a most formidable enemy. The submarine must act quickly. There is but one course—to sink quickly. Valves are opened and tanks filled. The craft sinks out of sight. It is safe for the moment. The agonizing uncertainty of the crew can be imagined. They know that a relentless enemy awaits them, that his searchlights sweep the water all night. Hour after hour drifts by. If the submarine's commander rises, a hail of shot and shell is sure to rain upon him; if he stays under water very long he and his men will die of suffocation. Why not move on? The waiting motorboat cannot see him. But in what direction and how far? He is almost sure to run into the shore and to puncture the thin shell that saves him from inundation. If he could only locate the harbor entrance he would be safe. An oscillator and a set of microphones will enable him to head for the inlet as surely as if he were traveling on the surface and he could see it with his eyes. He pulls the switch of the oscillator. A shrill note is sent through the water. His eyes on the steering indicator dial, he watches the response of the finger to an echo. The echo of what? Of the oscillator's vibrations reflected by the shore. He steers this way, now that way, barely crawling along, always watching for the echo on the dial. The finger on the steering indicator moves from side to side as the microphones pick up the echoes. At last there comes a moment when the finger stays at zero, when, in other words, there is no echo for the microphones to hear. That can mean only one thing: the oscillator is sending out its bleat not toward an echoing shore, but toward the harbor's mouth and toward the open sea, where safety lies. With his eye on the steering indicator the commander signals "full speed ahead," knowing that salvation lies before him.

Artificial Senses Take the Place of Eyes and Ears

The use of microphones on submarines not only increases the effectiveness of the submarine enormously, but opens up new and intensely dramatic possibilities. As soon as one submarine is equipped with devices for threading a course underwater with certainty all submarines will be similarly equipped. Grant that and at once we have the means of pitting submarine against submarine, of actually engaging in submarine fights. What strange encounters they will be—these underwater engagements of the future! Two vessels, blind but for steering indicators connected with microphones, circling around each other in the effort to ram or to plant a torpedo at the right moment, cocking electrical ears, as it were, and maneuvering entirely by sound—what battle of Wells or of Verne's can compare with it? Instruments, artificial senses, take the place of Nature's eyes and ears; hidden movements are electrically translated into twitches of a quivering finger on a graduated dial; one intelligence is pitted against another. Surely this is real scientific warfare—this battle of microphones!

A Sewer Banquet at $25 a Plate

TO celebrate the completion of a new sewer in St. Louis a cabaret banquet was held in the tube. A "banquet room" three hundred feet long and a gas-equipped kitchen were created. The food was cooked in the tunnel and served on twelve tables placed lengthwise.

The cost of the banquet was twenty-five dollars a plate.

The underground kitchen in which the meal for a banquet given in St. Louis' new sewer was cooked

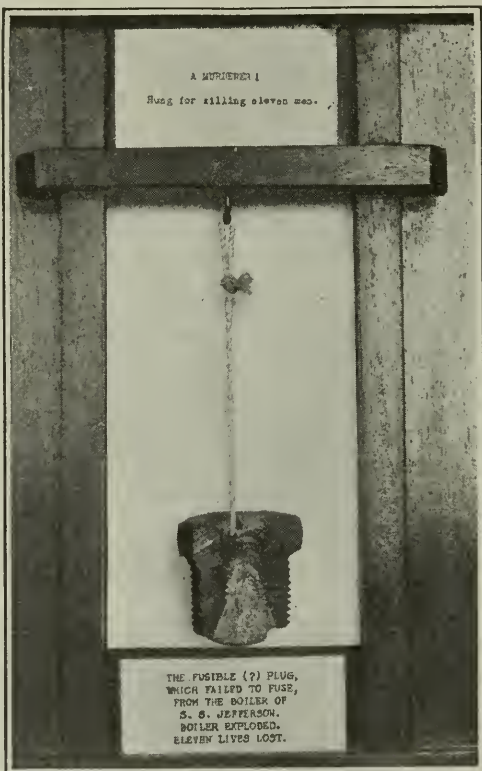
Hanging a Defective Boiler Plug as a Warning

A MINIATURE gallows from which hangs a defective fusible plug responsible for a boiler explosion which occurred on board the steamship Jefferson, near Norfolk, Va., on May 11, 1914, is one of the interesting curios on the walls of the office of Secretary Redfield, of the Department of Commerce in Washington. It is a grim reminder of a tragedy which cost the lives of eleven men. A small placard above it reads:

"A Murderer! Hung for killing eleven men."

Below it are the words:

"The fusible (?) plug which failed to fuse. From the boiler of the S. S. Jefferson. Boiler exploded. Eleven lives lost."



Impurities of the fusible filling of this plug prevented its blowing out and resulted in the loss of eleven lives. So, the plug was hanged as a murderer, in a government bureau

The plug consisted of a threaded brass bushing about an inch and a half in diameter, with hexagonal head. Through the center of the bushing runs a plug of fusible metal, which, in this instance, was defective; it did not blow out when the water in the boiler became low, thereby causing a disastrous explosion. When the plug was sawed open lengthwise it was found that most of the original filling had disappeared, only a few traces of it remaining embedded in a dirty, greenish-white mass of tin oxide, which would not melt until heated to a temperature somewhat higher than 2,900 degrees Fahrenheit.

Impurities in the fusible metal, which were the cause of its failure to blow out, are easily discernible. In subsequent investigations made by the United States Bureau of Standards ten hundred and fifty fusible plugs were examined. These were from one hundred and five different makers, and about one hundred of them had been in actual use for from four to twelve months. From a study of these plugs the Bureau recommends that the fusible metal itself should preferably be pure tin, because it has been found to be far more reliable and durable. The Bureau further recommends that the tin be as free as possible from zinc and lead.

One of the many types of deterioration of fusible plug fillings observed by the Bureau consists in the formation of a network of minute thread-like cracks or corrosion-regions, ramifying in all directions. The Bureau found that these penetrated the metal and then broadened out until the filling was largely, or wholly, oxidized and destroyed. The presence of small quantities of zinc in the tin was the main contributing cause of the network type of corrosion. This was proved conclusively by the investigation conducted after the disaster.

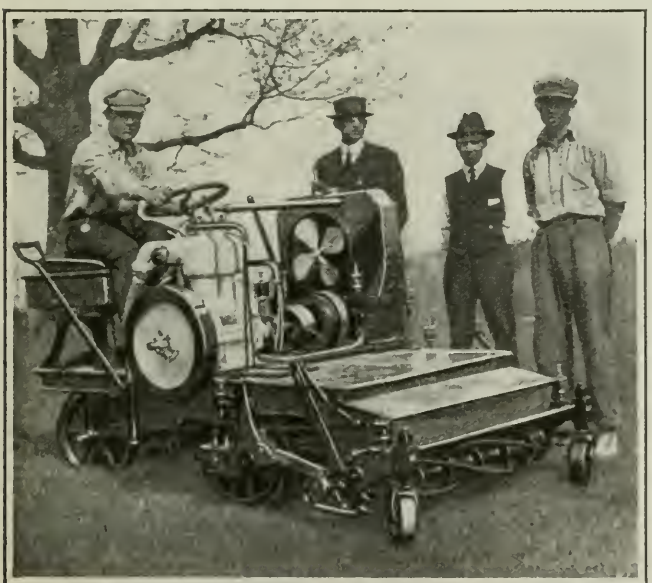
An Ingenious Combined Lawn-Mower and Roller

FOR smoothing golf links and other large tracts of land that require constant trimming, a combination lawn-mower and roller has been invented. The driving apparatus consists of a two-cylinder gasoline motor mounted on a platform in front of the driver and cooled by a rapidly rotating electric fan and water system. The machine is both broad and rather long, so that it can climb over rough grounds with a speed that hand mowers and rollers could hardly attempt.

Combining the two operations of mowing and rolling saves a great deal of time, and, due to the speed with which the mechanism travels over the ground, lawns or golf links can be put into condition and reoccupied in a fraction of the time required when the grass is mowed and rolled by hand.

The machine shown in the photograph weighs one thousand, one hundred pounds and is equipped with a sixteen-horsepower engine. It will operate on any grade up to twenty-five per cent.

By the simple manipulation of a lever, the driver can adjust the blades to cut any length of grass.



This lawn-mower and roller combined is able to smooth out the wrinkles and trim the grass on golf links in half the time usually required for such work

If this egg were a watch-dial, an hour would have only fifty-five minutes

An Egg With Hour Ridges

WE have heard of all sorts of freak eggs, from double ones to those having a few sporadic bumps on their surface, but never before have we seen one with ridges corresponding to the numerals on a clock dial. All that are needed are the hour and minute hands. There would be one difference, however, between using this egg-dial and that of a regular clock: it would register thirteen o'clock.

Freezing Cocoanuts to Get at the Milk

A PENNSYLVANIA man has devised a means of removing cocoanut shells by freezing the nut until the shell is slightly contracted, and then subjecting it to a comparatively high temperature so as to cause rapid expansion. Cracks in the shell are thus produced. A series of hammer blows then completes the breaking of the shell.

London's perambulators are now equipped with sidelights to avoid danger in the darkened streets

London War Affects Baby Carriages

LONDON has passed an unusual law which requires that baby carriages shall be equipped with sidelights. While no adequate explanation is given, it is believed that the new ruling was put into effect because of the darkness into which the streets are plunged because of the fear of Zeppelin raids. Baby carriages, while not dangerous objects, are objects of danger, and the fact that they are compelled by law to be equipped with a lamp to light their way, lessens the possibilities of collisions. The law requires that the light shall show white in front and red in the rear.

How War Mobilizes the Non-Combatant

ONE of the impressions of war received by Dr. George W. Crile, who served with the American Ambulance at the front, was that a civil community is terrorized when it is first under fire, but that in time this terror wears away and life under the sound of shells goes on quite normally. ("A Mechanistic View of War and Peace," The Macmillan Company).

"I observed that from Furnes to Ypres the farmers were quietly tilling the soil under active shell fire. In one instance just at the outskirts of Ypres I saw a fresh excavation made by a shell which had fallen on a newly-made furrow. The farmer was working at one end of the furrow and the German artillery at the other end. The farmer seemed no more disturbed than the artillery. An aeroplane fight high above our heads called forth the rapt attention of everyone in the fields, on the roads and in the houses, but even so the excitement was less than one usually sees at a baseball game.

"In Ypres, so long under bombardment, and so extensively battered, some of the citizens had stolen back in spite of shells and resumed their daily routine. I recall a little plaster house at the edge of the town, in the doorway of which two women were pleasantly gossiping and two little girls were playing with dolls. The nearer the front one goes, the more quiet and serious every one seems. It is the solemn atmosphere of the consecration of human life."

Adjustable Footrest

AN ingenious German named Stickler has invented a support for the leg below the knee and the foot, which can be easily adjusted to any form of chair or bench and afterwards removed without trouble when the need for its use is over. Thus, one of these footrests can serve a number of seats.

It has always been one of the drawbacks even to the most comfortable of ordinary chairs that while the upper part of the body is well supported, the feet, when they fail to touch the ground,

A comfortable foot and leg rest which can be used with any chair

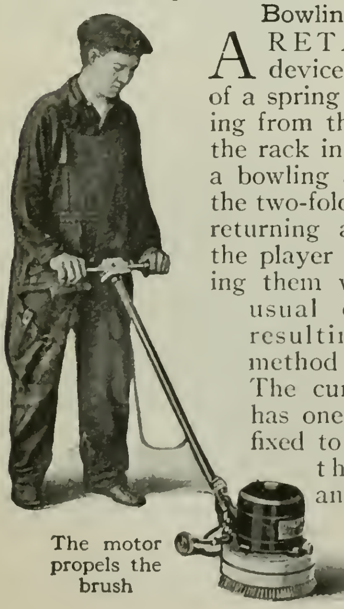
lack a rest. This enables one to work in a comfortable sitting position.

Floor Scrubber Propels Itself

A MACHINE for cleaning floors has been brought out, so quiet in its opertion that it can be used in hospitals and so gentle in its action that a frail woman can manipulate it without difficulty. Its chief feature of interest is that it departs radically from the suction or vacuum type of cleaner. Attached to the lower end of a long iron handle is an industrious but small electric motor. As the motor spins, it rotates a circular brush, which can be applied with any desired pressure to the floor surface. Behind the brush motor are two rubber wheels serving a double purpose—to act as a lever for regulating the pressure of the rotating bristles against the floor and as a carriage for rolling the equipment from one part of the building to another.

Because of the brush's rotary motion the machine is self-propelling. Various grades of brushes are supplied for various floor surfaces. For polishing hardwood floors and mosaic or tile, brushes of other types are employed.

Curved Spring Device Returns Bowling Balls



The motor propels the brush

A RETARDING device consisting of a spring chute leading from the gutter to the rack in the rear of a bowling alley serves the two-fold purpose of returning all balls to the player and returning them without the usual concussion resulting by the method now used. The curved spring has one end firmly fixed to the base of the housing and the other to an adjustor. No matter how swift a ball is thrown it is returned to the player with uniform speed.

A simple spring device retards the balls as they return to the player

Detachable Blades for Hatchets

HERE is a hatchet with detachable blades, made possible by spring clips co-operating with apertures and slots of the blades. When attached each new blade is as rigid and stable as the main body of the hatchet itself, and when it becomes dull it can be readily detached and reground. Thus the body of the hatchet becomes continuously serviceable, and one is always assured of a sharp blade. The blades can be economically made by stamping from sheet steel. From the standpoint of pure efficiency the hatchet makes a very effective weapon.

A detachable blade

Listening to an Electric Current

AN interesting electrical experiment, illustrating the fact that sound accompanies the passage of electricity through the body, can be shown in the following manner: Let two persons each hold an electrode from a small magneto or shocking-coil. Let one person, with his free hand, touch the other person behind and just below the ear. A buzzing sound, otherwise inaudible, can be heard. The tone of the sound depends upon the number of interruptions of the current.

When the Appalachian Mountains were lifted above sea-level, millions of years ago, these strata of limestone were arched up like a bubble in pie-crust. The core of the rock has been partly mined out to make cement

Rock Folded Like Cardboard

THE rocks in this photograph which are seen to be bent over in the shape of a loop were at one time—some millions of years ago—the flat bed of the ocean. When the Appalachian Mountains were uplifted above the sea they were raised with the rest of the land, and as the uplift was irregular these strata of limestone rocks were bowed up like a bubble of a pie-crust, which is lifted by the gas generated in the cooking of the pie. The core of this rock has been mined out for making cement. The remaining rock is also limestone, but as it is not of the proper consistency for making the best cement, it was left intact.

When rock is bowed or arched up in this manner, the result is termed an anticline. This anticline is exposed at several points along the Chesapeake and Ohio Canal, Maryland.

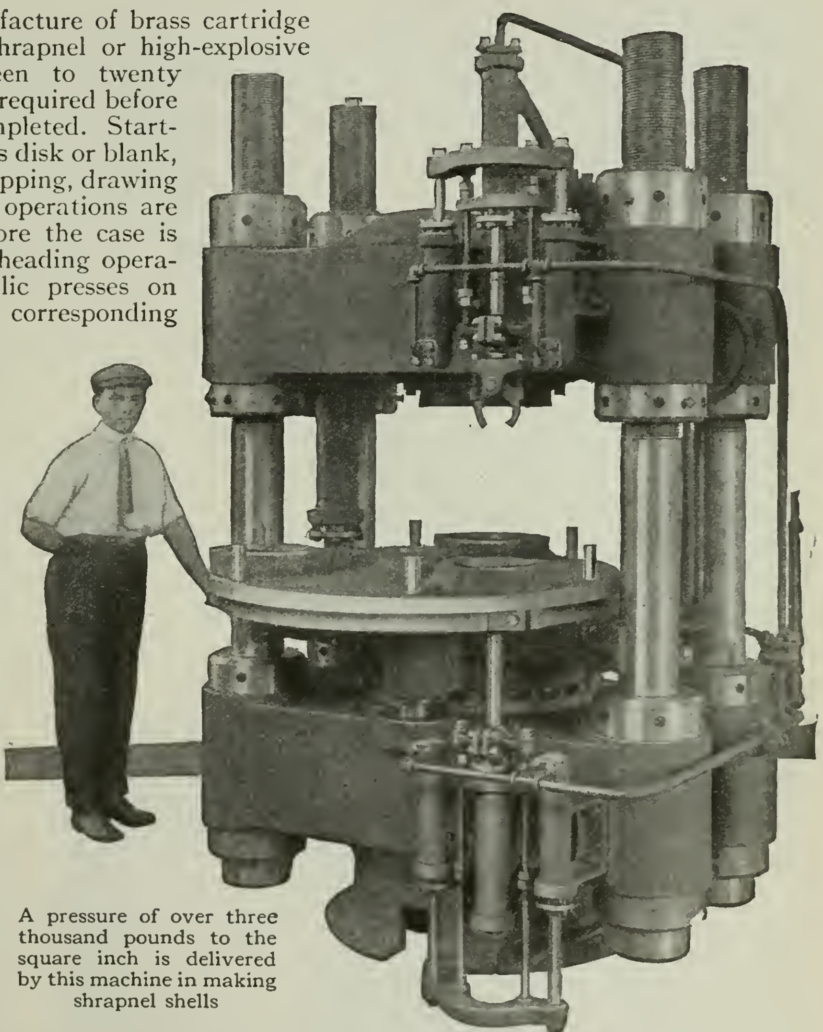
The House That Tin Cans Built

YOU have heard of the house that Jack built and you may have read about the house that junk built, but did you ever hear about the house that tin cans built? Huts built from tin cans—five gallon gasoline cans—are not at all uncommon in that section of America between the Rio Grande and the Tierra Del Fuego, as in the locality the five gallon can is a generally accepted standard of liquid measurement. While not entirely suited for a dwelling in Mexico, because it is not bullet-proof, this tin can house is very comfortable.

There is no such word as "can't" for the man who built this house; but he uses can frequently, his house being made of five-gallon gasoline cans

Giant Press Used in Making Shrapnel Shells

IN the manufacture of brass cartridge cases for shrapnel or high-explosive shells, fifteen to twenty operations are required before the case is completed. Starting with a brass disk or blank, a number of cupping, drawing and indenting operations are performed before the case is ready for the heading operation. Hydraulic presses on which dies and corresponding punches are employed, are used for all of these operations. A very powerful hydraulic press is used for the heading operation which is shown by the accompanying photograph.



A pressure of over three thousand pounds to the square inch is delivered by this machine in making shrapnel shells

The heading operation is accomplished by inserting a "fullering-block" exactly matching the indention previously made, between the head of the press and the top of the cartridge case, the latter being held in place by a suitable die. As the pressure is applied the fullering-block causes the brass to flow outward in all directions, thus forming the head of the shell. The pressure is furnished by a motor-driven, triplex, hydraulic pump, which delivers water at a pressure of thirty-two hundred and fifty pounds to the square inch.

The press has a revolving turret with dies to receive three shells. This provides for an almost continuous operation, as there is always one shell awaiting the heading operation and one shell being unloaded, while the other shell is undergoing the heading operation. The rotation of this turret is controlled by an indexing device, so that the shell is accurately held in place directly beneath the fullering-block.

The photograph shows a rear view of the press. The lever controlling the indexing device is shown at the extreme right.

A Switchman Who Became Judge, Though Armless

DAVID Moylan was formerly a switchman on a Western railroad. Through an accident he lost his right arm, but he refused to relinquish his position. Only when he had lost his left arm, through a second accident, did he turn to something else. Then he began the study of law and showed marked ability. With his examinations, however, came the first big handicap; but this man who seems undismayed at anything, proceeded to learn to write by holding a pen between his teeth. Using this method, he took the examinations, proving not only his mental ability, but good penmanship as well, for he can write better with his teeth than many persons can with their right hand.

After becoming a lawyer, he practised in that profession for four years. Becoming not only proficient but popular, he was elected to the City Council of Cleveland, Ohio, where he resides. He was as successful in this office as before, and was re-elected at the end of two years. Recently he ran for the office of Municipal Judge and won.

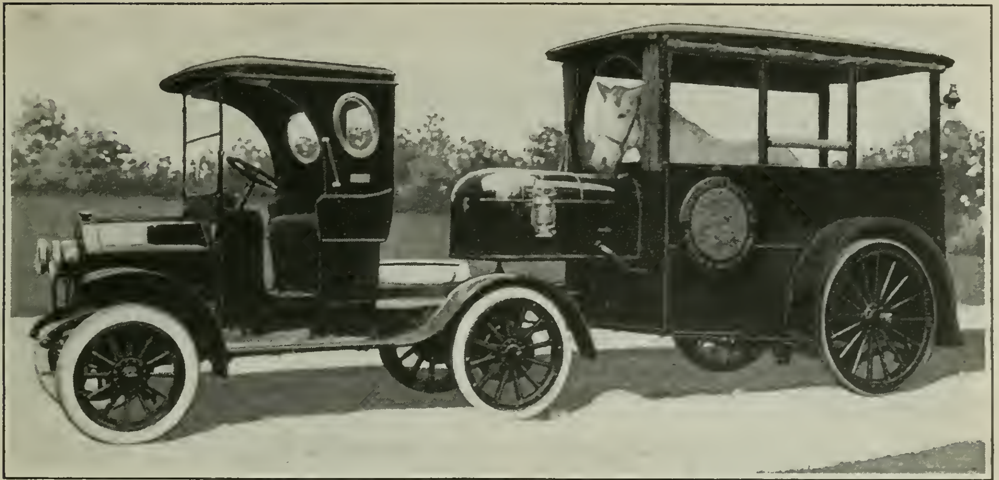
David Moylan was once a switchman, he is now a judge. Did an accident force him to rise to his present success, or would ambition have elevated him to equal responsibility? At any rate, he succeeded where many less unfortunate would fail.

Judge David Moylan lost his arms in two different accidents while employed as a switchman on a western railroad

Why We Can See Through Water

IF you go to an aquarium and look at the fishes or other animals that live in the water, you will see that in one case water may be very clear and transparent, and in another may be only half transparent. There are really all degrees possible.

When the waves of light pass through a translucent thing like frosted glass, they are twisted and broken and mixed. That is why you can see some light coming through, although you cannot make out things on the other side. But transparent glass lets waves of light come through it almost exactly as they come in, so that sometimes you are not sure whether the window pane is there or not. Water is much the same as glass in this respect. If there are no solid substances in the water, and if the water is still, it is very fairly transparent. Neither water nor glass nor anything else lets through absolutely all the light that comes to it. It keeps back at least a little, just as the air itself does with the light of the sun.



Every consideration is given to the injured horse in carrying him away to the hospital. This truck differs from the ordinary automobile ambulance in having a trailer

A New Type of Motor Horse-Ambulance

DIFFERING from other previous types of motor ambulances for sick or disabled horses in that it is a truck and trailer principle and not a self-contained vehicle, the latest unit, as shown in the accompanying illustration, has a low platform trailer into which the horse may walk with ease or be hauled in on a special device if unable to stand up.

The new equipment consists of a one-ton motor-truck and a trailer, the forward end of which is supported on the truck. The trailer has a specially low platform and a tail-gate which may be swung down to form a bridge to enable the sick horse to walk into the trailer body with ease. A second independent floor on rollers is provided in the trailer. When the horse is so disabled that he cannot stand up this platform is rolled out of the trailer and down the lowered tail-gate to the street, where the animal is securely bound to it with his head on a pillow to prevent injury. The platform is then hauled into the trailer by means of a steel cable wrapped around a drum carried in the gooseneck of the trailer-frame and revolved by a hand-crank as shown in the illustration.

The trailer is provided with a permanent top and curtains at the front, rear and sides for use in inclement weather. Two stanchions are provided at the center of the trailer at each side to support the ends of a canvas sling passed under the stomach of the horse to take the weight off his feet when one of his legs is injured.

Germany's Rubber Trade

THE war has had its effect on the rubber trade in Germany. The manufacture of rubber sporting goods, toys, articles of luxury and the like has been almost entirely curtailed. Had a demand existed, the lack of the necessary raw materials, even in substitute qualities, would not have been forthcoming. Business is very slack in sanitary and surgical goods, because the essential, fine crude rubber can only be had for military purposes and skilled labor, which is very important in this line, is very scarce.

The enormous consumption of solid and pneumatic tires by the German army has given the manufacturers all they can handle. Business decreased appreciably, however, towards the close of the year 1915. The cycle tire industry has not been favored by war conditions. Only reclaimed rubber has been available for making casings and only very limited quantities of crude rubber have been allowed for inner tubes. The restrictions on the use of cotton fabrics has practically stopped the making of cycle tires for other than military purposes.

A bridge, two miles in length and twenty feet wide, is stretched across Pen d'Oreille Lake, for the use of farmers who sell their produce in Sandport, Idaho

The Longest Wagon-Bridge in the World

IN the accompanying photograph is shown a bridge two miles long, twenty feet wide and twenty-five feet high. The tower in the center is the drawbridge through which vessels pass. By turning a heavy iron wheel the weights at the top of the tower are lowered to throw the bridge open.

This bridge is on the Pen d'Oreille Lake, and was built for the benefit of the farmers across the lake, as they had no other way of getting across water to Sandpoint, Idaho, to sell their produce and do their marketing.

Healing Magic of the Electric Arc

THE most intense heat produced by man is that of the electric arc, and the possibilities of its application in various branches of American industry have only begun to be realized. Like many other useful scientific agents, the electric arc has been adopted by the burglar. There is no safe known that will not yield to the electric carbon applied by the skilled "safe-cracker."

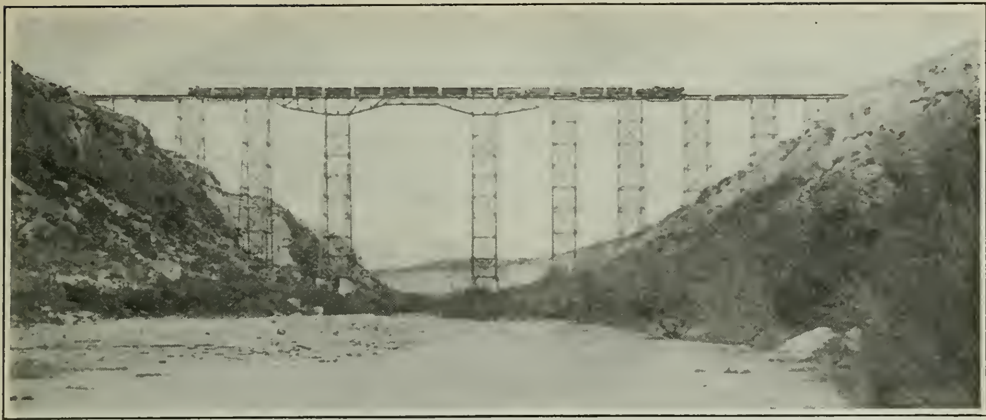
Broken or cracked castings can be quickly mended by means of an electric arc

Aside from lighting, the most useful purpose to which the electric arc has been put is in the mending of broken or cracked castings and metal parts of all kinds. A broken shaft, for instance, can be resurrected from the junk heap if a skilled workman, with adequate arc apparatus, is given a chance at it. Moreover, a broken metal piece repaired by the electric arc is as serviceable as when new. In fact, strain tests made upon repaired castings often result in breakage at a different point than where the repair was made.

The accompanying photograph shows a workman engaged in arc-welding. Due to the intense heat at the point at which the carbon pours its electrical fire upon the metal, the operators usually wear helmets, not unlike the gas helmets of the present war. They at least hold between their eyes and the arc a thick plate of cobalt glass. The amount of protection required depends upon the strength of the current fed to the arc.

Watch Your Oil for Gold Teeth

WHILE overhauling an old, two-cylinder car, E. E. Booth, of Pomona, Cal., found in the crank case a sizable piece of refined gold which had apparently been once the crown of somebody's tooth. Its presence in the oil and other residue has not been explained.



The guarding of this railroad bridge across the Pecos River on the Mexican frontier was accomplished by means of acetylene search-lights located on the banks below the bridge

Protecting a Bridge from Villa with Acetylene Lamps

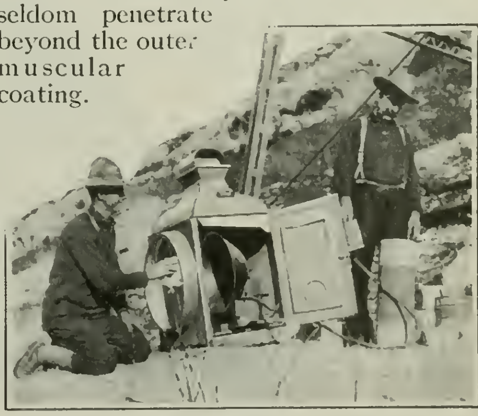
DURING the trouble in Mexico it was feared along the frontier that the Mexican desperadoes might destroy American bridges, thereby preventing, or more or less seriously hindering, the effort of the American troops ordered across the border in capturing bloodthirsty Villa.

On several occasions bands of marauders threatened to dynamite the bridge of the Southern Pacific Railroad, which stretches, a delicate steel thread, across the Pecos River. The Southern Pacific Railroad bridge which is three hundred and twenty feet in length, spans the lower course of the Pecos River where it flows into the Rio Grande. The bridge is one of the most important connecting links in the southern branch of the Texas division of the railroad, and its demolition, a comparatively easy matter, would cause a tremendous loss because of the delay in freight shipments. To forestall the plans of a possible Villa dynamite squad, troops were stationed at regular points along the roadbed of the river. At several places underneath the bridge, powerful acetylene search-lights were turned on at night. Because of the vigilance of the 19th United States Infantry, which was stationed on the bridge, the Mexicans made no attacks.

The Gentlest Bullet

A CAT may be killed by shooting, but the use of chloroform is generally considered more humane. Shooting has its merciful side also, and during the period of the present war, much has been said regarding the most humane bullet. The bullet used by the French infantry cannot be said to be desirable, yet it is perhaps the least painful and produces the fewest bad effects of any now in use. Its swiftness enables it to pass right through the body and to cut a very small, clean hole, without tearing the surrounding tissue. The chance of escaping important nerve centers is thus greatly increased.

The greatest injury is caused by tearing open the tissues and splitting the bones. Many heavy bullets act in this way as well as the dum-dum bullets, so much talked about last year. Shrapnel balls are not so disastrous in their effects. They have so little force back of them that they seldom penetrate beyond the outer muscular coating.



Vigilant American troopers kept the calcium focused on the delicate steel structure all night

Bathing under the glare of the calcium has become a popular recreation at some of Chicago's extensive beaches on the shores of Lake Michigan

Swimming by Searchlight

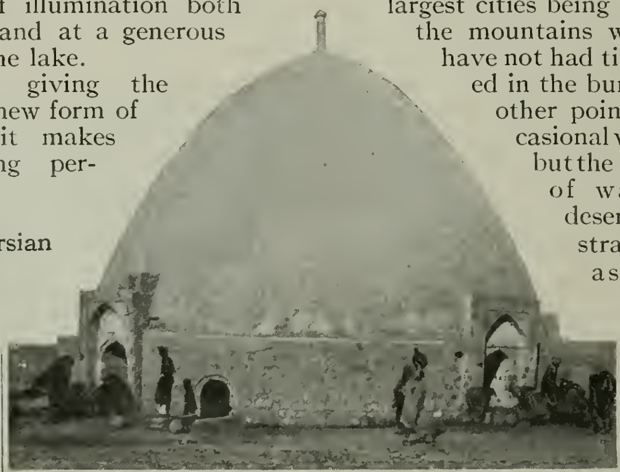
FOR the benefit of the tired business man and the tired business woman, unable to take advantage of Chicago's twenty-two miles of lake front during the daytime, the city has installed along some of the beaches powerful electric searchlights, so that the bathers can see just where, and with whom, they are swimming. After nightfall, the lights are turned on, throwing their rays in various directions, so that the bathers have plenty of illumination both on the beach and at a generous distance into the lake.

Aside from giving the Chicagoans a new form of water sport, it makes their swimming perfectly safe.

A Strange Persian Cistern

PERHAPS nothing could better illustrate the difficult nature of Persia as regards military operations than the accompanying photograph which shows the extreme measures that have to be adopted for the conservation of water over a large part of the region in which the Turks, Russians, and even a considerable number of Persians are now in conflict.

The Caspian watershed of Persia is fairly well watered and wooded, but all the region south of about the latitude of Teheran—the central and southern zones—are almost absolute desert, the largest cities being near the base of the mountains where the rivers have not had time to be absorbed in the burning sands. At other points there are occasional wells and springs, but the principal sources of water in these desert regions are the strange cisterns such as shown in the illustration. Stone conduits carry water from the mountains to the cisterns on the desert plains.



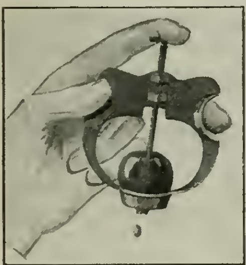
Water is carried many miles through conduits and deposited in these remarkable dome-covered Persian cisterns

Housekeeping Made Easy

How to Avoid Burnt Fingers

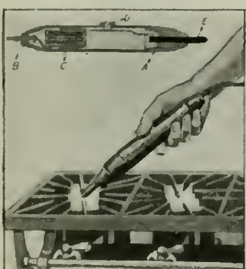
WHERE is the cook who has never burnt her hands draining scalding hot water from vegetables? Blistered hands may now become mere reminiscences, for there are upon the market excellent vegetable kettles of aluminum with lids held in place safely by clamps. On one side is a hand-hold for tipping the vessel and for holding the lid.

Cherry-Stoner Saves the Hands



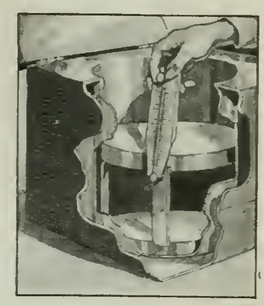
AN automatic method of removing the stones from cherries without touching the fruit with the hands or soiling it in any way, is afforded through the operation of the simple little device illustrated. Press the finger on the spring-rod, so that it goes through the fruit and reaches the stone, and continue pressing until the stone is forced out.

An Electric Gas-Lighter



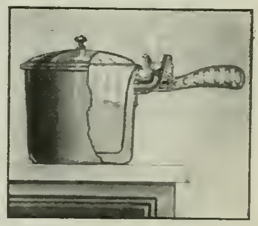
A GAS-LIGHTER which can be attached to an ordinary electric socket has recently been patented. A tubular insulating handle *A* contains a bank of electrical resistance *C* to which is connected a metallic leaf spring. By pressing a push-button *D* on the side of the handle the spring is brought into contact with a carbon electrode *E*. Connecting with the resistance coil is a wire *D* which, in turn, connects with the house circuit.

Efficiency in the Kitchen



THE cook, like most other responsible people, is depending less on her guessing apparatus and more on simple little instruments which insure accuracy. For instance, there is the kitchen clock, the graduated pint measure, scales of one kind or another, thermometers, etc. The graduated measure has superseded the various sized teacup.

Two Cooking Vessels in One



A COOKING utensil which comprises inner and outer vessels separated from each other and permanently connected together at their upper ends to provide a closed heating chamber which extends from the bottom of the outer vessel to the upper ends of both vessels, is able to distribute heat more effectively throughout the food in the upper portion of the inner vessel.

A Glue-Brush Like a Fountain-Pen

NOW comes a glue fountain that applies glue through a brush by pressure, doing away with the time consuming task of dipping and applying. Liquid glue is contained in a long metal barrel in which an inner barrel fits piston-like. At the lower end of the outer barrel is a small curved tube which points towards a brush. Forcing down the inner barrel urges the glue into the bristles of the brush.

A Vacuum Washing-Machine Which Sucks Dirt Out of Fabrics

CONICAL vacuum cups which see-saw up and down, do the washer-woman's hard work in the laundry machine devised by E. F. Beebe of Minneapolis. Besides saving rubbing, the cups cleanse the clothes with practically no wear and tear on the fabric.

The tub rotates beneath the cups, thus enabling them to reach every part of the washing. The wringer is pivotally hinged at one side of a post of the frame that supports the tub. It can be swung close up to the tub, or it may be swung to one side when the machine is to be used with a fixed tub. An electric motor usually furnishes the power, but a gas-engine may be used instead.

A number of electrically operated vacuum cups cleanse the clothes with very little wear and tear on the fabric

Try These

ONE of the latest household appliances is the hot-water platter. It is especially useful at breakfast time. Boiling water can be turned into the tank under the platter and the top screwed down. Then by placing the nickel cover over the food, it will keep hot for at least a half-hour.

Before cleaning tan or russet shoes, rub them over lightly with a flannel cloth wet with milk, first removing any stains with benzene. If this is done, the shoes will receive the polish much better and remain in a softer and more pliable wearing condition.

When hooks and eyes are used on the placket of a tailor-made suit, if the pair at the base of the opening are pinched down flat the placket will never tear or look shabby.

A good furniture polish can be made in the following manner: To six ounces of the best refined kerosene add one ounce of the best yellow resin, one dram of vermilion to color, and ten ounces of turpentine. Mix these ingredients at a gentle heat for at least an hour. Then strain and stir constantly until cold.

A canvas or linen household pocket, or sidebag, with a belt, will be found a great step-saver for the busy housewife In it may be stowed such articles as keys, pocketbook, memorandum pad and pencil, so that they are ready at hand.

Paint stains may be removed from cotton or linen by soaking in turpentine or gasoline. If on silk, do not use turpentine; ether will probably dissolve it.

Grass stains, when fresh, can be removed by soaking in alcohol. If the stains are old, rub with molasses and allow to stand several hours before washing out.

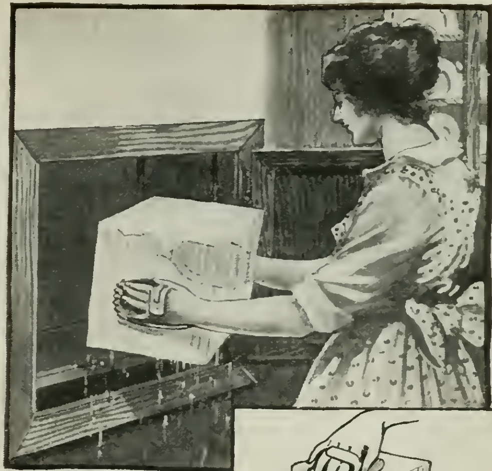
A Convenient Milk and Butter Slide for Refrigerators

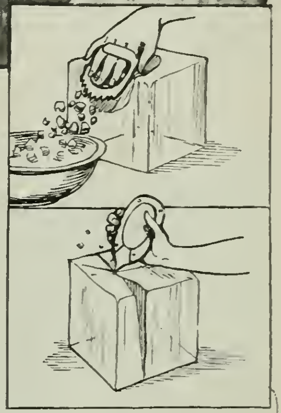
OF all the foods kept in a refrigerator milk and butter require the most frequent opening of the food compartment. They are removed for each meal, returned after the meal, and are taken out between meals for use in cooking. When they share the usual large chamber the entire compartment is opened to the warm air each time. A new refrigerator accessory is a milk and butter slide arranged separate. It reminds one of a drawer in an office filing cabinet.

Upon opening the small door a metal skeleton slide appears, so divided, that it holds two one-quart milk-bottles and three one-pound bricks of butter, each bar of butter resting on a removable sanitary tray which can be carried to the table. Only one-tenth as much cold air is lost as when the door to the main provision chamber is opened. The metal slide is plated with zinc, and nickel.

Not only does this arrangement prevent the rapid melting of the ice, but there is another advantage. Butter and milk absorb odors and vapors given off by other substances. This difficulty is obviated by means of this device and the odor of onions, meat, etc., does not reach the butter and milk.

Butter and milk should be kept separate from the other foods in the refrigerator





The disagreeable task of handling ice is greatly lightened by the use of a simple ice-grip which can be used for lifting, shaving, or splitting. It consists simply of a roughened piece of metal provided with a strap to fit the hand

An Ice-Grip With Many Uses

THE slippery, cold block of ice delivered by the iceman can be grasped safely by holding it with a pair of ice-grips. Each grip has an oval, roughened face to make contact with the block. On the back of each is a strap for the hand. For its second use a grip becomes an ice-pick. At one end is a sharp point for this purpose. When shaved ice is wanted a grip becomes an ice shaver.

Another Way to Rejuvenate Eggs

A MARYLAND man has found a means of preserving eggs with a substance known as "liquid petrolatum," which he claims will rapidly penetrate eggs, when applied externally, and make them proof against moisture or bacteria. The preserving substance is a mixture of hydro-carbons. When properly treated, eggs can be preserved under a normal temperature for many weeks without deteriorating.

Measuring the Light of the Stars

By Joel Stebbins

Professor of Astronomy in the University of Illinois

Prof. Stebbins' remarkable measurements of the heat of stars have attracted the attention of astronomers all over the world. Apart from the value of the results obtained, his work is interesting because it shows that astronomers are making use of modern technical advances, as in the case which he describes, sometimes before they are perfected for commercial purposes.—Editor.

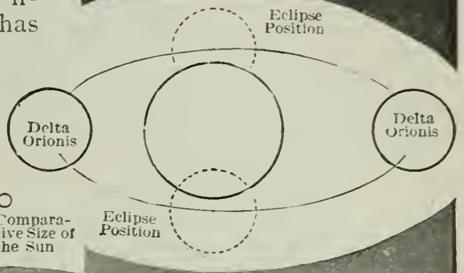
ONE of the standard problems of astronomy is the exact determination of the amount of light that comes from each of the stars. Not that the knowledge of the fraction of a candle power of each star is of any interest or importance, but that the measures are valuable for future reference, especially to determine the gradual changes in light caused by the dying out or the brightening of these distant objects. Our own sun being one of a class of stars, the best clue to the life history of the sun may be given by a study of other bodies of the same kind. We also find in the sky numerous extraordinary objects, called short-period variable stars, which change in brightness by fifty per cent or more in the course of a few days, or even hours.

Wanted: A Standard Eye

For general purposes the unaided human eye is one of the best instruments for measuring the light of stars, and most forms of photometer depend ultimately upon the eye for a comparison of two lights. Because of the difference between individuals, however, there is no such thing as a "standard eye," and astronomers have long been waiting for some purely mechanical device which will register light intensities. Let us note that such an instrument is even more in demand for commercial work, especially for testing electric lights. At present the ordinary householder has to take the word of somebody else for the amount of light he is getting from electric lamps. The lighting companies accommodate us with meters telling how much current we use, but we have no exact measure of how much light they are delivering. City authorities contract for a number of lamps of say one thousand candle power each, but who knows after the lamps are installed whether they furnish a thousand or only eight hundred candle power?

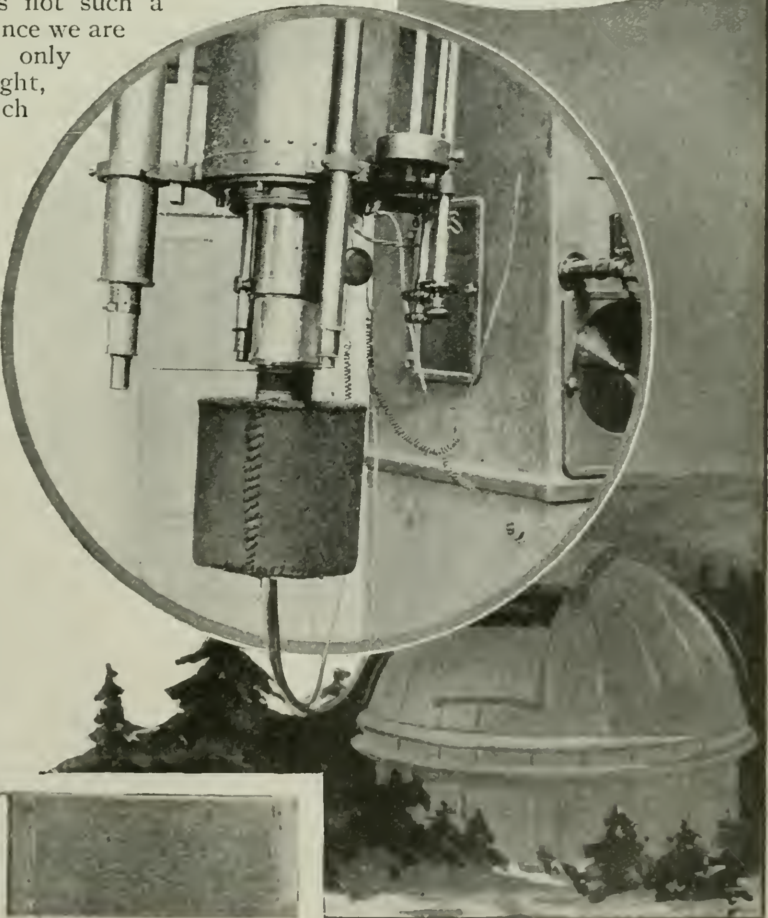
We see that there is a real demand for an instrument which, held at a given distance from any lamp, will indicate just how much light is being emitted. Needless to say, many experimenters have attempted to perfect such an instrument, but so far without success. The underlying principle of these devices has been to make use of some substance which changes its properties under the influence of light. One of the most important is the element selenium, a substance in the same chemical group as sulphur. For more than a generation it has been known that the crystalline form of selenium changes its electrical resistance when exposed to light. Other substances exhibit this same property, but none to such a marked degree as selenium. The ordinary arrangement is called a cell or bridge. Two wires are wrapped about an insulator, and on one face the selenium is deposited and then sensitized. The best method of sensitizing is a trade secret, but one standard method is to melt the selenium at four hundred and twenty degrees Fahrenheit, and then let it cool gradually, when it will crystallize and be light-sensitive. There must be a certain amount of mystery in the process, even to the makers themselves, for none of them can furnish cells of a standard resistance, nor even two cells which are precisely alike. On the opposite page is shown an unmounted cell of the usual form. In the dark it has an electrical resistance of about five hundred thousand ohms, but on exposure to strong daylight the resistance drops to about ten thousand ohms, or only one-fiftieth of the original.

The principle of a selenium photometer is, then, to connect a selenium cell with a small battery and to measure the increase of current, due to light, by means of an ammeter or galvanometer. However, there are several difficulties in this simple process. When selenium is exposed to a strong light, some minutes or even hours are required for the resistance to return to its original value. Selenium is extra sensitive to red light, and so does not give directly a measure of how bright a light would appear to the eye. For instance, a carbon filament lamp with its yellowish light will affect a selenium cell just as much as a much whiter tungsten lamp of double the candle power. Finally and worst of all, selenium is very irregular in its action, and no experimenter has yet solved to his own satisfaction the mysteries of this element.



The Selenium Cell Is Packed in Ice

As applied to the stars, however, many of the ordinary difficulties disappear. Star light is so faint, even at the focus of a large telescope, that the slow recovery of the selenium is not such a drawback; next, since we are usually concerned only with variations of light, it matters little which color is used; and lastly the irregular action may be controlled somewhat by keeping the selenium at a low uniform temperature. Strange as it may seem, when the light of stars is to be measured, a selenium cell at the end of the telescope is surrounded with an ice pack, the ice being renewed every day in sum-



In the circle is shown a selenium cell and ice pack attached to the telescope

The oval diagram above the circle pictures the system of Delta Orionis, showing orbit, eclipse positions, and comparative size of the sun

To the right—Unmounted selenium cell, natural size mer. Such an arrangement is shown in connection with the telescope of twelve inches aperture at the University of Illinois Observatory. Wires are lead from the telescope to a galvanometer in an adjacent room. Two observers are necessary, one to point the telescope and expose the selenium cell to the stars, while the other reads the galvanometer and records the measures.

With this short description of the device, let us see how results are obtained on the stars. Nearly every one has heard of the wonders of spectrum analysis; how, by studying the light of a star, split up into the different colors, the astronomer has been able to draw certain conclusions about the constitution of the body. For example, it is easily demonstrated that metals, such as iron and calcium, exist as hot vapors above the surface of the sun. It is not so well known, however, that by means of the spectroscope we can study the motions of the stars as well as their chemical constitutions.

It would lead us too far afield to discuss this phase of the subject, but let us state that peculiarities in the spectra of certain stars lead us to conclude that they are attended by large companions or planets which move about them. Such stars are called "spectroscopic binaries," since they are revealed by the spectroscope. The North Star is an object of this class, being in fact a triple system, as there is one body which revolves about the main star in only four days, while a second and more distant companion has a period of a dozen years. In some cases the planes of the orbits of these companions are at such angles that when they pass in front of the main stars there are eclipses as seen from the earth. About one hundred such cases are known, but more are being continually found. The study of these eclipsing binaries is especially important, since they give us the most direct measure of the diameters of the stars. Spectroscopic measures determine the size of the orbit in which the second body moves, while with the photometer is found the duration of the eclipse, which is simply the time necessary for the companion to pass in front of the main star, and hence gives at once the sum of the diameters of the two bodies.

The Stars in Orion

Any one who is familiar with a few of the constellations knows Orion, which is in the south in the winter sky. The striking feature of this group consists of three stars in a row, known as the Belt of Orion. The right hand star of the three is Delta Orionis, the Greek letter, Delta, meaning the fourth star in the order of lettering. This object is a spectroscopic binary, the period of the companion being six days. The star was one of the first observed with the selenium photometer, and by comparing it with other stars in the vicinity it was soon found that at intervals of six days there is always a loss of eight per cent of the light, an amount imperceptible to the eye. The eclipse lasts slightly less than one day. After an exhaustive study, the main facts of the system have been brought out, and the appearance of the two bodies as viewed from the direction of the earth is shown to scale in the oval diagram. From simple considerations it is established that the companion is about six tenths the diameter of the main body, and the four small circles show the successive positions of the companion in its orbit, which is not circular but slightly elliptical, and of course viewed at an angle. The dotted circles show the position for eclipses, and we find as expected that when the smaller body is behind the primary there is also an eclipse, but in this case only seven per cent of the light of the system is cut off, as compared with eight per cent when the companion is in front. This demonstrates that the smaller body is seven-eighths as intense for the same surface as the main body, and is hence far from being a dark planet.

The figure shows how close together the bodies are as compared with their diameters, and we also find that we are dealing with a giant system. It is very interesting to note the comparative size of the sun, eight hundred and sixty thousand miles in diameter. The larger star of Delta Orionis has fifteen times and the small star nine times the sun's diameter. The system, brought up and placed beside the sun, would not only appear large, but would be extraordinarily intense in comparison, the surface brilliancy of each component exceeding the sun at least twenty fold, so that the total light of the system is equal to about five thousand suns! Imagine the conditions of the earth if we had such a pair of bodies to govern us.

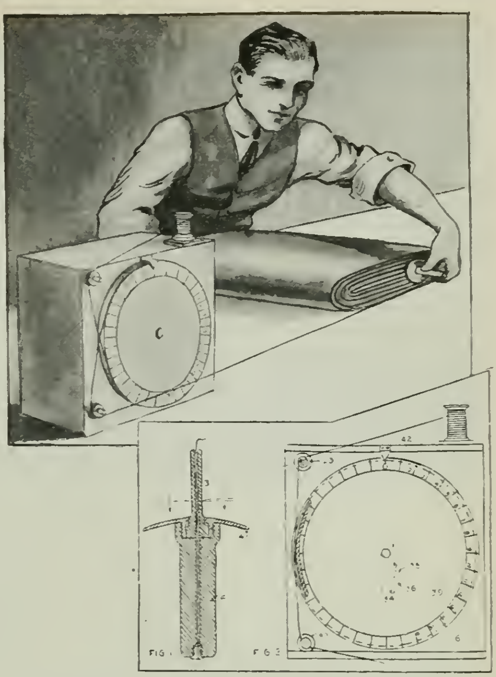
In spite of their enormous size, the bodies are not so very massive, exceeding the sun only about twenty-five times in weight, and therefore they are much less dense than the sun, one hundred and fifty times smaller in density, which amounts to saying that they average about six times as heavy as the same volume of air. According to current theories of the life history of stars, Delta Orionis, like the other objects in Orion, is very young, and in due course of time will contract and cool off and become much more like the sun, though of course remaining more massive.

The case here selected illustrates what can be revealed by electrical measurements of light changes which have entirely escaped eye observation. Many other stars are being studied in the same way, and it is possible to measure their diameters and weigh them, when the only effect at the end of the telescope is a minute electrical current set up by the light action. Thus we see that astronomers are making use of the modern technical advances, and in some cases, like the present, a new device may even be used with success in pure science before it is perfected for commerical purposes.

Measuring Cloth in the Roll

THE inconvenience of unwinding a roll of cloth to measure it has been obviated by a clever mechanism devised by Anthony Fobare. The exact length of any roll of fabric can be ascertained in a few minutes.

The idea consists in passing a thread between the folds of the roll and measuring the thread. For this purpose a tool shown in Fig. 1 is used. The thread passes through a handle 2, which terminates in a projection 3 about the size of a large knitting-needle. A disk 4 is placed between the handle and the projection. When inserting the projection between the folds of cloth this guard presses against the end of the roll, keeping the

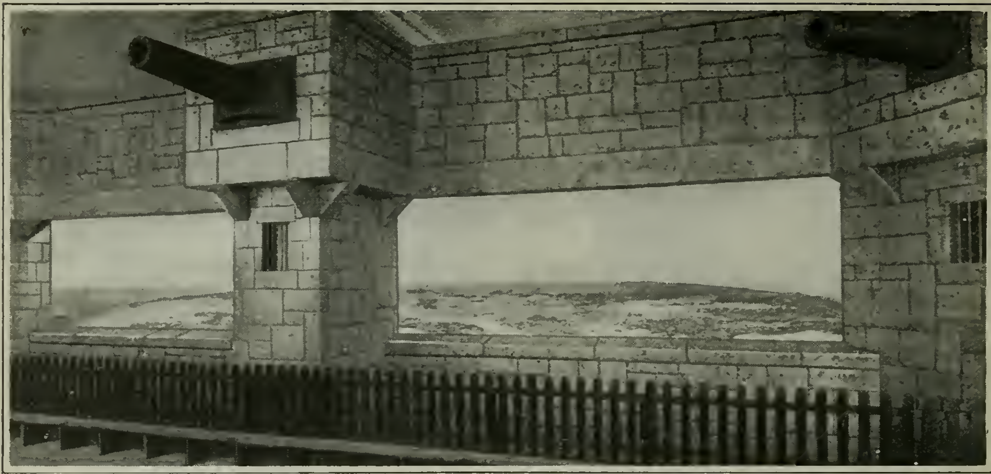


Unwinding a roll of cloth is unnecessary to find its length. A thread can be inserted between the folds and the length of the thread taken

projection a uniform distance from the edge.

The spool is mounted on a box 16 (Fig. 2). The thread is held under tension by passing between two disks 23 held together by a spring. After passing around a large pulley 39 attached to the side of the box, the thread again passes through two tension-plates 43 and then into the handle of the threading-tool.

The circumference of the pulley 39 is just one yard. On the threaded shaft of this pulley is suspended a traveler or rider 34, which moves along the threads as the pulley is rotated. A pointer 38 indicates the number of turns on a scale 36, placed parallel to the shaft. Every turn stands for one yard. The inches are recorded on the face of the pulley, the circumference of which is divided into thirty-six parts. When the measurement is begun the pointer 42 and the rider 34 should both be at zero. The unwinding of the thread, as it is woven into the roll of fabric, is thus recorded in yards and inches.



This panoramic map showing the entire portion of the world affected by the European conflict, was constructed in a prominent Chicago store as a permanent exhibit

A Marvelous War Map

THE lessons that the war has taught have been many. One of them is that we know less about Europe than we think we do. We are learning geography on a more detailed plan than we did in our school-days. To help us in locating battlegrounds and fortresses the owners of a large and prominent store in Chicago constructed a panoramic map showing the entire portion of the world affected either directly or otherwise by the conflict.

It may be stated that three months' labor by a corps of workers was required to design and construct the war map. The setting has been placed in the playroom of the toy section, and made to resemble a fort, as the view herewith makes plain. The idea was to make possible the instruction of both child and grown-up, and in this way to become a teacher so that the results would be productive of good to the public.

The view shows all the prominent cities in the war section, as well as forts, wireless stations, topography, steamship lines and railroads. It includes such countries as France, England, Germany, Russia, Holland, Roumania, Servia, Bulgaria, Greece, Turkey, Italy, Norway, Denmark, Ireland, Switzerland and Scotland. In each of these countries may be found the important cities and towns, together with churches, theaters, palaces, and other important buildings, all properly located with due regard to distance and other detail. Every body of water is shown. Submarines, warships and other sailing craft sail the oceans and seas. Wireless stations flash their messages, railroad trains race across country, and each city is lighted with its own lamps as well as the lights from other places that make prominent features of the exhibit.

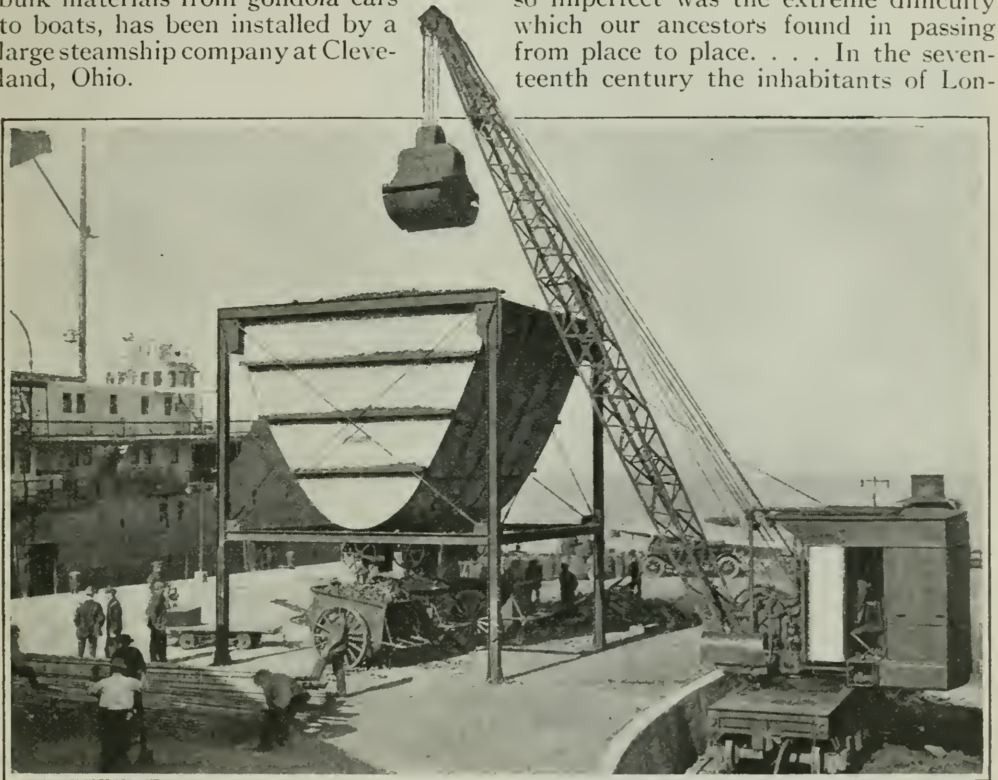
Every ten minutes there is a complete change in the scene, by means of the lighting effects, from daylight to darkness, and the cloud effects and electrical display are wonderful to behold. This is the most fascinating idea in connection with the otherwise wonderful exhibit, and marks a feat that stands out as unique and deserving of favorable comment from all who have witnessed the map. It cost thousands of dollars to construct, and is to be retained as a permanent exhibit.

A Successful Railroad

The best paying railroad in the world, according to length, is the Sandersville road, running from that city to Tennille, Georgia, a distance of three and one-half miles. In 1913 and 1914 a twenty per cent dividend was declared, while in some years forty per cent has been paid on the capital stock. The road's rolling stock consists of two locomotives and two coaches. It makes four round trips daily and hauls practically all the freight coming to Sandersville.

A New Way of Loading Steamers from Freight Cars

AN unusual handling plant designed to reduce the time in transferring pig-iron, coal, steel and various other bulk materials from gondola cars to boats, has been installed by a large steamship company at Cleveland, Ohio.



A gigantic locomotive-crane empties coal into the one-hundred-ton concrete bin from which it is loaded into carts through three hand-operated gates

A one-hundred-ton concrete bin, held above the ground by steel beams, is situated midway between the freight tracks and the steamship. A locomotive crane on the tracks transfers the material from the cars into the bin. Two-ton carts are hauled under the bin, and the coal drops into them through three hand-operated gates. As soon as the carts are filled, they are drawn to the steamship by means of electric trucks equipped with storage batteries. It is said that this plant has proved a decided success and has largely reduced the handling costs of bulk materials.

Bad Roads Make Bad Going

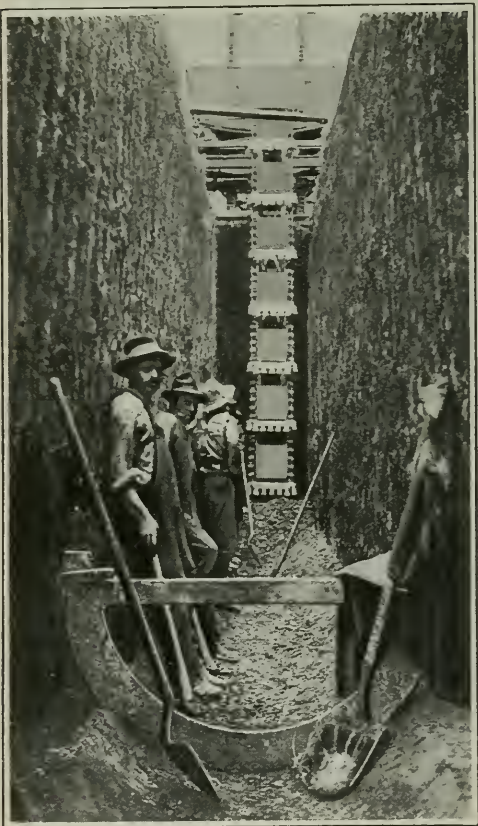
IT is no truer that history repeats itself than that men, in general, do not profit by experience. Writing of the bad condition of the roads in England in 1685, Macaulay says:

"The chief cause which made the fusion of the different elements of society so imperfect was the extreme difficulty which our ancestors found in passing from place to place. . . . In the seventeenth century the inhabitants of London were for almost every practical purpose, farther from Reading than they now are from Edinburgh, and farther from Edinburgh than they now are from Vienna. . . . When Prince George of Denmark visited the stately mansion of Petworth in wet weather, he was six hours going nine miles.

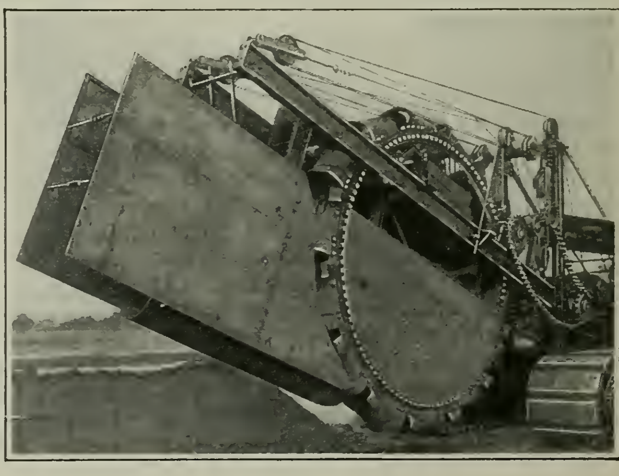
All this was the condition of highway traffic in England two hundred and thirty-one years ago and it can be duplicated in many parts of the United States today. It has been estimated by careful government experts that only about 150,000 miles of really first-rate modern highways are to be found in the United States; the total mileage of public roads in January, 1915, was 2,273,131.

Trench-Digging by Machinery

MODERN engineering requirements coupled with a persistent demand for labor-saving devices have brought into being several types



Above, the endless chain type of machine excavating a twelve-foot trench with cutting buckets. To the right, the wheel type of machine with its driving mechanism at the top



of trench-digging apparatus which are of ingenious construction. Of all manual labor, digging trenches by hand or excavating on a large scale by hand is the most laborious and expensive method. One of the largest single items in a contractor's specification, until the modern digging machines came along, concerned the amount of excavating to be done. With the several new types of mechanical excavators this item can be reduced materially.

In the machines recently marketed two general principles seem to be used. In one, cutting buckets are attached to an endless chain, while in the other they are mounted on the periphery of a wheel. In both methods the buckets are forced to bite into the ground at the end of a trench, carrying the dirt up with them as they rise.

The endless chain type of machine grips the dirt and hoists it to the surface in the same way as chain buckets on an elevator-hoist lift grain to upper bins. The wheel type has a curious mechanical feature in that the wheel itself has no central hub. Instead, it consists merely of a rim supported by four sets of rollers mounted on an internal framework. The reason for this is that it gets all the driving machinery up near the top of the wheel, enabling a deeper trench to be dug with a smaller wheel than would otherwise be possible. In fact both types have their driving mechanism located at the upper end of the chain, and both also make use of a transverse conveyor belt to carry the excavated material to wagons as fast as it is brought up.

Behind the wheel on the wheel type of machine is located a bracket-like or L-shaped framework, known as the "shoe."

"Caterpillar" wheels enable the big machine to travel over soft ground

This slides along the bottom of the trench and supports the rear end of the wheel frame work. Depth of digging is controlled by raising or lowering the front end of this framework, the rear portion of course riding along on the "shoe" according to the depth of the front end. A special feature of this "shoe" is that a man can ride on it laying tile or pipe as fast as the digging progresses.

Many widths and depths of trenches can be cut by the machines. Some have been made six feet wide and fifteen feet deep. One machine dug two hundred rods of eleven and one-half inch trench thirty inches deep in a ten-hour day, and another dug a thousand feet of twenty-inch trench five and one-half feet deep in the same time. Small boulders, tree roots, and similar barriers offer no great obstruction, and the machines accomplish work under difficult circumstances with a celerity that is surprising.

Various modifications of the chain-type and wheel-type have been made to fit special conditions. These relate largely to the shape of buckets used, since digging an open trench in sandy soil requires a far different kind of bucket than making a clean-cut channel in hard clay. To enable the machines to travel over wet, soft ground "caterpillar" wheels are used.

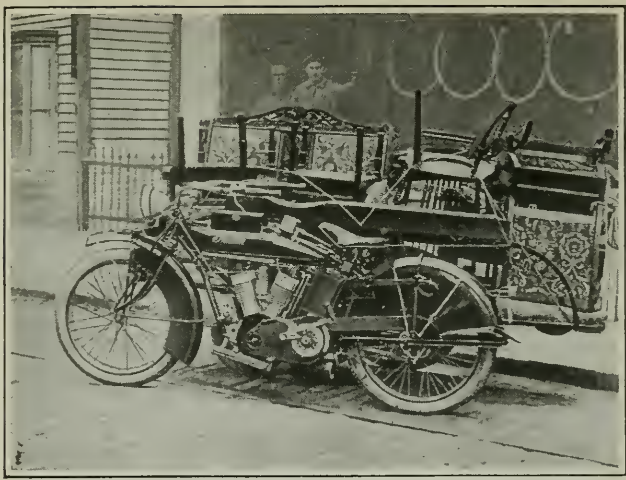
In a ten-hour day this machine will do the work of two hundred men

Traveling by Parcel Post

THOUGH our parcel post is a wonderful system, enabling us to send all kinds of strange things by mail, the English system can do one thing which we have, as yet, not attemped.

An Englishman who was in a hurry to reach a part of London with which he was unfamiliar, called at the general post office to consult a directory. Upon explaining his case, the clerk gave him the startling information that he could go by parcel post for the payment of threepence a mile.

He was accordingly placed in charge of a messenger who took him to his destination. The boy carried a printed slip on which was written "Article required to be delived" with a description of the parcel following.



This motorcycle owner finds it possible to save money by delivering furniture on a side-car chassis

Moving Furniture with a Motorcycle

THE wide range of usefulness of the motorcycle is shown in its utilization for commercial purposes. A furniture dealer in Westerley, Rhode Island, has found that he can make deliveries on a side-car as efficiently and more economically than by the horse and wagon heretofore used.

Upon a side-car chassis, he constructed a small van which can be extended when needed to a length of eight feet. Side boards are added to this, so that a large load of furniture can be carried. The motorcycle in the photograph carries upon its side-car two sofas, one large and one small, one upholstered and one plain rocker and two upholstered straight-back chairs. This load is handled with ease in spite of its bulk and weight.

Locating a Thunderstorm

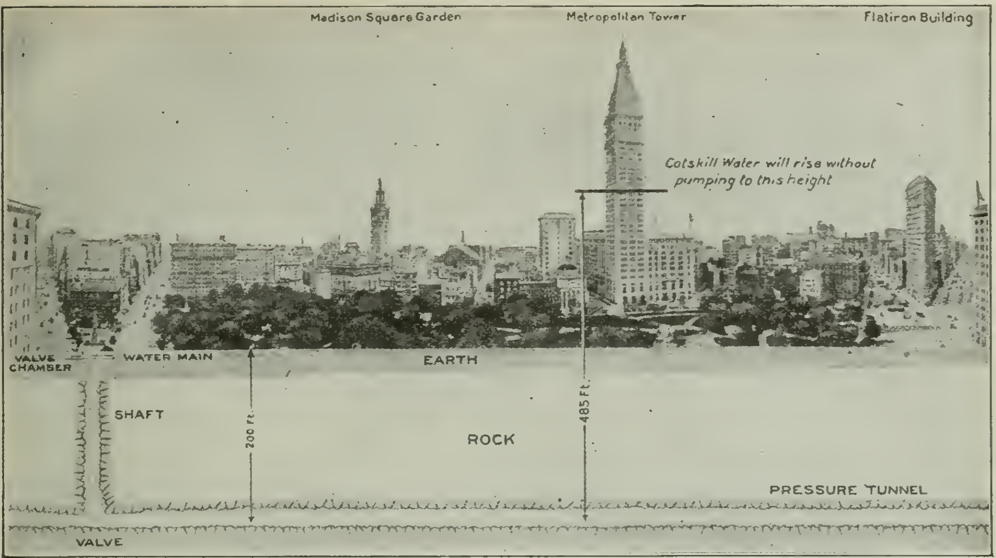
WHEN you see a flash of lightning, count the seconds before it thunders and you can tell how far away the storm is. Since light travels 186,000 miles a second, we may for all practical purposes regard ourselves as seeing the lighting the instant it flashes. But sound travels only 1087 feet a second. Multiply 1087 by the number of seconds during the interval between the flash and the thunder and the result is the distance between you and the storm. As a rule, from twelve to fifteen miles is the greatest distance thunder can be heard.

Stores on Wheels

A DAYTON woman who conducts a tobacco and confectionery shop has instituted a system of traveling stores that has served to increase her business to an appreciable extent. The traveling stores are in charge of small boys, but they are so arranged that the business is carried on in a systematic manner.

Each store is a wagon—a two-wheeled cart to be exact—and the goods are protected from the elements and the dust by glass covers. The carts are, in fact, traveling show-cases, and a full assortment of goods is carried at all times. An interesting and business-like feature is the special compartment for a cash register, which makes the outfit complete.

An enterprising woman has been able to increase her business by bringing her wares to the customer



Water supplied to the city of New York from the Catskills rises two hundred and eighty five feet under its own pressure

Water Rises to Three Hundred Feet in New York Sky Scrapers

A CITY possessing a pressure system capable of elevating water a vertical distance of nearly three hundred feet above street level without pumping is unusual. Yet New York's new Catskill supply system will accomplish this feat. Contrasted with the thirty or forty-foot heights which the average city system can attain, the performance is out of the ordinary, to say the least.

The artificial lakes supplying the water to New York are high up among the Catskill mountains, one hundred to one hundred and twenty-five miles north. In the case of the Metropolitan tower, for instance, this height to the supply enables the water to rise unaided two hundred and eighty-five feet above the ground level, or four hundred and eighty-five feet above the pressure mains, which are themselves two hundred feet below the street surface. The two hundred and eighty-five feet are more than two-thirds of the way up the occupied portion of the tower, so that but comparatively little pumping is necessary in order to reach the highest offices. The case is typical of all the large buildings in the city.

Heads such as that mentioned mean that pressures over two hundred pounds to the square inch have to be contended with in the huge mains so far below the surface. This condition necessitates unusual construction. In fact, the whole length of the mains from the Catskills to the city is made up of difficult engineering feats. Over much of the distance they are made of steel tubing, lined and re-enforced with concrete. In places they bore through solid-rock mountains, tunnel under rivers and lakes, burrow far beneath city streets and skyscrapers, all that the city may be reached by the shortest route consistent with engineering economy. Smaller mains near the surface care for the work of local distribution.

War and Trade

BECAUSE many foreign-owned vessels, which formerly traded between the United States and South American ports, have been withdrawn for war purposes, trade is thereby increased in proportion for American vessels. It is estimated that seventy per cent of our commerce with Brazil, the Argentine and other South American countries is now being carried under the American, Brazilian and Argentine flags. Of the remaining thirty per cent only about fifteen per cent is still carried in vessels of the nations at war.

What a Lot of Machinery to Chase Villa!

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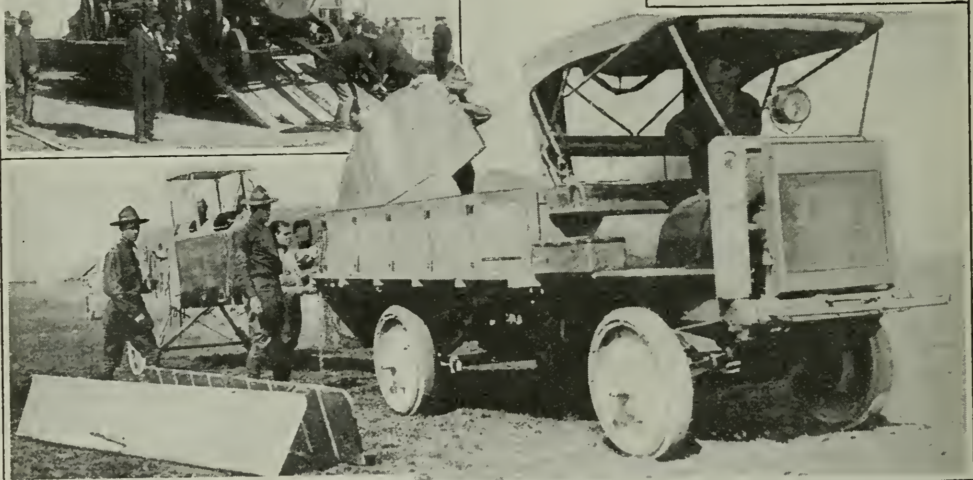
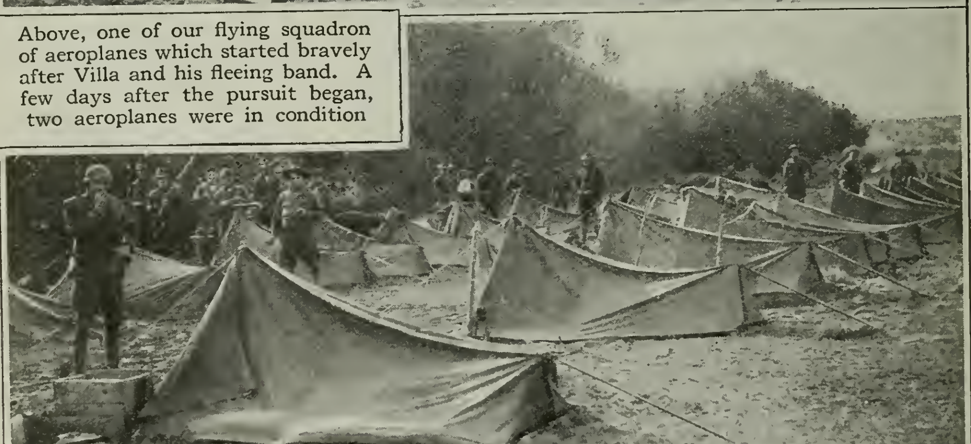
Above, a few United States trucks in the Mexican expedition. At left, water supply wagons



Above, one of our flying squadron of aeroplanes which started bravely after Villa and his fleeing band. A few days after the pursuit began, two aeroplanes were in condition



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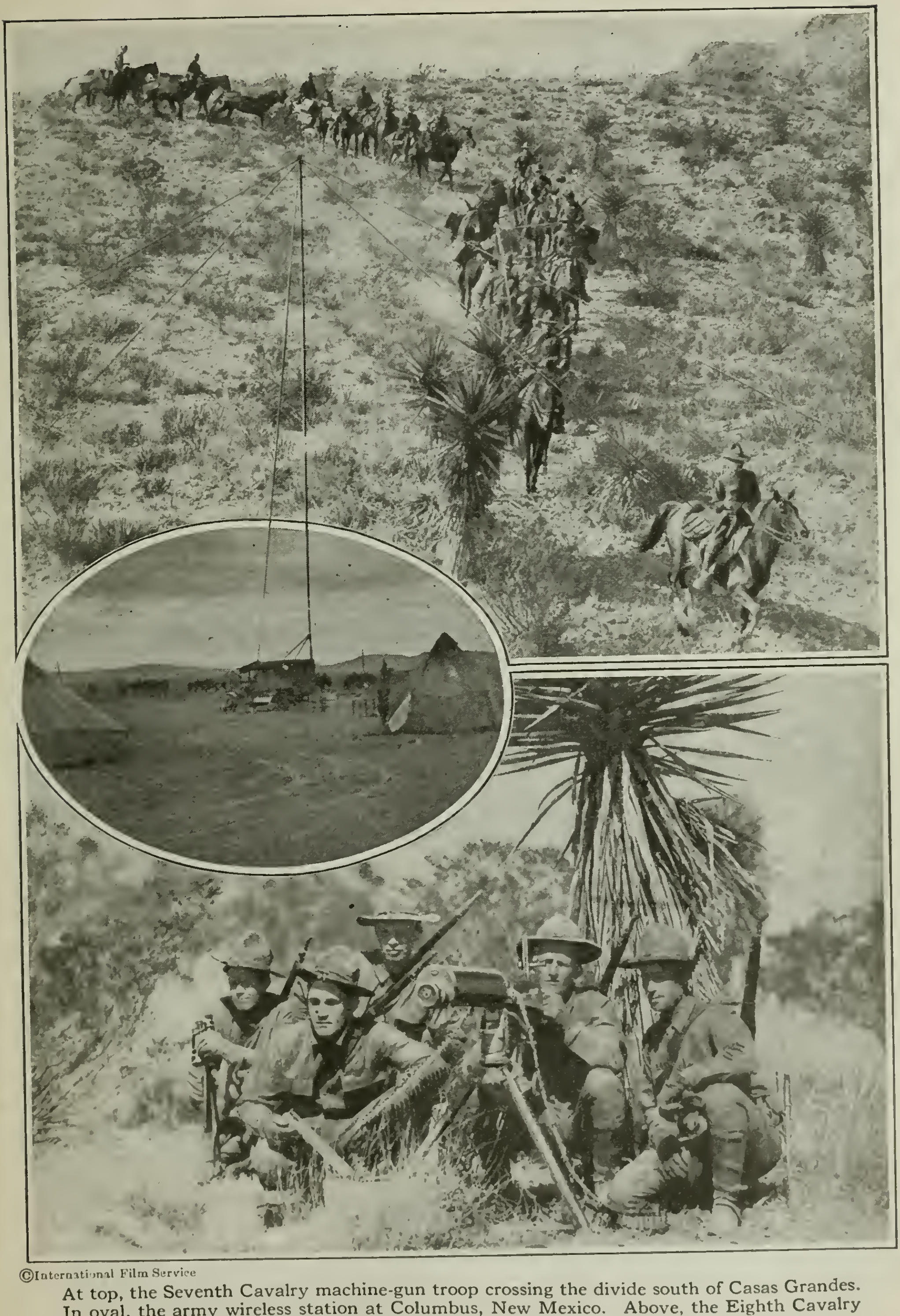
The Sixth Infantry encamped on the line of communication between the cavalry at Villa's heels and the base of supplies. One of these small tents is carried by each soldier, and is used only to give him shelter while resting

Tracking Villa in the Wilds of Mexico



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At top, the Seventh Cavalry machine-gun troop crossing the divide south of Casas Grandes. In oval, the army wireless station at Columbus, New Mexico. Above, the Eighth Cavalry machine-gun troop in practice. Many of our guns are obsolete in design; in the recent raid one gun became clogged and had to be abandoned

We Wonder If Villa Has These Conveniences

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Above, ambulance corps leaving Columbus, N. M. for the interior. At left, the "rookies" at Camp Cotton, El Paso, being whipped into shape for possible service in the future. Infantry men are shown going through skirmish drill

Photos © Int. Film Serv.

The cook preparing dinner for his waiting, hungry company. He is cutting bacon, the one staple product of the West obtainable in a sufficient quantity for the soldiers. Bacon and canned tomatoes—the latter because of the liquid—are the two table necessities of those who live in a country so dry that to waste a pint of water is to court the undertaker. Great difficulty has been experienced in the Mexican campaign because of the high winds which lash the sand and dust violently against man and beast. It is impossible to move in any one direction in a sand-storm. To prepare food under such conditions requires all the patience and fortitude that soldiers are credited with having

Our Punitive Expedition Into Mexico

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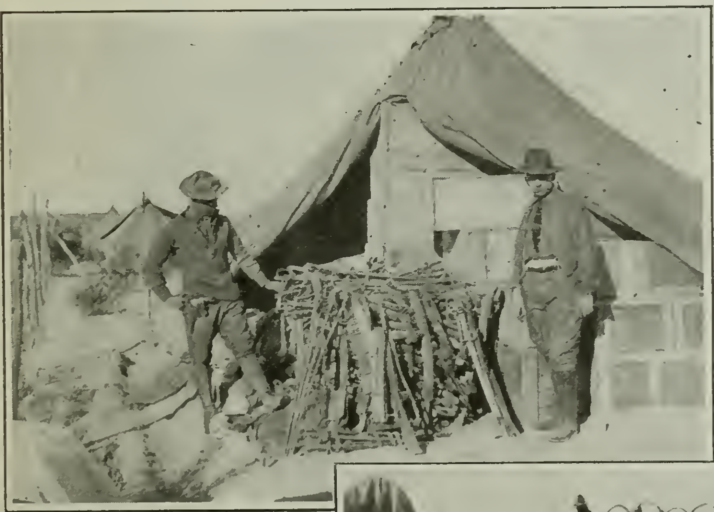
Caught between the roving bands of marauding guerillas, Mexican families have suffered terrible hardships during the past three years. In some instances the homes of peaceful people were destroyed and the members murdered without any reason other than the satisfaction of some alleged leader's lust for blood. Siding with Villa or Carranza was useless to ward off these plundering bandits, seeking to destroy both life and property. The photograph shows a band of Mexicans making their way to the United States, where they can set up house and be safe under the Stars and Stripes. Many American families have also been obliged to leave homes and industrial interests, and seek refuge on our own soil to escape the depredations of Mexican outlaws



Mexican weapons captured by Americans. The lifting of the embargo on arms has placed within the convenient reach of every cut-throat in Mexico weapons of the most modern type; in fact, weapons of the same effectiveness as those used against them by the United States troops. Mexico has suffered shortage of everything except arms and ammunition during her recent state of internal revolution. At right, troops of the Punitive Expedition drawing water from an improvised well near Divisional Headquarters at Casas Grandes, Mexico

Things the Recruiting Office Never Mentions

Some of the huge baskets in which provisions and munitions are shipped to the Russian Army on the firing line

Above, an unusual test, even for a dispatch bearer's motorcycle. Some of the most notable feats of the war have been accomplished by sturdy motorcycles, but most machines "in Active Service" have a short life

Even menagerie elephants have to do their bit for England. In the streets of Manchester this great tireless beast hauls heavy drays

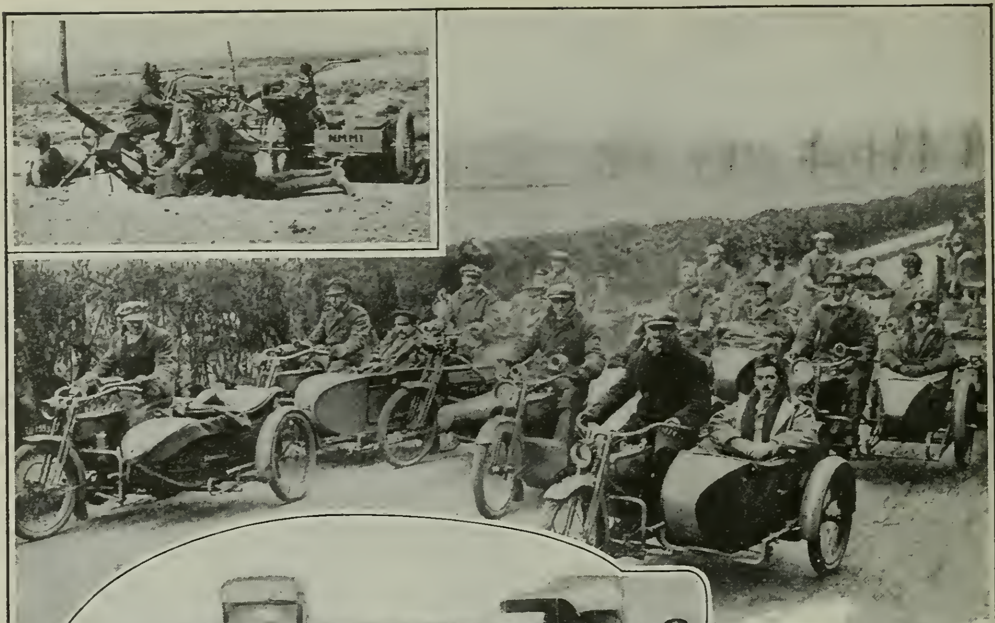
Does This Mark the Beginning of a New Labor Era?

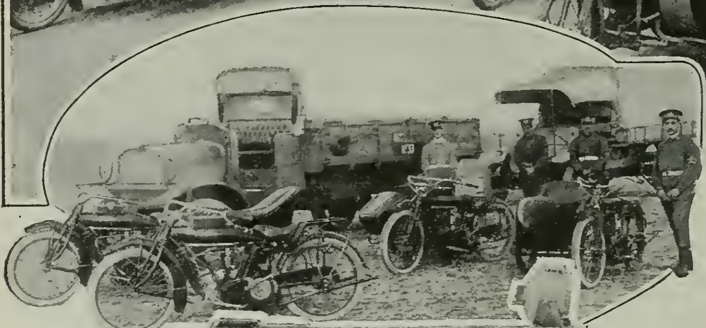
A three-inch shrapnel shell contains approximately two hundred to three hundred bullets, each one-half an inch in diameter. A matrix of resin or other smoke-producing substance keeps the bullets from rattling, and determines the location and time of explosion by creating a black smoke. At the right, French women loading shells. A small car with receptacles for the shells is run along between the work-tables to receive the shells when prepared

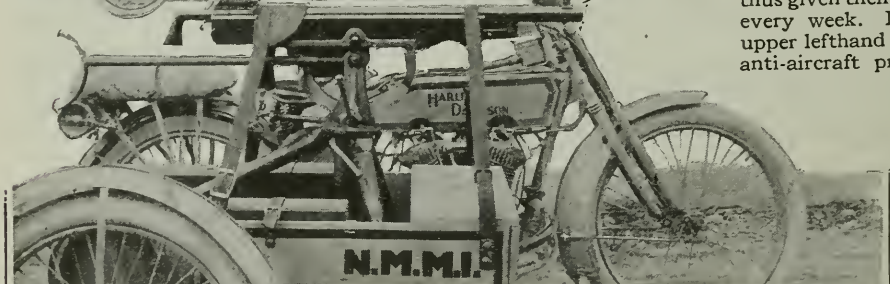
For the first time in history, women have been obliged to take the places of machinists, and they have displayed exceptional skill in such work

Above, tamping down explosive charge with cork stopper. At right, adjusting "safety-heads" to prevent premature explosion of the charge

The Modern Orderly Rides Not on a



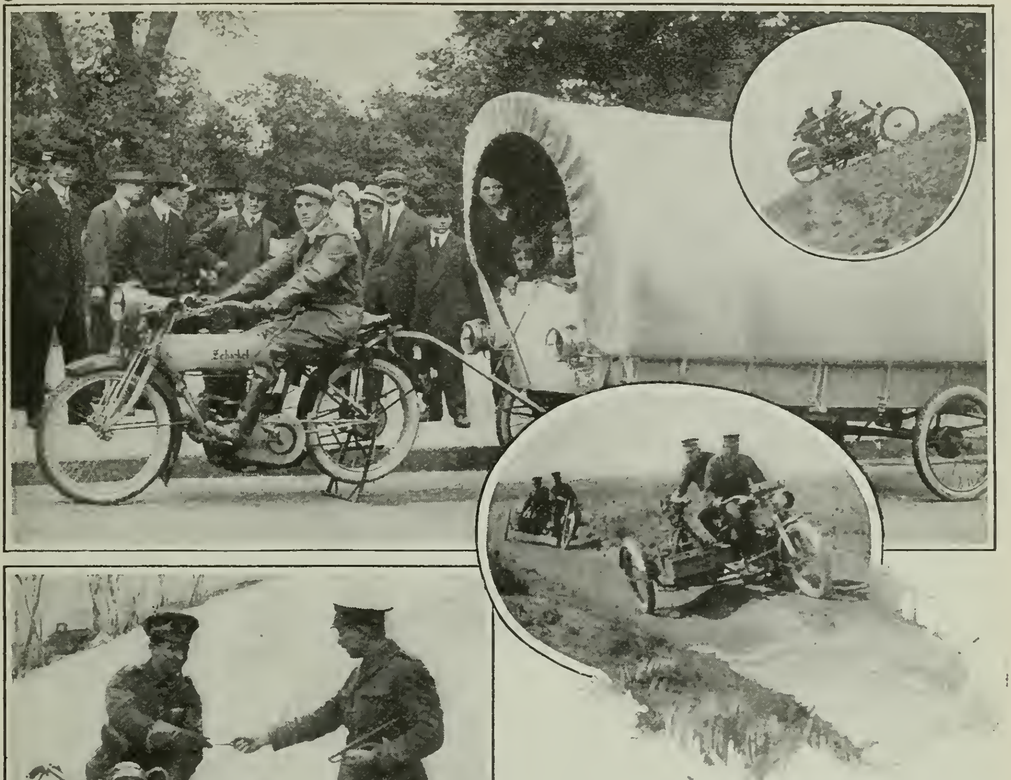




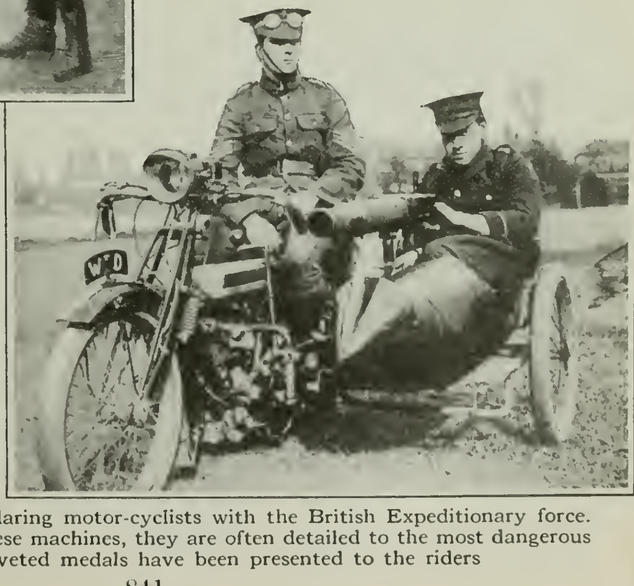
British riders taking wounded soldiers for an outing. Thousands of convalescents are thus given their airing every week. In the upper lefthand corner anti-aircraft practice

Two of the principal uses of the motor-cycle on the war front are carrying dispatch riders at terrific speed from one part of the line to another, and making forays while mounted with light machine guns. Six or eight of these fragile-looking motor-cycles make a formidable battery, and even the most reckless opponent might well hesitate to attack them.

Snorting Horse But on a Swift Motor-Cycle



At top, a motor-cycle trailing a prairie schooner with accomodations for four. In the circle and oval, a motor-cycle bearing a small machine gun — the design of Sergeant Leonard (U. S. A.)

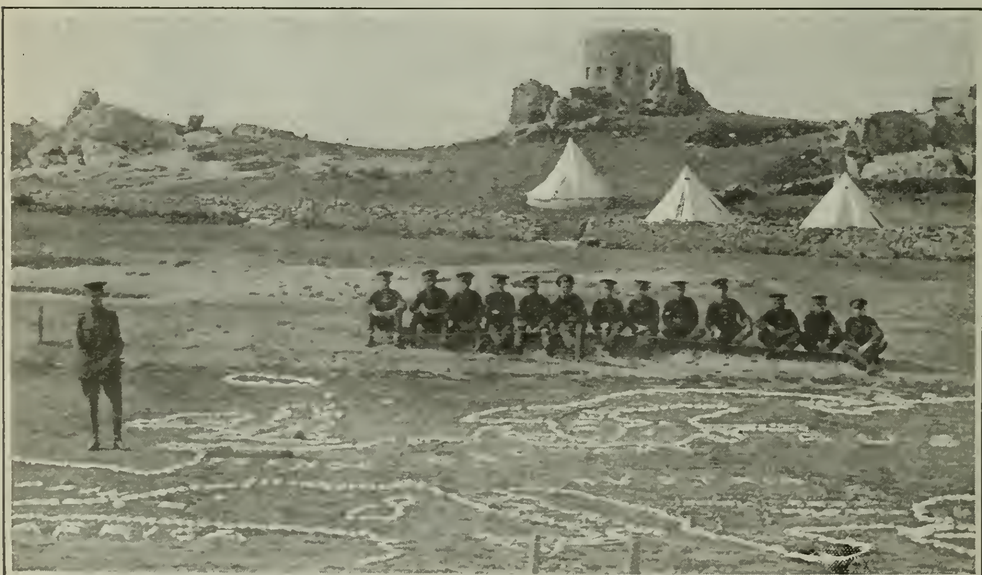


A few more glimpses of the daring motor-cyclists with the British Expeditionary force. Owing to the great speed of these machines, they are often detailed to the most dangerous work, and many coveted medals have been presented to the riders

Nothing Is Unusual in Europe Now

Russia like every other seemingly civilized country harbors its money counterfeiters. The United States is, however, comparatively free from counterfeiters compared with foreign countries. In Russia and Italy the destruction of counterfeiting "plants" is an everyday occurrence. The photograph shows a group of Russian counterfeiters gathered about their press and dies. Note the crude type of machine employed in this illegal industry

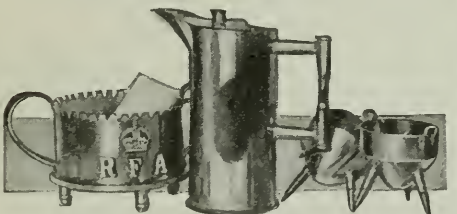
A wholesale capture of Russian firearms by Austria—the work of one day's fighting



British troops which are being retained in England awaiting the call to the front while away their time by making a huge war map of Europe with cobblestones

Repairing the Human Wrecks of War

An idea of the enormous number of casualties on the battlefields may be obtained from this glimpse of a German storehouse containing splints for wounded arms and legs

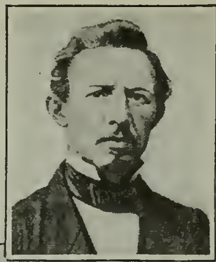


The mental unrest of the disabled men is eased by encouraging them to make trinkets of empty shells and cartridges

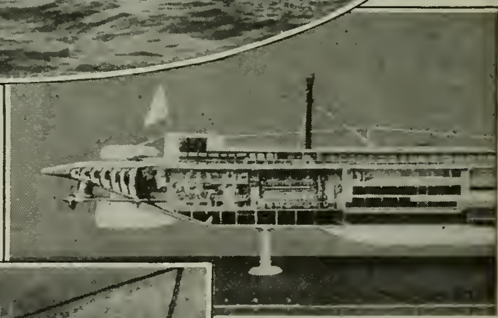
An artificial sunbath of ultra-violet rays which is being used by a German military hospital for healing

A repair for frozen fingers—a glove with elastic bands which stretches the fingers and thus hastens the cure

Although Bushnell and Fulton had both demonstrated the practicability of navigating a vessel under water, Germans took but little interest in the subject until 1850. In that year Wilhelm Bauer, whose portrait appears to the right, built the U-boat illustrated. Bauer served as a Bavarian artillery officer in the Danish War and had ample opportunity to note the havoc wrought by Danish warships on Schleswig-Hollstein troops. He thought it would be easy to build a submarine boat which would destroy the Danish warships. The Prussian government was not very encouraging, and so he had to build his vessel with the aid of private citizens

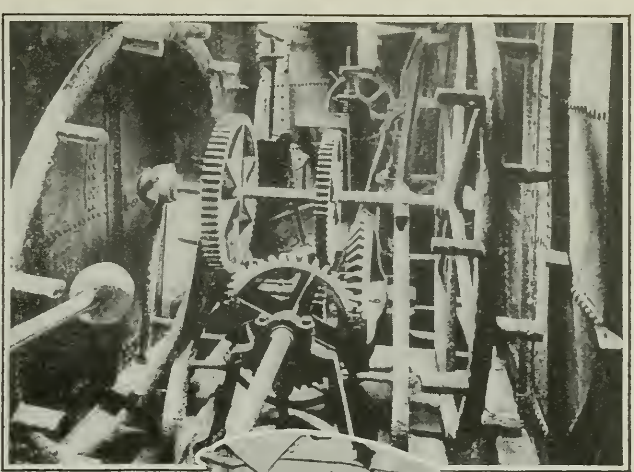


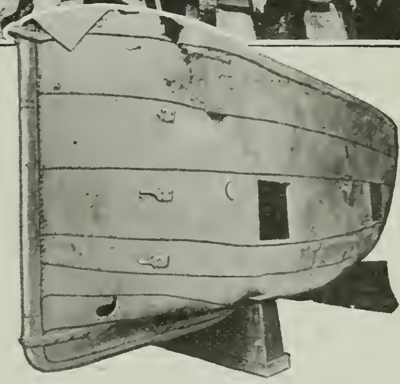
In the oval, a squadron of German submarines. Two types of submarines have been developed, known in this country, respectively as the Holland and the Lake types. Americans are prone to regard Holland as the pioneer submarine inventor



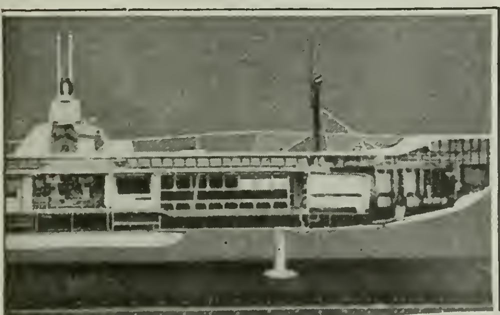
The photograph to the left shows the great gaping hole blasted in the side of an unarmored ship by a German torpedo. The latest type of German submarine carries from ten to twelve torpedoes. It is equipped with six torpedo tubes (four ahead and two astern). In the nose or warhead of a torpedo from five hundred to seven hundred pounds of gun cotton are carried—a high explosive of terrific possibilities as the picture convincingly testifies

Take Kindly to Its First Submarine

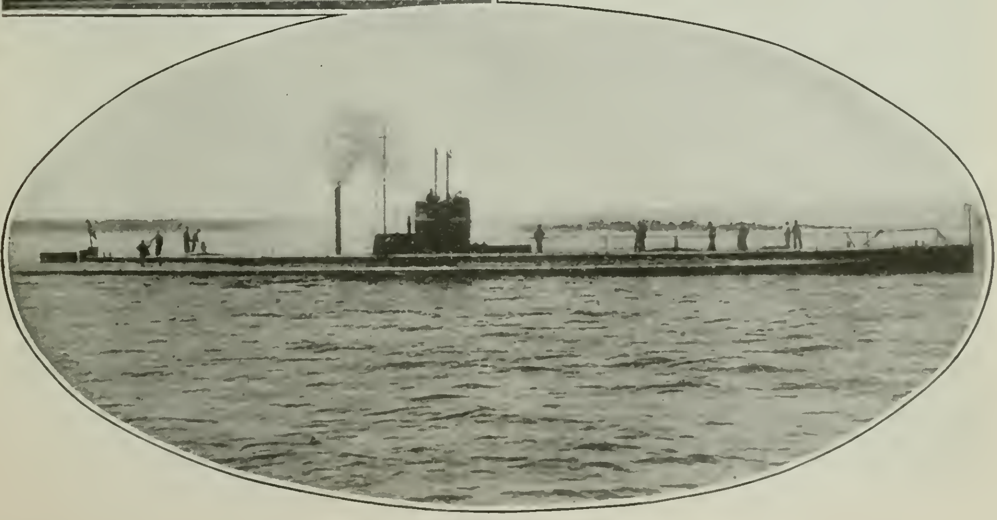




The two photographs to the right show respectively the internal operating mechanism and the exterior of Bauer's ill-fated submarine. The boat was propelled by means of pedals and a train of gear wheels and cog wheels. The "Brandtaucher," (Fire Diver) as Bauer's boat was called, made just one trip in Kiel harbor. That was in 1851. The boat foundered, but fortunately the crew was rescued. The vessel was not strong enough to stand the pressure of water when submerged. In 1887, thirty-six years later, the government undertook some dredging in Kiel harbor for the purpose of building a torpedo basin. Bauer's submarine was then discovered, raised and transferred to the courtyard of the Berlin Naval Museum, where it may now be seen. The submarine is a product of many lands and many minds. Even in ancient times efforts were made to navigate vessels under water—apparently with little success. Napoleon gave the subject some thought. It was with him that Robert Fulton dealt. The submarine, as we see it, combines the ideas of Bushnell, Fulton, Nordenfeldt, Holland and Lake



To the left, a German submarine of an early type shown in section. Below, a German submarine of a late type. These late submarines have a radius of action of about 2,000 miles; that is, after having filled their oil tanks they can travel for that distance before it becomes necessary to replenish their fuel supply

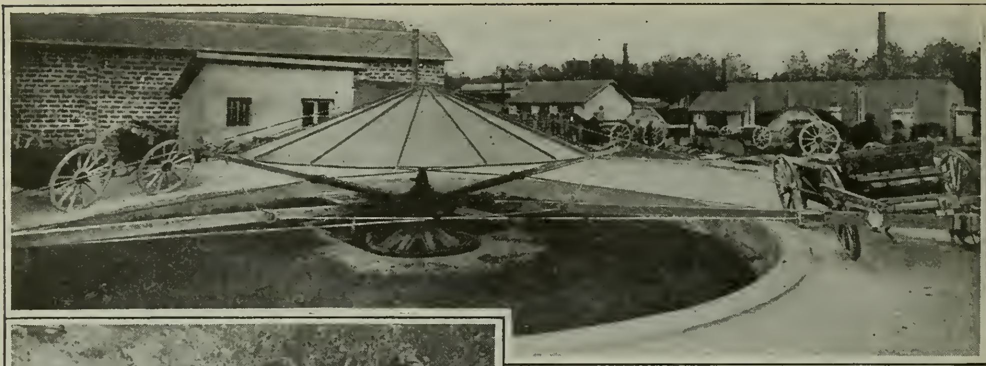


French Life Along the Western Battle Front

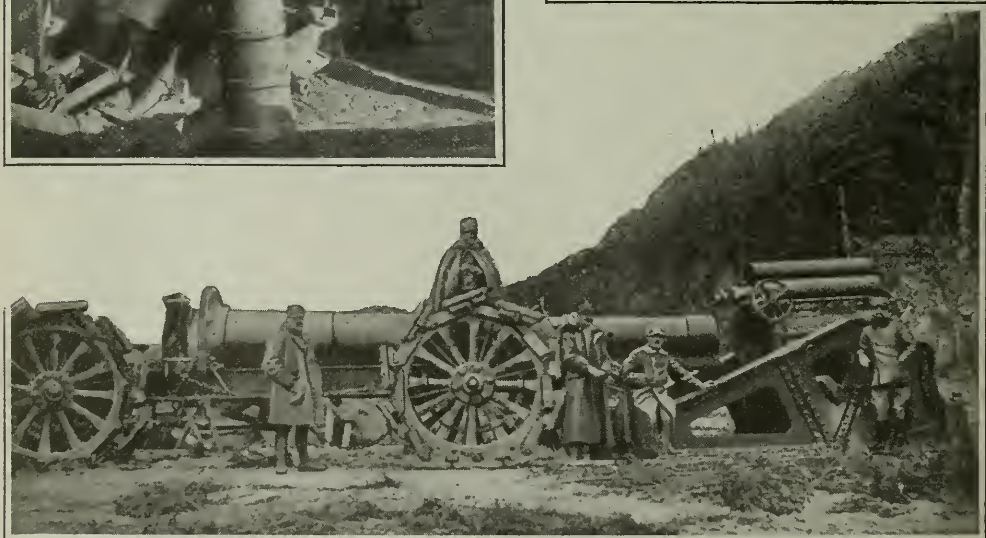
© Underwood and Underwood, N. Y.

At left, French grenadiers. With their shields and metal helmets they look for all the world like Middle Age soldiers. Below, an improvised officers' quarters. At lower left hand, a legging impervious to barbed wire, invented by George Lynch, the war correspondent. At lower right hand, a Scottish Highlander

At top, a German dépot of telephone materials containing a vast amount of wire and other devices for the prompt installation of an efficient telephone system. The telephone, more than any other single factor, has made trench warfare possible. The illustration shows Vedrines, the famous aviator in his Morane monoplane. The gun shoots straight ahead, and bullets which happen to hit the rapidly revolving propeller are deflected



Above, French gun carriages being tested at the Creusot works. At left, an Austrian mortar at maximum elevation. Below, a 220-millimeter (8.8-inch) gun .



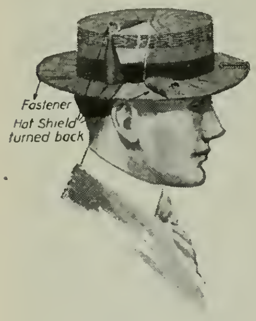
The Italian engineers have proved themselves among the best in the world. Time and again the Austrians have been surprised by having shells dropped upon them, apparently from the skies. The Italians had dragged huge guns up precipitous mountain slopes and were safely installed out of the enemy's range on plateaus, from which shells were fired over mountains. Here we see a 305-millimeter gun (12-inch) being assembled on a mountainside

How a Zeppelin Raider Appears to Englishmen

A target for hundreds of British anti-aircraft guns. This remarkable photograph was taken as a marauding Zeppelin, on a bomb-dropping raid, passed a quiet East Coast town on its way to lightless London

Straw Hat Insurance

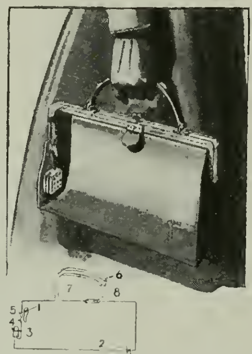
NO longer need we fear the elements when we essay forth in our new straw hats. Come dust or rain — our protection is ample.



The invention that calls forth this outburst of enthusiasm is a light hatshield, printed in imitation of the kind of hat it covers —supported by an ingenious frame and fastened in place by tension clips. That it may always be at hand in case of need, it is kept folded inside the crown.

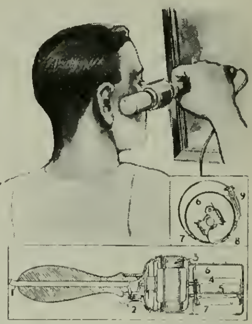
Fooling the Pickpocket

NO one can open the bag shown in the illustration without being detected, whether it is being carried or not. A small battery 2 is connected with a bell 3, which is connected with a metal plate 4, located near, but not touching another plate 5. Connected with plate 5 is one of two bars, 6 and 7, placed the one above and the other below the handle of the bag. The other bar is connected with the battery, a small switch being inserted between them for breaking the circuit when desired. Situated close to the two plates 4 and 5 and actuated by one of the hinged mouth-bars of the satchel is a switch or contact-bar 8. When the bag is opened, this bar touches both plates and thus completes the circuit, ringing the bell, and warning the owner.



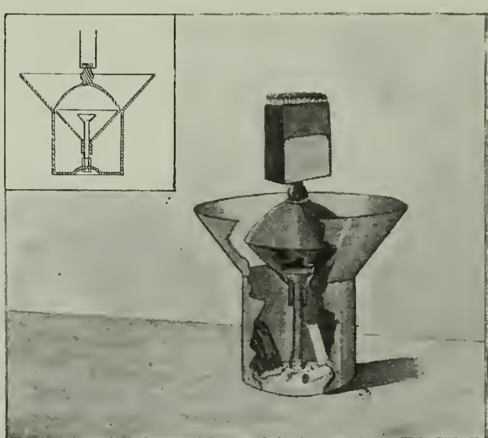
A Buzz-Saw Safety Razor

RAZORS have been further improved by means of a device for rotating a safety blade. A small motor 3 is encased within an insulated handle. Small gear-wheels, 6 and 7, transfer the power to a revolving shaft 5, to which is attached a razor-blade 4. The electric current is carried to the motor by means of a cord 1, which passes through the handle, as shown in the diagram. The lever 2 serves for turning on the current. In operation the blade moves close to the opening 8.



A Tray to Hide Unsightly Cigar Ashes

AN ash-tray which eliminates the unsightly appearance of cigarette stubs and the fumes they give off, is shown in the illustration. A funnel-shaped part has its lower opening attached to the upper rim of a cylindrical box. Resting in the funnel is another member, consisting of two cones with their bases together. At their widest part, they rest on the funnel at its junction with the box. A ring-shaped trough is thus formed, into which ashes may be deposited. The cone is supported by a vertical pin attached to the base of the box. By lifting the cone, the ashes fall in the box. The ill-smelling fumes, however, are prevented from escaping.



These Desert Mates Never Quarrel

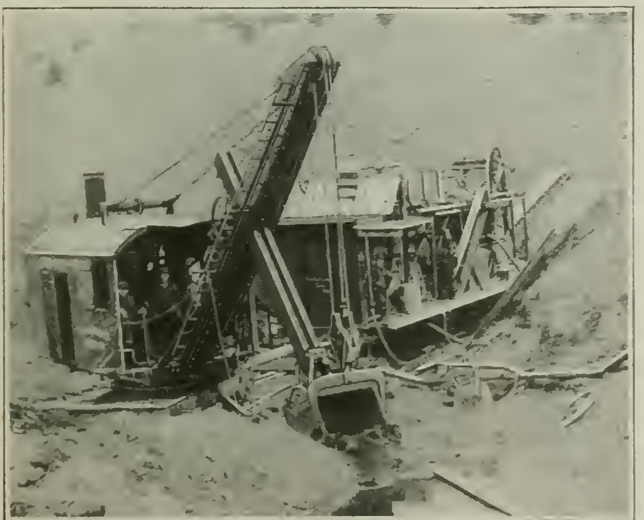

The widely differing peculiarities of a mule and a camel are here combined to form a curious team

OVER one of the trails of the Sahara Desert the queerest of teams is employed in drawing a two-wheeled cart, which carries light freight. The team consists of a camel and a small mule, and while the loads may be unevenly distributed between them, the mates never disagree. Naturally, they are rarely in step. Each draws his portion of the load in his peculiar way, the camel loping along with great strides while the mule trots—almost scampers—beside him.

This Gold Dredge Is a Glutton

FROM the farm lands of Ohio has come an application for patent to Washington—and it has been granted—upon a placer-mining dredge which can wash and extract the gold from six hundred to twelve hundred cubic yards of ore dirt in a day. Moreover, an active application of the principle contained in the patent is doing its work daily in the placer fields of Colorado.

The action of the mining machine is not entirely unlike the well-known gold-dredge, or "gold hog," as it is familiarly called in California and Alaska. This machine, however, runs on tracks instead of in the water and shovels the dirt from behind instead of from in front. A capable steam dredge digs up the pay dirt, swings it above the separating machinery and drops it into a hopper. Water is sprayed on the incoming dirt at the rate of two thousand gallons a minute. The loosened ore then undergoes amalgamation (dissolving in mercury), the precious mass dropping below the hopper into a tank in which it is heated, the mercury being vaporized and re-condensed, and the gold accumulating in the tank.


The dredge gulps from six to twelve hundred cubic yards of gold-laden dirt every day

Two New Colossal Bridges

NOTABLE among the great engineering feats of the year 1915, are the colossal bridges which were constructed. As successor to the unfinished structure over the St. Lawrence at Quebec, which collapsed a few years ago, a new bridge, the longest arch in the world, is being completed. Its span is 1800 ft. During six months of last year about 32,000 tons of steel were placed in this bridge.

The beautiful arch over Hell Gate, 977 ft. long, is of massive construction for carrying great weight.

A Device for Numbering Photographic Plates and Films

A PLATE and film-numbering machine invented by John R. Stephenson of Pullman, Washington, makes it possible for the photographer, professional or amateur, to keep an accurate record of his photographic plates and films. In operation and appearance the machine resembles a small adding machine. It prints any desired number on the light-sensitive surface of the plate or film (which after development is termed a negative) by the transmission of light through transparent figures arranged on opaque numbering strips. These strips bear the numbers 1—9 consecutively and 0.

This simple device, resembling in appearance a small adding machine, enables the photographer, professional or amateur, to preserve an accurate record of his photographic plates and films

The machine has a slot in which the point of a pencil may be pressed and the strip slid along in its groove in the numbering machine until the desired figure is positioned over the opening in the table member of the machine, through which the light passes to print the numeral on a photographic plate or film, resting on the table of the machine. The rays from an electric flashlight under the table member are reflected by a slanting mirror up through the opening and through the figures on the numbering strips of the machine, to transfer the numbers to the photographic plate or film.

Guide pieces on the table member hold the photographic plate in the proper position over the numbering machine. This makes it easy to operate in the dark, as it furnishes its own light for handling and the guide pieces insure proper positioning of the photographic plate or film to be numbered. It is possible to print the photographs either in white or in black. If transparent numbering strips having opaque figures are employed, small opaque surfaces, with transparent numerals appearing therein will be plainly legible when the dry plate or film is developed. If opaque numbering strips having transparent numerals are employed, opaque figures will be printed.

Submitting Photographs for the London Exhibition

THE sixty-first annual exhibition of the Royal Photographic Society will be held as usual in August and September of this year. Mr. C. E. K. Mees of the Eastman Kodak Company has been appointed one of the judges in the scientific section of the exhibition and he will receive photographs from exhibitors.

Transparent numerals on a small opaque area or opaque numerals can be transferred to each negative

Why Does a Rifle Crack?

By Edward C. Crossman

A WAR strength infantry company lay in our rear. We walked toward its far-off target, nearly in the line the bullets would take, a few yards' divergence to the left giving us the safety margin we felt would be enough with such expert marksmen. From some indefinite point in the air to our right, there came a sudden burst of high, thin, eerie crashes, the thin crash that comes from the leap of the electric spark from the static machine, repeated in fitful fashion. Most extraordinarily, the sound lacked any definite point of origin; it seemed higher than we were; and it seemed to come from our right. Nearer than this we could not locate it. A slight lull in the sharp crackling, and there came another sound—the heavy, dull thudding of guns fired at a great distance. As we progressed toward the long fire target twelve hundred yards from the infantry, the queer crackling noise followed us, growing thinner and more weird, but the thudding of the far distant guns grew fainter.

Photograph by Ordnance Department, U. S. N.

This picture was taken when the bullet was eight inches from the muzzle, and traveling at a speed of roughly a half-mile a second. The two wires making the contact and the electric flash by which the photographs were made are shown as two black lines. The bullet takes its own picture. Note the eddying effect of the air behind the bullet. The fastest mechanical shutter, giving an exposure of one-thousandth of a second, would allow the bullet to move 2.7 feet during the opening of the lens

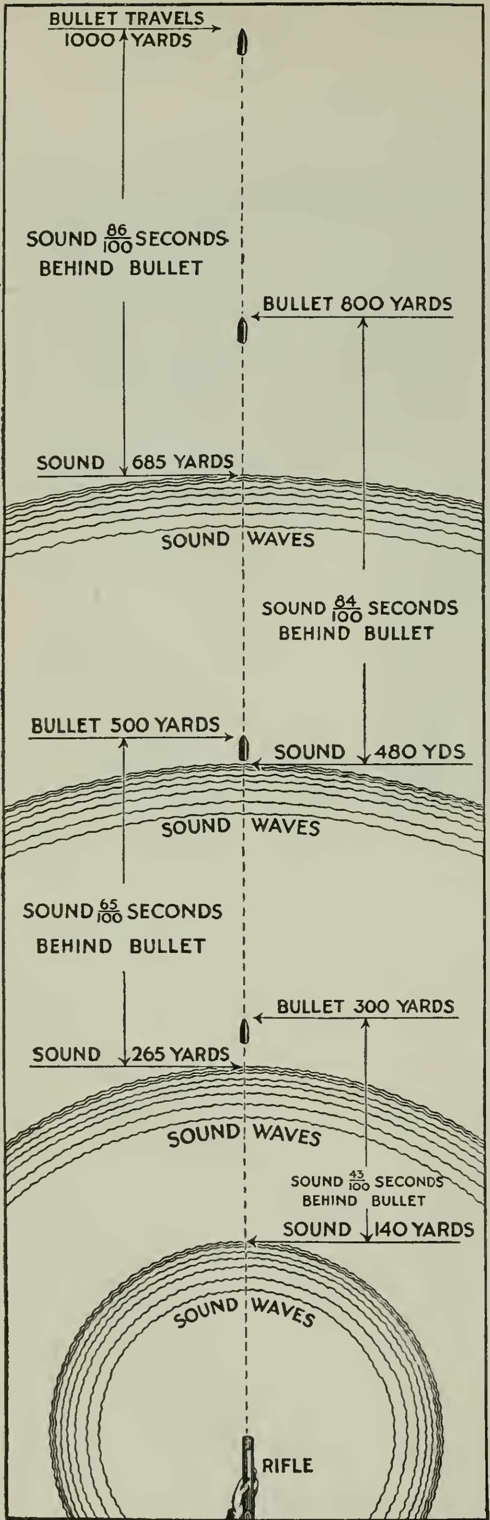
Photograph by Ordnance Department, U. S. N.

The bullet was photographed when six inches from the muzzle, just escaping from the blast gases of the rifle. Note the outline of the sound wave diverging from the nose of the bullet. This is the first stage of the exit of a bullet from a rifle's muzzle. It is not unlike the bow wave of a boat

We were walking not more than one hundred or one hundred and fifty yards from the line of fire of a trained infantry company, delivering its fire at a group-target twelve hundred yards, roughly three-quarters of a mile, away.

The thin, high-pitched crackling, that seemed at one time like the leap of the high-tension spark of the static machine, at another like the cracking of whips, and again like the vicious crash of a stone through glass, came from the flying bullets of the United States service rifle, which starts with the speed of twenty-seven hundred feet per second. The thudding, that fell off to almost nothing at twelve hundred yards, came from the rifles themselves, the only sound one hears when close to them, but the least noticeable at a distance when one is close to the course of the bullet.

As we gained the target, a new sound



mingled with the irregular crashing of the bullets—a high-pitched whine, with an occasional vicious yowl punctuating the noise. This came from the ricochetting bullets, striking the ground short of the target and then glancing off and pursuing their erratic course through the air, their velocity much diminished, their travel changed to an end-over-end whirl, and the bullets themselves defaced and battered by the impact with the ground.

Back of the target the bullets passing through it went into the waters of the lake several hundred yards out, with the noise of heavy blows, almost as hollow and heavy as the impact of a well-swung carpet beater on a huge, loose carpet. Almost the same sound comes when a bullet strikes flesh, human or otherwise.

Normally the sound of the progress of the modern military bullet up to nearly a mile, is the high-pitched, ear-splitting vicious crash. At longer ranges it hums, probably from an increasingly unsteady flight. Or possibly it hums all the time, but the sound is killed by the vicious crash that accompanies the bullet while it is traveling fast.

Under some conditions of air and background, not yet clear to me, bullets hiss. The sound is noticeable at the skirmish, on the six hundred yard range at Camp Perry, and at the great matches. It is never heard at the range of the writer's club, situated in the hills with every chance for sound to be echoed back and reproduced, nor has the writer heard it on any other range. However, this hissing noise is audible only at the firing point. Trial out along the flight of the bullets developed that either they did not hiss to the person so located or else the hiss was covered up by the usual crash, which amounts to the same thing in the end.

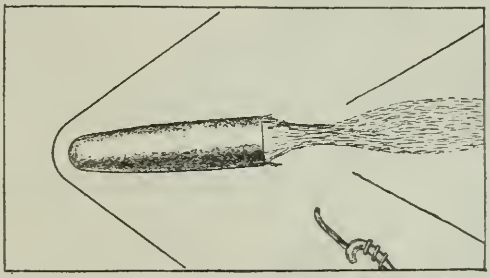
Never do bullets howl unless they have been tipped out of normal flight by striking some obstacle. The howl is merely the noise of a more or less jagged missile whirling end-over-end, while the normal bullet, traveling nor-

Sound is slower than a bullet. Bullet crash and rifle report are heard one after the other. The crash is due to air rushing in to fill the vacuum behind the bullet mally, slips through the air like a trout through water.

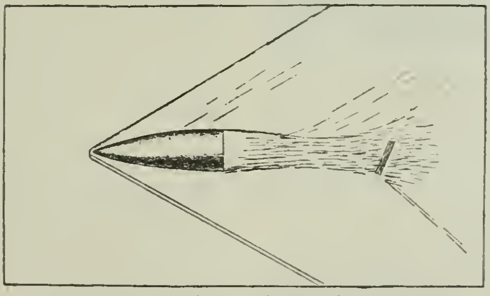
The soldier, fired on and missed by a single sniper without other sound to confuse or cover up that pertaining to him, hears two distinct sounds, if the firing takes place within four hundred yards or so. Phonetically they are "Pack-punk." The first is a vicious and menacing crash. It is the bullet arriving with its regards to him; the second is the report of the rifle which follows along some distance behind the bullet. The modern bullet travels faster than does sound, which has but the speed of eleven hundred feet per second. The person watching the jet of steam from the whistle of the far-off locomotive and noting the interval of time which elapses before the whoop of the whistle arrives, will appreciate that sound is a leisurely traveler.

The crash comes from a vacuum formed in the rear of the flying bullet by its enormously quick displacement of air. The bad shape of the missile allows the air to flow back again around the stern, like water around the stern of the fast moving boat. Finally, the air rushes in behind the bullet and makes the crash just as the air rushes in behind the electric spark.

Only at speeds higher than twelve hundred or fourteen hundred feet per second is this sound heard. Strangely enough it is not heard if the bullet has started at very high speed and falls to this lower one. Possibly what is heard in such case is the crash of the bullet at some distance farther back where the velocity is still high enough to produce a crash.



Drawings from photographs of bullets in flight. Showing older type, metal jacketed, small bore military bullet in flight. Note bow wave of air driven ahead of the bullet, and the eddies of air in the wake like water in the wake of a ship. Directly in rear of the base of the bullet is the vacuum that causes the sharp crash as the air closes suddenly in upon it



The flight of the modern spitzer bullet, which is used by Germany, England, France, the United States and some other nations. Note the sharper angle of the bow wave, and the greater vacuum in the rear of the bullet. This is caused by the fact that these lighter sharp-point bullets are driven at far higher velocity than the older type, and the vacuum is more pronounced. Also the noise is more marked. A bullet which tapered down to the stern as sharply as the point of the bow would have little vacuum and little noise. The photograph from which this sketch was prepared was made by Professor Boys by means of an electric spark produced as the bullet cut the wire

Military rifles drive their bullets at speeds of from two thousand to three thousand feet per second. The same bullets, loaded to give velocities of less than fourteen hundred feet per second, do not make a sound. So, black-powder or low-power rifles like the familiar .22, do not produce this crash from their bullets. The difference in the arriving time of the two sounds, bullet crash and report of the rifle which fired it, is very noticeable at the long ranges. At one thousand yards, for instance, the bullet of the United States rifle arrives at the mark 1.86 seconds after it leaves the muzzle of the rifle. The bullet thus covers the distance at the average speed of about sixteen hundred feet per second. Sound, traveling at the uniform rate of eleven hundred feet per second, takes 2.7 seconds to make the trip, and the bullet and its accompanying crash, thus arrive nearly a second ahead of the report of the rifle. So comes about the phenomenon of the two distinct sounds; first the bullet crash, and then the report of the rifle.

A special pair of steel braces was used to straighten the crooked legs of this valuable baby llama

Straightening a Baby Llama's Knock-Knees

IF mechanics had not come to the rescue of a valuable baby llama at the Cincinnati Zoological Gardens, he would be a useless little llama now. Llamas with knock-knees are not wanted by any zoological garden.

He was made a perfectly good llama by the use of a special pair of steel braces so constructed that they would straighten out the crooked legs and in the meantime allow him to enjoy life by frisking around with his mother like an ordinary baby llama.

To accomplish this unusual task of straightening out the legs, a pair of steel braces were constructed, each having six straps so attached that they buckled around the legs. Thus the braces were held securely in place. The straps were tightened day by day and gradually drew the legs closer and closer to the steel braces so as to straighten out the curves.

At first the little llama refused to walk with the braces on his legs. Soon he got over this and frisked about with his mother as if the stays were not on his legs at all. Freedom of movement was accomplished by hinging the braces at the knees, so that they could bend naturally in walking.

It took two weeks to draw the legs into normal position. As a matter of safety, the braces were left in place until the legs became strong enough to bear the weight of the animal.

Vegetation that Thrives Where Water Is Scarce

THE weather in the deserts of our great Southwest is such that only three months in the spring are sufficiently moist to permit any considerable vegetable growth. The cactuses, which are practically the only form of vegetation courageous enough to live in such arid regions, protect themselves in an almost human way against destruction. The outer coat of the barrel cactus, shown in the illustration, is almost as strong as bark and is armed with long formidable spines, arranged in rows of clusters. These rows are an effective barrier to most animals seeking the inside of the cactus, which is composed of pith soaked full of water. The water is stored up during the short rainy season, as squirrels store nuts for winter.

A traveler quenching his thirst from a barrel cactus

A New Powerful Farm-Tractor

ONE of the most powerful of the many farm tractors now on the market has recently been offered to the public. This new machine is remarkable not only for its great pulling power, but for the ease with which it plows through almost impassable swamp, marshes and beds of streams.

The features of construction that permit of successful usage under such severe conditions are the double-worm drive and the swivel action of the axles. The four-cylinder develops sixty horsepower, but since this power is directed to both front and rear axles, great tractive ability results.

This four-cylinder tractor develops sixty horsepower, which is divided between front and rear axles, affording great tractive ability

Killing Insects with Poisonous Gas

FRUIT growers of California who have long contended with insect pests are now employing a new method of killing the pests, which is said to be exceedingly efficient. Under the old system of spraying the trees, the best result that could be obtained under the most favorable conditions was the removal of from eighty to eighty-five per cent of the insects. By fumigating the fruit trees with hydrocyanic gas, it is said that one hundred per cent results are usually obtained.

A gas-making machine has been recently placed at the disposal of the fruit growers, which mixes the component parts of the gas and liberates the fumigating gas in any desired quantities. In the employment of this machine, a tent is placed over the tree which is about to be treated. By means of markings on the canvas the number of cubic feet occupied by the tree is accurately measured, and the amount of gas to be employed is thus decided. It has been discovered that the strength of the gas mixture to be used depends upon the size and age of the tree. On the average tree, from ten to fifteen feet in height, a strength of about one ounce of cyanide to one hundred cubic feet of gas is the average dosage.

The proportion of cyanide, acid and water is adjusted in the machine. The usual proportion is that of equal parts of cyanide and acid, but the proportion of water varies from two to eight parts.

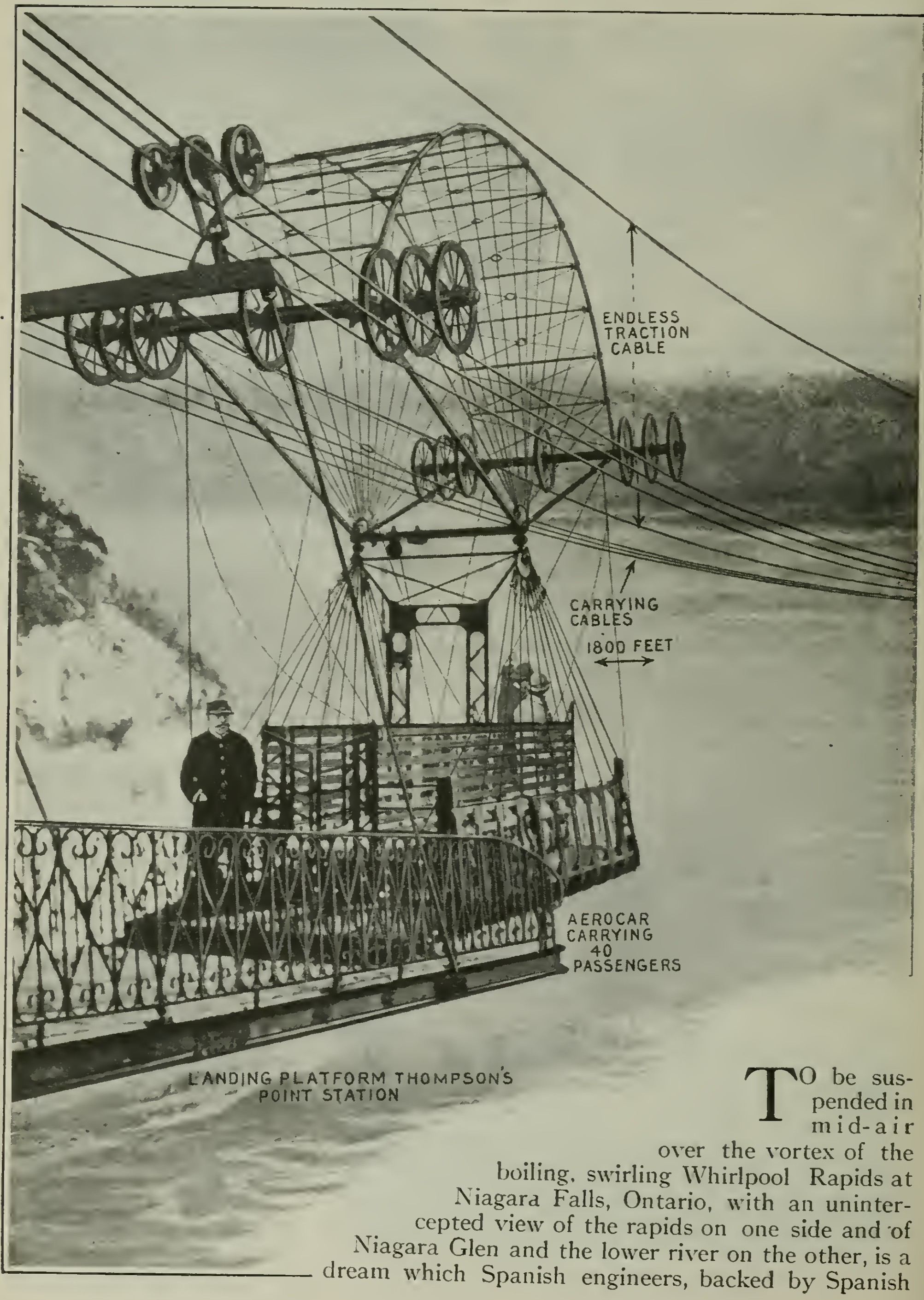
The gas is liberated under the tent, and permeates the enclosed space, thus fumigating every branch and leaf of the infected tree. The gas is held in the tent for about an hour, when all the insects are usually found to have perished.

The ordinary equipment employed by contractors to fumigate an orchard consists of one gas machine, of the type shown in the illustration, about thirty tents, and a staff of five or six men.

An equipment for fumigating an orchard consists of one gas-machine, about thirty tents and five or six men

Niagara's New Air Route

By Charles W. Person



TO be suspended in mid-air over the vortex of the boiling, swirling Whirlpool Rapids at Niagara Falls, Ontario, with an unintercepted view of the rapids on one side and of Niagara Glen and the lower river on the other, is a dream which Spanish engineers, backed by Spanish capital and patents, have realized. An aerial scenic cableway now spans the Rapids from cliff to cliff.

For sheer excitement and thrill the trip by air over the Whirlpool outdoes anything that tourists have ever experienced. True, there is the first stage of the cableway which climbs the Wetterhorn in Switzerland; but it can not compare in magnitude with the Niagara project. Then there is the tramway at San Sebastian, Spain, for the transportation of tourists from a trolley terminus to a casino overlooking the Bay of Biscay—the only previous installation of the system in use at Niagara Falls and owned by the same company. But, the span at San Sebastian is only nine hundred and nineteen feet, while at Niagara it is eighteen hundred feet. It may be safely said that Niagara now has the longest and probably the safest scenic cableway in the world.

It was the successful operation of the San Sebastian cableway, for the past six years, during which time it carried as many as twenty-six thousand passengers in a single season, which brought Torres y Quevedo, the inventor of the system, to Niagara Falls. No time was lost in starting operations. Work was begun July 12, 1915. The cables are now erected, and cars are now running upon them.

Diplomacy and Engineering

The Whirlpool is situated some three miles below the Falls and is almost entirely within Canadian territory. Hence, the two anchorages or terminals of the cableway, Colt's Point and Thompson's Point, are both in Ontario. Because the boundary line between New York State and Ontario forms an acute angle, which is intersected by the cableway about sixty feet within the apex, the promoters found themselves in a diplomatic tangle. After securing the sanction of the Province of Ontario and of the Victoria Park Commission of Niagara Falls, they had to obtain permission from Albany, since the bed of the river is owned by New York State, and from Washington, since the water is owned by the Federal Government.

But the restrictions did not stop here. The engineers were cautioned against erecting a cableway which would cross the tracks of the Niagara Belt Line Railway, and they were further warned against damaging the cliffs on either side of the Whirlpool. To increase their difficulties they were forbidden to build any towers or structures which would rise above the level of the tracks of the railway running along the cliff.

Heavy rock excavation at Thompson's Point. The Whirlpool appears below

This first cableway of its kind in America was built at a total cost of sixty thousand dollars, exclusive of engineering expenses and exclusive also of the car and loading platforms, both of which were built in Spain. With past experience to guide them, the promoters have no doubt a duplicate installation could be built for forty-five thousand dollars.

The Torres system is simple in the extreme. It consits merely of six parallel carrying or track cables which hold the passenger car, each cable being securely attached to a fixed anchorage at one end of the line and to a counterweight system at the other. The cables are fastened at Colt's Point to a seven hundred and forty-one ton concrete block, and at Thompson's Point each is attached to a ten-ton counterweight or stretcher after passing over a grooved sheave. These counterweights move freely up and down in steel guides, as the load is diminished or increased. Thus, the tension upon the cables is not increased by the weight of the car, although the deflection of the cables is, of course.

In other words, a sudden load thrown upon the cables causes the counterweights to rise and the cables to sag. The greater the load on the cables the greater will be the sag. But the tension will not be increased; it always will be ten tons to the cable. Thus, the tension in the track cables depends solely upon the counterweights and not at all upon the weight of passengers borne by the car.

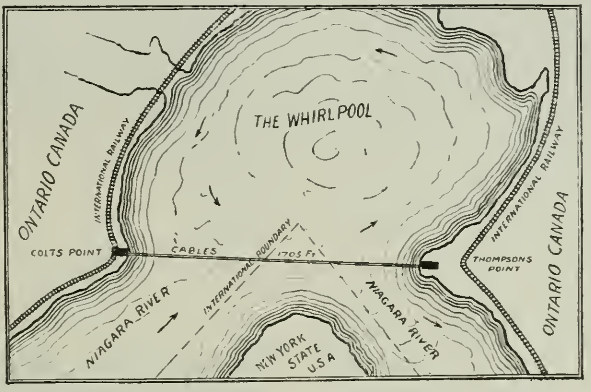
Suppose a Cable Should Snap?

For this reason the sudden breaking of any one track cable would not be serious, as the other cables would support all the weight of the car without any increase in their tension. Should a cable break, the car filled with passengers would fall suddenly and then bob up and down until it assumed a new position of equilibrium. The breaking of two cables at the same time is considered impossible by the engineers.

The simplicity and safety of the Torres system lie in the fact that each cable is put into fixed tension from the start of operations, that this tension never varies, that the resistance of the cable can be verified at any time by increasing the load on the counterweights, that if any cable or fastening is faulty it will probably break when heavily weighted for trial or inspection trips, and that if a cable does break practically no extra strain is put upon the other cables.

The passenger car is propelled by a traction cable fastened to a ten-ton counterweight box, arranged in steel guides similar to the track-cable counterweights. This creates a tension which adjusts any slack caused by the rising and falling of the car. At San Sebastian the car holds only fourteen passengers, but at Niagara seats are provided for twenty-four passengers and standing room in a raised aisle for twenty-one more besides the conductor.

The engineers have determined to a nicety what would happen to the car if the traction cable were to break. As the two terminals are nearly at the same height above the river level, one being 249.5 ft. and the other, 246.5 ft., they figure that the car would run backwards and forwards along the track cables until it came gently to rest at the lowest point of the sag of the cable, which would be about the center of the span or directly over New York State. A light basket which holds one man and which hangs from pulleys which can be readily thrown over two of the track cables, would be used in the rescue work. The emergency man would attach a relief cable to the marooned car, and an auxiliary engine installed for the purpose would pull the car back to Thompson's Point.



Map showing cableway. Note the small portion which extends over New York State

Some Interesting Safety Devices

There are several safety devices of ingenious construction, among the number being an automatic control stop which halts the car within three feet of the concrete station. A clamp on the car strikes the face of the control stop, prevents the car from traveling farther, and then engages with it in such a manner that the car cannot slip back from the landing platform. Furthermore, the car gates cannot be opened until the clamp has engaged with the control stop, and even then only the right gates can be opened. In addition to this, there are limit switches which prevent the power from being turned on again, and thus jam the car against the station once the power has been shut off.

To string the cables across the Whirlpool the traction and track towers and sheaves were first erected. Then a long rope was carried around the face of the cliff from Colt's Point to Thompson's Point. When this was pulled taut a wire rope was hauled across with the aid of a hoisting engine, and then the traction cable was pulled into place. This cable was used to haul the track cables across.

The trip from from point to point can be made in about five minutes. To test the car cast-iron bars weighing thirty nine thousand and nineteen pounds, or three times the working load of the car with forty to forty-five passengers, were distributed on the floor. A trestle was built and the car was suspended by its wheels from it. The test was satisfactorily met.

Inventions for the Navy

LAST July, Secretary of the Navy Josephus Daniels announced the creation of a board, afterwards designated as the Naval Consulting Board, headed by Thomas A. Edison, for the purpose of aiding in the development of the Navy and the defense of the nation, by giving expert consideration to the many needs of the Navy and the many inventions that might be submitted to it. Public announcement of the creation of this board was accompanied by an invitation from the Navy Department to the inventors of the country to submit their ideas.

Seven months later, not less than five thousand inventions, ideas and suggestions had been received.

Advantage is taken in South America of the intense heat of the tropical sunlight in drying cattle hides. The odor is the most objectionable feature of this method

Drying Cattle Hides in a Broiling Tropical Sun

ONE of the strangest sights which will greet the traveler from the North in visiting the small tropical countries along the eastern coast of South America is an occasional large tract of land covered with long racks of wood upon which are strung cattle hides drying in the sun. Whenever one of these interesting tracts is approached the visitor after one or two experiences does not have to be forewarned; the odor which arises from them is almost unbearable. The intense heat of the tropical sun causes rapid decomposition of the fleshy parts, which cling to the hides, so that they dry quickly; but while they are drying the stench that emanates from them is sickeningly offensive.

Dried hides comprise one of the chief means of revenue of Uruguay.

A Whipping Machine to Cure Nervousness

THERE must have been merit in the "birch tea" of childhood, for the same remedy is prescribed in sanitariums nowadays for invalids. In other words, it is considered that a healthy reaction may be gained from a "spanking."

In the mechano-therapy departments of up-to-date institutions, the "whipping post," a mechanical device for therapeutic paddling is an accredited healing-machine.

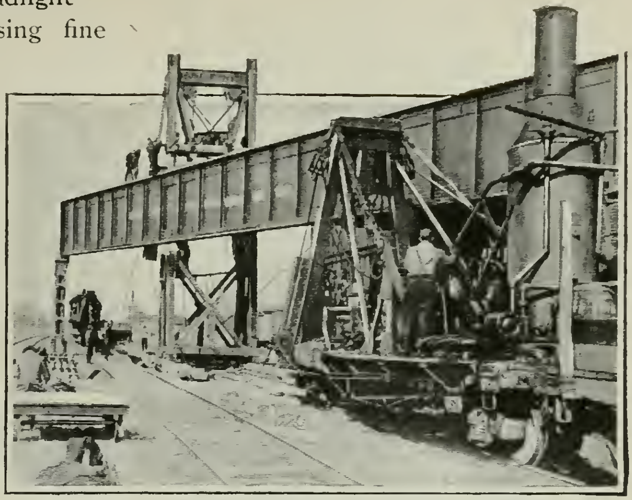
You are whipped by straps of heavy cloth or leather attached to two rapidly revolving posts. When you take the treatment you step backward into the flying whips and receive their blows upon your legs, back, abdomen or chest, depending upon the malady from which you are suffering. The impact of the straps is just sufficient to set the blood in free circulation. There is no smarting, stinging sensation because the straps are broad enough to eliminate any possibility of a cutting blow. You are paddled rather than lashed.

His nervous, tired body is receiving a soothing series of slaps

The "whipping post" is valuable in many types of nervousness. It is also valuable in increasing blood circulation and relieving numbness. Certain forms of paralysis though not responsive to other treatment, are benefited.

An Electric Iron With a Headlight

AN electric iron for pressing fine linen, elaborate centerpieces and similar articles, where extreme care is highly important, has a small electric lamp in the same position that a head lamp occupies on a locomotove. The lamp is shielded from accidental blows by a metal cap attached to the end of the handle, the shield also serving as a reflector, concentrating the light upon the work in hand, and preventing the rays from shining in the eyes of the operator. The lamp is connected across the heating coils, taking its current from the cord which runs to the socket.



By planning each move beforehand, these huge girders, weighing over a hundred tons each, were handled easily

This electric iron with a headlight is just the thing for ironing when it is necessary to use special care

How Record-Breaking Girders Were Handled

TO erect record-breaking girders weighing up to one hundred and thirteen tons and up to one hundred and thirty-two feet long, in connection with grade-crossing elimination work in Chicago, required a plant unusually sturdy and capable of quick work. Every operation had to be known beforehand; for two of the five spans were over high-speed tracks where a maximum of only two hours' interruption to tracks could be allowed. That the calculations of the bridge engineers was correct is evidenced by the fact that the fifteen girders were all placed without exceeding the allotted time.

A tower was designed which would straddle the track below, its columns or legs resting on wheels which rolled along the rails, so as to enable the workmen to place it at the exact spot desired. The tower was then securely blocked up on sills and the lower cross-bracing removed to allow the heavy girders carried on four steel flat cars to run beneath. A huge pair of hooks then took hold of the girder by its upper flange and lifted it to the proper elevation, so that it could be swung around until its end bearings would come over the steel columns, whereupon it was lowered into place. Power to raise the girders was supplied by giant derrick-cars through steel cables, one of which may be seen near the top of the rail in the accompanying illustration.

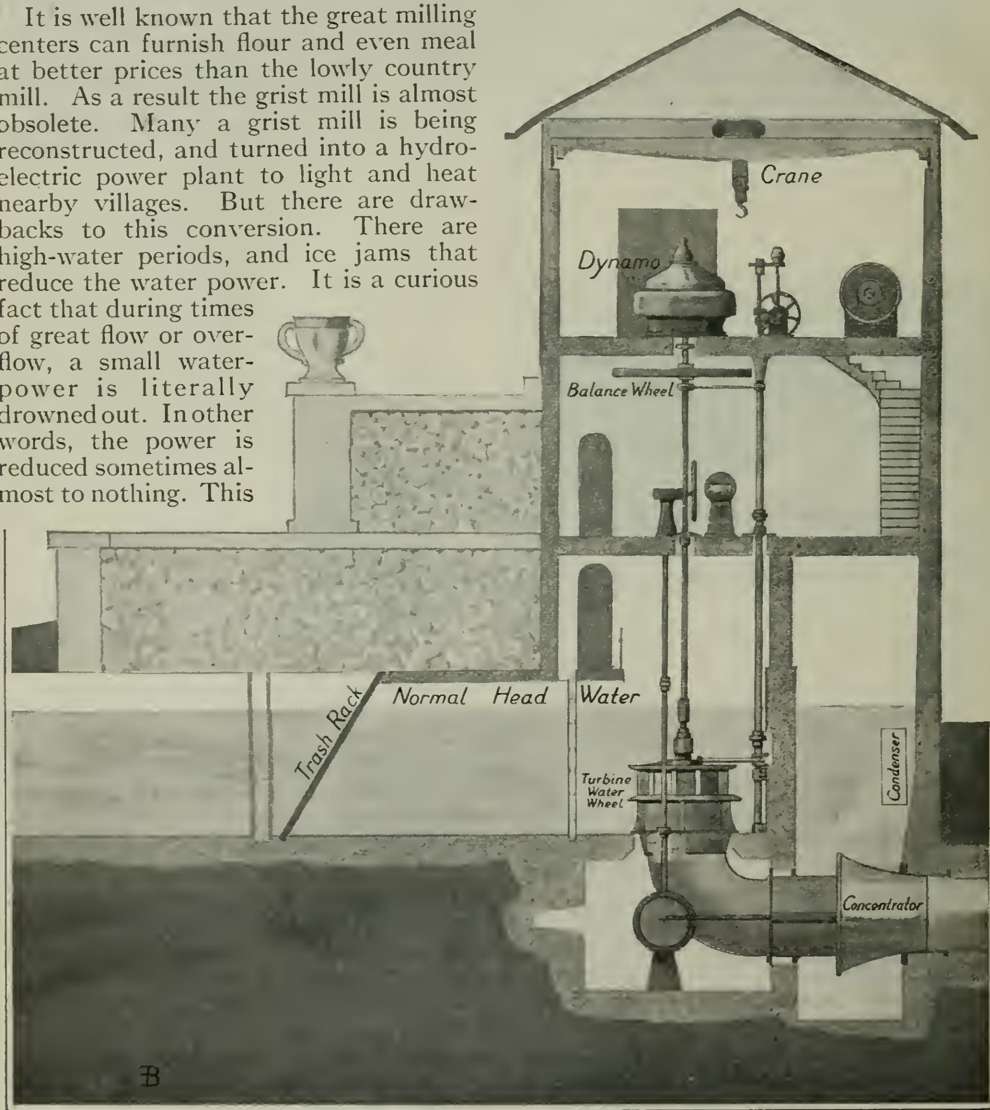
Removable leg sections or "gates" in the rear of the tower provided for disengaging it from the girder just erected and moving it to the next. After the three girders in one span were in place, the tower was jacked up on a bed of greased rails along which it was slid across the tracks to the next span.

The girder, when hoisted in the air, could be moved only a trifle endwise because of its weight, and hardly at all laterally.

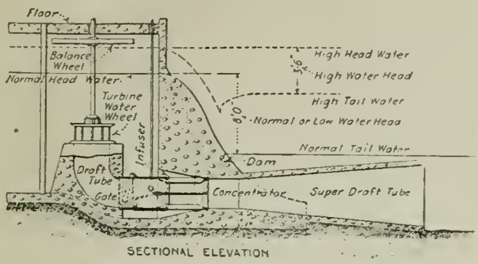
A New Era in Water Power Begun at the Henry Ford Farms

HENRY FORD'S Farms serve as an experimental field for the various appliances being developed by Mr. Ford. His new home is located on the farms. This is near Dearborn, Michigan, on the north bank of the river Rouge, on the site of a pioneer mill.

It is well known that the great milling centers can furnish flour and even meal at better prices than the lowly country mill. As a result the grist mill is almost obsolete. Many a grist mill is being reconstructed, and turned into a hydroelectric power plant to light and heat nearby villages. But there are drawbacks to this conversion. There are high-water periods, and ice jams that reduce the water power. It is a curious fact that during times of great flow or overflow, a small water-power is literally drowned out. In other words, the power is reduced sometimes almost to nothing. This is due to the fact that water rises faster below than it does above a dam during a freshet. The tendency is to conceal even the location of a dam in very high water. Hence, the head pressure on the turbine water wheel is reduced, so that little or no water will pass through it, with the



The water power plant here shown is located at the Henry Ford Farms, near Dearborn, Michigan. The low head of water is increased by use of an "accelerator" which relieves the result that it cannot drive its generator during high water periods.



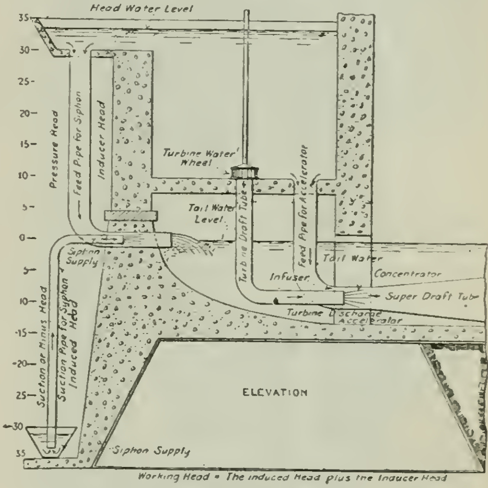
Vertical section through the turbine and concentrator, showing different water levels and other details

The current consumer needs his light and power during rainy seasons and thaw periods. Therefore, the small water power has been considered a hazardous investment without a steam engine or gas engine in reserve.

The river Rouge is a sluggish stream draining a wide flat valley. It flows into the Detroit river, which is often affected by winds on the Great Lakes. This causes the Rouge to back up and lower the head at the Ford dam at times when other conditions are favorable to good power.

The farms' water power has been modernized. It is now an electric station which provides current for the village pumping station, for Mr. Ford's home, and the various requirements of the farms. The problem of variable heads, and variable flow, in connection with constant requirements, was of special importance. Therefore, some new ideas and new apparatus were developed in the solution.

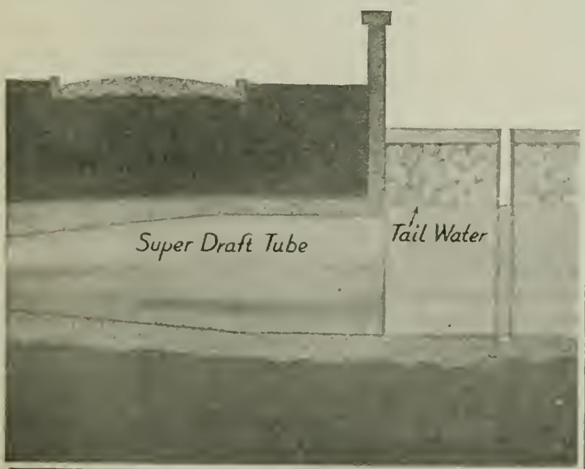
As has been already stated there are times of excess flow, in which the actual head pressure on the turbines is lowered. If a greater number of turbines were installed to use this surplus water the cost, together with the expense of larger foundations and buildings required, would be prohibitive from an investment point of view. This made it necessary to try to increase the head by the use of the surplus water itself, in other



The concentrator is in reality a tube within a tube, acting somewhat like a siphon

words, to set the mischievous water to work. This was done to the extent that the turbines can develop more than their normal power at times when they otherwise would be rendered powerless.

This was brought about by an apparatus which leads a portion of the surplus flow to the turbine discharge pipe in such manner that a vacuum is formed for the turbine to discharge into, thereby adding atmospheric pressure, or head, to the water head already acting on the turbine. This produces the full head conditions for the turbine. In turn, full power is furnished. This apparatus is called a



pressure at the lower end of the turbine, and augments the pressure at the intake end

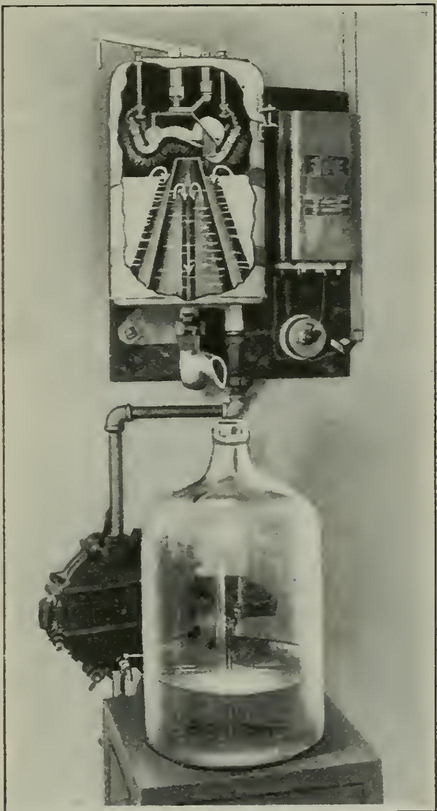
"turbine discharge accelerator," because it can accelerate the flow of water through a turbine water-wheel. It is adjustable, and it can readily be regulated to the river conditions.

The illustrations will give a general idea of the new device. The results were so marked as to appear incredible. Some of them are as follows:

1. The turbine wheel can be made to develop its normal rated power at half head.

2. The turbine wheel can be caused to develop nearly double its rated power at its normal head. (It will, of course, use more water in both cases).

3. The turbine can be made to develop a fair amount of power at proper speeds, when the head seems to be almost totally destroyed by high water. The latter conditions are extreme and are not often met in practice.



This household size apparatus will sterilize one thousand gallons of water for five cents

Sterilizing Water by Ultra Violet Light

ULTRA violet light is not visible to the eye, yet it affects a photographic plate, decomposes many chemicals, causes sunburn and sunstroke, and kills bacteria. Nature's purification of rivers owes something to the ultra violet portion of the sun's rays. Why not use it to purify drinking water? That idea has actually been carried out at Saint Malo, at Rouen and at Luneville, all in France.

The best commercial source is the mercury arc in which mercury vapor in a high vacuum becomes luminous as it conducts the electric current. The ultra violet cannot pass through the glass. Hence, the lamp tube must be made of clear quartz, one of the few solids transparent to these rays.

The light tube is a "pistol lamp," as it is called, because it is bent into a U-shape and enclosed in a quartz jacket as a protection against the cooling effect of the water. The pistol tube is immersed in the flowing water while the connections are outside the tank.

The capacity of apparatus now in the market varies from twenty gallons an hour to ten thousand gallons an hour or, by increasing the number of units, to any figure for large city water plants. An experimental plant in one American city forces the water through concrete channels two feet wide, three feet deep and twenty-six feet long, affording a contact period of thirty seconds with the ultra violet rays. The pistol lamps are spaced thirty inches apart, and in front of each is a baffle of wired glass in which a rectangular opening is cut to divert the water against the quartz tube.

The smaller types are used in sterilization of drinking water for homes, clubs, hospitals, factories, etc., purifying swimming pools, sterilizing water for ice plants and can even be found with armies in the field. The Austrian army carries a portable type on a motor car. In five minutes after starting the generator the soldiers fill their canteen with sterile and palatable drinking water. The household size is efficient and economical.

What Blood Pressure Means and How It Is Measured

IF for any reason the blood pressure is raised, the blood circulates more freely through the brain as well as through the other parts of the body, giving a feeling of buoyancy and confidence. The man who is working at a terrific rate, however, must have a high blood pressure, but if continued above a safe normal point, it will result in the "burning up" of his vital forces, resulting in many organic as well as nervous disorders.

High blood pressure does not always mean one and the same unalterable thing. It may be a sign that the arteries have stiffened to such an extent that the heart is taxed to pump the necessary volume of blood through the arteries and with sufficient speed. It may mean an improper condition of the blood itself—viscosity—the old-fashioned "thick blood" come to life again as a reputable scientific fact. It may mean that the heart has become too big for its job, as when an "athlete's heart," trained to push a big stream of blood, keeps on trying to do so when the demands of office work do not require it. It may also result from excessive pumping of the heart due to abnormal mental stimulation in the form of worry, or continuous mental or nervous strain.

A device for measuring blood pressure, an ingenious instrument called a "manometer," has recently been perfected. The instrument records the pressure of the blood on a diaphragm dial very similar to a steam-gage dial. The scale is divided into millimeters.

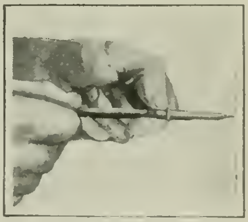
The apparatus, which is the invention of Dr. Thomas Rogers of Rochester, New York, is one of the most important surgical instruments devised in years, ranking with the pulmotor, stethoscope, and clinical thermometer. Its operation is comparatively simple, but its reading requires an expert. The best results are obtained when a stethoscope is used in connection with it.

The air-bag is first strapped on the subject's arm over the main artery, and is inflated with a bulb attached to it. The operator then adjusts a stethoscope to his ears and finds the pulse. The throbbing of the pulse against the air-bag is communicated through a rubber tube to the case containing the diaphragms upon which a vibration is set up. These vibrations, which are synchronous with those of the pulse, are translated into millimeters by the delicate needle of the dial.

Manometer being used in measuring a man's blood pressure

A Clean Way of Removing Pens from Their Holders

A DEVICE for readily ejecting a pen from its holder without soiling the fingers has been invented by Joseph H. Bremer of Tampa, Florida. His penholder terminates in inner and outer sleeves, which are slotted longitudinally from their outer ends. In this slot a pen-ejecting bent steel wire slides to push the pen along. The shank of the wire is formed into a ring, which encircles the penholder. To remove the pen the ring is grasped and forced toward the end of the holder, and the bent steel wire pushes off the pen-point and thus spares the fingers.



A bent steel wire ejects the pen

Straw bottle-casings and a tack-hammer made this pleasant thatched garden-house

A Summer-House from Straw Bottle-Casings

SHE was the thrifty wife of a restaurateur in a California suburb and the gardens about the establishment made it a point of interest for motorists from the city. The ambitious little lady thought that a summer-house among the palms and acacias would improve the grounds, but building material was expensive and so was expert carpenter hire. She was determined and practical. "If I will furnish half the building material, and half the labor, will you furnish the other half?" she asked her husband, and he agreed willingly to the plan and thought nothing more of it until he saw carpenters at work erecting a very light skeleton of a summer-house. It was a frame of the lightest and cheapest wood—a few slender uprights on a circular ground plan and flexible half-inch boards which could be bent about them in a circle, the posts spaced four inches with an allowance for a door and a small window. It was a half-day's work for two men. "But that is no summer house!" the husband exclaimed. "There is no shelter there from wind or sun. It's no better than an onion crate!"

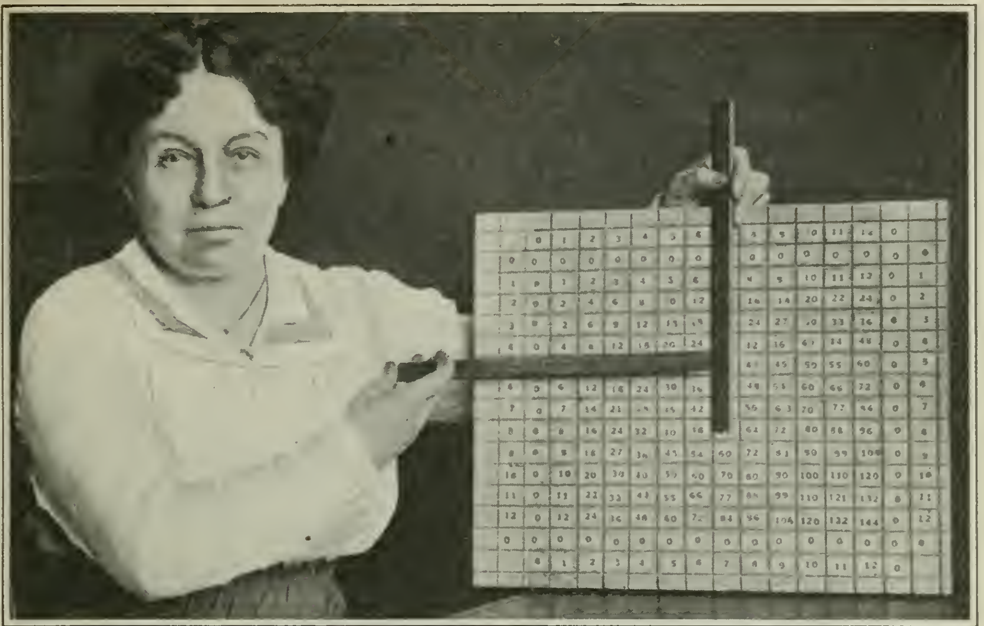
"Wait and see," rejoined his good wife. "My share of the summer house has not been contributed." She went down into the cellar. Presently she emerged, bearing an armload of what every one would call rubbish. The straw casings of wine bottles had been accumulating below for years, and her husband had planned to burn them some day. The straw was a nuisance, a fire menace, and a possible hiding place for rats. It proved to be anything but rubbish.

It was not damp or dirty, except for a bit of dust that could be shaken off. That clever wife immediately set about tacking the straw casings upon the frame of the summer-house. It was the lightest sort of work, just a tap with a tack hammer and the wisp of straw, bound by its strands of twine, was in place. The casings were overlapped like shingles, so as to shed a light rainfall, and the roof was treated in the same way, the peak being topped with half a dozen casings bound into a conelike ornament. When a round table and a few chairs were set inside the summer house, it turned out to be one of the most popular corners of the place.

A Water-Wagon in Actual Use

A REAL water wagon, with passengers, may be seen in the accompanying illustration. These men are not on the water wagon for moral purposes, but are engaged in towing huge rafts of lumber through the shallow water at Carleton Point, Prince Edward Island. One raft is visible at the extreme right of the picture. The great weight of lumber necessitates the employment of six horses, which have become accustomed to wading and seem to like it, especially in hot weather.

By means of this water wagon men and horses huge lumber rafts are towed through the waters of Prince Edward Island



The checkered chart is a new and painless device, which quickly teaches the mysteries of multiplication, division and subtraction to the most reluctant pupil

Learning Arithmetic With a Woman's Invention

THE reason we honor Miss Albertina Bechmann this month is because she has invented a painless way of learning the multiplication, division and subtraction tables.

Her invention consists of a board on which are printed rows of figures from 0 to 144. The rows are separated by grooves. If you want to find out what 6 times 4 is, all you have to do is to find the figure 6, at the top of the board, and the figure 4 at the side, and to place a ruler in the groove nearest 6, as shown in the photograph, and another ruler in the groove nearest 4. In the corner made by the two rulers you will find your answer, 24.

If you would divide 24 by 6, you place one ruler between 6 and 24 and the other ruler in the groove running at right angles to 24, and, presto! you have your answer, 4, at the outside end of the second ruler. Also, by Miss Bechmann's painless system, 8 times 0 is never 8, as many children think. It invariably shows that 8 times 0 is 0.

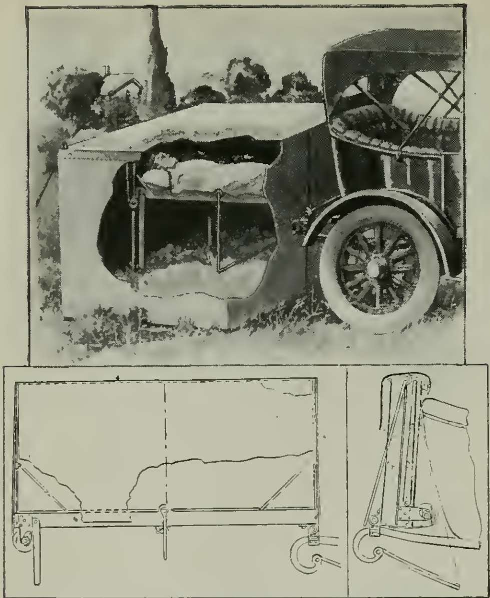
If you would know what 6 plus 18 is, you hunt up the 6 column, and underneath the 18 you will find your answer, 24. If you would subtract 6 from 24 you would find your answer, 18, right above 24.

Austria Exhibits Paper Substitutes for Cloth

IT was announced last November by the Austrian Ministry of War that paper vests and foot coverings had been received for the forces in the field, and that the officials should instruct the men that paper, as a poor conductor of heat, was an excellent protection against cold. Attention was also called to the hospitals that paper was a good substitute for fabric, and that cellulose wadding afforded a sanitary dressing for wounds.

Later, at the suggestion of Max Schuschny, an exposition of paper products designed as protection against cold and a substitute for cloth, was held. The invitation to exhibitors brought fifty, and within five days twenty thousand persons had visited the exposition. Of all the useful articles exhibited, perhaps the most important was the "Danish quilt," consisting of crumpled newspapers. These coverlets have been used extensively for hospital purposes in the royal palace of Austria.

Some Ingenious
For the



The bed can be set up in a few minutes and shelters the tourist from wind and rain

An Automobile-Bed for the Tourist

THE delightful independence of touring in an automobile can be improved upon by means of an automobile-bed. Wherever nightfall overtakes the traveler, he can make up his own cot and sleep in his own tent, completely sheltered from wind and rain and with no expense for a hotel room.

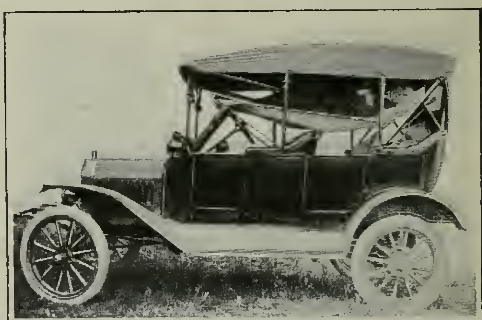
The metal frame of the bed is jointed in the middle; and a leg is attached at this point on either side. A cross-bar connects the legs, so that they will swing together when the bed is being folded up. One end of the frame pivots on a shaft secured to the side bars of the automobile, as shown in the illustrations. The two outer legs are pivoted to the frame.

When not in use, the legs are swung up against the frame; the outer half of the frame is folded over the inner half, or foot of the bed; and the whole lifted to an upright position against the back of the tonneau. Small ratchet wheels at each of the joints are provided for holding the legs in position and also for locking the entire frame when folded up. A light metal framework is provided to be set up over the bed. Curtains are stretched over the frame to form a sort of box-tent, as shown in the illustration.

A New Ford Folding Bed

AN entire bed equipment which weighs but fourteen pounds, and which may be folded and packed away, with the exception of blankets and comforters, in a tool box, is the latest thing devised for Ford owners who wish to avoid hotel bills. The equipment includes a piece of strong canvas, two poles or iron bars for spreaders, one for the foot and the other for the head; four half-inch iron rods for supports leading from the car-top supports to the four corners of the canvas mattress, and four ordinary straps with buckles.

No changes need be made in the car other than to put two brass or iron rings in the dash to which the front straps are fastened. The half-inch rods resting at opposite angles on the car-top supports hold the canvas mattress above the seat tops, thus giving ample room beneath for "lower berths" for the children, while the straps running from the four corners of the mattress to rings in the dash and rings in the rear are buckled taut to keep the mattress from sagging. The bed is more rigid, due to this method of securing it, and it will easily support two grown persons.



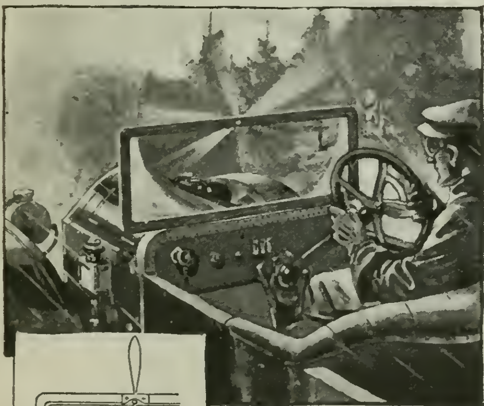
This car may be truly nicknamed "The Flying Bedstead"

With or without a tent the bed equipment comes in handy on touring trips. For instance, it may be used as a lounging hammock by attaching short ends of rope at either end of the canvas bottom, or it may be used as a table-cloth.

New Accessories Touring Car

Rain Protector for Automobile Wind-Shield

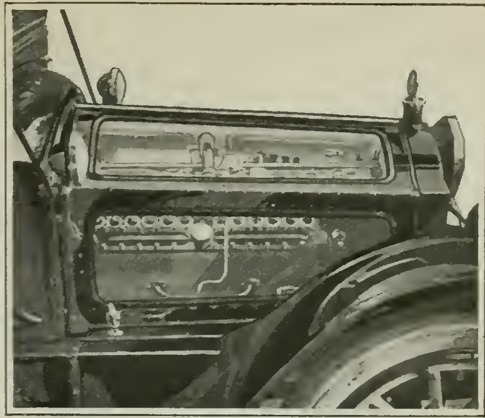
WHERE a wind-shield is used for the front of an automobile, the driver's view is dimmed by rain falling upon the glass. This is often a great drawback in running the car. Various means have been suggested for keeping wind-shields clean. The accompanying illustration shows one which has at least the merit of originality. A rotating propeller is used to drive off the rain drops. It is claimed that this is accomplished effectually, at the same time not obstructing the view, for it is a well-known fact that one can look through a rapidly rotating propeller.



This propeller blows the rain away from the wind-shield

A Handy Automobile Grease-Gun

A NEW grease-gun which saves the automobile man trouble when his machine needs lubricating, has been placed on the market. It consists of a can of grease. Attached to its side is a pump gun which pushes a quarter pound of grease into the casing every time the pump is pulled up and pressed down again. To prevent the grease from escaping when the gun is not in use, a long rubber hose with a patent stopper is provided.



With his hood made of tough glass, the driver can examine his motor while speeding along the road

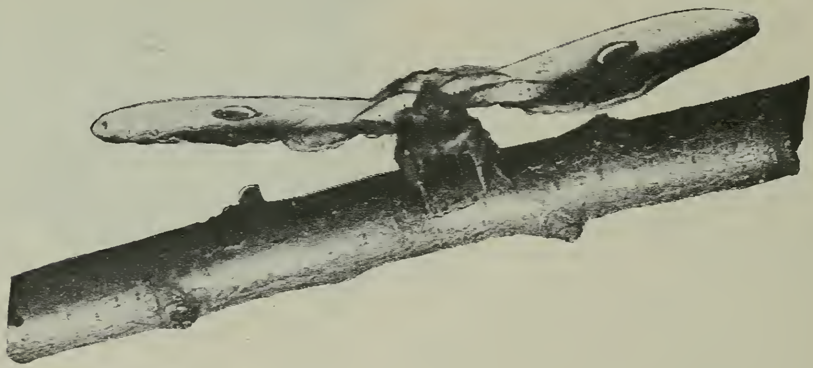
A Glass Hood for Automobiles

USEFUL and practical is the automobile glass hood built recently by Earl C. Anthony of Los Angeles, California. True, hoods of isinglass have been used, but they are easily broken and destroyed. This creator of novelties realized this fact, and as a result of his determination to eliminate this drawback came the glass "machine house."

With one stroke a quarter-pound of grease is forced into the casing

Chasing Butterflies for Money

By J. McDunnough



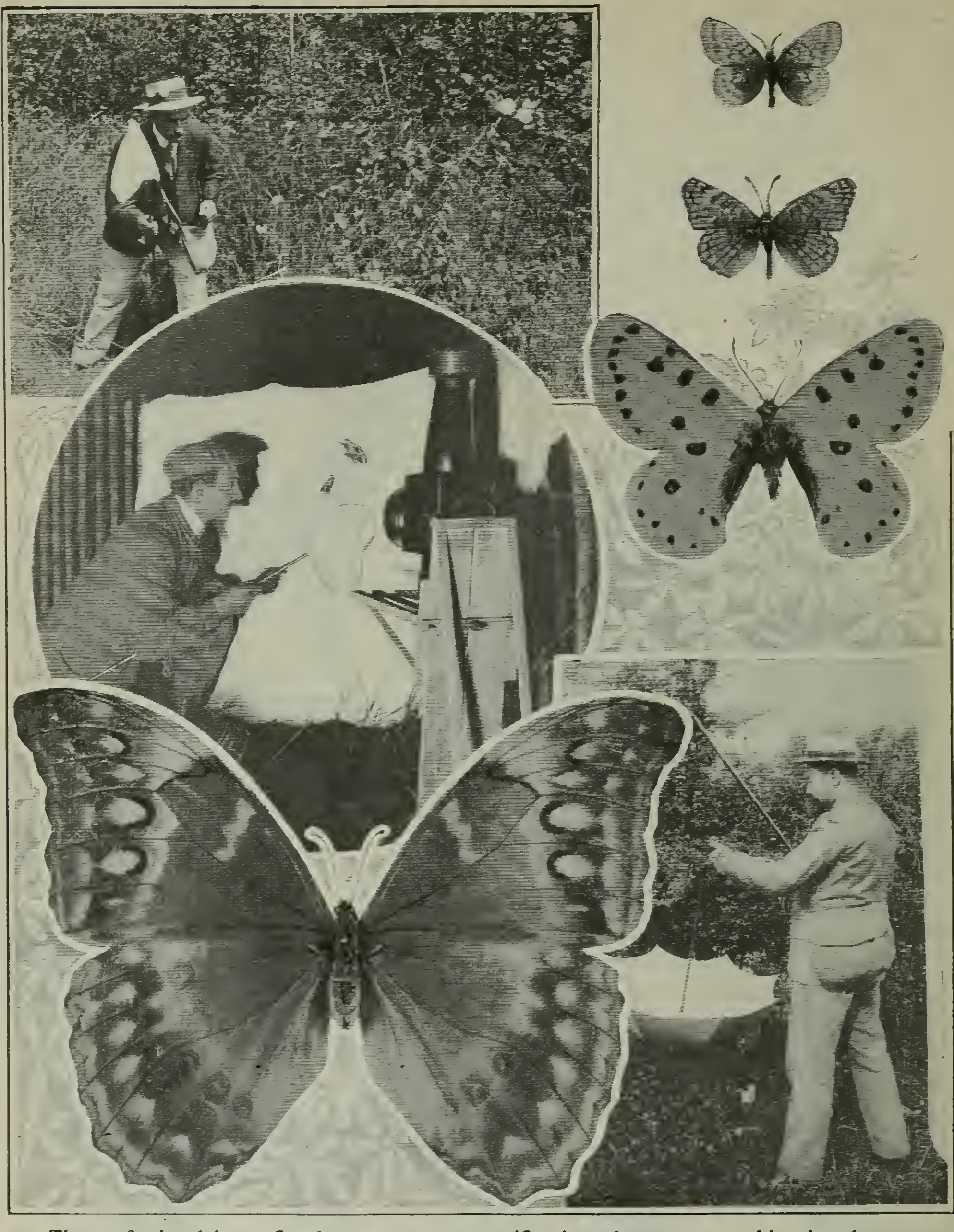
MORE or less periodically a lurid account crops out in the newspapers to the effect that some millionaire, usually a member of the Rothschild family, has paid a fabulous sum for a butterfly—a sum ranging anywhere, according to the vividness of the reporter's imagination, from five hundred dollars to ten thousand dollars. The effect on the average reader is either to cause a sneer of pity that anyone, even a millionaire, can be such a fool as to part with so much money for so frail and useless an object or else to create the impression that it is simply necessary to go out on the front porch or into the back yard with a hat or broom or makeshift net, knock down some unwary member of the butterfly family which happens to stray within reach, impale it on a pin in a cardboard box and ship it post haste to the aforesaid millionaire in order to receive by return mail a substantial check.

These newspaper tales seem to have a common origin in the fact that some twenty or thirty years ago an expedition to one of the islands of the Malay Archipelago was financed by a member of the Rothschild family. One of the prime objects of this expedition was to secure specimens of a large butterfly of a pure black color of which only a single specimen was known at the time. In this the collectors were perfectly successful. Besides securing specimens of the species in question, however, the expedition brought back a vast quantity of other material of great scientific value. The total expenses were doubtless considerable, probably well above ten thousand dollars; but it was not correct to assert, as it was asserted at the time, that this sum had been expended for a single butterfly. It was not spent even for specimens of a single species of butterfly.

The variety of butterflies is not as a rule due to the fact that there is actually a great scarcity of certain species in Nature, but rather because these species frequent inaccessible regions or countries. Those brilliant metallic blue butterflies of South America, the giant Morphos, generally fly in the tree tops of almost impenetrable jungles, making their capture on the wing very difficult and almost impossible ; today, however, collectors armed with field-glasses search certain trees for the caterpillars which can often be secured in good numbers without any more difficulty, after they are once located, than that of climbing the tree and cutting off the twig on which the caterpillar rests. By confining these larvae in jars or cages with a sufficient supply of the food plant they undergo their transformation just as well as or even better than in a natural state. In due course of time the butterfly emerges and is thus secured in much more perfect condition than if it had been caught on the wing. As a consequence of the increased supply the price of these species has dropped tremendously during the last twenty years, many of them being today obtainable at the cost of a few dollars per specimen. The same thing is true of the brilliant Ornithopteras of the Indo-Malay region, those huge butterflies with a wing expanse of from five to eight inches, and whose color is a combination of velvety black with either green, yellow, orange or blue. Fifty years ago in order to secure these species it was necessary for a collector practically to take his life in his hands and penetrate unknown regions inhabited by fierce head-hunting tribes; today, owing to the advance of civilization and the improvement in means of transportation, numbers of the species appear on the market each year; the natives have been trained to hunt for the caterpillars and breed perfect specimens of the insect, and whereas in former years collectors would regard even tattered and torn specimens as almost priceless, today for a few dollars a specimen perfect in every respect may be purchased.

In the Palaearctic region all species of butterflies from Tibet have always commanded a high price owing to the

Many butterflies are easily raised in captivity from cocoons picked off trees



The professional butterfly chaser uses every artifice in order to capture his winged prey. The time-honored net is supplemented by light at night, in order to apply practically the effect of flame on moths. An umbrella is a handy receiver for cocoons shaken from bushes

virtual impossibility of European collectors penetrating into the country; of late years, however, the Catholic missionaries who have succeeded in establishing themselves in this region have been instructed by Mr. Charles Oberthur of Rennes, France, the owner of the second largest private collection of butterflies in existence, in the capture of insects and they in turn have trained some of their native converts. Through their agency large numbers of species which formerly were of extreme rarity or even unknown to science have been obtained.

Another region which furnishes numerous interesting and highly prized butterflies is the high mountain ranges of Central Asia, the Panier Range and the Thian Shan Mountains. Formerly species from these localities were scarcely known outside of Russian collections, but about eight years ago they began to appear on the market in enormous quantities. A Russian who had been commissioned by the Hagenbecks of Hamburg to secure live specimens of the snow leopard occupied his spare moments and those of his men in the early morning hours by picking the half-frozen butterflies off the flower heads on which they had rested over night. To judge by the quantities he secured by this method the region must have been a veritable Eldorado for the butterfly collector. As a result of his activities several species which formerly commanded a price of from ten dollars to twenty dollars a specimen became an absolute drug on the market and were almost given away.

Two Hundred Dollars for a Glittering Butterfly

Of course there still remain some rare exotic butterflies for which possibly a wealthy collector might be willing to pay from one hundred dollars to two hundred dollars a specimen, but such species can almost be counted on one's ten fingers; and it is safe to say that within the next fifty years even the price of these will be considerably reduced, for as soon as collectors become acquainted with their habits and haunts and succeed in breeding them the supply will at once increase.

In our own country, where half the indigenous species of butterflies known to science have been described within the last sixty years, there is probably no species for which more than five dollars a specimen would be paid, and the majority of species could be purchased for less than one-tenth of this sum; the rarest ones are those frequenting the desert regions of the Southwest and the great barren lands of the Far North. The inaccessibility of these regions is again the cause of the rarity, for the very fact that they have remained unmolested in their haunts by man and his civilization is proof enough that at certain seasons they should be found in large numbers.

In this connection, and as an illustration of the contention, the following story is told at the expense of one of the best known private collectors in the country. In the early eighties a collector brought back with him from Arizona two or three specimens of a new species of butterfly which he had obtained at considerable risk to life and limb by climbing some precipitous crags around which they were flying and hanging there by toes and finger nails until an unwary insect came within striking distance of his net. For years no further specimens could be obtained and finally, after making an unsuccessful trip to Arizona in search of the species our collector let it be known throughout the district that he would pay two dollars a specimen for all caught and brought to him. Imagine both his delight and consternation when a native son arrived one fine morning with over one hundred specimens of the long sought species which he had captured with the greatest ease congregated around a moist spot on the ground in some remote canyon. It is said the collector kept his word and purchased the specimens, but needless to say the offer no longer holds good.

When one considers that the number of private individuals willing and able to purchase specimens is very small and that further there are seldom any repeat orders after a small series of specimens has once been obtained, it stands to reason that as a commercial enterprise butterfly collecting is less attractive than selling clocks. On the other hand as a delightful means of spending one's spare moments it cannot be too highly recommended; the eye is trained to observe, the body is invigorated in the chase, the brain cleared of cobwebs by the fresh, pure, country air, and finally there is always the possibility of securing a little extra pocket money by the disposal of rare species which one has succeeded in running to earth.

"Once Over" and the Road Is Done

THERE has been put to work on the roads in the vicinity of Philadelphia, a new and interesting piece of road-making machinery, which is attracting attention because it performs several operations at once. After one passage over a poorly-built or worn-out piece of roadway, the surface has been planed, scarified, rolled and left in good condition for use. The "once-over" is all that is necessary at the time. If a roadway is treated by this machine two or three times at intervals during the early part of the season it is in reasonably good shape for months of service.

Two treatments of the roadway during the season keep it in excellent condition

The machine, necessarily heavy, weighs about eighteen thousand pounds. It is drawn by a traction engine of from twenty-five to forty horsepower, according to the character of the work to be performed. There are two low-hanging blades on either side; as the machine passes along, these scrape off the surface of the road at the sides, bringing the loose earth to the center. The scarifier cuts off the hummocks in the center of the grade, which is then packed down hard by the action of the roller. A feature of the roller's work is that the crown of the road is as nicely rounded as if done by hand.

A traction engine pulls the machine which performs the three functions of scraping, cutting and rolling

Drainage is essential in road maintenance, but it is impossible where there is a thick growth of vegetation at the sides of the road. Three trips over the road during the spring and early summer not only place it in good condition, but keep down this vegetation for the entire summer.

The apparatus will make a roadway thirty feet wide or may be adjusted to one-half that width. While its work is most effective in rejuvenating an old road it may also be used for building new roads in connection with an ordinary tractor-blade grader.

Some Record Dredging at Panama

THE *Cascadas*, the largest all-steel dredge in the world, which made three new high records for dredging in the Culebra Cut at Panama, can remove thirty-five thousand tons of material with ease every working day of twenty-four hours. The heaviest train ever hauled by one locomotive, from Baltimore to Philadelphia, consisted of fifty-five cars with four thousand four hundred and one tons of coal. The output of the *Cascadas* on one day, however, weighs more than the contents of eight such trains. Furthermore the *Cascadas* is an all-American product, designed, constructed and erected in this country by a company which is the largest manufacturer of its kind in the world.

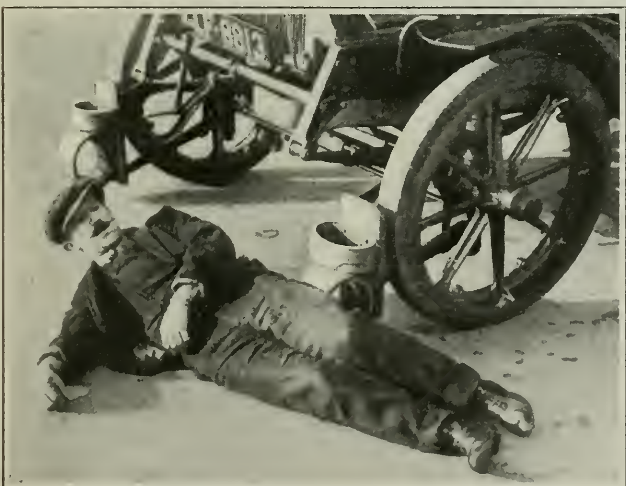
A Fender for London Omnibuses

THE darkening of London streets, in the presence of hostile Zeppelins, has given rise to a new danger—that of being run down by automobiles. Many such accidents have already been successfully averted by a new device which is attached to the front of the automobile. Two heavy arms project forward from the axle and support a piece of wood two feet long and one foot wide, placed on end, face forward, directly in front of the wheel.

At the base of this guard is a rubber attachment, consisting of a short length of large rubber tubing, the axis being horizontal. Above is a similar piece of rubber of smaller diameter, its axis placed perpendicularly. These rubber pieces are further strengthened by curved metal pieces on their inner surfaces next to the board.

Whichever way the wheels turn, the guards remain in the same relative position, since the projecting arms are attached to the rotary portion of the axle next to the wheel. This attachment, simple as it may seem, effectually prevents running over a pedestrian by pushing him out of the way.

The exigencies of war have given rise to many such safety expedients. The danger from darkened streets is only one of the many problems to be dealt with. Even more serious difficulties have to be met on the continent.



The rubber guards strike the body and gently tosses it to one side away from the heavy wheels

A magnet tied to a string picks up clips and pins and thus saves money

He Did It With His Little Magnet

GATHERING up the fragments, as the Bible tells us, is a sure way to a life of plenty. Even so elusive and ephemeral a thing as the soap bubble is being conserved in these days of scientific management and office efficiency.

Even the office boy has heard the call of thrift, and has answered it by attaching a string to a magnet and pulling it over the office floor and pushing it into inaccessible corners, the result of which has been an acquisition of pens, pins, paper clips and numerous office accessories which would otherwise be lost.

Why a Featherduster Is Like a Fly

ANYBODY can see a feather duster in the hands of the housekeeper, but it takes a microscopist to discover that the fly uses a similar duster in the characteristic and amusing performance known to children as "fiddling." From its own viewpoint the house-fly is neat and cleanly, but it cares not where it scatters its dust, nor how much it inconveniences and menaces human beings. The fly dusts its body with praiseworthy industry and continuity, passing one leg over the other with a peculiar rolling motion, using each like a featherduster, and the leg being dusted as another duster.

Under the microscope, the legs, not only of the house-fly but of others related to it, are seen to be covered with hairs and bristles, which under low power, give the entire leg a feathery appearance. In some flies even the terminal claws are hairy. The fly is evidently annoyed by the dust, and much of its spare time seems to be devoted to the fiddling process. A microscopist who wants to prepare a fly for microscopical study usually allows it to develop under a bell glass, or in some other condition in which the dust cannot soil the specimen. The accompanying illustration of a fly's fiddling legs show, even under the highest power of the microscope, not the slightest particle of dust, because the fly was prepared immediately after such transformation. The purpose of the picture is to display the feathery legs in their fiddling position, free from dust. The freedom from dust is, in this instance, due to the skill and ingenuity of the microscopist, not to the diligence of the fly.

With these featherduster-like legs, the fly spends much of his time freeing himself from particles of dust

The moral of the picture: A feather duster in the hands of a diligent housemaid can spread more disease germs than a hundred flies with their microscopic feather dusters, and the mechanism is the same. Campaigns against the fly should include the duster-wielding housewife. Placards should be exhibited with pictures of a fly and a housewife and with this legend: "These two animals spread disease with their featherdusters."

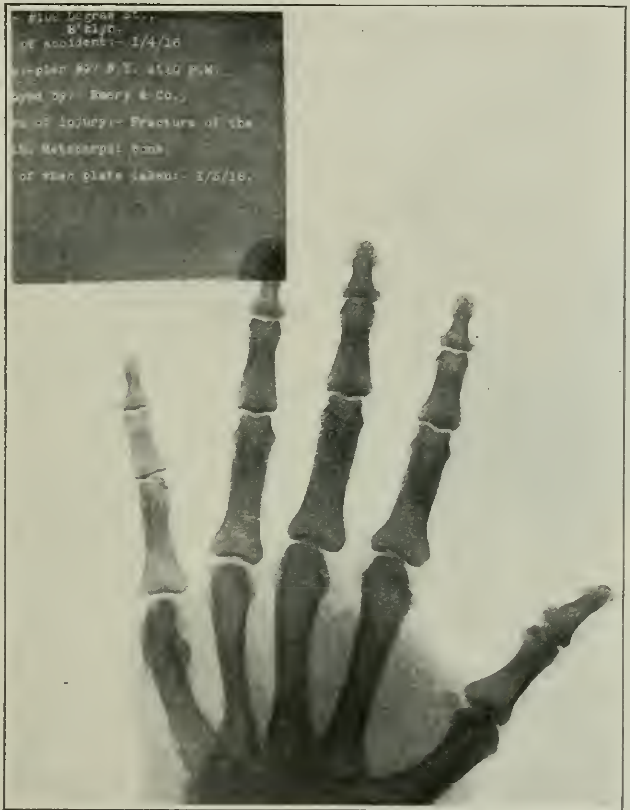
Paraffin Protects the Labels of Chemical Bottles

IF the amateur chemist will paint a thin coating of paraffin over the labels of his reagent bottles with a fine brush he will be saved much time and bother in replacing labels. The paraffin will prevent any drops of reagent from attacking and badly discoloring the labels. Most reagents do not act on paraffin. The paraffin coating should extend about one-quarter of an inch beyond the edges of the label.

X-Rays and the Law

X-RAY pictures have been used as evidence in law suits brought for personal injuries in order to show the injured parts clearly. To mark the negative for identification, lead letters (opaque to X-Rays) have been used, arranged at one side of the part photographed. This method did not eliminate the possibility of fraud, and hence the photographs so marked were not always acceptable to the courts. There was no way of proving that the name and date on the picture were not forgeries. As a result some fifteen States have passed laws which prohibit the courts from receiving an X-Ray photograph as evidence unless the plate or card on which the name, address, date and remarks are written is placed either under or over the parts injured. Suppose the bones of a hand are broken and the fracture is to be photographed. It will be necessary under the law in question, to place a label directly on or under the injured part in order to make the photograph acceptable to the court. The lead letters heretofore used cannot be arranged in this manner; they hide the fracture and thus vitiate the evidential value of the photograph.

Dr. Aurelius De Yoanna, Brooklyn, New York, has invented and patented a method of authenticating X-Ray plates which will allow him to mark the injured part and arrange a label directly on or beneath the injured part. It is impossible to "fake" the photograph. After the photograph has been taken, the fracture is distinctly seen through the label. Thus the method overcomes the objection to the lead letters heretofore employed, and at the same time the various State laws are obeyed.



To be used as evidence in an accident case, an X-Ray photograph must have a label which could not possibly have been forged

The label is so pliable that it may be used on curved parts of the body and in connection with celluloid films or plates. When used with a celluloid plate the label may be placed on the plate or film or on the injured part and the X-Ray taken in the usual manner.

The label itself is made of lead, tinfoil, or any other material opaque to X-Rays, so that when written on by a pencil, pen, stylus, typewriter or other device the writing will become transparent to the X-Rays. Hence, the written or printed matter on the label may be easily read, and the fracture beneath the label carefully studied. This label complies with the law and at the same time does not injure in any way the finished photograph.

Motor-Truck's Energy Runs a Pipe-Threader

HUNDREDS of arc lamps have been transferred from wooden pole supports to the structural iron work of the elevated railway, in Philadelphia. To do this, several miles of pipe had to be threaded and cut to varying sizes. The cutting and threading work to be done advantageously had to be done as the work progressed.

Out of this necessity a novel motor-driven pipe-threader was built by the superintendent of the electric company. A portable truck was equipped with a screw-cutting machine, driven by electric motor. The energy for its operation was

Current from the truck furnishes power to the screw-threading machine

furnished from the storage batteries of the truck used by the company for the transportation of men and material. The pipe-cutter was set up at any desired location, the necessary wire connections made, and it went to work. It was moved along and no time was wasted delivering pipe back and forth between the work on the street and the company's shops.

Oiling the V's on a Lathe

TO keep the V's of the lathe bed oily and in condition, a piece of heavy felt should be glued over the V's on the four wings of the carriage. The felt should be almost saturated with oil each day. As the carriage moves back and forth over the V's, the oil will spread over the surfaces in contact and emery and grit will be prevented from accumulating between the carriage and the lathe bed.

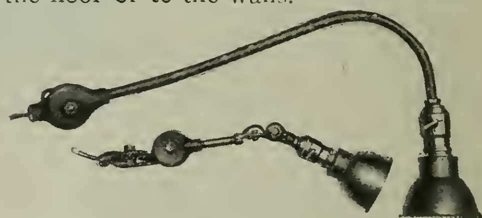
Slow-Setting Plaster of Paris

THE rapidity with which plaster of Paris becomes hard when mixed with clear water in the ordinary manner often proves to be a very objectionable feature, especially if one desires to do several little jobs with one mixing of the plaster. To overcome this fault, if the plaster is mixed with water to which has been added an equal quantity of strong cider vinegar the plaster will remain soft and workable for a very much longer time than when mixed with water alone.

Adjustable Light-Holders for Factory Illumination

ROWS of machines are peculiarly hard to illuminate economically without some such arrangement as is provided with a new adjustable holder which has just found its way into the market. By its use all machines can be lighted to save current and to prevent eyesight troubles on the part of the operator.

The new device is made of steel tubing and equipped with one or two joints which make the light adjustable. Long rows of machines, such as sewing machines, linotypes, drafting rooms, and the like, are individually lighted by standards with the globe in a steel shade, and all the wires lead to a long conduit. Where tables are not permanently established the standards can be fastened to the floor or to the walls.



These adjustable light holders will solve many a difficult problem in factory lighting

For Polishing Furniture

THE polish generally used on mission furniture is the dull wax finish. If, instead of applying only wax, alternate coats of boiled linseed oil and wax are used, a polish will be obtained which is brighter and more durable than the ordinary finish.

Making the Burglar Chase Himself

REASONING that the easiest way to dispose of a burglar is to scare him with the thing he most fears, and that is a pistol, a Chicago man, R. C. Mayberry, has devised an apparatus which will fire off cartridges and do the scaring automatically at the very moment the burglar begins work.

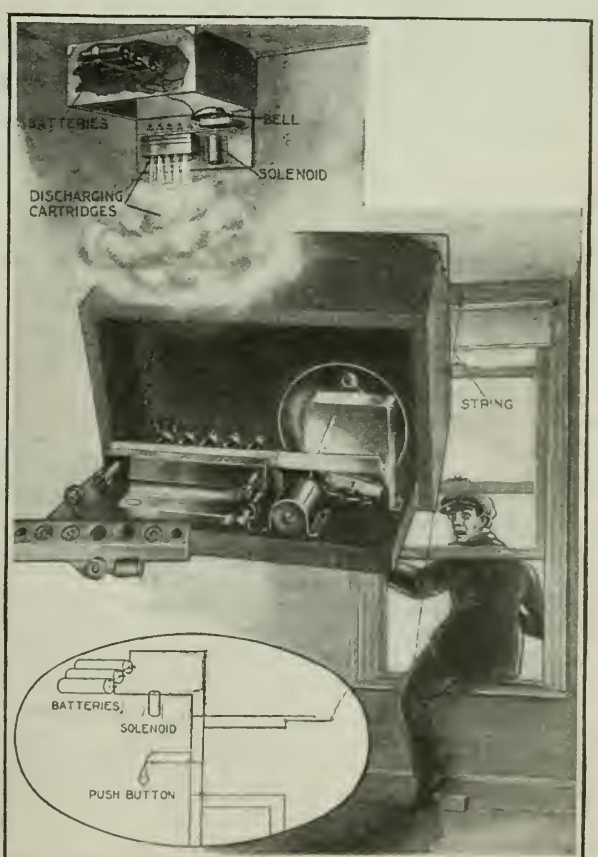
The burglar unwittingly sets off the contrivance himself and does his own frightening, as it were. This is accomplished through the aid of numerous push-buttons or other switches, located at points along the path a burglar must pursue in entering a building. Thus, the raising of a window will close one of the switches and cause the contrivance to operate. If, once inside, the burglar should stumble over a string stretched across his path or step on a loose board, a fusillade will surely greet him. As soon as he operates one of the numerous switches, his presence is promptly heralded far and wide by powder, smoke, and noise.

The device is in part mechanical and in part electrical in nature. Housed in a small box about five inches square and ten inches long, it is preferably suspended from or attached to the ceiling of a room. Hence, it is out of the way and less accessible to would-be tamperers.

The mechanical part of the apparatus consists of a small clockwork mechanism which rings a high-pitched bell on the principle of an alarm-clock. The slow unwinding of the spring as it operates the bell, causes a cam-like contrivance to revolve, at each successive turn releasing a firing-pin on one of five .44 blank cartridges located in a metal bar nearby.

The electrical part of the mechanism comes into play in starting. The burglar's closing one of the switches causes current from dry-batteries, located within the box, to be sent through a small solenoid. This operates a small bolt-lock and permits the bottom door of the box to drop down, at the same time starting up the clockwork with its resulting exploding of the cartridges and ringing of the alarm-bell. As the bottom door drops down smoke from the cartridges escapes.

The burglar either departs before he has had any opportunity to secure loot, or else leaves so many clues behind in taking his ill-gotten goods along that his ready apprehension later is an easy matter. The robber has no means of knowing, of course, whether the shots are coming from a mechanical contrivance or from an outraged householder's revolver. He never stops to investigate.



Five blank cartridges are fired in rapid succession when the window is opened

The only part of the craft which escaped undamaged is one of the propellers. An idea of its size may be had by comparing it with the spectators in the distance

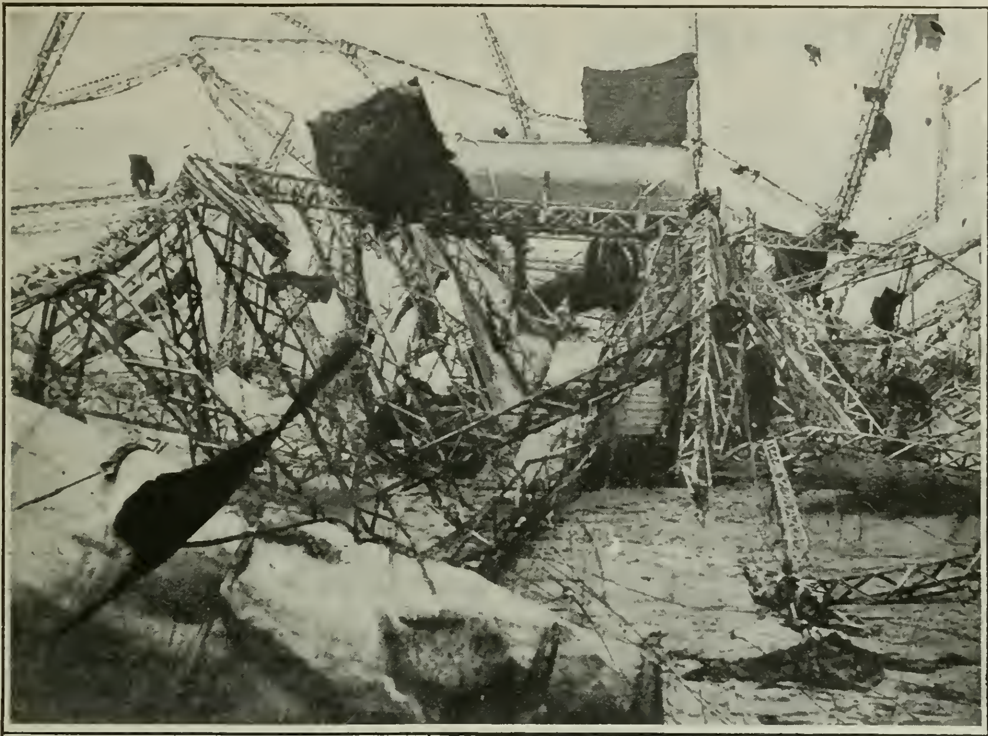
Punctured Zeppelins

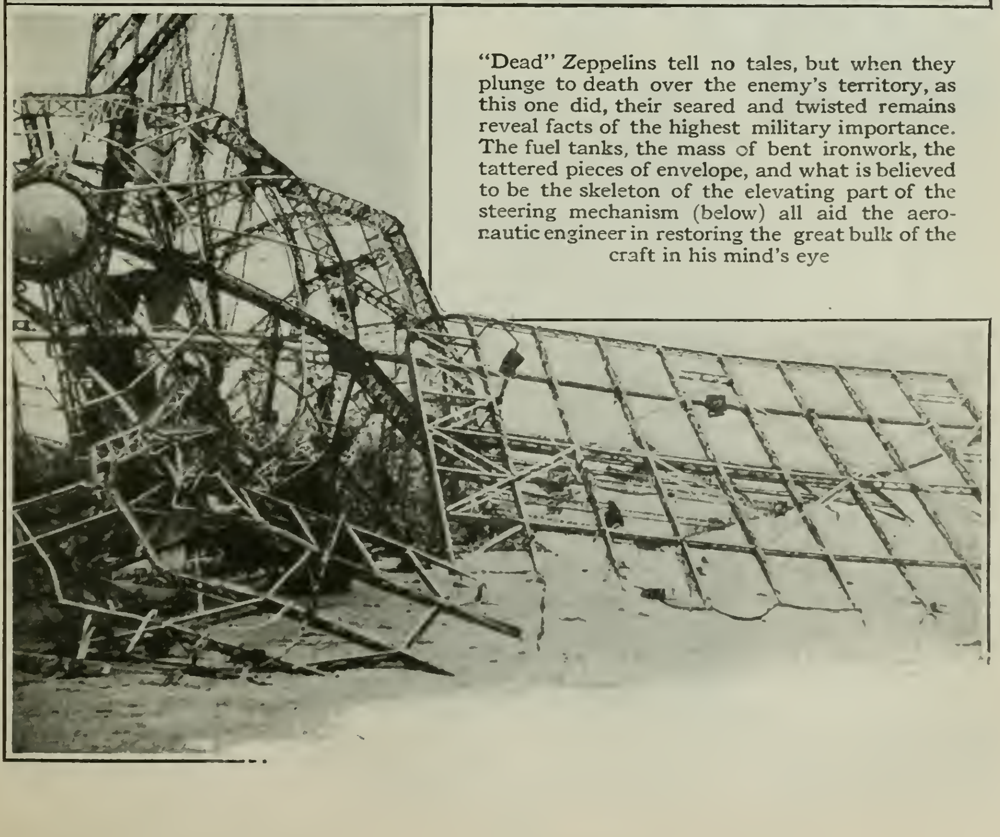
"SOMEWHERE in England" there lies the mangled and crushed remains of what was once a bomb-dropping Zeppelin. In the mass of wreckage large fuel tanks, twisted net-work, a propeller which escaped un-scathed in its downward plunge, testify mutely to its colossal size. But as to the number of the craft, the identity or size of its crew, and the location of the spot which unwittingly proved to be its grave, no one, save those in authority, knows. The hand of the censor is on the mouth of every eye witness.

As far as the actual capturing or enforced landing of Zeppelins over enemy soil is concerned the campaign waged by Germany has been a notable success. With the possible exception of the "L 77," which was brought down near Revigny, France, the Allies have little definite recent information of the construction and features of these dread-noughts of the air. The "L 77," French discovered, possessed a fifth propeller which was attached to the stern gondola and which was driven directly from an additional engine. Hence, there were five engines in all, capable of developing a total of one thousand horsepower. The crew is believed to have numbered twenty-three men. About one and a half tons of bombs were carried. One official described the bomb-releasing device as consisting of a hook which was opened by an electrical apparatus controlled by a push-button in the central cabin of the airship. No armament heavier than machine-guns was carried.

The most recent attempt to salvage a marooned Zeppelin was made by the English when the "L 15" was forced to land off the Kentish Coast after it had been damaged by an anti-aircraft battery. After the crew had been rescued a trawler attempted to tow the water-logged airship to harbor, but the dead weight proved too much and it sank. England was thus thwarted in an attempt to examine at her own time and convenience the character of the aircraft used against her.

From such airships as have fallen into the Allies' hands, however, comes the information that Count Zeppelin is breaking away from the pencil form so long established by him and that he is building his new destroyers in a stream-line shape.





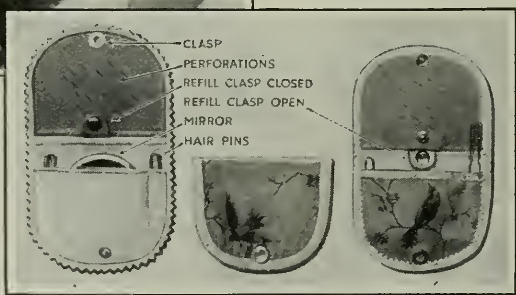
"Dead" Zeppelins tell no tales, but when they plunge to death over the enemy's territory, as this one did, their seared and twisted remains reveal facts of the highest military importance. The fuel tanks, the mass of bent ironwork, the tattered pieces of envelope, and what is believed to be the skeleton of the elevating part of the steering mechanism (below) all aid the aeronautic engineer in restoring the great bulk of the craft in his mind's eye

The Purse Powder-Holder

LAUGH as we may at woman's vanity, it is nevertheless a weakness which has been so greatly commercialized and traded on that thousands of manufacturers are maintaining large and profitable plants solely for the making of such toilet novelties and toilet accessories as powder puffs, cases for powder puffs, mirrors, rouges of all kinds, etc.

Time was when a few women—those with more vanity or perhaps more temerity than others—carried, for the purpose of applying powder to their faces, a small square of chamois in the center of which reposed some loose powder. The rest either did not use powder or, if they did, dabbed it on their faces only in the privacy of their boudoirs. This method was unsatisfactory and inconvenient; the loose powder was spilled and wasted as it was applied. An ingenious and far-seeing manufacturer then put on the market a small, round, cotton or wool contrivance which was used in connection with the square of chamois and loose powder. A decided improvement, this proved a boon to the fastidious lady who wished to repair the ravages of an afternoon's shopping to her complexion before she reached home. Still, its use also entailed waste of powder as well as the inconvenience of carrying about on one's person a bulky package from which the powder persisted in leaking into the purse or pocket where it was carried.

At last a very compact and useful little novelty has been invented which not only combines facilities for carrying powder, but also provides compartments for the mirror and hairpins, so necessary in fastening veils, stray locks, etc.



This compact little case contains a mirror and hairpins, besides the chamois powder-puff. The powder cannot spill out of its container, yet it is always ready for use

Half of the little case is made in a pocket form to hold the powder, with a small opening at one side which is closed with a clasp. The inside of this half—that is, the side applied to the skin—is made of chamois slashed or perforated so as to permit the powder to sift through easily but without waste. The other half, which folds directly over the puff side, serves as a preventative for the leakage of powder and also provides three little compartments, one large one for a mirror and two smaller ones for hairpins. When not in use both sides are held together with a clasp fastener, so it makes a flat and compact arrangement which may be very easily carried in the purse or pocket.

Hazards of Motion-Picture Acting: Real and Faked

By E. T. Keyser

SOME people maintain that a camera will not lie. They are correct. A camera shows exactly what happens; but if you place the wrong construction upon what you find in the picture that is entirely your own fault.

If, in a screen comedy, an automobile proceeds casually to ascend the front of a skyscraper, don't miss the remainder of the reel by rushing to the box office to enquire the make of the machine. Perhaps it has not such a very good hill-climbing record after all. Had you watched the filming of that particular scene you would have observed that a representation of the skyscraper's front elevation reposed flat on the floor and that the automobile traveled over it in the usual manner, while, above it, and with lens pointed downward, the motion-picture camera was recording the fact.

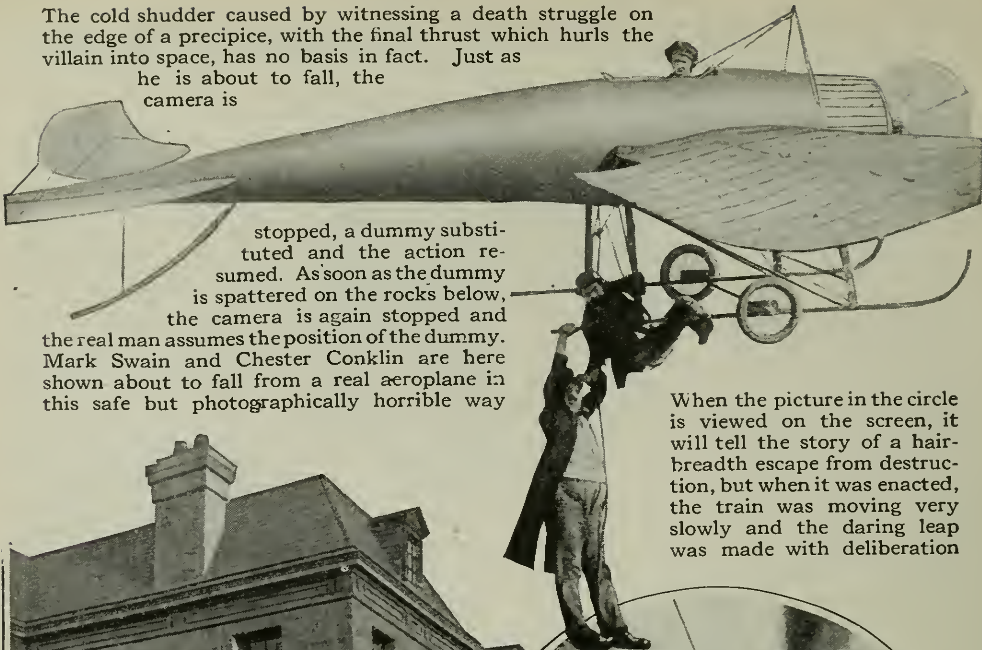
A most wonderful exhibition of athletic prowess, as evidenced by a swimmer's ability to jump from the water to a springboard ten feet above, was produced by the simple method of having the aquatic Samson run backward along the board and jump off backwards. Then the film was run through the projecting machine reversed, presenting indisputable evidence that the flying fish of the tropics had found a human rival.

Speaking of jumping, have you noticed the effortless manner in which comedy characters lightly vault to the top of a wall which would have baffled the crack pole-vaulter of your old college team? The actor is photographed while making a short jump from the ground. The cameraman ceases grinding while the jumper ascends the wall via a ladder, placed out of range of the lens. Then the actor jumps down. The second "take" is reversed and joined to the first, thereby showing the superiority of knowledge to training.

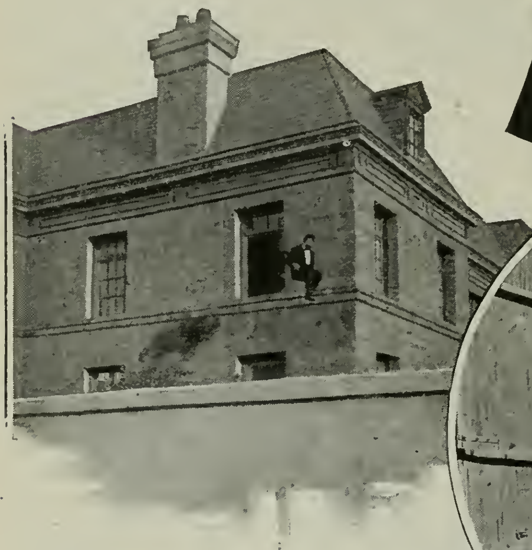
But it is not in comedy alone that the ingenuity of the cameraman and of the cutter is shown. Nellie, the little daughter of the engineer, wearied by a long day's quest of the elusive buttercup, goes to sleep on the railroad track, with her downy cheek pressed close to a fish-plate. Papa, driver of the crack flier, with the Limited in tow, rounds a curve and sees with horror his angel in the path of the iron monster. To stop the train is impossible. Must Nellie die! Perish the thought. With an agility bespeaking long practice in saving little Nellies, papa climbs forward on his engine, reaches the cow-catcher and, just as its cruel bulk is about to crush out the fair young life, leans over and triumphantly raises his child in his strong right hand and out of harm's way.

Helen Gibson playing the leading role in a breathlessly exciting railroad drama

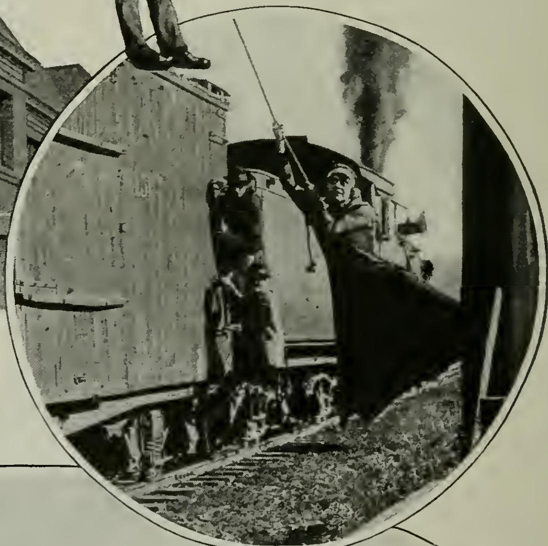
Before complaining to the S. P. C. C. of the reckless manner in which children's lives are



The cold shudder caused by witnessing a death struggle on the edge of a precipice, with the final thrust which hurls the villain into space, has no basis in fact. Just as he is about to fall, the camera is stopped, a dummy substituted and the action resumed. As soon as the dummy is spattered on the rocks below, the camera is again stopped and the real man assumes the position of the dummy. Mark Swain and Chester Conklin are here shown about to fall from a real aeroplane in this safe but photographically horrible way

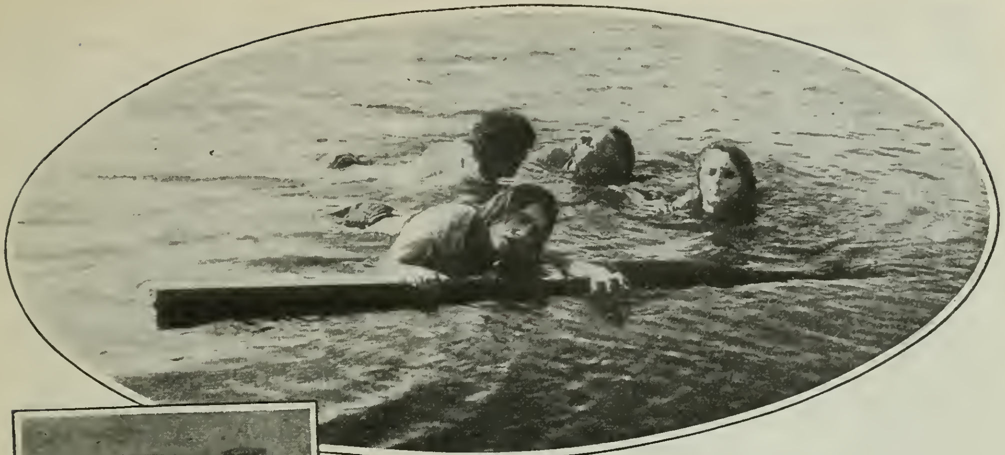


Above, a leap for life. This jump was not faked

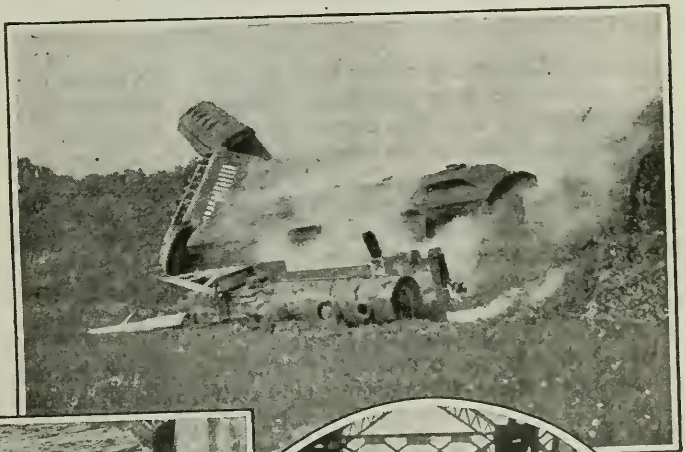


When the picture in the circle is viewed on the screen, it will tell the story of a hairbreadth escape from destruction, but when it was enacted, the train was moving very slowly and the daring leap was made with deliberation

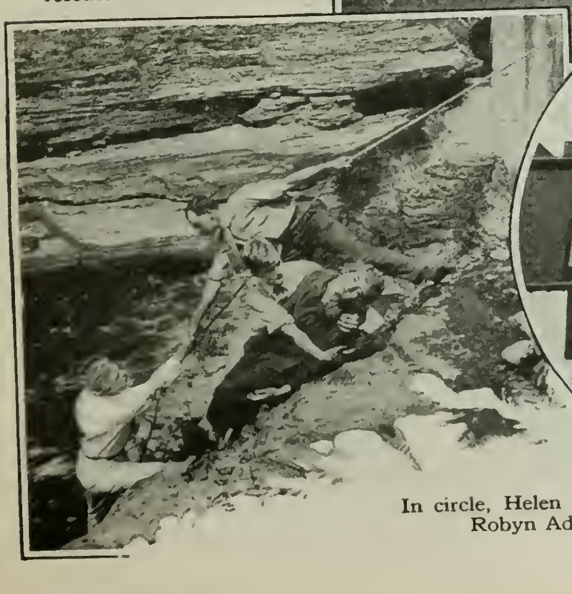
A wrecked bridge makes a good setting for a film story

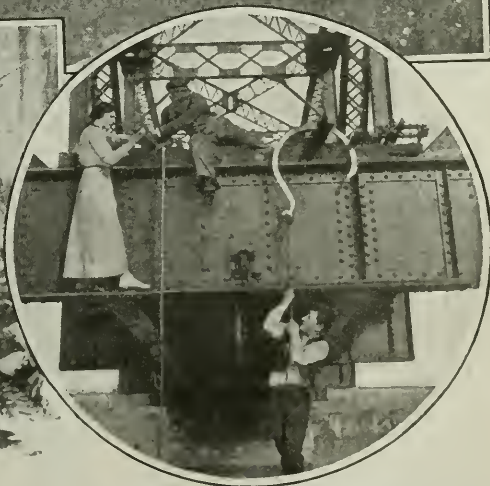


Above, a real water scene. Ability to swim and dive is invaluable to the moving-picture actor. In some instances, the "struggle for life" which appears on the screen is not faked. Below, a horrible train wreck from which some cherished heroine miraculously escaped



Above, jumping from a burning building into a net. Below, Pearl White rescued from drowning





In circle, Helen Gibson, former telegraph operator, and Robyn Adair "playing" on a railroad bridge

Douglas Fairbanks has forsaken the regular stage for such dare-devil "stunts" as this

endangered to make a few feet of film, come and watch how it is done. Behold the locomotive with the engineer on the cowcatcher, Nellie in his arms. Observe that the train is moving slowly backward and that the camera man is grinding slowly. Papa lays Nellie carefully down on the track; then walks backward to his cab. When the film, reversed, is run rapidly through the projector, there will be another thriller on the screen.

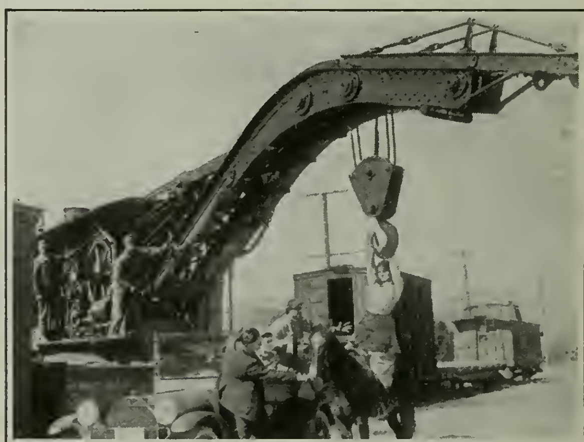
[N. B.—It is now considered advisable to use hard coal when doing this feat, since a keen observer in the audience once noted that the clouds of smoke were pouring *into* the stack instead of out of it.]

Did you ever notice the realistic manner in which a screen motor-car will bump its victim? It is so natural that you would imagine yourself witnessing an actual occurrence at Fifth Avenue and Thirty-fourth Street while the traffic policeman's back is turned. There are several methods by which the operation may be performed without losing the bumpee's services for the next picture. The victim may lie down in the road, right up against the front tires and the car is started on the reverse with a most natural jump. Then the cameraman ceases turning while the car is brought to the other side of the prostrate one, with the back of the rear tires touching him this time. Quick throwing of the lever into speed forward produces another jump. The whole performance looks very tragic when it gets on the screen.

Another method is actually to bump and push the victim over and then to pass over him at slow speed with the camera-crank also turning slowly. A rather spare style of architecture is preferred in the victim of this method, as clearances must be carefully considered.

But it is not all trick work, however. There are actors of the screen whose artistic sense or pure dare-deviltry causes them to yearn for a realism which lands them alternately in the Hall of Fame and the hospital.

Some time ago, Irving Cummings worked in a picture which called for a close crossing of an automobile and a railroad train. Picking his crossing, he timed a particular train from a given point to the exact spot selected for the crossing. Then, with a stop watch, he timed his car, from a start from which he could view the train reaching the fixed point. He averaged train and car for several days. At last he made



Helen Gibson makes a safe landing on a horse from a crane on a moving wrecking-train the dash. There was enough accuracy in his arithmetic to get the crossing but he left part of the rear mudgard aboard the cowcatcher. The engineer, who was the only extemporaneous actor in the event, took a week off at the picture company's expense to recover from the shock.

Not so long ago Anita King, in "The Race" went off the end of a broken bridge and twenty feet out into the water, while an officer was waiting in the Hollywood studio to serve an injunction upon her to restrain her from carrying out the performance. Some one who had received a tip of what was to happen and who feared for the actress's safety had made a strenuous effort to prevent the hazardous leap.

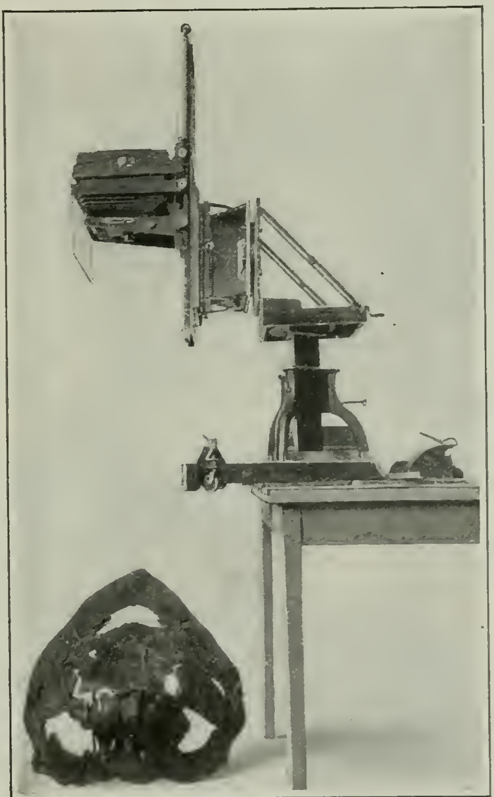
Elmer Thompson has just jumped his car across a twenty-seven-foot gap in a bridge out in Camarillo, California, in the taking of a scene for "The Secret Submarine." The car lighted on the forward wheels with the rear ones elevated like the hind legs of a bucking broncho. It was touch and go whether the machine would somersault or right itself. It happened to do the latter.

In "The Trail of Danger," Helen Gibson is swung by the derrick of a rapidly moving wrecking train, from the saddle of a horse, to the deck of one of the cars.

This combination of cameraman, cutter and realistic actor is responsible for more thrills on the screen than can be found in any three-ring circus, outside of the posters. The life of a moving-picture actor is a series of thrills.

A Camera Which Can Be Tilted At Any Angle

In photographing natural history objects such as skulls, mounted fossils, etc., it is often necessary to take a view of the specimen as seen from above. In most cases the object can be taken off its stand and placed against a vertical screen with the side to be photographed toward the camera. Sometimes, however, the object is so delicate that one dare not turn it from its upright position, or it is too valuable to risk handling, or it may be altogether too large to do so, as for instance in the case of a dinosaur skull weighing a quarter of a ton or a completely mounted fossil animal.



Sometimes a fossil skull weighs a quarter of a ton; it cannot be lifted to be photographed. That is one reason why this camera was invented

For such cases, there is in use by Mr. A. E. Anderson, photographer to the Department of Vertebrate Paleontology of the American Museum of Natural History in New York, a camera of his own design, which can be tilted at any angle, or, in fact, turned upside down, as shown in the illustration. The camera has a ground glass eleven by fourteen inches and is provided with an unusually long bellows. The stand supporting it is so constructed that the camera when turned upside down can project a considerable distance beyond the vertical axis on which it ordinarily rests.

With the aid of this camera, Mr. Anderson has found it possible to photograph anything which presented itself, whether it was too heavy to be lifted or too delicate to be moved.

Four four-mule teams are more efficient when pulling together than when separate where extensive transportation is necessary. The maximum traction effort required is less than four times the maximum for a single team

Expensive Transportation

IN many engineering projects, the cost of transporting equipment and materials assumes a very high relative value.

In illustration, may be cited the case of the hydro-electric development of Big Creek in California. The site of the works was to be located fifty-six miles from the nearest railroad. It was estimated that to do this work with teams, the transportation cost would have been about twenty dollars per ton. So, the contractors built a standard size railway.

But they could not construct a railway in order to supply materials for a transmission line, which is two hundred and forty-one miles long. Teams had to be employed.

A little consideration will make clear why it is better to unite four four-mule teams into one than to use them separately. A loaded wagon must ordinarily be hauled by a team able to overcome the maximum difficulties. A string of four wagons would hardly all of them have their individual maximum difficulties at the same moment. In other words the maximum traction effort required for the string is probably less than four times the maximum effort required for a single wagon.

A Traveling Laboratory for Testing Railway Scales

ONE of the interesting phases of the United States Bureau of Standards' work is the testing of railway-track scales by means of traveling test-cars which make their way over the great railway systems of the country.

Two test-cars are now engaged in this work. Each test-car carries ninety thousand pounds of standard weights, eight of ten thousand pounds each and four of two thousand, five hundred pounds each. The car carries also a small truck driven by an electric motor on which the weights can be placed so as to be rolled on to the trucks of the scale to be tested.

The test-car is used for detecting faulty railway scales

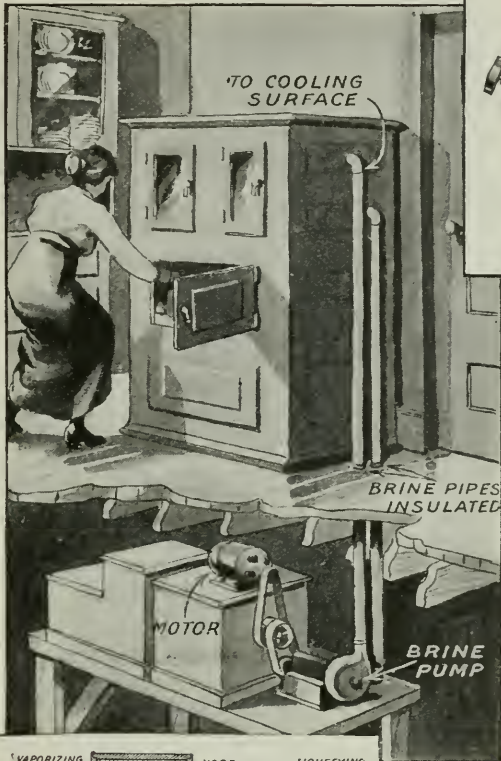
At the forward end of the car there is a crane which can be extended through the end doors, and which carries an electric hoist for raising the truck and placing it on the track. The work of the first test-car demonstrated that seventy per cent of the number of freight scales tested showed an error of at least two hundred pounds in weighing a freight car of one hundred thousand pounds. This proves that the test-car was needed.

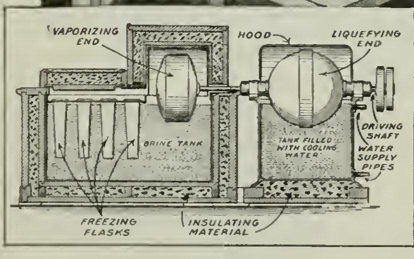
Ice Making at Home

By Jay F. Bancroft

THERE is no sound scientific reason why a household refrigerating machine should not be a commercial success and go into very general use in private homes. There is a wide demand for such machines, and much money and engineering skill have been expended in their development. Notwithstanding this, it must be admitted that they have not gone into use very extensively in private households.

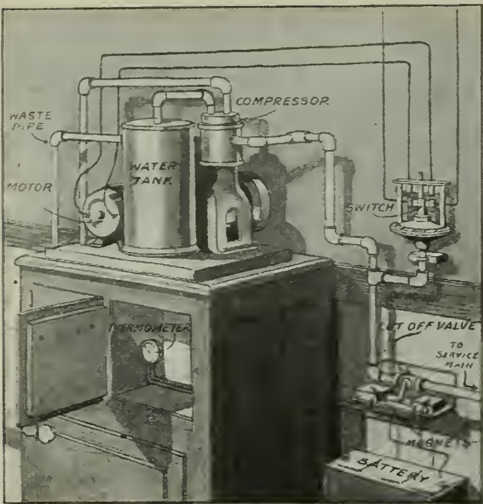
The use of refrigeration to cool and preserve our food and drinks is so general that it has now come to be regarded as an essential factor in our daily life. Nevertheless it is surprising how few users of such refrigeration there are who could accurately explain even the principles on which the ice-cooled refrigerator works. Everybody knows that in order to cool a substance it must be placed in proximity to a cold body, such as ice. There are numerous ways in which cold bodies can be produced mechanically, but the only way in practical use in household refrigerators is by the evaporation of a liquid. If the hand is plunged into warm water and then exposed to a draft of air the hand dries, but also becomes very cool. This cooling effect is more pronounced if ether or alcohol is used instead of water, for such liquids evaporate more readily. The cooling effect is due to the fact that the liquid has changed to a vapor, and in doing so has absorbed a perceptible amount of heat from the hand, which heat disappears with the vapor. This principle is extensively used in dry climates for cooling water which is placed in porous-walled vessels exposed to the air. The small amount of water that seeps through the porous walls and is evaporated will cool down the remainder of the water within the vessel.





The refrigerating apparatus here described can be conveniently located in the basement below the kitchen. The principal feature of this machine is the dumbbell container shown in its relation to the other parts of the machine. This machine is so nearly automatic that the services of an expert attendant are not necessary

Should water be placed in a pan under the receiver of an air-pump such water can be very much cooled, or even converted into ice, by removing the vapor as fast as it is formed. Only a small fraction of the liquid is evaporated, but in the evaporation of this small fraction a



In ammonia machines, high pressure is avoided by means of an automatic switch which stops the motor

large amount of heat is absorbed from the remainder of the water, which is thereby cooled to the freezing point. This heat apparently disappears in the vapor, for the vapor is no warmer than the water from which it comes. This heat is said to be latent. Now should the pan containing the cooled water be connected with a pipe-coil located in a refrigerator, the cold water would perform the same function as ice. In practice, however, water is not used in refrigerating machines, more volatile liquids being used instead; the vapor discharged by the pump is condensed and returned to the evaporator to be again evaporated.

Of the several well-known types of refrigerating machines, the gas compression and expansion machine is the one most generally used for cooling household refrigerators. All compression machines are made up of four distinct parts, viz.: a compressor or pump, a condenser, a refrigerating-coil, and an expansion valve between the condenser and the refrigerating-coil. These are connected in a closed cycle so that the compressor can suck out the gas from the refrigerator-coil and discharge it under high pressure into the condenser, where the hot gas is cooled by running water. The combined effect of pressure and cooling causes the gas to liquefy. This liquid passes through the expansion valve into the refrigerator-coil where it evaporates because of the low pressure maintained by the suction of the compressor and the heat absorbed from the articles being cooled. The function of the refrigerant is that of a heat-carrier; it takes up heat in the refrigerator and discharges it into the cooling water. It is able to do this by reason of the work of the compressor which maintains a high pressure in the condenser, where the heat is discharged, and a low pressure in the refrigerator-coil, where the heat is absorbed. The refrigerants most generally used are ammonia, sulphur-dioxide, and ethyl-chloride.

The most essential requisite of a household refrigerating machine is that it shall be so nearly automatic that the services of an expert attendant shall not be required.

A near approximation to this requirement seems to have been attained by the machine shown on page 891. The larger of the two hollow shells encloses the compressor, and the shell itself is the condenser and runs in cooling water, while the smaller shell acts the same as a refrigerator-coil. When completed this device is charged with a suitable amount of sulphur-dioxide and lubricating oil and is then sealed up. As all the moving parts are sealed up, the escape of gas is effectually prevented. By reason of the ingenious manner in which the compressor is constructed all danger from high pressure is overcome.

The illustration on the preceding page shows how this machine may be used to cool a refrigerator on the dining-room floor of a home, the machine itself being in the basement.

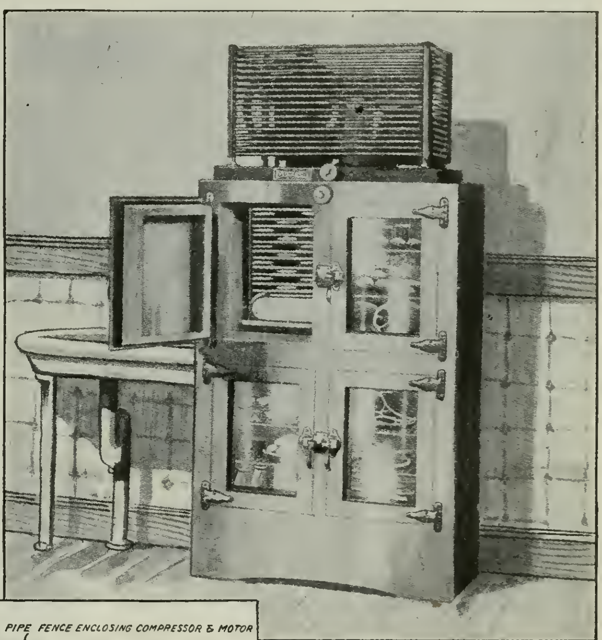
While ammonia is a most excellent refrigerant in large machines, it is not much used in household machines because of the danger of the high pressure in the condenser and the possibility of leakage. Ammonia machines for household use are usually so arranged that the switch controlling the motor is closed by the pressure of the water flowing to the condenser, and whenever the water fails or is turned off the machine is automatically stopped. In this way dangerously high pressures in the condenser are avoided. In all ammonia machines the pressure in the condenser usually rises as high as 150 pounds. With sulphur-dioxide as the refrigerant the pressure in the condenser is rarely over 50 pounds, and the heat generated in compression is also much less than when ammonia is used.

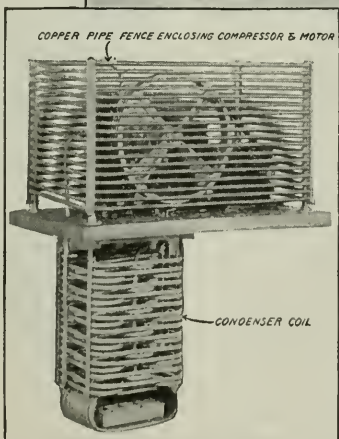
In most of the household refrigerating machines, all parts of the machine, including the electric motor, are arranged on a bed-frame which rests on top of the ordinary household refrigerator, the expansion or refrigerating-coil extending down into the compartment usually occupied by ice. This coil may be arranged in a tank containing brine to store up reserve cold for times when the machine is stopped, or the coils may be so arranged as to hold small cans for freezing ice.

In one of the recent sulphur-dioxide machines, shown in the accompanying illustration, the use of cooling water is dispensed with and air-cooling is substituted. In this machine the condenser is composed of a great length of small copper pipe coiled around to form an enclosing fence about the compressor and motor. The spokes of the fly-wheel of the compressor are arranged at an angle so as to circulate air over the condenser-coil. The elimination of the cooling water is obviously a very attractive feature of this machine.

Another household machine, using ethyl-chloride as the circulating refrigerant and embodying a rotary compressor, is shown at the top of page 894. It is very compactly arranged and is constructed on sound engineering principles.

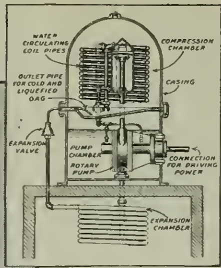
Still another household machine uses a low-pressure refrigerant known as the "Barsmith liquid," or "Barsmith gas," having many of the characteristics of sulphur-dioxide. In construction this machine consists of a refrigerant container, an expansion-valve, a brine tank, a compressor, a condenser, and a motor, usually an electric motor. The brine tank is located in what is termed the ice compartment of the refrigerator. The other parts of the machine may be located on top of the refrigerator. The expansion-valve is connected with the brine tank. The liquid refrigerant passes from the container to the expansion valve, expands to a gas, and bubbles up through the brine and is collected in a dome on top of the brine tank, from which it is drawn off by the compressor, compressed and cooled and passed back to the container ready for another cycle.





In this sulphur-dioxide machine the use of cooling water is dispensed with. Instead, a condenser composed of a great length of small copper pipe coiled around to form an enclosing fence for the motor and compressor is used. The air cooling method employed in this apparatus is, in many ways, an advance over that of other refrigerating machines

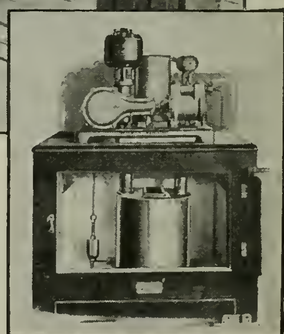
As in other machines, the motor is started and stopped by means of a



This machine has a rotary compressor and employs ethyl chloride as a circulating refrigerant

thermostat in the refrigerator. The weight of this machine complete, including the brine tank, is about 160 pounds.

In recent years much has been done towards the development of an absorption household-machine, and several meritorious machines of this type are now on the market. An absorption machine is much like the compression machine, the principal difference being that the compressor is replaced by a still or boiler. This still is partially filled with strong aqua ammonia. When heat is applied to the still the dissolved ammonia is driven off as a gas into the condenser, where it is converted into liquid ammonia just as in the compression machine. After all the ammonia is driven off from the still and collected in the condenser, the burner under the still is extinguished and the still, with the water from the aqua ammonia, is allowed to cool down. Cold water has a great affinity for ammonia and at once begins to take up gas from the liquid ammonia which flows from the condenser into the refrigerating-coils. This evaporation of liquid ammonia in the refrigerator coils causes intense cooling. Check valves are placed between the still and condenser and between the refrigerator-coil and still so as to make the ammonia flow in the proper direction. Of course there is no cooling done during the distillation period, but this period is generally very short compared with the absorption period. Usually one distillation a day is sufficient. One great advantage of this is that there are no moving parts and hence no noise. The flow of the fuel gas and cooling water is automatically controlled in the later machines. The automatic devices will need some attention to keep them in order, especially the check-valves. The principal objection to these absorption machines is the high temperatures and pressures used. The alternate heating and cooling of the still tends to



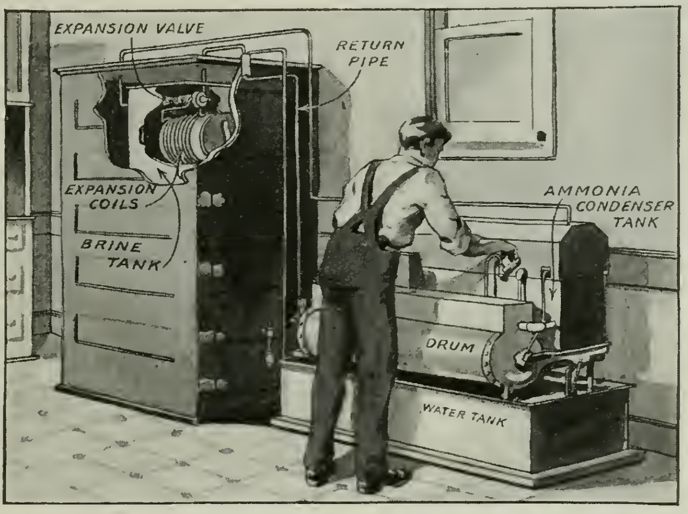
"'Barsmith liquid," which is similar to sulphur-dioxide, is the refrigerant used in this compact machine weaken the metal walls of the still, which in time will cause leakage of ammonia-gas.

It may be said that any compression machine can be used with any volatile refrigerant that will boil at 30° F., or under, when exposed to the atmosphere, but in practice certain minor differences are observed in the construction of the machines on account of the differences in pressure of the various refrigerants used. Inasmuch as all the machines above referred to are practically automatic, and can be run, and are being run, without a skilled attendant, it is hard to understand why such machines are not more generally used.

The high cost of the first installation is probably the largest obstacle to their very general use. Take a machine whose first cost is $900 and whose life is, say, ten years, you have a fixed charge of about $12.00 per month. Add to this the cost of electric current, and the cost of whatever repairs and adjustments may have to be made by skilled experts during the life of the machine, and you have a bill considerably in excess of the cost of 100 pounds of ice per day.

One of the most objectionable features urged against compression machines is the noise made by the motor and compressor. Even when the machine is located in the basement it can be heard over most of the house, and at times such noise is deemed very objectionable. Another cause of trouble is in securing a constant and even flow of cooling water to the condenser, where constant running cooling water is used. In many places the water supply contains sediment or dissolved minerals which will tend to collect under the controlling valve and diminish the flow of water.

Most people imagine that the temperature in an ordinary ice-cooled refrigerator is lower than it really is and when they install a refrigerating machine they try to keep the temperature down below 40° F. The insulation in the ordinary refrigerator is not sufficient to maintain such temperature and hence the use of electricity to run the machine will be excessive.



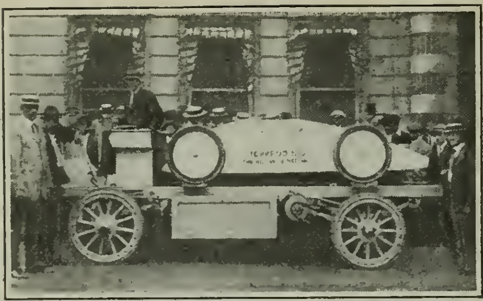
An absorption machine, though expensive to install, ought soon to repay the initial cost

When the public is fully aware of the great advantages, sanitary and otherwise, of this character of cooling, over the ice-refrigerator plan, the difference in cost, it is believed, will be cheerfully accepted.

The actual cost to build a machine of this character that sells for $900 is probably not one fourth of that amount. It is fair to presume that the first cost price of all these machines will soon be materially reduced.

Unfortunately, several machines have been put on the market which were faulty in design and involved engineering defects which made their failure a certainty, and these failures have cast a shadow on the really meritorious machines.

All the difficulties and obstacles tending to prevent a commercial success of these machines are apparently capable of being overcome by engineering skill.



The "Torpedo Kid" was modeled after a falling drop of oil

An Electric Automobile Built Like a Drop of Oil

OUR present day pear-shaped racing automobiles are all distant cousins, so to speak, of the "Torpedo Kid," a car designed by Walter C. Baker, the creator of the first American-made electric. In a dash at Ormonde Beach, Florida, some years ago, it did a mile in 56 seconds, establishing a world's record for speed at that time.

Oddly enough Mr. Baker came to be the originator of the first pear or cigar-shaped racer by studying the shape of a drop of oil as it fell through the air. He observed that the drop, while falling, was not round but took the form of an ellipse. In short time he arrived at the conclusion that a solid body of the same shape as the drop of oil, if cut in two and built low to the ground, would offer the least possible wind resistance. He followed out this theory in the construction of the "Torpedo Kid," and its initial record of a mile in 56 seconds proved that Mr. Baker was right.

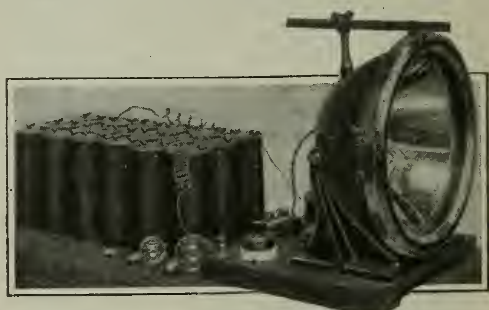
Other automobile manufacturers were quick to see the advantages of the constructional features embodied in the "Torpedo Kid," with the result that pear-shaped racers, electrically and gasoline-propelled, began to dot the courses of our race tracks. For a while the electric racers held their own against the others, but the gasoline engine improved so rapidly that before long the electric racer was as scarce as it was before the heyday of the "Torpedo Kid." However, Mr. Baker has built a larger car along the same lines as his speediest electric, and it is said to have made one hundred and twenty miles an hour. A few years ago it was entered in some races in France but before it could give account of itself, it got beyond the control of the driver and ran amuck, injuring several bystanders.

Signaling Three Hundred Miles

A PORTABLE electric signal-light which, although operated by dry-cell batteries, gives two hundred and fifty thousand candlepower, has been designed and constructed by E. G. Fisher, chief of the instrument division of the United States Coast and Geodetic Survey. It is to be used during the summer in the mountainous regions of Idaho and Oregon on primary triangulation where the distance between stations is frequently as much as one hundred miles. No larger than the ordinary automobile head-light, the packed apparatus weighs about twenty-three pounds. Under ideal atmospheric conditions the light will be visible through a telescope of ordinary power for a distance of two hundred and fifty to three hundred miles.

The great power of the light is due to a new type of tungsten filament designed by Mr. Fisher. The filament is concentrated so as to confine the light to as small a point as possible—very much as in the gas-filled lamps now used for street-lighting. There are two tiny coils of filament about one tenth of an inch in height and one thirty-second of an inch in diameter, connected by a loop at the top. The glass bulb is about two inches in diameter.

The light is about one hundred and seventy times more powerful than that given by the acetylene signal lamps now being used by the survey.



A specially constructed tungsten filament enables this lamp to throw its rays a distance of three hundred miles

Strange Mineral Spring Deposit in a Nevada Desert

ONE might study this desert photograph a long time before reaching the conclusion that it pictured the deposit of a mineral water spring, and a very small spring at that. The spring is situated on the southern border of South Carson Lake in western Nevada and is known as Allen's Springs. The flow of water is less than one-half gallon a minute, but in this very arid country even this meager supply is important as it represents the only drinkable water within a radius of over twenty miles.

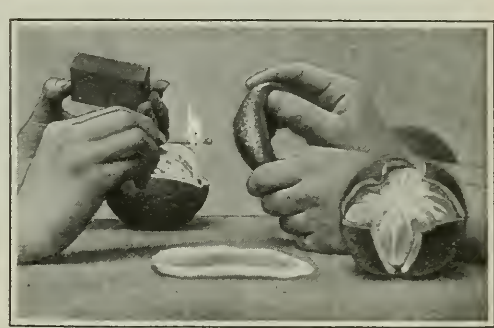
The strange looking deposit is a yellowish porous mass of tufa, chiefly carbonate of lime, which has been left as the waters have evaporated in the desert sun. In addition to this tufa from the spring, there are thinner incrustations of similar material that were deposited from the waters of the now extinct Lake Lahonton which, in prehistoric times, was a lake of enormous dimensions. No definite conclusion can be reached as to the time in years that has elapsed since this lake reached its maximum area, except that geologically speaking the existence of the lake was recent—perhaps seventy-five or one hundred thousand years ago.

As the waters from a Nevada spring evaporated, a strange deposit was left. It is yellow, porous tufa

Orange Peel Oil Is Explosive

EVERYBODY knows the flavor of orange peel, but not everybody knows what causes that flavor. It is due to the oil contained in little cells in the rind. If the peel is bent so as to strain these oil-laden cells, the oil bursts out, often as a visible spray and usually perceptible to our sense of smell, and often as a greasy film on the fingers.

As shown in the accompanying photograph, the peel may be so bent as to rupture a large number of these cells at



A miniature explosion occurs when the oil from an orange peel is ignited

one time, and to fill the air with an oily mist. If, at the moment of bending, a lighted match be applied by an assistant a decided explosion will follow. This experiment is most successfully performed in a darkened room or in a room wholly dark except for the light from the match.

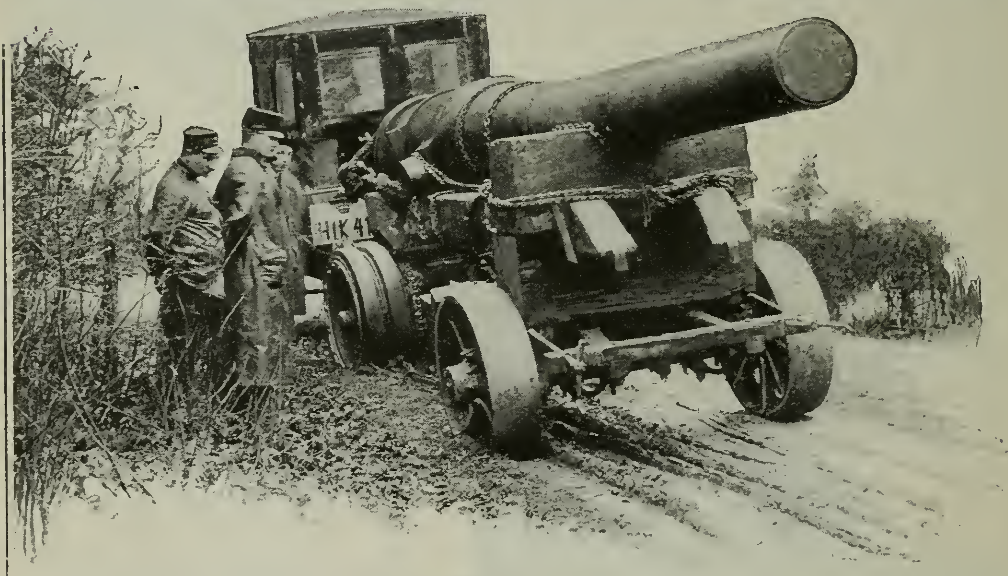
Air Raids Involve Problems Hard to Solve

LONDON'S problem of placing anti-aircraft guns is a serious one. The farther away from London they are stationed, the greater the number required to make the passage across the fortified zone sufficiently perilous. On the other hand, the nearer the guns are brought to the city, the more restricted is their action for fear of inflicting injury on those they are intended to defend. A possible solution to this problem is the employment of mobile guns.

The use of aircraft as a defense against air attacks has been officially stated to be inefficient by itself. The difficulties to be met are not regarded as insuperable, however, and great hopes are placed in future developments along that line.

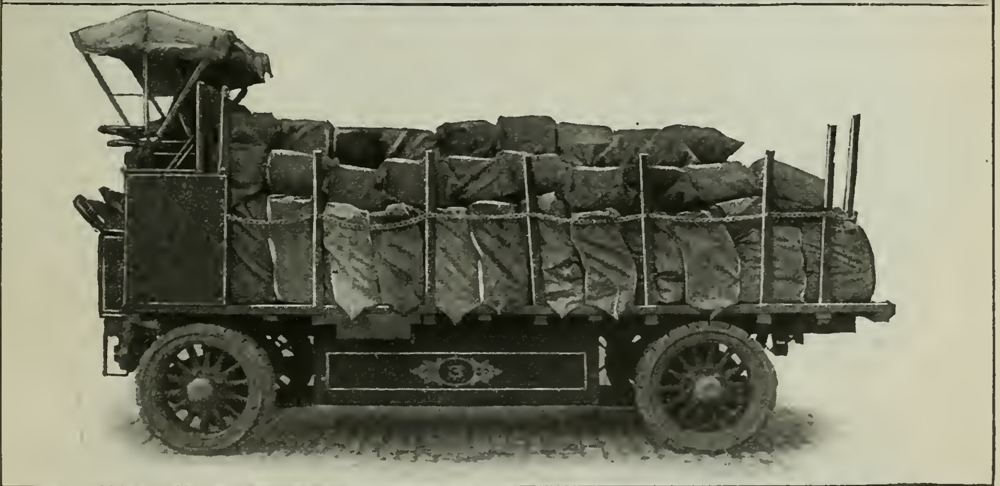
Truly a War of Motors

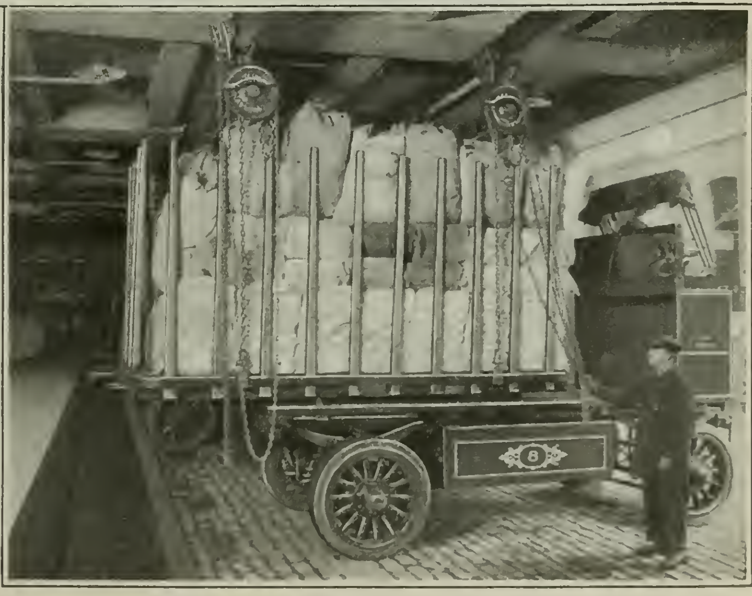
Besides displacing horses at the front in the World War, motor-trucks are also used to carry wounded chargers off the battlefield. Four ambulances like the one shown are now with the British Army in France. Each holds two horses. One side of the body swings down so that animals can walk or be hauled in. The twenty-ton naval gun below was carried by an American tractor over eleven miles of mountain roads which were badly torn up by shot and shell. Despite these difficulties, the load was delivered



The great number of motor vehicles now in use in the war has necessitated the employment of vehicles whose sole purpose is to make quick repairs. The unit shown at the left is an American workshop with the Ninth Australian Corps. Note the complete equipment of forge, anvil, vise, drill presses and tools. Also note how the lower half of the body swings down to form a convenient working platform

A Truck with a Long Day

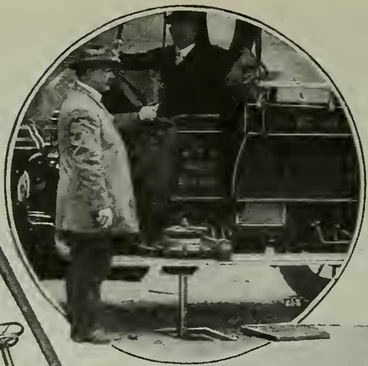


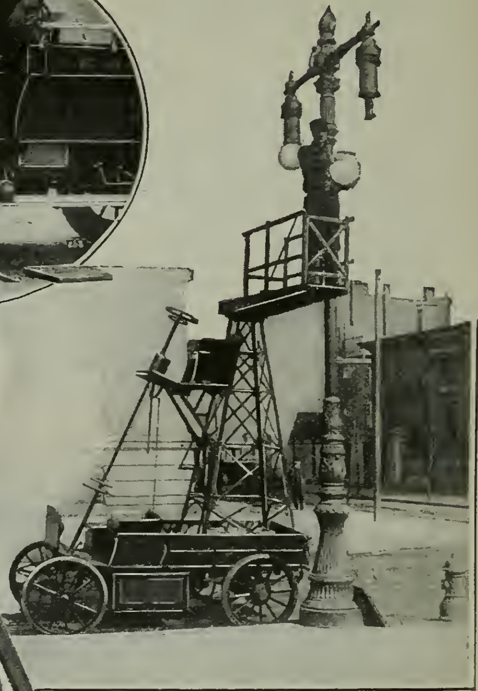


This motor-truck may be used twenty-four hours a day. A number of bodies for various uses are utilized with the chassis, and by substituting one for another the truck may be constantly at work. The bodies are loaded while the truck is busy, and when it arrives at the loading-platform the bodies are exchanged by means of the overhead tackles shown in the lower illustration. Local transportation facilities have progressed rapidly since the motor-truck supplanted the horse

Consider These Miracles of Mechanics and Think

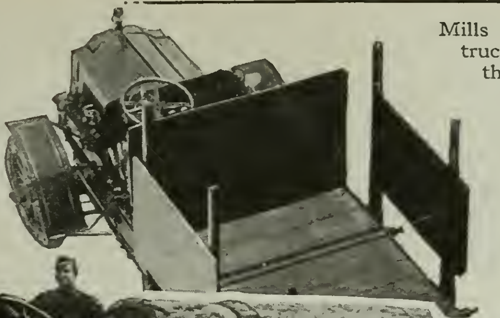
The device pictured on the right has robbed bursting water mains of their terror. The mechanically operated valve-closing apparatus is mounted on the running board. Below will be seen two pictures showing an electric truck used in Philadelphia for trimming arc lights



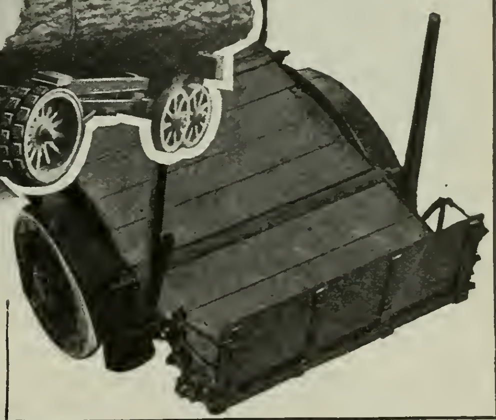


Above, a truck fitted with a steel tower and swinging extension platform. The driver may operate the truck either from the driving seat or from seat on the tower. Below on the left is a truck which cleans a street as a rubber squeegee cleans a window. The spiral-shaped rubber roller leaves the street remarkably clean. The tank may be removed and another body substituted. Below, a fire-truck with a motor-operated ladder extensible for about eighty-five feet

How Little We Accomplished With Horses



The automobile-truck has invaded the forest and is taking the place of logging trains. This method is cheaper than the maintenance of railroads; and a motor-truck does not have to stick to a track



Mills may operate their own trucks and thus send into the woods for their logs, whereas logging trains either haul to tide-water or to a regular railroad. Few logging roads run to the mills that they feed

A crew of three or four men is required for a logging train, but a single man can handle a motor-truck freighted with logs

In the National Museum at Washington is a model of the Island of Trinidad, showing the topographical details on a scale of one inch to sixty feet

A Model of Trinidad's Famous Asphalt Lake

THERE are several places in which natural asphalt in one form or another exists with but few impurities, the best known and largest being located on the Island of Trinidad, a British possession lying off the northeast coast of Venezuela. The island includes about one thousand seven hundred and fifty square miles of rather barren land. Near its center is a lake of natural asphalt about one hundred and thirty acres in extent, which furnishes over two hundred thousand tons of material each year. Nearly one half of this total is sent to the United States.

Nature seems to have endowed this remarkable lake with miraculous powers. The supply never decreases appreciably, in spite of the great number of tons of asphalt removed annually. From some eternal pitch-spring located far beneath the surface there continues to flow a steady stream of this fine road-building substance. Naturally it is not like water in consistency; it flows very slowly like cold molasses or tar. It is not unlike the asphalt seen in the carts in your own home town, but it is not boiling or even hot, except for the heat of the tropical sun which renders the work on the surface very uncomfortable. Since the lake is fairly solid, the men and teams go out on its surface to dig and haul the asphalt to the refining plant on shore. Although not molten, this lake has a perceptible motion, which prevents the construction of buildings for refining or a railway for transmission on its surface.

In the highest part of the model and near the center the black asphalt lake glistens. On the shore near at hand stands the refining plant, and the little tram-way which conveys the material ready for shipping down to the pier at the water's edge. Scattered about the island are many fine residences and rows of houses where dwell the working men and their families, as well as a club house built to accommodate the visitors, since the island has been converted into a very good winter health resort.

An Improvised Flour Bin

IN the absence of a kitchen cabinet a convenient flour sifter can be made by using an ordinary bag and placing a sifter in the opening, after securely fastening it with heavy string. The bag is inverted and hung from a nail, conveniently placed above the work table by running a heavy string through the bottom. At first the flour will sift out as it shifts into position, but it will soon settle in the bowl of the sifter.

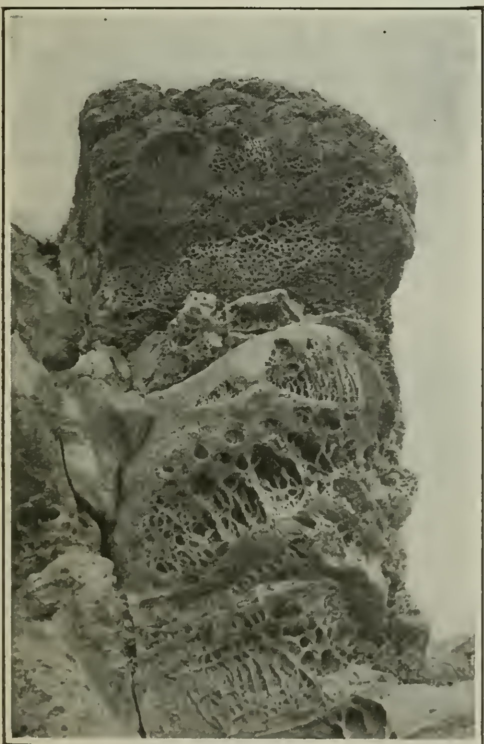
A flour sack is also a flour bin

A Strange Spongelike Rock

THE so-called sponge rocks near Livingston, Montana, have attracted the attention of many travelers and scientists on account of their remarkable tracery and porosity. They appear like huge pieces of pumice stone intricately carved by Nature into innumerable cells, webs and cavelets. Some of the pieces are almost threadlike.

The rock is sandstone, which was formed millions and millions of years ago when the entire State of Montana was the bottom of a sea. In the course of ages, Montana has been bodily uplifted several thousand feet.

The spongelike formation of the rock, as it appears to-day, is of course due to the wearing action of water and wind, the softer particles of the rock having been washed or blown away, leaving the harder portions standing. There are a number of these rocks in the same locality, and several of them are said to have been appropriated by wild bees and other insects.



The spongelike appearance of this rock is due to the wearing action of wind and rain

Take this portable dark-room with you in the woods and develop your negatives on the spot

A Portable Dark-Room for Photographers

A PORTABLE dark-cabinet has been invented, which does away with many inconveniences encountered by photographers in developing their negatives without the advantage of a suitable dark-room. A metal framework supports a table or shelf adjustable to any desired height. Extending above the table are two rods supporting a square frame to which is attached a large hood. This hood completely envelops the table and affords enough room for the upper portion of the photographer's body behind the table. A hole in one side of the covering is used for introducing the materials in the cabinet. Another hole in its lower part is provided with a strap or elastic band, which passes around the waist of the operator as he enters the hood.

The cabinet is lighted by a window of ruby glass directly over the table and opposite the photographer. Fresh air is supplied by means of a mask with a rubber tube leading to the outside. Tourists who take many pictures can make good use of this cabinet.

What Shall We Do for Gasoline?

THERE are about two and one-half million automobiles in use at the present time. By the end of the year their number will be well over three million. All of them consume gasoline. There are also three hundred thousand motor-boats, forty-five thousand motor-trucks, thirty thousand gasoline farm tractors, and an untold number of stationary engines, all dependent on gasoline. Over thirty-five million barrels of gasoline are annually required to meet the demands of these many motors.

The total gasoline content of all the oil produced in this country in 1915 is estimated at 1,892,500,000 gallons.

According to the preliminary report on the investigation of the rise in the price of gasoline, prepared by the Federal Trade Commission, the 1915 exports of gasoline amounted to fifteen per cent of the entire gasoline content of all the crude petroleum produced in the United States within the year 1915, Exports for the year of gasoline, naphtha, and benzene totaled eight hundred and twenty-four million, five hundred and fifty thousand gallons, as against two hundred and thirty-eight million, five hundred thousand in 1914.

We are burning up gasoline faster than we can distill it from the crude oil which we pump out of the earth. In past years so much gasoline was produced that some of it could be set aside for possible later emergencies. But even these stocks are now practically exhausted and we are living almost from hand to mouth.

It has been suggested that benzol be used. Not until the war began did the United States of America make any serious attempt to recover benzol as a by-product of coke making.

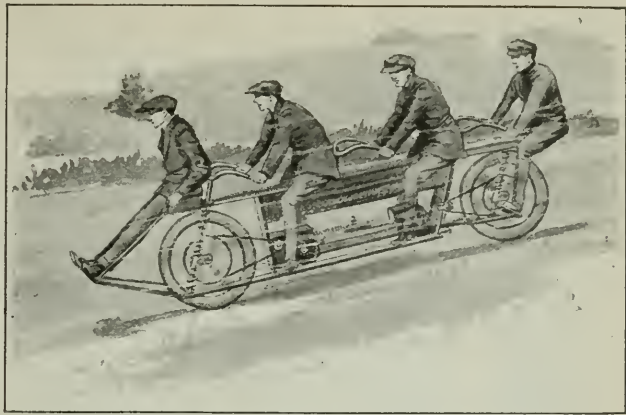
Benzol is not greatly different from gasoline. Motorists object to it because it requires adjustments in the motor. Moreover, the quantity of it available will always be so limited as to preclude widespread distribution.

What is known as casing-head gasoline has been finding increasing favor. Casing-head gasoline is literally squeezed out of natural gas just as you squeeze water out of a sponge. The output of gasoline thus extracted is about one million and a half barrels a year.

In the ordinary method of distilling petroleum, heat is applied. At low temperatures the vapors of the lighter constituents of the oil are distilled off and condensed. As the temperatures increase the heavier vapors rise; finally a heavy mass is left from which no fuel at all can be distilled. The line of demarcation between gasoline and kerosene is ill-defined. Hence in the days when the kerosene lamp was in vogue and when gasoline could not be sold for lack of automobiles, the oil refiner retained as much gasoline in his kerosene as he dared. Nowadays the situation is reversed. Gasoline contains as much of the kerosene element as possible. From year to year, gasoline is becoming heavier and heavier. But even this device of the refiner, made necessary by the enormous demand for motor fuel, has failed to meet the situation. So, for years oil chemists have been trying to devise plans whereby kerosene itself could be subjected to further heat treatment—a heat treatment which is known as "cracking," and which serves to break up the kerosene molecules into gasoline molecules. One of the most successful of these processes is that invented by Dr. Burton. Thanks to him at least three hundred thousand automobiles are now running on cracked gasoline. More recently Dr. Rittman has come to the public notice as the inventor of a cracking process for which marvelous things are claimed. Dr. Rittman believes that the cracking process will solve the gasoline problem.

A cheap motor fuel is a vital necessity to the automobile industry. The cheapest at present available is kerosene. But unlike gasoline it demands a special type of carbureter—an apparatus which will perform its function far more scientifically and accurately than is necessary with gasoline. If present indications mean anything at all they mean that motor car manufacturers will develop a type of carbureter which can be successfully used with kerosene.

Freak Motorcycle Carries Four Passengers

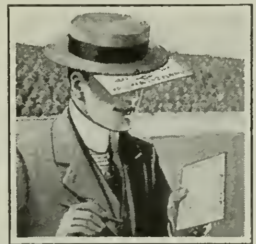


This four-passenger motorcycle is under the control of the man in the rear

THE oddest thing yet constructed in the motorcycle line is a freak mount designed to transport four passengers, with the foremost man sitting on a spring bucket seat and the other three directly behind him on regular motorcycle saddles. The frame of the machine is a double trapezoid. It has the front and rear wheels sprung somewhat on the lines of spring forks, with a shock spring above and a recoil spring below. The wheelbase is sixty-six inches.

The motor, which uses kerosene as a propelling fluid, has two cylinders and is water-cooled. Each cylinder has two pistons. There are two crankshafts coupled by means of a longitudinal rod having worm gears. This rod drives the camshaft, magneto and water pump. The final drive is by V-belt to the front wheel. Four-inch tires are used, and band-brakes are fitted to both wheels.

Combined Eye-Shade and Program



Program and eye-shade combined

A COMBINED eye-shade and detachable program or printed matter section can be affixed to a hat by a simple curved clip device having a shank at one end to engage a loop on the eye-shade, and at its other or free end, extending below the attaching shank to press on and grip a hat brim firmly.

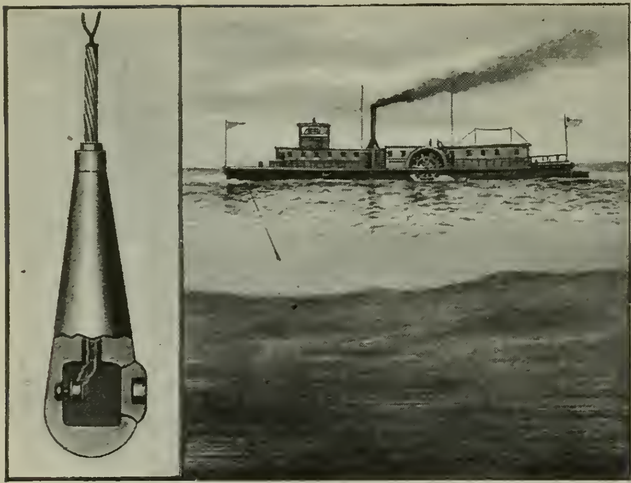
The eye-shade passes under a hat brim and the clasp holds it firmly in place with all types of hats.

Illuminating a Highway With Pockets of Light

UNTIL Wilson Fitch Smith, division engineer of the Catskill aqueduct system of water supply of New York city, worked out an illuminating plan of his own by using lanterns and boxes, nearly two thousand feet of the State highway which is laid out on the dam across The Bronx valley, was unlighted.

Novel system of highway illumination along the crest of the Kensico reservoir

Mr. Smith did not want to erect unsightly poles on top of the dam for illuminating the highway at night, and as there was no other method available, he hit upon the novel idea of lanterns and boxes. Subsequently cubical pockets were cut in the heavy stone slabs and the proper connections made. The lantern-box combination gives a remarkable uniformity of light, and the artistic effect is pleasing.



A simple telephone transmitter dragged through the water reveals the nature of the river-bed

Navigating a River Boat by Sound

TO determine the character of inland river beds, steamboat captains are using microphones installed in sounding leads. On each ship an armored cable leads from the microphone to a telephone receiver and dry batteries. When the sounding-lead drags over the mud bottom, a dull groaning sound emanates from the receivers, while a stony or pebbly bottom will cause a series of sharp, staccato raps.

Doing Away With the Dish-Cloth

A DISHWASHER has been perfected which does its work quickly and well and which eliminates the unsanitary dish-cloth. The machine consists of a cylindrical container with a diameter of about two feet, funnel-shaped at the bottom and having a tightly-fitting cover to prevent the escape of steam. A wire tray with grooves holds the plates in an upright position, and a central basket contains knives, forks and spoons. After being filled, the tray is placed in the bottom of the container. Above it is another tray for the teacups, water-glasses and smaller dishes. Below both trays, in the funnel-shaped bottom is a triangular arm, or fan, which rotates at a high speed, throwing the water upward against the dishes.

After placing the trays with their dishes in the machine, hot water is poured in, the cover adjusted, and the lever operated for two minutes. The soiled water is then drained off, fresh boiling water applied, and the operation repeated. The dishes are thus washed and sterilized. They dry of their own accord if the water is hot enough. Of course it is well to scrape the dishes reasonably clean before putting them in the container.

The convenience of the machine may be increased by a water-pipe connection and a drainage pipe. Also a small motor eliminates the use of the hand-lever in operating the machine.

Washing and drying the dinner dishes without a cloth and towel

If you want further information about the subjects which are taken up in the Popular Science Monthly, write to our Readers' Service Department. We will gladly furnish, free of charge, names of manufacturers of devices described and illustrated.

Bird Protection for Electric Lines

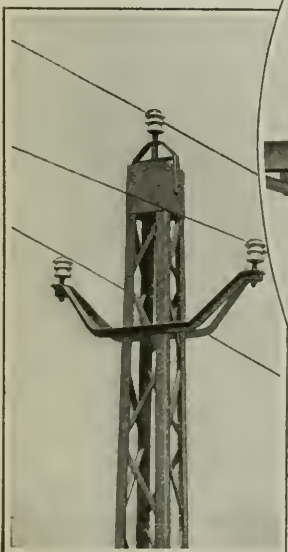
SOCIETIES for the protection of birds have insisted with particular emphasis that central station managers should provide suitable safeguards to prevent the electrocution of birds which perch on high-tension lines. These endeavors have generally been welcomed by the power companies, not because they pity the birds, but because short-circuits might be produced and great damage caused. The arcs produced through the body of a bird, between the line and grounded iron parts, are a serious menace for electric plants. Fluctuation in voltage is caused and worse still may happen if two birds should produce short-circuits. For this reason the system illustrated in the accompanying figures was evolved by one of the large German electric companies.

In order to prevent the production of electric arcs between a grounded pole-arm and live conductors, an insulating button is fixed wherever there is a risk of such bridging. These insulating buttons are either pointed or flat. A bird can perch upon them with impunity. Such arrangements will be welcomed by all bird lovers.

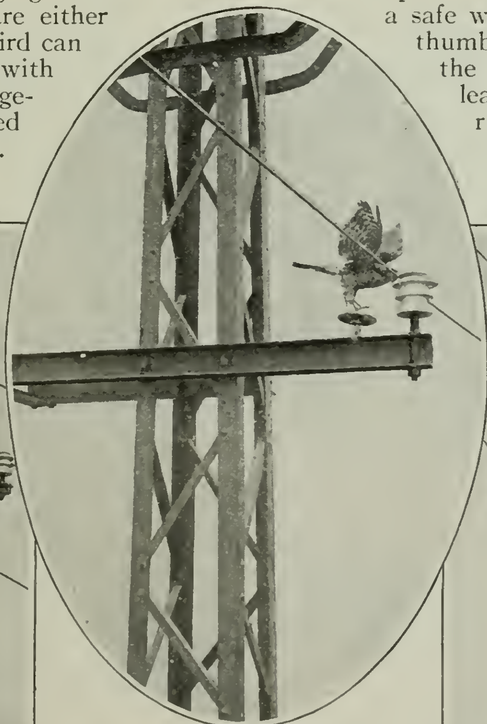
A convenient lifter for hot dishes

It Saves the Cook's Hands

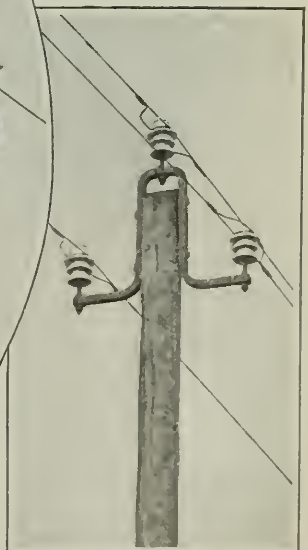
NO modern cook need make a burnt offering of her fingers on baking day, for it is no longer necessary to draw hot, handleless pie-pans and pudding-bowls from the oven with hands poorly protected by dish towel or apron. For a few cents she can buy a simple mechanical lifter which solves the difficulty. This consists of wire loops to hold the hot dish, and a safe wooden handle with a thumb latch for adjusting the lifting loops. To release the dish simply requires a slight pressure on the lever.



Inclined arms are an effectual safeguard



The production of electric arcs between a grounded pole-arm and a live conductor is avoided by means of an insulating button



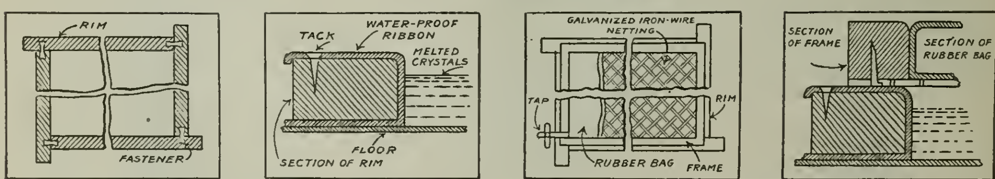
Wooden poles only require insulating supports

Ice Skating in Summer Without Ice

ICE can be made artificially for summer skating. It has the disadvantage of melting. For that reason, chemists have devised glassy surfaces which will stand heat and which will be as acceptable as ice in winter.

Some years ago a German patented a process, in which thick pasteboard plates are immersed in very hot linseed oil and varnish, mixed with glue. After becoming thoroughly permeated with this mixture, they are subjected to a powerful pressure, which squeezes out the excess of oil and gives them great strength. When dry, the plates are immersed in hot paraffin and again put under pressure. To one side of each plate a layer of parchment is applied; the other side is coated with gypsum and tar. The plates, with the parchment sides up, are then fitted together on the floor and united by cement. The finished surface of the rink is coated with a material consisting of one part of glycerin, two parts of wax, and three parts of oil. An unusually smooth floor is thus formed; but ordinary skates cannot be used, since their sharp edges would soon cut up the surface beyond repair.

Another compound contains soluble glass, fluor-calcium, asbestos, ground glass or flint, paraffin and soapstone. These substances, when thoroughly mixed, are applied to the floor. A thin coating of soluble glass and a layer of paraffin are then added. Absolute smoothness is obtained by passing a heated roller over the surface. If the surface becomes scratched, more heat is applied, or fresh coats of glass and paraffin are added.



Diagrams showing treatment of floors. The hot salts are poured into frames on the floor. After solidifying, the frame is removed and used for the next section. The frame with the galvanized-iron wire nets is used in re-surfacing the floor, a rubber bag filled with steam being laid on it. The heat is thus applied without bringing the bag into direct contact with the salts

Skating on Salt

The idea of using crystalline salts, such as the carbonates and sulphates of sodium, potassium and other substances having like properties, has also been suggested. The salts are boiled and then poured directly on a water-tight floor, having raised edges. The floor should be laid in sections, by means of a frame for holding the melted salts. After they solidify, the frame can be used for an adjacent section.

The porous substance permits the surplus moisture to pass from the magnesium chlorid to the crystalline top layer or vice versa

This same method has been improved so that a good permanent sliding-surface is obtained. When the rink becomes badly scratched, due to excessive use, heat is applied by means of a rectangular frame supporting a wire latticework. The frame is placed on the floor and a rubber bag, filled with steam, is laid on the lattice-work. The action of the heat melts the salts, so that a flat, smooth surface is formed.

Another device for heating resembles an ordinary garden rake. Steam is blown on the floor through a longitudinal slit in a tube. The tube has a handle and two runners for guiding it across the floor. The pipe for supplying the steam passes down the handle and connects with the lower horizontal tube.

This smoothing process is too frequently necessary, owing to the varying degrees of humidity in the atmosphere. To do away with this difficulty, at least partially, one inventor places a thick sheet of sodium carbonate upon a layer of porous material, which, in turn, rests upon a floor having many intersecting channels. Water, circulated through these channels, is absorbed by the porous material and thus comes into contact with the top layer. This tends to prevent the air from affecting the sodium carbonate, but does not completely overcome the difficulty.

The nearest approach to perfection is a combination of substances now being used in Germany with success. Below the porous layer is a sheet of some hygroscopic (water-attracting) substance such as magnesium chlorid. When the air is humid, the excessive moisture from the crystalline top layer passes into the middle porous layer, and then into the bottom layer; when the air is dry, moisture reaches

Intersecting channels underneath the salts are filled with water to be taken up by the porous layer the salts on top by passing up through the porous substance from the magnesium chlorid below. In this way a good sliding surface is maintained.

Limbering the Muscles of Fire-Fighters

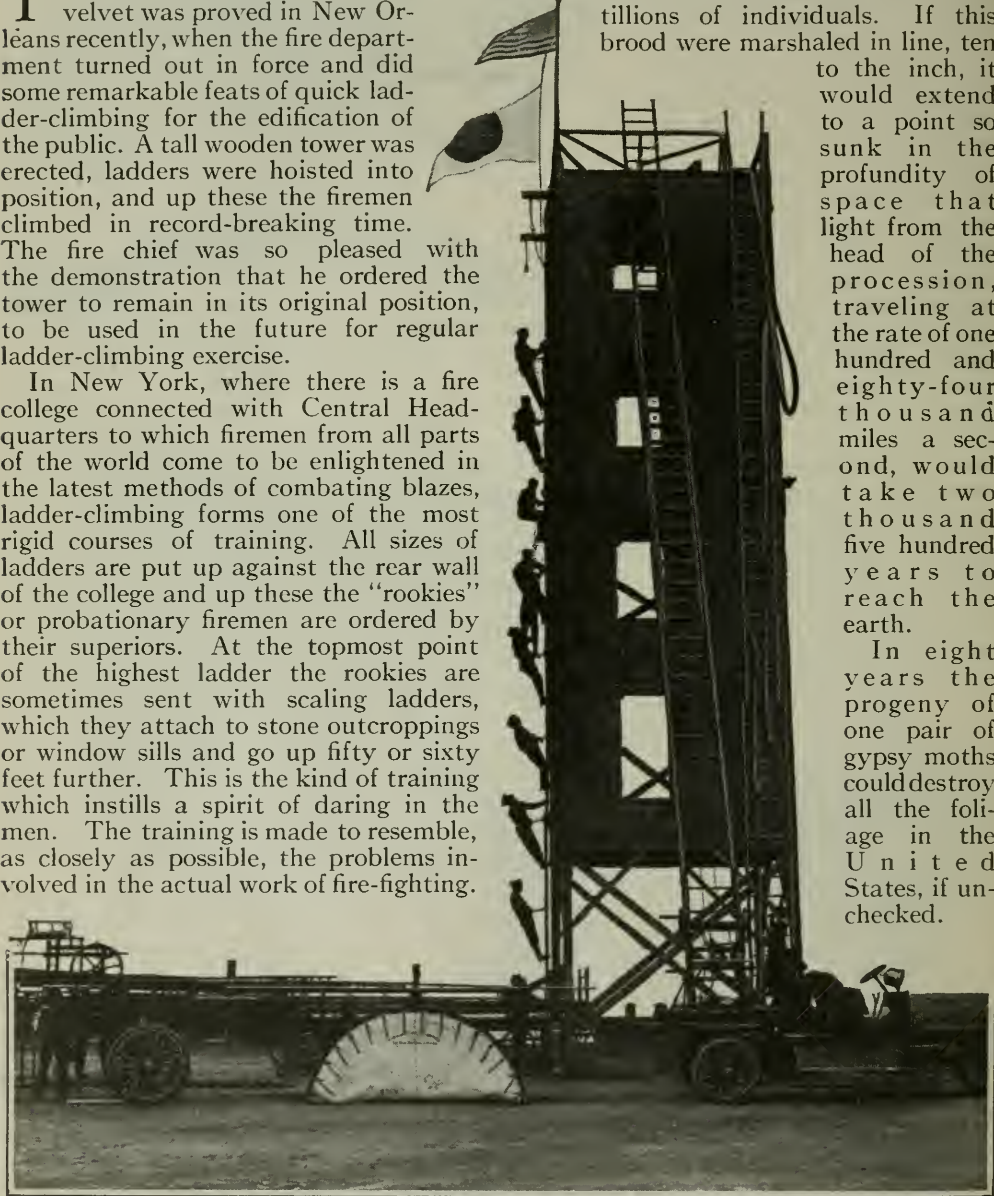
THAT the fireman's life is not all velvet was proved in New Orleans recently, when the fire department turned out in force and did some remarkable feats of quick ladder-climbing for the edification of the public. A tall wooden tower was erected, ladders were hoisted into position, and up these the firemen climbed in record-breaking time. The fire chief was so pleased with the demonstration that he ordered the tower to remain in its original position, to be used in the future for regular ladder-climbing exercise.

In New York, where there is a fire college connected with Central Headquarters to which firemen from all parts of the world come to be enlightened in the latest methods of combating blazes, ladder-climbing forms one of the most rigid courses of training. All sizes of ladders are put up against the rear wall of the college and up these the "rookies" or probationary firemen are ordered by their superiors. At the topmost point of the highest ladder the rookies are sometimes sent with scaling ladders, which they attach to stone outcroppings or window sills and go up fifty or sixty feet further. This is the kind of training which instills a spirit of daring in the men. The training is made to resemble, as closely as possible, the problems involved in the actual work of fire-fighting.

One Reason for Appreciating the Value of Birds

THE fecundity of certain insect forms is astounding. The progeny of one little insect, the "hopaphis," sees thirteen generations born to it in a single year, and would, if unchecked to the end of the twelfth generation, multiply to the inconceivable number of ten sextillions of individuals. If this brood were marshaled in line, ten to the inch, it would extend to a point so sunk in the profundity of space that light from the head of the procession, traveling at the rate of one hundred and eighty-four thousand miles a second, would take two thousand five hundred years to reach the earth.

In eight years the progeny of one pair of gypsy moths could destroy all the foliage in the United States, if unchecked.



A demonstration of firemen's ability in ladder-climbing in New Orleans, La. These men proved so efficient in practical life-saving methods, that their chief ordered the tower to be left in position for the drilling of recruits

Thousands of ducks find a safe shelter and breeding place at the United States Game Preserve at Wichita, Idaho

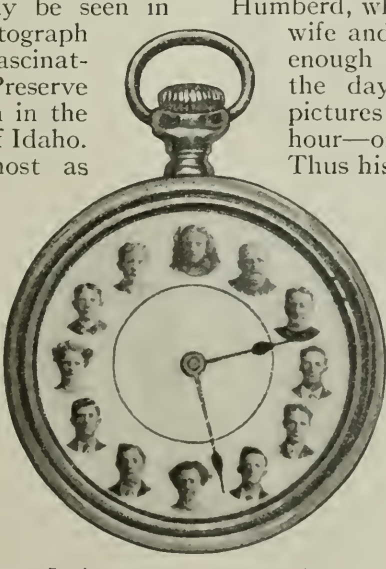
Game Preserve for Ducks

TO protect the wild ducks and other birds, besides having a general closed hunting season, a number of game reserves have been established both in the United States and Canada. Wild fowl soon learn the safety of such resorts and enormous flocks may be seen in these havens. The photograph shows an exceptionally fascinating view in the Game Preserve established by Uncle Sam in the Wichita National Forest of Idaho. These same ducks, almost as friendly in the Game Preserve as tame ducks, allowing themselves to be photographed at very close range, will be as wild and wary as hawks as soon as they have left its protecting borders and scattered among adjoining lakes and rivers.

What Time Is It? Half-Past Aunt Sarah by This Watch

IF you happen to ask C. W. Humberd of St. Joseph, Missouri, what time it is by his watch and chain he is apt to reply: "Just about half-past Edith" or "a quarter to Calvin" or "fifteen seconds after Albert." And then, of course, you are shown the watch and the mystery begins to unravel itself.

Humberd, who is a contractor, has a wife and ten children, just a big enough family for every hour in the day. Humberd had their pictures arranged—one for each hour—on the dial of his watch. Thus his watch has thirteen faces—twelve of them smiling.



It is nearly half-past Aunt Sarah by this curious watch

Humberd himself starts off as one o'clock. Then comes Mrs. Humberd an hour behind him. The eldest son is three o'clock, followed by two other sons, so that it is six o'clock before the first daughter appears. At nine o'clock there is another daughter, and so on down through the whole happy family of children.

Are Metals Alive?

CHANGES in hardness, strength or elasticity in certain metals may be due to conditions analogous to disease in organic tissues, according to some metallurgists. This theory of the disease of metals has been so far accepted in Germany that the Imperial Navy Yard at Wilhelmshafen sends metals regularly to "the autopsy room and dissecting tables" of Professor Heyn, a leader in this kind of work. This new conception of metals is due to the studies made some years ago by Professor Jagadis Chunder Bose, an East Indian physicist of Presidency College, Calcutta, who proved experimentally that it is scientifically wrong to divide matter into "living" and "dead." He demonstrated that the phenomena which we commonly associate with life should also be associated with non-living metals, books, paper and the like.

It seems as if metallurgy will create a new and vastly important branch for itself—the branch of producing inoculating material for metals, which shall change their temper and form swiftly instead of waiting for the slow processes of forging and tempering that obtain to-day.

Heyn has been studying the modifications in iron under all grades of temperature, and he holds that the metal passes through various stages of disease that produce structural changes just as the cells of plants and animals change in form, size and position. He heats copper in order to find why that metal suffers from over-heating, and he concludes that it becomes poisoned with copper protoxid, which so sickens it that its structure changes and partially breaks down.

The metallurgists have joined the chemists in erasing the line which divides all substances into organic and inorganic—just as the line between animal and plant life has ceased to exist. The German metallurgists have come to speak as a matter of course of the life that unfolds itself in steel under various temperatures that are applied to it in working it. Poison steel with hydrogen or hydrogenous matter and you so sicken it that it gets into a condition where it is as brittle as if it had been ruined in tempering.

Pure glycerin cannot be frozen by ordinary means, even at twenty degrees below zero. But, introduce a bit of glycerin that has already been frozen and the rest begins to congeal. This process is nothing more nor less than inoculating an inorganic substance with crystals in order to breed in it the condition of crystallization.

Bredig, a German investigator, found the point of infection in the crumbling tin roof of the Council House at Rothenburg. The roof suffered from a disease, now known as tin pest.

Answers to Sam Loyd's April Puzzles

Answer to "Off His Beat"

The mathematical cop says that his conversation with the Roundsman occured at 9:36 A. M., because 1/4 of the time from midnight would be 2 hours and 24 minutes, which added to 1/2 the time until midnight, 7 hours and 12 minutes, equals 9 hours and 36 minutes. Had the Roundsman not remarked it was morning, 7:12 P. M. would have been an equally correct answer.

Solution of "At the Auto Races"

The race of the three autos might have terminated in 26 varied results, as follows:

Assuming that all three finished six ways, viz: A, B, C; A, C, B; B, A, C; B, C, A; C, A, B; C, B, A. Then A, B, C in a dead heat or A, B; A, C or B, C in a dead heat for the first place. Then again, A first with B, C, in a dead heat for second or B first with A, C, second or C first with A, B, second. Then there are various results in which one or more of the cars fail to finish. All three might fail to finish. Then there are nine different results in which one car failed and with two failing to finish there are three ways.

Answer to "Cheese and Crackers"

Let us call the weight of the cheese X, and the balance board would be 1/2 X. Four-fifths of the board, and therefore, 4/5 of its weight would be on one side of the balance point. Let us assume that the beam was 5 feet in length. Then on the cracker side, at the point 2 feet from the fulcrum (the average distance), would be a weight pressure of 2/5 X pounds. This being equivalent to a 1/5 X pounds pressure at the extreme end. On the cheese end of the beam would be a pressure of 1 1/20 X pounds. This to balance would require a pressure of 21/80 X pounds at the end of the long arm. Since a pressure of 16/80 X already existed, the difference to be made up in crackers would be 5/80 X.

Therefore, the ratio of crackers to cheese would be as 5 to 80.

Answer to "At the Stamp Window"

The cashier gave the postal clerk a $1,000 bill in exchange for 18,816 one-cent stamps, 14,112 two-cent stamps, 10,584 five-cent stamps and 5 eight-cent stamps. No other United States bank-note can be divided in the manner necessitated by the cashier's order.

Answer to "Juggling the Digits"

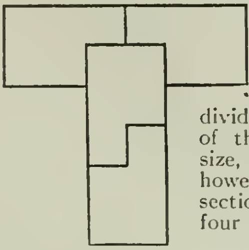
Solution of the schoolmistress' puzzle of the digits involves the interesting principle of "residual roots," which means the continuous addition of a group of figures until a single figure results. For example, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, added together equal 45. Four and five equal 9. No matter how those figures may be grouped in a sum, without employing fractions, the "root" number will always be 9. The root of 1916 is 8, so it is apparent that the given problem cannot be worked out without resorting to some method which will reconcile the discrepancy in roots. Following are three methods wherein fractions are employed to bring the result:

1907 $\frac{56}{28}$	1907 $\frac{68}{34}$	1907 $\frac{86}{43}$
3	2	2
4	5	5
1916	1916	1916

Answer to "How Old Was Jimmie"

On school registration day Jimmie was 9 3/5 years of age; his mother was 38 2/5 years; his father 50 2/5 years and his sister 16 4/5 years.

Answer to "Dividing the Farm"



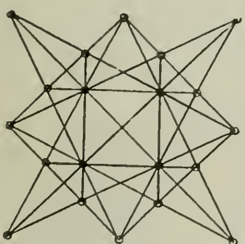
The accompanying diagram shows how the land formed like the letter T is divided into four pieces of the same shape and size, it being necessary however to turn over one section in order that all four may be exactly alike.

Answer to "On the African Firing Line"

There are 8 cocoanuts in evidence in the picture, which may be accounted for as follows: The Zulu threw the first and the monkey the second and third. Then the Zulu picked up one and threw it back. The one he threw came back with two more from the monkey, which would account for five upon the ground. Again he picked up one and threw it, bringing two more, which would account for 7 on the ground. Once more he picked up one and threw it as his parting shot. It came back, making seven on the ground as shown in the picture. According to schedule, the monkey was entitled to two shots, and in the picture we see his first, which scored a bull's eye.

The Zulu threw 4 cocoanuts.

Answers to May Puzzles



Answer to "Play Ball"

The diagram shows how 18 rows, 4 balls in line, may be scored in an arrangement of 20 balls.

Answer to "How Large Is This Man's Lot?"

The lot must have been 150 feet wide by 150 feet deep, having an area of 22,500 square feet. He had 190 poles, and if he had placed them two feet apart around the lot, he would have been 110 poles shy, whereas, if he had planted them two yards apart he would have had 90 poles left over.

Answer to "Children A-plenty"

Miss Pocahontas Smith must have been 24 and little Captain John 3, with 13 brothers and sisters ranging between. "Seven times older" is equivalent to "eight times as old."

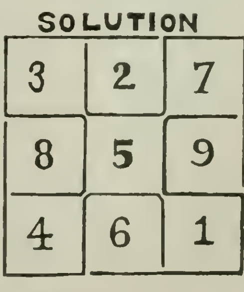
Answer to "A Daisy Game"

The correct reply to play of 1 and 2 is to take 8. This divides the daisy into two parts of 5 petals each. You may then imitate every play of your opponent. Should he reduce one side to 4, you reduce the opposite to 4, and so on, which enables you to remove the last petal and win.

Answer to "While You Wait"

The cobbler charged 90c. for repairing men's shoes, 75c. for women's and 45c. for children's.

Answer to "Reversing Magic Squares"

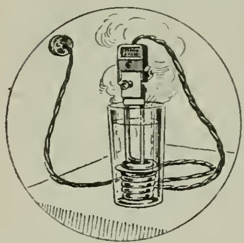


The diagram shows how the 9 little squares are constructed of four similar continuous lines. The diagram also shows an arrangement of the 9 figures in which totals of the 8 rows are dis-similar.

Little Inventions to Make Life Easy

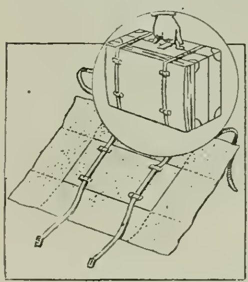
Why Weren't They Thought of Before?

Small Electric Heater



THE electric heater shown in the illustration is very serviceable for quickly heating small quantities of water or other liquid in a suitable vessel. The large heating surface insures very quick action. An easily detached connector adds to the convenience.

Packing the Things You Never Can Cram into Your Suitcase

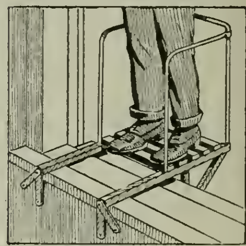


THE attachment fits the side of a suitcase and is meant to increase the capacity of the interior. The central rectangle is made of stiff material, while the side-pieces fold in on it, completely covering whatever is placed inside. The neat, flat bundle thus made may then be fastened to the side of the suitcase with tie straps provided for the purpose.

The Fruit Picker's Sleeve-Chute

ATTACHED to the wrist of the operator is a sleeve. Fruit grasped by the hand slides down the cloth tube and into the bag. The fruit-picker's other hand is thus left free to grasp a ladder, tree-branch, or other support. Much time is thus saved over the older method of holding a pail or basket with one hand and dropping picked fruit into it with the other.

Safety-First for Window-Cleaners

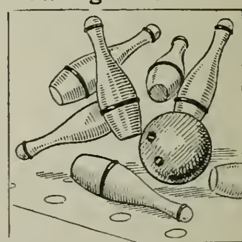


A SMALL platform is clamped to a window-ledge to serve as an extension to the outer sill. This gives a wider foothold outside the window and materially increases the safety with which window-washing operations may be undertaken on high buildings. A railing around the top of the platform lessens the danger of a chance miss-step.

A Mitten-Duster

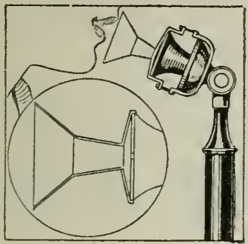
A MITTEN-duster which can be slipped on the hand enables the housewife to dust furniture as with the ordinary dust cloth and at the same time keep her hand perfectly clean. The mitten consists of a hand-shaped piece of soft felt; a bunch of cotton yarn is attached to the lower edge and serves to gather the dust.

Muffler for Bowling-Pins



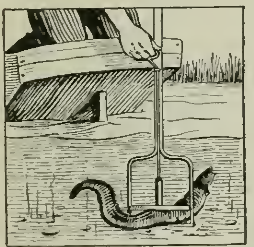
THE noise made by falling bowling pins is a nuisance, especially when the alleys are in the vicinity of a hotel or other place where quiet is desirable. This difficulty is overcome in large part by cutting a groove in the belly of the pin and in the top, and then putting in place a rubber band to deaden the sound made by the falling pins. This acts effectively as a muffler and reduces insomnia in nearby places to a minimum.

Telephone-Mouthpiece Deadens Outside Sounds



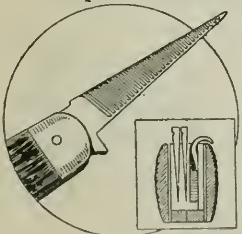
THE added mouthpiece shown has a second diaphragm attached to its inner end. This absorbs the outside noises which interfere with telephone conversation. Through a central hole in this outer diaphragm sounds spoken into the mouthpiece are carried to the inner diaphragm in the ordinary manner. The invention is particularly useful in mills and factories where pounding and noise make it impossible to telephone with ordinary apparatus.

Down with the Portcullis, and Your Fish Is Caught



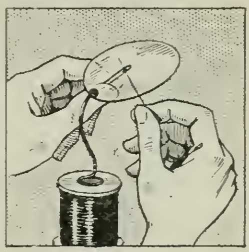
THE fisherman plants his trap in paths frequented by fish. When the prey swims through the metal archway, a quick jab on the handle causes the top cross-piece to descend, pinning the fish tightly to the spikes beneath. The catch may then be drawn up through the water and dropped into the boat.

Improved Pocket-Knife Punch



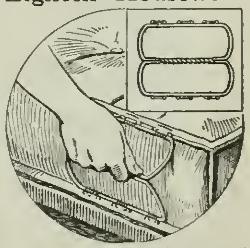
A NEW pocket-knife has a blade L-shaped in cross-section. It is especially adapted for use as an awl or punch. The inner edge of the punch is sharpened, so that it can be used in reaming out and cutting into a hole. Slanted corrugations on the blade's exterior assist it to penetrate hard substances, since they grip the material screw-fashion. The new punch is no more in the way than the ordinary knife-blade, since it folds compactly into the handle when not in use.

A Magnifying Needle-Threader



ALMOST every professional or home seamstress, as she approaches middle age, begins to have trouble to see well enough when threading her needle. There has been devised an adaptation of the magnifying glass to serve her. A lens which will enlarge three and a half times is supported by a little standard fitting into the spool of thread. The glass can be turned to any desired position as the seamstress looks down through it at her needle and thread. The lens is also available for other purposes, such as removing splinters, or studying fine print or small pictures or maps.

Mattress Handles Lighten Housework



TWO rectangular wire frames, hinged together at the middle, are fastened to the mattress with heavy safety pins or any other convenient means. A handle is located near each corner of the mattress; other handles are provided in the center if necessary. By grasping the handles a housewife can move a mattress much more easily than by seizing the bulky cloth itself.

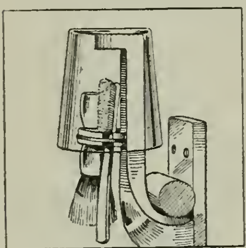
A Perfume-Wafting Fan

CONTAINED within a fan-handle is a layer of cotton or other fabric, while at the top of the blade is a strip of blotting paper clamped across a hole. On both these absorbent materials perfume is poured. As the fan is swayed in the air the perfume is given off. Because of the novelty of the idea, the fans are advanced as a valuable advertiser for perfumes.

An Umbrella with an Electric Fan

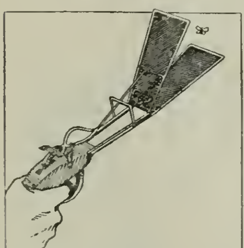
HERE is an umbrella with an electric fan to keep you cool on a hot day. Within the hollow handle of the umbrella are concealed both a dry battery and a motor. A shaft extends through the umbrella casing from the motor to the axis of the fan, which is so constructed that the blades open and close with the umbrella. By pressing a small push-button at the side of the handle, the fan blades are made to revolve as long as pressure on the button is maintained.

Convenient Holder for Toilet Articles



A CLAMP, fastened to a wall, has a notched lug for gripping a toothbrush, shaving-brush, and other toilet article. A glass, placed over the top to keep the dust off, is readily removed at any time. In the hollow of the arm back of the glass a shaving stick may be deposited, thus making the whole a compact and convenient fitting for crowded bathrooms.

The Mechanical Fly Swatter

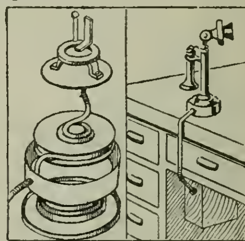


TWO mesh screens such as are used on ordinary fly killers are pivoted so that when a trigger is pulled, a spring causes the two screens to come together like the jaws of a trap, thus catching the fly between the two screens and crushing it. The handle of the device is shaped like a pistol stock, and the spring mechanism is actuated by a trigger, as in a pistol. If desired, the two screens may be locked together, and the device used as an ordinary fly "swatter."

Two Kitchen-Forks in One

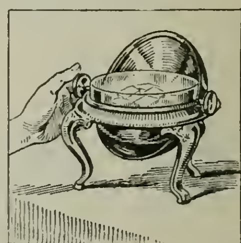
A DOUBLE kitchen fork that meets one of the housewife's troublesome problems is shown in the cut. In taking vegetables, tender meats, and other similar foods from the pan it is customary to use two forks, one in each hand, in order to prevent breaking the food into small pieces. The double fork enables one to make the transfer with only one hand, leaving the other hand free for handling the utensils and for other purposes.

Cord Reel Is Telephone Convenience



TO take up loose telephone cord and prevent it from getting entangled with desk materials, a reel is actuated by a spring, having just enough tension to keep the cord wound up but not sufficient to move the telephone. The attachment will fit any ordinary desk-telephone. The spring is the lowest of the three coils shown in the illustration, the cord being the others.

A Sanitary Butter Dish



A SANITARY butter dish protects the butter from dirt, dust, and flies, and at the same time keeps it cool and solid. The butter is contained in the tray of crystal glass; beneath is an ice chamber in which ice may be placed in warm weather. The cover is turned over the butter to protect it when the dish is not in use; when the butter is needed the cover easily swings into place underneath the glass. This dish is not only convenient and useful, but ornamental as well.

For Practical Workers

Curing a Noisy Automobile Hood

MANY of the cheaper cars develop an annoying series of noises after they have been in use for a time, and most of these may be entirely eliminated by a little careful attention. The most common cause, outside of the mechanical depreciation, is looseness at the hood, as this rubs against the hood-ledge on the radiator and dash, and produces squeaking. The hood is liable to rub on the filler-board between the frame and hood side, as the frame distorts due to highway irregularities, and if the hold-down clips are loose, the hood will rattle.

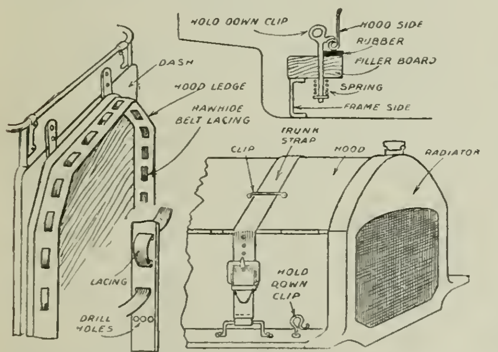


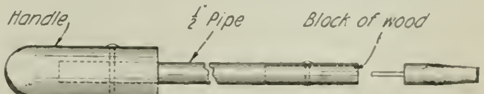
Diagram showing the use of rawhide to prevent hood from rattling

A very simple method of overcoming this trouble is to remove the strip of shoe-lace or light webbing ordinarily used on the hood-ledge and substitute for it, a good, broad, rawhide belt-lacing. The webbing is not heavy enough to keep the hood away from the ledge and soon flattens out. The rawhide is not only thicker and broader, but it is more enduring. In order to use the lacing, the small holes in the ledge-strip must be enlarged, which can be done very easily by making a drill hole on each side of them and then punching out the metal with a chisel.

Another good way to cure hood rattle, which is unavoidable with thin gage hoods, is to run a trunk-strap over the hood as shown. This should have a series of holes for the buckle at each end, the buckles being carried by shorter straps attached on each side of the car, so the hood can be raised on either side without entirely removing the strap. The strap is guided by clips riveted to the hood, the straps carrying the buckles being held down by clips fastened to the filler-boards. Much improvement can be made by interposing a thin strip of rubber from an old inner tube between the hood side and filler-board as shown. The springs regularly furnished to seat the hold-down clips can also be replaced with stronger ones.—VICTOR PAGÉ.

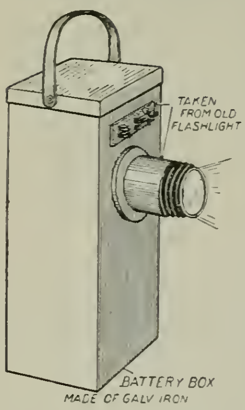
A Long-Handled Screwdriver

A LONG-HANDLED screwdriver can be constructed in a few minutes with a block of wood, a piece of ½" pipe and a dowel ½" x ½". A slot is sawed in one end of the pipe to prevent the screwdriver from turning. The accompanying diagram illustrates the construction. Any length screwdriver may be constructed by the variation of the length of pipe used.



A screwdriver of any length can be constructed with a block of wood, a piece of pipe and a dowel

Making an Electric Lantern from a Flashlight

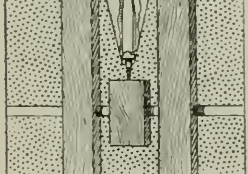


A SMALL tubular flashlight of the double tungsten battery type, of about 1¾-in. diameter, may be converted into lantern form at a small cost. The regular type of dry battery is used, being cheaper and more durable.

The body of the lantern is made of galvanized iron. Its base is 3¼ ins. by 3½ ins. square, and its height is 9 ins. Two 10-32 machine screws are let through two opposite sides near the top, and soldered in place. The handle is drilled at each end, slipped over the screws and fastened on the outside with small brass nuts. Two notches are made in the cover to enable it to set down over the screws.

The lens, metal ferrule and cap are removed from the fiber body of the flashlight and soldered to the front of the battery box, as shown in the illustration. The switch may be used by mounting it as shown. One terminal of the battery is grounded to the box; the other runs to the switch and from there to the bulb. After giving the box a coat of black enamel, the lantern is finished. It is in many ways an improvement over the original flashlight.—A. Dane.

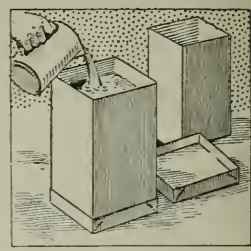
Driving Screws in Inaccessible Places



DRIVING a set-screw in a place too small to admit the fingers to hold the screw may be accomplished as follows:

Roll a piece of paper into a cornucopia with the hole just a trifle smaller than the screw. By dropping the screw into this and holding it in the hole with as light pressure on the screwdriver you can drive the screw home.

A Home-made Ice-Mold



TO help reduce the high cost of living, many people would freeze their own ice during the winter months if they had molds that were practical and inexpensive. Get at a furnace shop an old hot-air pipe, the larger the better. Cut into sections about two feet long and press into square tubes to afford a chance for the expansion of the freezing ice. For each tube or mold, make a pan for it to set in by bending up the four edges of a sheet of tin, making the pan about two inches deep. Fill the pan with water, place a tube in it and the first night's freeze will give a solid ice bottom. Add each day as much water as will freeze hard, till the mold is full. Put into the refrigerator, without removing from the mold. As many tubes can be used as desired or convenient.

How to Etch a Water-Set

THE easiest method of frosting glass is by means of hydrofluoric acid. A complete water-set can be beautifully etched with very satisfactory results.

Procure a water-set of any description; the quality of the glass makes no difference with the frosting process. Dip each piece in melted paraffin, being sure that every point is covered. After cooling, inscribe, with a knife-blade or etching-tool, the letters or design to be used, and see that the wax is entirely removed from the design.

Place all the pieces in a box, lined with heavy Manila paper. Also set a bottle of hydrofluoric acid in the box. Do not remove the acid from the original container, since it will eat through glass; simply remove the stopper and place a cover over the box. The fumes of the acid will act on the glass so long as exposed. From 36 to 48 hours give a good heavy frosting.

This method can be used on electric bulbs, glass doors or any glass that can be properly exposed to the hydrofluoric acid fumes. The acid will keep for months.—L. E. Fetter.

Grinding Out Dies

AFTER continued use, dies sometimes require a little more clearance. A grinding attachment for this purpose is shown in the diagram. The coupling is fastened to a small motor-shaft. A piece of drill-rod, 1/8" in diameter is attached to the other end of the coupling, and a small piece of metal is forced on to the end of the wire to form a shoulder for the wheel.

Using a wheel with a diameter as small as 1/4", and having it mounted on the slender rod, which acts as a flexible shaft, it will find its way to small places that otherwise could not be reached without a stone.

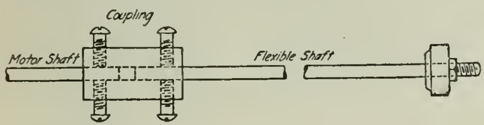


Diagram showing simple appliance for grinding out dies

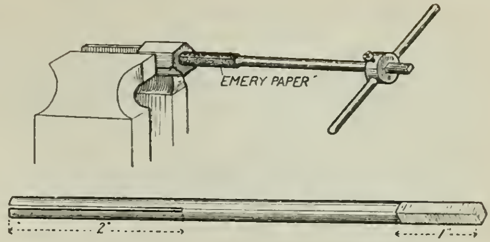
Drilling Holes in Sheet Metal

IT is very difficult to drill holes in even fairly thick sheet metal and practically impossible in thin metal, especially brass and copper. The following method will be found serviceable:

Drill a hole of the desired size in a piece of steel of suitable size. Square off the shank end of the drill and place the point in the chuck clear to the top. Close the jaws lightly so as not to injure the drill. A piece of drill rod with the end squared off is better, this piece constituting the punch.

Lower the punch and place the steel so that the punch enters the drilled hole. If the punch is raised carefully the hole will remain directly under the punch. Hold the sheet metal up against the punch; then lower both at the same time. They will not disturb the steel block underneath, when together. Additional pressure with the press-lever forces the punch through the sheet into the hole, taking with it a piece of metal the size and shape of the punch.

If the holes have a definite location, mark the center lightly with the center punch. Turn your punch in a lathe, leaving a small point in the center. By placing the center punch mark on this point, holes can be located with accuracy.



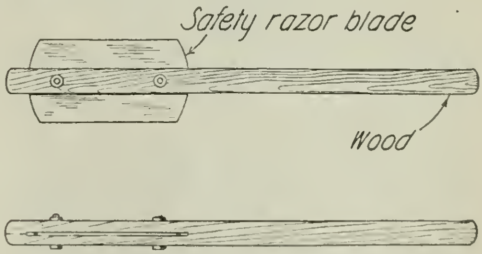
This reamer does accurate work and can be easily made

How to Make a Reamer

AN accurate and efficient reamer for enlarging steel or brass bearings, etc., can be made as follows:

Obtain a round steel rod and make a 2-inch slit at one end. File about an inch off the other end and square it so it will not slip in a brace. The length and diameter of the rod will depend upon individual needs and uses. Cut a strip of emery cloth 2 ins. wide. Insert one end in the slit in the rod and wrap the rest around it. The rod, with the emery cloth, is then inserted in the bearing to be reamed and turned by means of a brace.

This tool gives a smooth, clean, accurate cut and is much better than a round file for the same purpose. A set of these rods may be made from old pieces of steel that are found lying around most workbenches and will often come in very handy.



An old safety-razor blade is just the thing for making a scalpel

A Home-made Scalpel for Trappers

IN skinning animals, a very sharp knife is needed. A good scalpel can be made from safety-razor blades, as shown in the diagram. New blades may be substituted by removing the bolts. This tool is especially useful in dissecting skunks and muskrats.—E. S. CLARK.

A Hose Connection Guaranteed Water-Tight

THE hose connection illustrated, has an upper part with a tapered end to fit the rubber washer in the large end of the lower part. Near the end of each part, which engages the hose, is an enlargement to keep the hose from

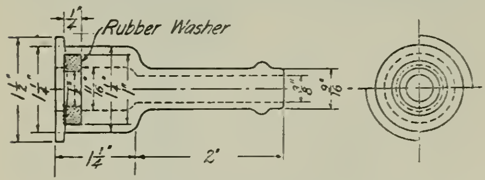
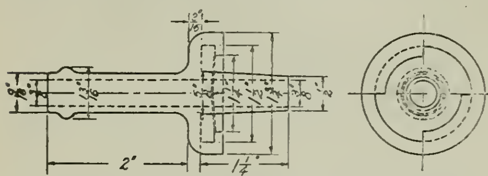


Diagram giving proper dimensions of hose connection

slipping off. Small clamps can also be used. Each flange consists of 2 segments of a circle, 90°, each opposite the other and tapered, or rather increasing in thickness, so that after the 2 parts are placed together, a 90° turn, and sometimes less, will make the connection perfectly tight.—JOSEPH K. LONG.



A ninety-degree turn makes this connection perfectly tight

Silver-Plating Glass

HERE is a good recipe for silvering mirrors or silver-plating glass of any kind.

Two solutions are used. For convenience they may be designated as solution No. 1, and solution No. 2.

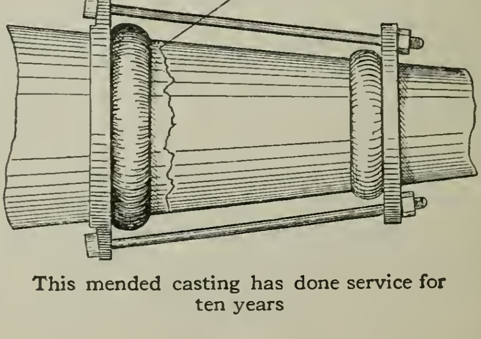
Solution No. 1 is prepared as follows: To a one per cent solution of silver nitrate add pure aqua ammonia, drop by drop, till the precipitate is almost all dissolved. Let this stand and then filter. The filtrate is solution No. 1.

To prepare solution No. 2: Dissolve one gram (.04 oz.) of silver nitrate in a little water and add to 500 cubic centimeters (17 fluid ozs.) of boiling water. Then dissolve 0.85 gram (13.12 grains) of Rochelle salts in a little water and add to the 500 cubic centimeters of boiling water containing the silver nitrate. Boil for 20 or 30 minutes till the gray precipitate has collected, and filter the solution. This filtrate is solution No. 2.

The glass surface to be coated must be carefully cleaned with alcohol to remove all traces of grease and dirt. All other surfaces which are not to be coated, should be painted with melted paraffin after the glass has been cleaned with alcohol. This leaves a clean exposed surface on one side of the glass to which the silver will stick. In coating with the paraffin, be careful not to get any on the clean surface. Mix equal parts of solutions No. 1 and No. 2, and place the glass to be coated in the solution. The silver will stick better if the clean exposed surface of the glass is rubbed with a small cotton swab, saturated with the solution. Leave the glass in the solution till the coating of silver is as heavy as desired. Then scrape off the paraffin, being careful not to mar the silver deposit on the rest of the glass. If desired, to protect the silver coating, two thin coats of white shellac may be applied.—L. G. HASKELL.

How to Mend a Broken Casting

WHILE placing a casting in his lathe, ten years ago, a machinist permitted it to drop on the tailstock, breaking the casting, as shown in the illustration. It was a serious break in those days, when cast-iron could not be welded so readily as now. The only recourse was a harness of two turned rings and two bolts. The arrangement may be seen in the illustration; it does not look good, but it is still doing service.—N. G. NEAR.

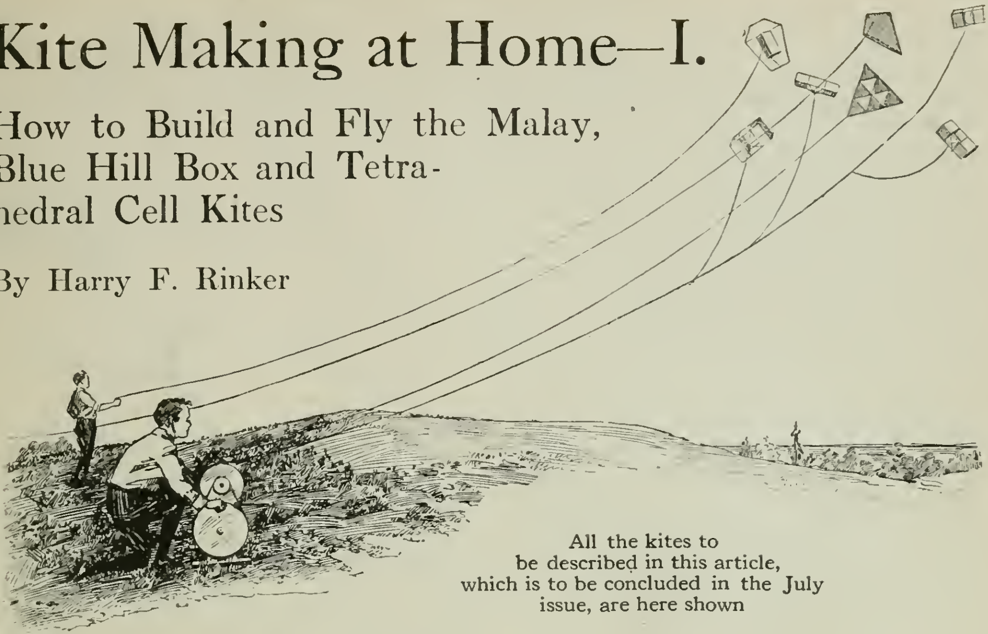


This mended casting has done service for ten years

Kite Making at Home—I.

How to Build and Fly the Malay, Blue Hill Box and Tetrahedral Cell Kites

By Harry F. Rinker



All the kites to be described in this article, which is to be concluded in the July issue, are here shown

THOUGH the kite is usually thought of as having four corners, with a grotesque face painted on each side and terminating in a tail of rags, the fact is that this sort of kite has disappeared. Today every boy who is scientifically inclined, can build for himself kites which are as much ahead of the one Benjamin Franklin used as the motor-cycle is an improvement over the bicycle.

Building the Malay

We will begin operations by making six-foot Malays, each of which carries 18 sq. ft. of sail, or 108 sq. ft. for the battery. The maximum pull from these kites is delivered at approximately 45 degrees flying angle, and the tangent of 45 degrees being .707, the resultant pull equals approximately 7/10 the horizontal wind force per square foot. With a ten-pound breeze, therefore, the pull of one kite will be 126 pounds, and six of them will pull 756 pounds. It is evident, therefore, that some mechanical advantage is needed by the operator to handle such a force as this, and such apparatus will be discussed later.

The design of the kite is as follows: The frame of this kite consists of two sticks at right angles to each other, supporting the sail. For the six-foot kite, the two sticks are each 6 ft. long. The vertical stick is placed keelwise, while the transverse stick is laid flatwise across it. The required size for the vertical stick is 1 in. by ½ in. and for the transverse stick ⅜ in. by ¾ in. Take a piece of clear white pine, spruce, or fir stock, 1¼ ins. thick, and split it once. Plane up the split edge to a straight edge, and rip off, parallel to it, six pieces ¾ in. wide. The majority of the fibers in each piece must run from end to end. Clamp up and plane off to 1 in. thickness, as shown in Fig. 1. Take apart and lay flat on bench as in Fig. 2, and dress to ½ in. thickness. Spring each piece carefully in your hands to see that it has uniform strength. Get your cross-sticks from 1 in. or ⅞ in. stock in a similar manner:

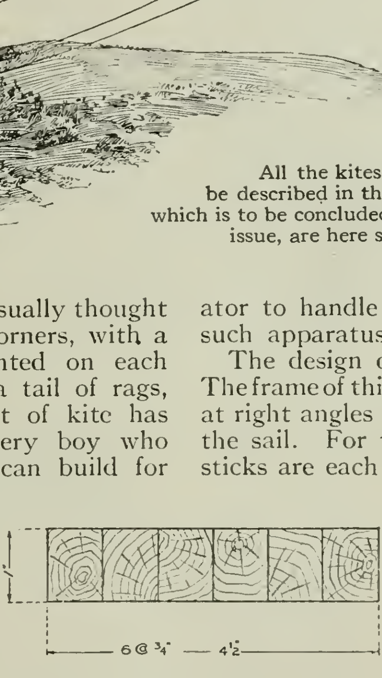


FIGURE 1

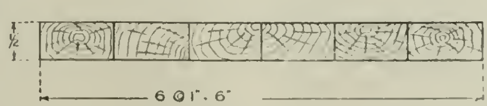


FIGURE 2

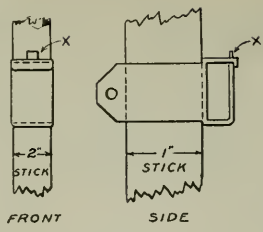


FIGURE 4

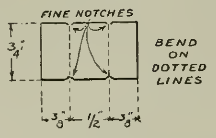


FIGURE 5

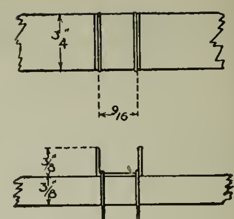


FIGURE 6

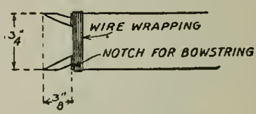


FIGURE 7

Dress them clear and clean with a good sharp plane. Now mark them as just described. Make six brass clips, of No. 22 or 24 gage brass, as in Fig. 3. Also make six as shown in Fig. 4.

The bolt in the clip on the upright should be tight enough to pull it into the wood, and the wires on the transverse stick should do the same so that clips will not slip, but at the time avoid bruising the wood more than necessary. The twisted ends of wire can then be turned in, and soldered. The ends of each stick should then be wrapped with several turns of wire, keeping about ⅜ in. from the extreme end. These wrappings should also be soldered. The ends of the cross-stick should then be notched for the bowstring, as in Fig. 7. The bowstring when applied should pull the cross-stick as in Fig. 8. Always leave the bowstring so it can be slipped. The distance X should be about 6 ins. for a very light wind, and about 10 ins. for a 10-mile breeze. If not satisfactory at first adjust after trial.

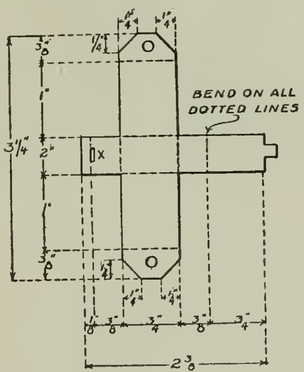


FIGURE 3

Finally make a saw cut about ¼ in. deep in the end of each stick, sawing the ¾-in. way on the cross-stick and the ½-in. way on the upright. Then take a string, strong enough to stand considerable pull, and pass around the frame through the saw cuts. Make a slip-knot where you join and hold in your hands or fasten temporarily. Square your frame by measuring this string till corresponding parts on each side are exactly equal, moving the sticks in relation to each other till you get the frame true. The cross-stick will now be exactly at right angles to the vertical, and the bowstring should pass about 10 ins. behind it.

The center lines of the two sticks must cross exactly 18% of the length from the top of the vertical stick. Be exact if you want your kite to balance. So, 72 ins. × 18% = 12.96 ins. = distance from the top. Mark 13 ins. with a pencil, and shade this slightly upward. Now mark the exact center of the cross-stick.

The best material for making the sail is known as silesia or cambric in the dry goods stores. Any combination of colors can be used if desired, but they must join in a straight line up the keel. Blue and yellow, white and red, green and pink, etc., are all strong contrasts. However, the colors seen most distinctly at great heights are red and white, black and white, orange and red, and blue and white. Whatever the colors you select, and plain ones are as good as any, start by marking out on the floor with chalk the four points of your frame. Sew your cloth firmly on a sewing machine, and lay it out as in Fig. 9.

Sew a brass curtain ring, 1 in. diameter, in each corner, so it can be hooked into the saw-cut. Tie a stout string from ring to ring, putting the rings in place on the frame and pulling into position till both sides are exactly the same

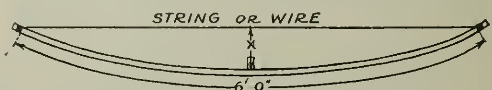


FIGURE 8

length. The extra length on the cross-stick must be fulled on the string toward the top of the upright so as to

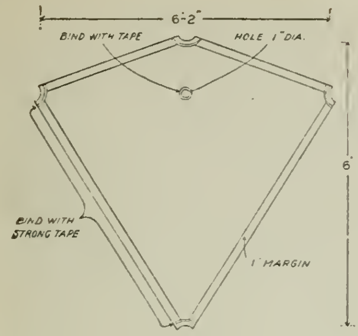


FIGURE 9

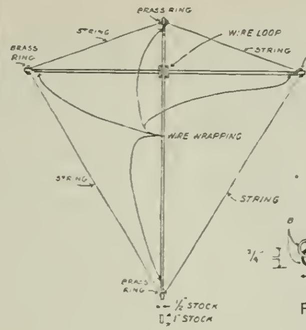


FIGURE 10

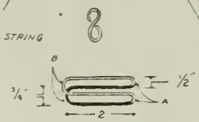


FIGURE 12

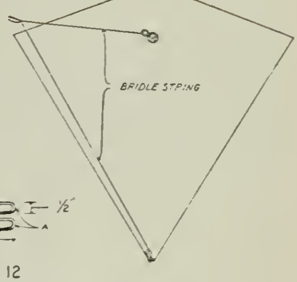


FIGURE 11

bring all the slack in the center. This forms a pocket under pressure, making the head-sail which keeps the kite from pitching. Turn over all the edges and sew them firmly and evenly. You will now have a cover with rings in each corner and re-enforced edge. Turn the raw edges in. Remember it is windy where this kite goes. To bridle the kite, get a piece of wire and bend it as shown in Fig. 12. Solder it into an endless loop. This must be slipped on as the sticks are put together, so that the loops marked *A* project through the 1-in. hole in the sail, while those marked *B* pass behind the upright stick. The bridle string is fastened by means of an S-link—as shown, at each end. One link is hooked into the loops marked *A*, and the other into the ring at the bottom of the kite. You now have a kite which when knocked down and the sail wrapped around the sticks, forms a package 6 ft. long and about 2½ ins. in diameter. You can carry six of them easily. You can get on a trolley car or boat with them without trouble, while, if not made as above you could not handle one. After a little practice, they can be put together in a few seconds, and they will carry a boat along in good shape at an amazing speed when properly flown.

The flying cord used by the writer was a steel wire No. 18 gage, in ½-mile coils, tested to 750 pounds. A special reel was used for this wire, with multiplying attachment, and smaller steel wires, No. 22 gage being used for each individual kite.

The method of flying is this: A kite is set up, bridled, and hooked to one of the small wires, this wire paid out from an auxiliary reel, until 200 ft. are aloft. The main flying wire is then attached. When 400 ft. are aloft, the reel is checked. A second kite is flown with 200 ft. of lead wire and hooked into the main wire. Both kites are then paid out on the reel, till another 200 ft. is aloft when a third kite is flown and attached. This process is continued till all the kites in the battery are aloft. The reel used contains one mile of wire.

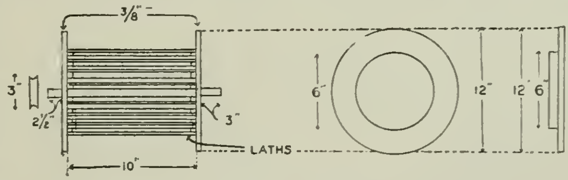


FIGURE 13

The method of attaching the kites to the main line may seem to the novice a means of inviting trouble but in practice each kite flies higher than the main line, and invariably some slight difference in balance or variation in direction of the wind at different heights sets them out from the main line at different angles, so that they do not interfere. Four of these kites in a 10-pound wind will give two-thirds the pull of six, as a matter of course. So if you had a 15-pound wind, four would be about all you could handle, while in a 30-pound wind, one would be fully capable of keeping you busy even if it did not break its back, for a 30-pound wind, blowing 80 miles an hour would give a total loading on the vertical rib of 540 pounds, which is nearly the ultimate. It will not be necessary to demonstrate further than the figures given, that this kind of kite flying is strenuous enough to hold a man's attention when his whole battery is aloft in a 10-pound wind.

The reel is made of two circles of ⅞-in. material, 6 ins. in diameter. To one side of these pieces, other circles of ⅜-in. material, 12 ins. in diameter, are glued cross-grain, and further secured by a half-dozen clenched brads. To the inner 6-in. circles nail slats of ¾-in. material, 1 in. wide by 10 ins. long. Cut the holes in the center of the ends 1 in. square; put a square stick tightly through these holes, allowing it to project 2½ ins. at one end and 3 ins. at the other. Turn bearings for the frame in each of the projecting ends. These will be 1 in. in diameter. If you have no lathe you can whittle them with a knife and sandpaper. The frame is made, as shown in Fig. 13.

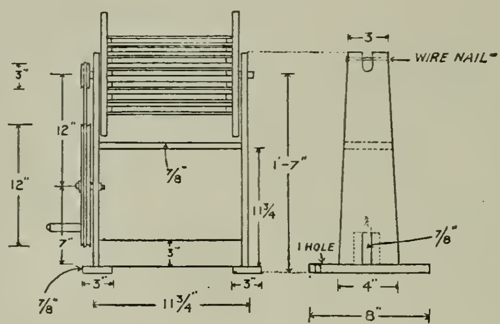


FIGURE 14

Obtain two grooved pulleys of the diameter shown and a piece of sewing machine belt. Put the belt on the pulleys crossed. This will give it better contact. Screw into the 12-in. pulley a handle about 1½ ins. from the edge, and you have a good stout reel which will bring your string in four times as fast as an ordinary reel. You will appreciate this when you have tried both. No checking arrangement is needed on your reel. When necessary to check, take the string in your hand and snub around the projecting end of the axle. Two iron pins, 15 ins. long, of ½-in. round iron, pushed slantwise toward the front through the 1-in. holes into the ground, will take the strain.

The construction and methods of flying the Blue Hill box-kite and the tetrahedral cell will be discussed in the next issue of the Popular Science Monthly.

How to Protect the Surface of a Laboratory Table

STRONG acids and other chemicals of strong composition are continually spoiling the appearance of laboratory tables. The following treatment may therefore be found of service. It can be recommended for preserving the experimenting table from the injurious effects of strong acids or alkalis that may be accidently spilled, provided the liquids spilled are not left on too long. Two solutions are required, as follows: The first one consists of one part of bluestone dissolved with one part of chlorate of potash, in eight parts of boiling water.

For the second solution, dissolve 1½ parts aniline hydro-chloride (which a chemist can obtain to order), in 10 parts of water. Having thoroughly cleaned the table, apply the first solution as hot as possible, and with a flat brush. Apply another coat as soon as the first is dry, and then two coats of the second solution. When thoroughly dry, rub with raw linseed oil, till polished, and wash with hot, soapy water. A good black surface is thus given to the wood, in addition to the acid-resisting qualities. After it is perfectly dry, a little linseed oil, applied with a cloth, will also be of advantage. A hard surface with considerable luster is thus obtained, which will resist damage to its surface, especially from acids.—Wm. Warnecke, Jr.

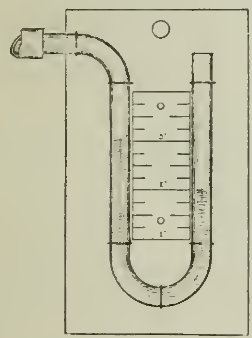
A Mission Stain

ONE of the best and cheapest stains for mission furniture can easily be made by mixing black asphaltum with turpentine. Any desired brown shade can be obtained by varying the amount of turpentine. Apply the mixture to the work with a brush. After it has been on a minute, rub it dry with a clean cloth or cotton waste. It will dry quickly and leave a dull mission finish.

Gaging the Stack Draft

THE draft pressure of a stack is expressed in inches of water, meaning the amount of draft required to change the difference of equilibrium of two communicating columns of water, measured in inches.

The draft of the chimney can be easily obtained with the use of the little gage illustrated herewith. The fuel consumption of a boiler can be figured whether or not it is in proportion to the results, etc. The illustration shows how such a gage is made. A single length of glass tubing with an inside diameter of ¼ in. is bent to the required shape by holding over a small flame and bending very slowly when hot. Fasten to a board with wire or brass straps. Arrange a scale of inches between the two columns.



Glass tube used for gaging stack draft

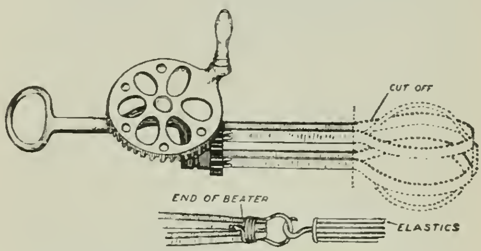
To read the draft, place the gage on a wall in a vertical position and put a little water into the tube so that it just balances in either column. Connect a piece of rubber tubing to the left leg and seal in a small opening in the stack or pipe. The draft or suction at the end of the tube will cause a slight vacuum in the tube and will cause the two columns of water to change their level. The draft may vary from ¼ in. to 2 ins. according to height of stack, temperature and weather conditions. The draft pressure required will depend upon the kind of fuel used. Wood needs little draft, about ½ in. or even less. Bituminous coal will require ¾ in. to 1 in. and anthracite or slack will need a draft of 1½ ins.—B. F. DASHIELL.

A Safe Way of Bending Pipes

THOSE who try to bend piping without kinking by filling the pipe with sand and still fail, will attain better success if they pour molten lead into the pipe, allow to cool and then bend. Heat the pipe, allowing lead to flow out.

A Toy Rubber-Elastic Winder

A DISCARDED egg-beater may be easily converted into a toy aeroplane winder. Cut off the loops which formed the beater part. Wire the stubs together and make two wire hooks or loops for fastening the rubber bands. The winding will be greatly facilitated by increasing the length of the crank.



An old egg-beater can be converted into a good toy winder for rubber motors

A Cheap Beam-Compass

A WOODEN rod, such as drygoods merchants use for cloth, makes a good beam-compass, by attaching a pencil and nail as shown in diagram. The pencil is flattened on opposite sides, to be gripped in the beam, and the head of the nail has been filed off. The rings consist of brass tubing. When using ink, the ruling-pen is gripped like the pencil.—WM. TURNPENNY.

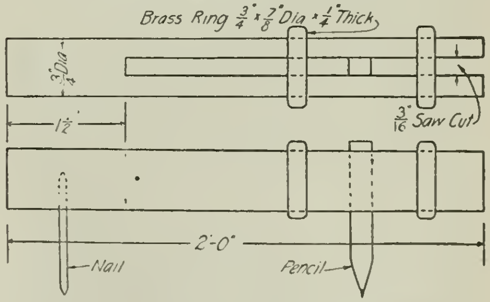
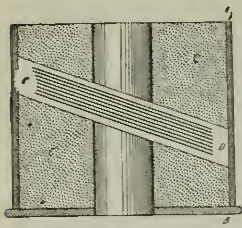


Diagram showing construction details of beam-compass

Removing Waterproof India Ink Spots

IT is not generally known that black India ink, especially the waterproof kind, may be removed from nearly any material by placing a blotter underneath and pouring household ammonia over the dried ink. Care should be taken that the blotter does not become saturated with the blackened ammonia.

How to Make a Polariscope to be Used with a Microscope



MANY microscopic objects that appear uninteresting and devoid of structure when examined in the ordinary way, develop surprising beauty of form and color when viewed by polarized light. This applies to the majority of crystals and rock sections, as well as many vegetable sections containing minute crystals embedded in the tissues. A beam of light may be polarized by passing through a specially cut prism of Iceland spar, or more cheaply, by using a bundle of glass plates inclined at a certain angle. The polarized beam is allowed to pass through a transparent object and afterward through a second prism or bundle of glass. The polariscope will therefore consist of two parts, one placed beneath the stage and called the polarizer; the other somewhere above the object, and called the analyzer. The best position for the analyzer is usually considered to be just inside the body-tube of the microscope, immediately above the objective. A low-power objective measuring about 1 in. is best when working with polarized light.

The accompanying illustration shows the details of the polarizer in section. The several parts may be mounted in a brass tube *A*. Any tube that happens to be handy will do, but it must make a nice fit in the understage fitting of the microscope, so as to be capable of rotation without danger of falling out. A paper tube can be used as a substitute, though of course it will be less durable than metal. If paper is used the tube should be made by coating one side of a strip of paper with thin glue or good strong paste and winding tightly around a rod or tube of suitable size, care being taken to prevent the formation of wrinkles. If several layers of paper are wound on, the tube will be hard and strong when dry. One end must be closed with a cap *B*, perforated in the center with a hole ⅓ in. in diameter and projecting sufficiently beyond the tube to afford a convenient grip.

Two pieces of cork *C*, *C*, must fit neatly in the tube. Each of these must be cut as shown in the illustration, the slanting sides forming an angle of 57 degrees with the side of the tube. Further, both corks must be perforated with a hole of the same size as that made in the cap *B*. The holes should be carefully made with a cork-borer so that they will be continuous when the parts are assembled, and parallel to the axis of the tube. They should be blackened inside with photographic dead-black, or else lined with black paper having a dull surface. After fixing one cork by means of fish glue, a number of thin microscopic cover-glasses *D* should be dropped in, each of which must first be cleaned thoroughly with tissue paper or chamois leather. About 18 will be sufficient. They are best handled with a pair of small pointed forceps. The second cork can then be inserted, a gentle pressure being applied to keep the thin glass plates from moving and so rubbing dust off the corks.

The analyzer is merely a replica of the polarizer, but small enough to go inside the body-tube of the microscope. In this case it will not be necessary to have a cap at the end of the tube, since, if the polarizer rotates, the analyzer does not need to move.

A polariscope made in this way is inexpensive and the results, though somewhat inferior to those obtained by the use of Iceland spar prisms, will repay the trouble of preparation. One or two selenite films should be purchased, mounted on microscope slides of the ordinary size, 3 ins. by 1 in., and placed immediately beneath the object. By this means, the range of color is greatly increased.—H. T. GRAY.

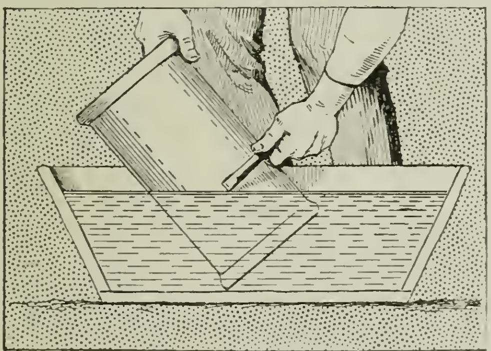
To Stop a Lathe Quickly

WHEN polishing or turning small diameters in the lathe it is usual to speed the lathe up to its limit. This is all right, but in stopping it is the custom to throw the belt shifter quickly, which often causes the reverse clutch to be engaged; and if it happens suddenly the result is that the belt comes off. This trouble can be easily prevented by placing a collar on the shipper rod which will prevent the reverse clutch from engaging.

Cutting Tile at Any Angle

IT is often desired to cut tile, cast-iron pipe, or even steel pipe at an angle in order to make a turn in the pipe line. Where these pipes are so large (as they usually are) that they cannot be laid in a miter box for cutting, and where it is desired to mark them quickly and correctly at the same time, the following is a good expedient:

Set the tile in water at the correct angle, as shown in the diagram; hold it there and make chisel marks all around at the surface of the water. The cut can then be made, after removing the tile from the water, in a true plane. Where care is taken in lowering the tile into the water so that it will not be wetted too high, the "wet edge" on removal will serve as a good guide for the path to be cut.—W. F. Schaphorst.



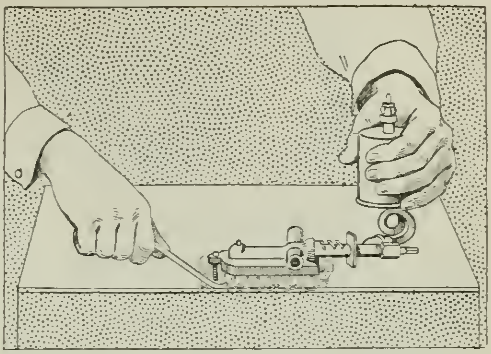
Piping and tile may be easily cut at any angle by dipping in water

A Substitute for a Soldering Iron

IT is often necessary to repair a leaky wash-boiler, tea-kettle or other utensil quickly, and if no soldering iron and appliances for heating it are at hand, the work must be taken to a tinsmith.

Moreover, a small soldering iron in the hands of an amateur is a difficult tool to use on large work because heat is rapidly conducted from the iron by the cold sheet-metal upon which it is used.

In many households may be found self-heating flat-irons. As shown in the drawing, the burners from such irons may be used to good advantage for soldering. Since the flame is directed downward by the pressure from the tank, the principle is essentially the same as that employed when using an alcohol lamp and a blowpipe.



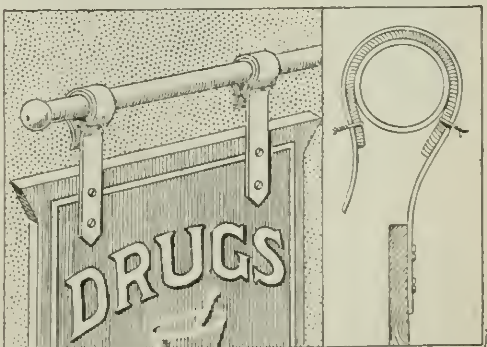
A good substitute for a soldering iron is made from the burner of an ordinary self-heating flat-iron

A heavy copper wire may be used in place of a soldering iron. If the wire is short, it will be necessary to place it in a handle or wrap some sheet asbestos around one end, as it will become too hot to handle. This "soldering iron" will remain hot until you can finish the job.—C. H. Patterson.

Taking the Squeak Out of a Sign

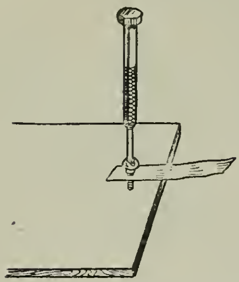
INSTEAD of being kept awake nights by a squeaking drug store sign, the writer resorted to the following expedient to silence the offending advertisement: Insert two pieces of leather strap between the iron pipe which supports the sign and the strap-iron hangers, as shown in the diagram. Fasten the ends of each by twisting soft iron wire around the hanger.

No oil is needed and the leather will wear for a long time.



The squeaking drug store sign can be silenced with two pieces of leather

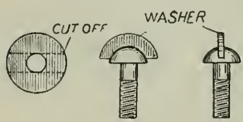
Handling Fine Screws



IN repairing watches, clocks, spectacles and other small articles, the difficulty of inserting very fine screws into their respective holes may be easily overcome with the aid of a piece of paper. The screw is first pierced through a strip of stout paper, which is then held, with one hand, over the hole, while the screwdriver, held in the other hand, gently presses the screw into the required position.

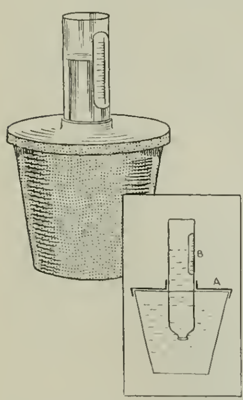
When the screw is partly driven, the paper is torn away and the screw finally driven home.—GEORGE H. HOLDEN.

A Home-made Thumb-Screw



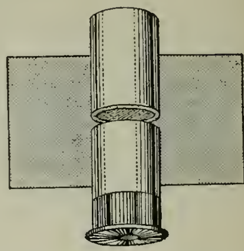
THE materials needed for making a thumb-screw, are a round-headed screw and a washer. Cut the washer as shown and sweat it into the slot of the screw. If the washer is a good fit, very little soldering will be necessary to insure a perfect union.—L. E. FETTER.

How to Make a Barometer



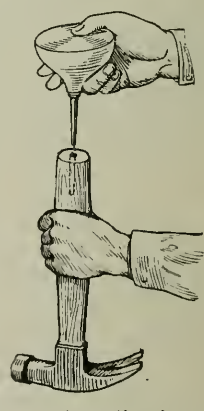
A SIMPLE but reliable barometer may be made from an ordinary tumbler and a test-tube or vial. The vial, about two-thirds full of water, is inverted in the tumbler, which is nearly full of water. A tin cover *A*, provided with a hole in the center, will serve to support the vial in an upright position. The greater the pressure of air, the higher the water will rise in the bottle, and vice versa. A little paper scale, ruled as shown, may be attached at *B* to indicate the degrees of fluctuation.—H. J. GRAY.

Making a Long Distance Shot with a Shotgun



IT is sometimes necessary to take a chance on making a long shot, in shooting into a large flock of ducks, especially in hunting on water. Cut a shell into two pieces, making the cut between the shots and powder as indicated in the illustration. If you have made the cut in the right place you will have a wad left at each end. Now put the portion of the shell containing the shots into the gun chamber and then put in the portion containing the powder. Of course your gun must be an open-bored gun. When you fire, the portion of the shell containing the shots will travel the same as a bullet, but upon striking the water it will burst and the shots will scatter in every direction, and you are sure to bag some game that would be otherwise impossible to reach.

Oiling Hammer Handle



A HAMMER handle which is well oiled will outlast two ordinary handles, as the oil penetrates the wood rendering it springy and also preventing dry rot. In the accompanying illustration is shown the methods by which a hammer handle may be thoroughly oiled. A ¼-inch hole is drilled in the end of the handle for a depth of about 2 ins. The hammer is then put in an upright position, and the hole filled with lubricating oil. When the oil has soaked into the wood, fill again, repeating the operation until the handle is well oiled. If desired, a small wooden plug can be driven into the hole to keep the oil from leaking out before it has completely soaked in.—O. B. LAURENT.

How to Build and Sail a Small Boat—II.

By Stillman Taylor

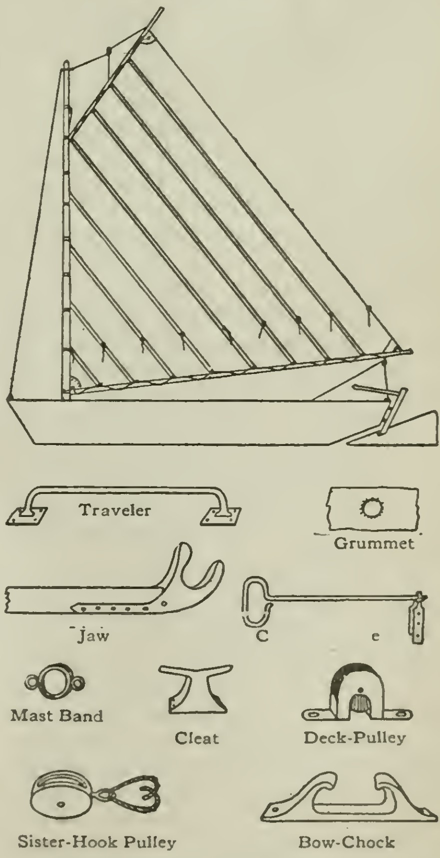
(Concluded from May Issue)

IN rigging the boat with a single sail, known as "cat-rig," the mast should be stepped well forward, say about 18 ins. from the stem. If a sloop rig is preferred, the mast is stepped farther aft, to make more room for the head-sail or jib. The cat-rig is the best for a small boat. It is faster and is much more easily and quickly handled. In any case, where the hole is cut in the deck, a mast-block must be screwed firmly on the underside of the deck, and a second block with a hole cut in the center for the heel of the mast to set in, is screwed to the floor directly under the mast-hole in the deck.

The boat should be painted with three coats of good paint, and to avoid the difficulty of reaching the extreme parts of bow and stern after the decking is on, paint these places as the work progresses, not forgetting to paint the bottom underneath the keel, and the inside of the centerboard trunk. A single coat of thick paint will suffice. The outside, or the entire coaming may be finished "bright" if desired, in which case give it three or four coats of good spar varnish.

The mast may be rounded by planing and tapering a spruce or white pine or cedar stick, 3 ins. by 3 ins.; or a natural pole of the required diameter may be cut in the woods. Make it 3 ins. in diameter from heel to deck, then a uniform taper to the top which should be 2 ins. Square the heel to fit the mast step, making a loose fit, to allow for swelling. A round spar is not at all difficult to make. Simply plane off the four corners, then take these corners off to make it six-sided. Now plane these six corners off and a nearly round spar is secured. Scrape round with a steel cabinet scraper, and finish with sand-paper.

The boom should be about 2½ ins. in the center, tapering to 2 ins. at the foot (mast end) and about 1½ ins. at the other end. The gaff may be made 2 ins. in the center, tapering to 1¼ ins. at either end. Both boom and gaff should be made at least 6 ins. longer than the width of sail, to allow for stretching of the canvas. A goose-neck attachment may be used to attach the boom to the mast, or a patent sail hoist may be used for both boom and gaff. These are expensive, and the ordinary boom and gaff-jaws will answer. Jaws may be purchased with cleats and



These diagrams show the construction of several small parts of the boat other fittings, or sawed out from oak or ash.

A light sail is needed, and this may be made at home on the family sewing machine, or sewed entirely by hand. Five-ounce unbleached cotton drill is heavy enough, and yard wide material may be used. The bights or laps are made by turning over a fold on each side, about 1 in. wide, and stitching along the two edges. Narrow laps about 6 or 8 ins. make a neater appearance and strengthen the sail. The laps must be made to run parallel with the leech, as shown in the sail plan, page 929. The corners of the sail should be re-enforced with a segment of canvas sewed on each side. About 1 foot above the boom, sew in a row of reef-points (1/8-inch cotton rope) so that 6 ins. may hang from either side. By tying these together around the boom, the sail is shortened or "reefed," as the nautical term expresses it. The sail may be bound with cotton rope, but a simple and strongly stitched hem will answer. At the leech make a 1-in. hem, so that a small rope may be run through to take up any slack as the sail stretches out. This prevents that bug-bear among sailors, a flapping leech, and makes the sail set flat and not bag.

The sail is attached to the mast by mast-hoops; either oak or metal hoops may be used. Seven or nine hoops will be needed, in the 3 or 3½-in. size. Grummet holes must be worked in the sail on the side marked hoist, and the sail secured to the hoops by seizing with a double strand of marline. To make the grummet holes, purchase a dozen or so of ½-inch galvanized iron grummet rings, cut a ½-inch hole and place a ring on either side of it, and sew over and over with waxed sail-twine—overcasting the ladies term it. Your mother or sister will show you how to do it. A row of grummets must also be worked in along the boom and the gaff to attach the sail to these spars, putting a grummet at each lap or bight.

To rig the boat, procure a mast band with two eyes, of the right size to slip down about 2 or 3 ins. from the top, where it should bind firmly. Drive the band on with the two eyes fore and aft, that is, in line with the boat. To the forward eye, splice or seize a length of 3/16-in. wire rope, which must be long enough to reach the stem where this end is secured by seizing to an eyebolt screwed into the oak stem. Instead, a strap fitting the stem may be used. This is the stay to support the mast.

To the rear eye in the mast-head band, seize a metal pulley-block (2-in. shell, for ¼-in. rope is correct size). This is for the peak halyards. A foot or so below this block, screw an eyebolt in the mast and fasten a similar pulley for the throat halyards. To the gaff, splice or fasten a bridle of wire rope and to it fasten the end of the peak halyard, either with a bridle clip or a bull's-eye, which is merely a wooden ring with a groove in the outside circumference in which the rope is spliced or seized.

On each side of the deck, opposite and about 6 ins. from the mast, screw a galvanized deck-pulley. This arrangement will lead the halyards aft to within reach of the helmsman, and also serve to support the mast.

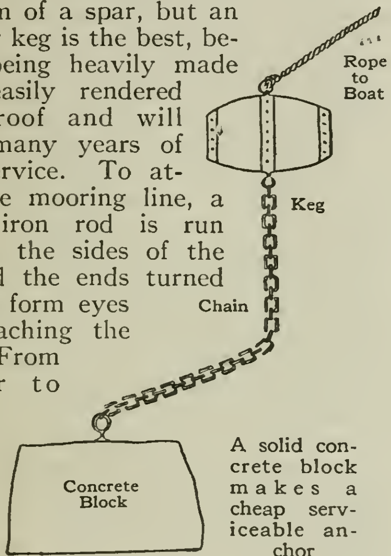
At the bow, screw an open bow-chock 3-in. size, on each side of the stem on deck. A cleat is unnecessary on the forward deck, for the mooring line may be more securely fastened to the mast.

The main sheet may be rigged in several ways, but in a small sail like this no great purchase is required, and two single blocks will be sufficient. To avoid shifting each time when going about, however, a traveler may be screwed to the after deck. This is simply an iron rod about 18 ins. long, fitting with a sliding ring to which a pulley is seized. When going about on another tack, the sail shifts without attention. Cleats for belaying the sheet may be screwed to each side of the deck, but a cleat placed in the center of the rear seat or on the deck, will make it unnecessary to shift the rope every time one goes about.

A Cheap, Practical Mooring for Your Boat

While a 20-pound anchor is about the right size for our craft, most boatmen prefer to use a heavier mooring for the permanent anchorage, with a marking buoy or pick-up. One of the best moorings is easily and cheaply made of concrete. For a small boat, an old dishpan makes a splendid form in which to cast our anchor. A good quality of Portland cement must be used, in the proportion of one of cement to two of gritty sand. Mix thoroughly and add a quantity of broken or any old iron bolts and other small bits of scrap iron you may happen to find. In the center of the form, embed a large eyebolt with a large washer firmly riveted to the end.

The buoy or pick-up may be made in the form of a spar, but an old beer keg is the best, because being heavily made it is easily rendered waterproof and will stand many years of hard service. To attach the mooring line, a heavy iron rod is run through the sides of the keg and the ends turned over to form eyes for attaching the cable. From anchor to buoy, chain is best but rope is all right if renewed each season.



A solid concrete block makes a cheap serviceable anchor

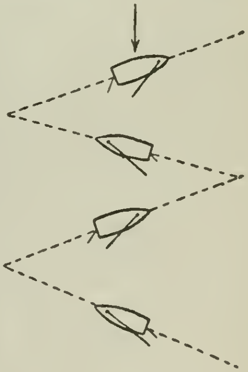
How to Sail Your Boat

The knack of handling sailing craft is quickly learned, but the many little practical wrinkles of seamanship are only to be picked up after considerable experience on the water. Sailing is not the dangerous sport many people imagine it to be, however, and if the boat is of good model and not over-rigged, practically all accidents may be placed at the door of carelessness and ignorance or a desire to appear smart and show off. Of course every boatman should know how to swim; one does not anticipate a capsize or collision, it is true, yet accidents occur now and then, and the ability to keep afloat is well worth acquiring—even if only for the greater confidence it gives.

As every boat possesses certain characteristics and little peculiarities, the handling of one craft differs somewhat from that of another, but the principles of handling are the same for all craft propelled by sails—from the four-masted schooner down to the little skiff we have just built. Hence, the owner should know his own craft—how much sail she can safely carry to get the best speed, and so on.

While a knowledge of the theory of sailing is not at all necessary to sail a boat, every skipper should have some idea of the effect of the wind on his craft. Now the wind pressure against the sails of our boat acts in two directions—it presses and drives the boat ahead, and also forces it sideways, to make it tip or "heel." The pushing force of the wind is of course encouraged in every possible way, by proper rigging and handling, while the heeling tendency is counteracted by making the boat sufficiently stable to resist the upsetting force. This is gained by building the craft of ample beam, by using a deep or heavy keel, or by ballasting the boat with lead, iron, rocks, sand-bags or other heavy weight placed on the bottom of the craft.

When a smooth-bottomed craft (like a common row-boat) is fitted with a sail, the side pressure is so marked that the boat will be forced sideways even faster than it is propelled ahead. This sliding or "making leeway" as sailors call it, must be eliminated so far as possible, and this is done by using a deep keel or—in the case of the boat we have made, by using a centerboard. When sailing close-hauled or beating against the wind, the centerboard is dropped, thus affording resistance to the side pressure. When sailing free, or directly before the wind, the board is raised, so that all the driving force of the wind may be gained to propel the craft forward.



By "tacking" a boat can proceed against the strongest wind

Owing to the fact that the wind pressure on the sail exerts a certain force on the bow of the boat, this "veering" is overcome by swinging the rudder at an angle. This balances the force of the sail. Every well-designed and properly rigged boat—whatever its size or number of sails—should have what sailors call a "weather helm;" that is, if the tiller is let go, the boat will fly up into the wind and come to a stop with the sails shaking. This is accomplished by using a properly proportioned head sail or jib, and in single sail or "cat-rigged" boats like the one we have made, by stepping the mast well forward toward the bow. A few boats carry a "lee helm," that is, if the tiller is let go the boat sags off to leeward, and if the rudder is not thrown across to prevent it, the sail will jib over and the boat swing around as on a pivot. A boat thus badly rigged and balanced, is a dangerous craft for anyone to handle; it is a tricky boat. Furthermore, a boat so balanced is slower under sail, because the rudder must be swung across at a considerable angle in order to keep it headed up to the wind, and this drag of the rudder greatly retards the speed.

Some boats can sail closer to the wind than others and the single sail or cat-rigged type will point higher to windward than a sloop-rigged craft which carries a jib. No boat can sail directly against the wind; therefore, when sailing up-wind we must travel at an angle—which diagonal course is called "tacking." Suppose we are sailing close-hauled—beating to windward, the wind blowing in the direction indicated by the arrow, page 931. As we cannot sail directly against the wind, we must "tack" or sail a certain distance close-hauled with the wind on one side, and then go about and sail close-hauled with the wind on the other side. Thus we proceed to windward in a series of zig-zag courses.

In the diagram just referred to, the wind is "dead ahead" and the tacks are equal. If the wind is a point or two off, as shown in the next diagram, one tack will be longer than the other, as shown in the dotted lines. This sailors call "making a short leg and a long leg."

Tacking against the wind or "beating to windward" as most skippers call it, naturally requires much practical experience before one can get the best speed out of a boat. Some boats will sail closer than others but any well-designed and properly rigged craft should be able to point up within 45 degrees of the wind.

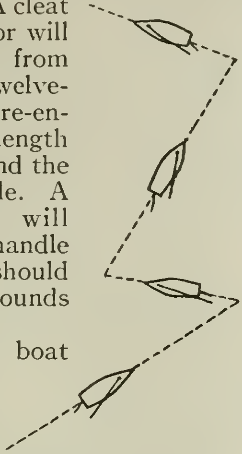
When sailing as close-hauled as possible the sail must be trimmed rather flat. It is, of course, possible to pull in the sail too much; this must be avoided for if trimmed too flat, the speed of the boat is much retarded and the side drift or leeway becomes more marked. In trimming the main sheet, pull it very flat, then ease it off until the edge of the sail along the hoist or mast wrinkles and flutters. The old hand always makes use of this fluttering, which indicates one is sailing "full and bye" or as close to the wind as possible without sacrificing an iota of speed.

In handling the boat, a good skipper will endeavor to "coax" his craft closer to the wind, "crawling to windward" as the sailor calls it. This is done a thousand and one times during a day's sail, by heading the boat close and then easing it off, with the sail just a-flutter.

When going about on another tack the boat is eased off a trifle, and the rudder thrown across, slowly and steadily. If the rudder is worked too quickly it checks the speed and may even put the boat in "stays"—so that it simply drifts sternwards, and necessitates swinging the bow around with an oar. When sailing with companions, going about is generally preceded by calling out "hard-a-lee," which warning enables passengers to duck the boom as it swings over, and to shift to the windward side if needed.

The approximate trim of the sail with the wind at the several points of the compass, is shown on page 933. No. 1 shows the sheet trimmed flat for sailing close-hauled, No. 2 with bow wind, No. 3 wind a-beam, No. 4, wind abaft the beam, No. 5 wind on the quarter, and No. 6 with wind dead astern.

In small sailing craft, the boat is commonly ballasted or trimmed by shifting the weight of the skipper and one or two companions, but the boat may be ballasted if desired. Perhaps the best way to do this is to fill a couple of canvas bags with sand or fine gravel, and place them on either side of the centerboard trunk. A cleat tacked along the floor will prevent the bags from shifting. Ten or twelve-ounce canvas bags re-enforced by sewing a length of 3/16-in. rope around the seams will be suitable. A rope strap-handle will make it easier to handle the bags, which should weigh about forty pounds each.



If the wind is not "dead ahead" the "tacking" must be irregular

In ballasting, the boat must be trimmed to ride on an even keel, or with just a trifle more weight aft of midship. If sandbags or other weights are used, ballast to an even keel, and your weight aft will trim the boat correctly. Too much weight forward makes a boat difficult to steer, and too much ballast aft causes the stern to drag too much water.

The skipper of any boat—be it large or small, should keep his "weather eye" open at all times. When sailing in a river or landlocked lake or bay, one must be on the watch for puffs, and head up into the wind or ease off the sheet a few inches. Moreover, the main sheet should not be made fast, but held in the hand, so that the rope may be cast off to run free at a moment's notice. In a brisk breeze, a half-turn around the cleat will take all strain from the hands, but allows the rope to render free at will.

When running straight before the wind, every boat will swing more or less from side to side, and this "yawing" is counteracted by swinging the rudder slightly in the opposite direction as the bow swings. A little sailing experience will show how the trick is done, for the good sailor can tell the behavior of a craft by the "feel" of his hand on the tiller.

When going about or changing the course, the novice should always come up into the wind, rather than pay off and jib the boom over. The experienced skipper can jib in even a heavy wind by easing off the sheet as the boat pays off and the boom swings over, and quickly pulling the sheet as the craft swings on the other tack.

It is well to keep in mind this rule of the road at sea; that a boat on the starboard tack has the "right of way" over a craft on the port tack. By starboard tack is meant the wind blowing from the right or starboard side (sail to left or port) and vice versa when on the port tack.

When sailing past the lee of a vessel at anchor, or an island, keep your weather eye open. Your boat is certain to be becalmed or "blanketed" while passing, and as she draws clear of the object, the full force of the wind will strike your sail. Remember this and avoid a possible capsize. It is foolhardy to attempt to sail close to steamers and other large craft, for the sake of riding the swells. Keep away from them.

Sailing a boat in rough water demands judgment, especially when the wind and sea are a-beam. This is the most dangerous point of sailing, and calls for a cautious hand on the tiller. If the wind is strong and fresh, it is the wisdom of a sailor to reef and shorten the sail, rather than to stagger along under the whole spread. There is an old maxim which runs something like this—"A sailor shortens sail in time, but the landlubber cracks on sail until all is blue." Keep this in mind and avoid taking chances.

In rough-water sailing, with the boat

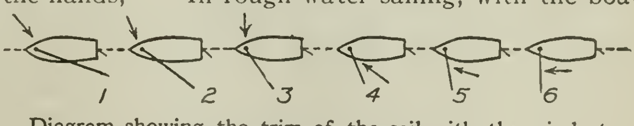


Diagram showing the trim of the sail with the wind at different points of the compass

heeled over to some fifteen degrees, a heavy roller may even capsize the boat. Guard against this, and when you note a particulary big wave coming, put up the helm a trifle, so that the wave may be taken on the bluff of the bow or abaft the beam. This use of the weather helm is one of the essentials in seamanship, Should a big wave seem

All sorts of vegetables and meats can be baked in this camp oven without burning

about to come aboard over the bow, luff quickly into it and meet the wave bow on.

When running before a strong wind and heavy sea—"scudding" as the sailor knows it—the man at the tiller must be on the alert to keep his craft from broaching to, that is from flying up in the wind, on the one hand, and being "brought by the lee" on the other, which means running off so that the wind is on the other quarter.

The boom should be well topped up to keep it high above the water. As most small craft are not often rigged with a topping lift, the sail should be hoisted well up on the mast to afford more clearance for the boom above the water.

Should you happen to be caught out in a gale or squall, it may be possible to run to port under bare poles, or ride out the gale. Even a small boat will weather a heavy blow by rigging up a sea anchor. Of course a regular sea anchor is best, but a fairly good substitute may be fashioned by tying together a raft made of oars, boathook, seats, sails, cushions, etc., and let it drag from the bow, paying out some fifty feet of rope.

No sport is more exhilarating than sailing, and the fun is greatly enhanced if one can sail a boat which he has himself constructed.

A Camper's Dutch Oven

WHEN you go camping in the summer, either for a short or prolonged outing, the old-fashioned Dutch oven, which at one time was very commonly used, cannot be excelled as a cooking arrangement. It is a sort of fireless cooker, which can be built and set up anywhere by means of a few bricks or stones. It will cook meat, biscuit, bread, potatoes or anything else. The beauty of it is that it cooks by indirect heat or by reflection.

It is constructed of any kind of bright tin. To make a large one with an opening of about two feet, take a piece of bright sheet tin about 6 ft. long, and 3 or 4 ft. wide. Lay this out, and cut in the shape shown. Then roll it up, and fasten the edges by riveting. Cut a circular piece of tin to fit the back. Then directly through the center fit a thin piece of sheet iron from the open front to the apex. This is to hold the bread, biscuits and other articles. A smaller size may have an opening of about 21 ins.

This funnel-shaped piece of tin is set up on the ground, with bricks or stones supporting it on either side directly in front of your camp fire of blazing wood. The food is cooked entirely by reflection. The heat from the fire is reflected from the bright tin sides to the food. In a short time the heat inside the funnel is sufficient to cook a steak or fry a fish. Nothing will burn, for the heat is not direct, and there will be no cinders or ashes in the food.

The heat can be regulated by the distance from the fire, but the oven should not be placed close enough for the smoke and cinders to enter the funnel. The articles of food can be placed in the oven, and the open fire built. All that is required then is an occasional replenishing of the fuel. The Dutch used this oven in the house by placing it in front of the open grate fire. It can be used to good purpose in this way in the winter.

This camp oven is so cheap and so easily constructed, that it can be discarded when the bright surface of the tin has worn off, and a new one made. An oven of this sort affords a reliable and simple means of cooking outdoors.

Experimental Electricity

Practical Hints for the Amateur

Wireless Communication

Sharpness of Tuning in Radio

By John Vincent

THE effect of increased resistance in a freely oscillating circuit was described in the May article of this series. It was pointed out that the more rapid loss of energy, brought about by the presence of this added resistance, reduced the number of current oscillations in the circuit. It was also indicated that when the persistence of the circuit was thus reduced (as its damping or decrement increased), the system became less sharply tuned.

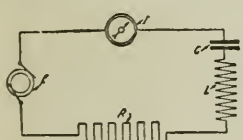


Fig. 1. A simple circuit

Just what is meant by the "sharpness of tuning?" Before this can be answered, it is necessary to look more closely at the effects of tuning itself. This phenomenon of resonance is, perhaps, made of more use than any other in the science of radio telegraphy; and yet it is often grossly misunderstood, even by skilled operators and experimenters.

Mechanical illustrations of tuning, drawn from the art of music, have been described in book after book; yet there seems to exist some difficulty in carrying over, into the purely electrical cases, the physical facts which these analogies should teach. Suppose that one disregards, for the moment, the sympathetic tuning forks and the tuned strings (both of which vibrate, though only one is plucked), and that one considers a simple electrical circuit having in series an inductance, a capacity, a resistance, a current indicator and a source of high-frequency sustained voltage. Such a circuit is that shown in Fig. 1. In the February article the effect of altering the circuit impedance by changing its inductance and capacity was described; when the values of the coil L and condenser C just neutralized, for the frequency generated by the alternator E, resonance was secured and the current indicated by I became a maximum.

The same circuit may now be studied with the alternator at rest. If a charge of electricity is placed upon the condenser and allowed to discharge freely through the circuit, there will be set up a feebly-damped alternating current of the character indicated by Fig. 2; this is on the assumption that the resistance R has a small value, as is usual in practice. The frequency of this free

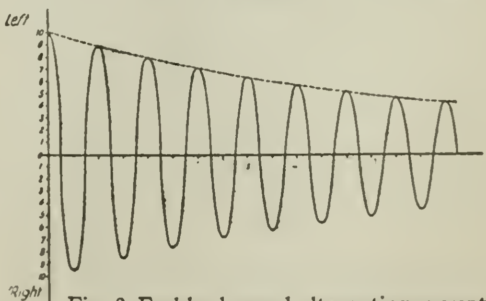


Fig. 2. Feebly-damped alternating current

oscillation may be determined by wavemeter measurement, or may be computed according to the rule given in the March article. Speaking generally, what happens is that the dielectric of the

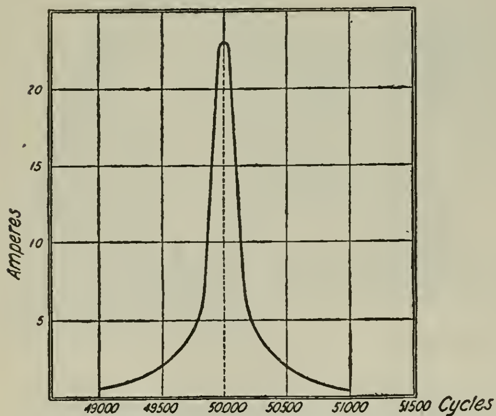


Fig. 3. Curve showing the rise and fall of current by varying the frequency

condenser is electrically strained in one direction when the charging voltage (or pressure) is applied to it; as soon as the pressure is relieved, the strain reacts and its energy produces a current through the circuit (Fig. 1) from the positive plate of the condenser toward the negative side. In passing through the inductance the current sets up a strong magnetic field, which expands and stretches away from the coil as the current through it grows larger. Since there was only a definite amount of electrical energy forced into the condenser by the original charging voltage, there is a limit to the amount of current which can be produced by the discharge; as soon as this limit is reached the magnetic field around the coil *L* begins to contract, and adds its energy to the current flowing toward the negative side of the condenser. By this time the condenser is fully discharged, that is, the two plates are at the same potential. But the magnetic field is still collapsing on the coil, and therefore, current is forced to continue flowing in the same direction as before; this results in a piling up of potentials on the "negative" plate of the condenser and a reduction of electrical pressure on the plate which was "positive." In other words, the reaction of the magnetic field has caused the condenser to assume a new charge, of polarity opposite to that which it had originally. The pressure of this inverted charge increases until the energy of the magnetic field is exhausted; then the condenser discharges once more, but in the opposite direction. A current flows back through the inductance, and an expanding field is set up, just as before, except that the polarity is reversed. The contraction of this second magnetic field forces a new charge upon the condenser, and this time the polarity is the same as of that which began the oscillation. Since a limited amount of energy is set free in the circuit, and since some of this energy is used in heating the wires (because of their resistance) each successive charge and each successive current is smaller than that which preceded it, and the free oscillation is damped, as shown in Fig. 2. The greater the resistance of the circuit the greater the proportion of the original energy, which is lost in heat at each oscillation, and the sooner the current is damped down to a very small value.

What has this internal action of a resonating circuit got to do with its resonant condition, or its tuning (which is much the same thing)? In a word, everything. Why? Because "tuning"

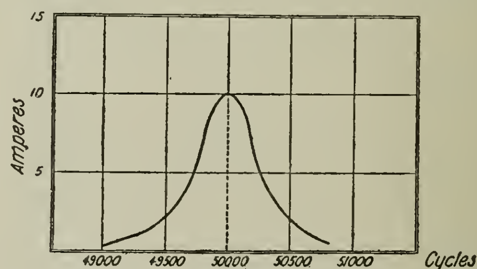


Fig. 4. Curve showing changes in current by altering the resistance

is little more than taking advantage of this self-swinging power of a circuit so that energy may be added to it at just the right time to give its oscillations the largest amplitudes possible. In adding small amounts of energy to an oscillating electrical system, the addition must be made by the application to it of corresponding magnetic or electric forces. That is, small charges must be put upon the condenser one at a time, or small additional currents must be introduced by way of the inductive portions of the circuit. These charges must be applied at the instant that the natural (or self-oscillating) charge of the condenser is of their polarity, for otherwise no advantage of increased charge would be had; similarly, the increments (or additions) of current must be made when the natural current is flowing in the proper direction, for, if not, there would be an opposition to the normal current in the circuit and no increase would be secured. This is as certain as the fact that, in order to make a swing go higher and higher, it must be pushed when it is moving or about to move in the same direction as the applied force; and it is true for the same reason.

Let us now assume that the alternator *E* in Fig. 1 is capable of delivering 1 kilowatt of electrical power at 50,000 cycles per second, but can run safely at speeds as high as that giving 100,000 cycles. Let the inductance and capacity be of such values that the natural frequency of the circuit is 50,000 cycles per second (corresponding to a wave-length of 6,000 meters), and consider that the total resistance is two ohms. If the alternator is started from rest and gradually speeded up, it will produce pulses of alternating voltage at gradually increasing frequencies. These voltage impulses will charge the condenser *C* first in one direction and then in the other; but very little current will flow, because there is no tendency for these lower-frequency voltages to co-operate by resonance. As the frequency comes close to 50,000 per second, however, the current will commence to rise, and at 50,000 cycles it will reach a maximum of about 23 amperes. At this frequency the small voltage additions produced by each cycle of the alternator are impressed upon the condenser exactly in step with the natural oscillation voltages, and the greatest possible oscillation current results. When the frequency is increased beyond 50,000 cycles, the resonant value of the circuit, the circuit begins to fall off very rapidly. If one measures the current at each of a set of frequencies near the tuned point, the result may be plotted in the form of a curve like that of Fig. 3, where the intersection over each frequency shows the amount of current indicated by *I* when the alternator is run at the corresponding speed. It should be noted that the rise and fall are extremely sudden.

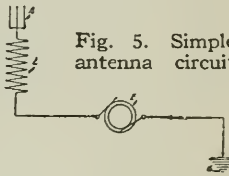


Fig. 5. Simple antenna circuit

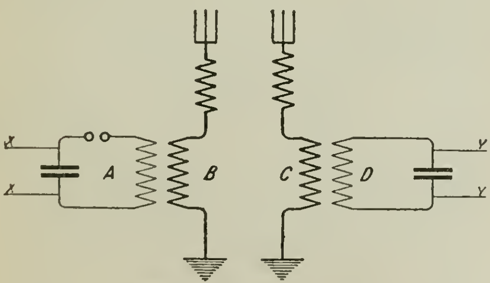


Fig. 6. A closed and an open circuit (A and B) are used to radiate waves to a receiving antenna, C

Suppose now that this same experiment be repeated with all conditions remaining the same, except that the total resistance of the circuit is set at 10 ohms. As the speed of the alternator is increased it is noted that the current begins to rise in the neighborhood of 50,000 cycles, as before, and to fall after that speed is passed; the interesting features are, however, that the maximum current is now only 10 amperes, and that the rise and fall near the resonant point are not nearly so sudden as before. By taking a series of careful measurements and plotting them out in curve form, a diagram like that of Fig. 4 may be produced. The slope of the sides of this curve is considerably less than that of Fig. 3; the effects of adding resistance have evidently been to decrease the current at resonance, and to make the circuit less sharply dependent upon applied frequency. We know that this means the tuning of the circuit has become less sharp; we know also, that the adding of resistance has increased the damping of the free oscillations in the circuit. These two results are closely related.

Next, the application of these experiments to a modern radio telegraph transmitter may be considered. If the condenser, inductance and resistance of Fig. 1 are replaced by the antenna circuit of Fig. 5, it is easy to see that the constants of the two circuits may be made substantially the same. If the total antenna resistance is 2 ohms, the resonance curve of Fig. 3 will indicate the variation of antenna current with frequency; while, if the resistance is 10 ohms, Fig. 4 will be correct. In the former case over twice the current will flow between antenna and ground than in the latter; if the antennas are of the same height, that having the lower resistance will radiate energy over four times as effectively. However, in order to keep the current at its maximum value in the low resistance antenna, it is necessary to regulate the frequency of the alternator much more closely than is needed in the second case. Thus, in an alternator sender, low resistance and consequent high natural persistence may be a practical disadvantage; it is sometimes necessary to compromise between highest electrical efficiency and greatest operating convenience.

In all the above cases the source of radio-frequency power is an alternator, and the currents and waves involved are of the continuous or sustained type. In such circuits the damping does not effect the sharpness of radiated waves, but only their amplitude and the ease with which the greatest intensity may be secured and maintained. In spark-discharge circuits, which depend upon their natural constants to determine not only the amplitude and frequency, but also the decrement of the oscillations within them, the circuit damping becomes of the greatest importance. The details of this branch of the subject are so involved that it is not possible to treat them fully in a series of elementary articles such as these; only certain fundamental facts can be presented.

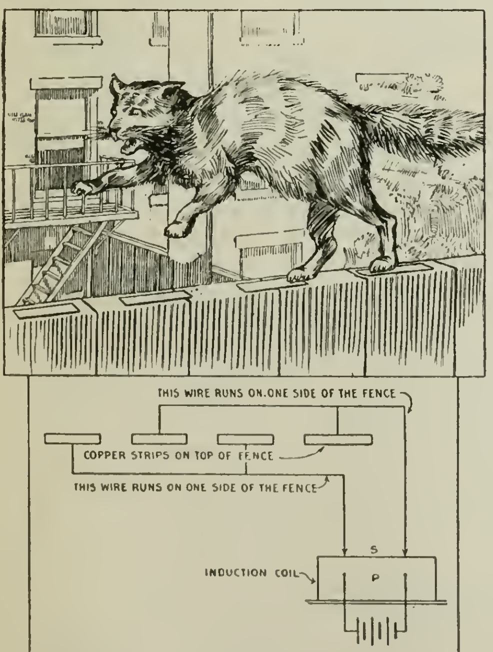
From the experiments in connection with the circuits of Figs. 1 and 5, it is evident that the maximum transfer of energy from the alternator to the circuit in which it is connected can occur only when there is minimum impedance (or at the tuned point), and maximum persistence (which corresponds to the condition of least effective resistance). This broad principle is applicable to all cases of resonant transfer of energy; the largest exchange occurs when the exciting oscillations and the excited circuit are of the same frequency and of the greatest persistence. It makes little difference whether the energy is transferred magnetically, as in an inductive coupler, or by electromagnetic waves extending over long distances; agreement of frequency and persistence are essential. It is well to note that if the exciting oscillation is damped there is no gain secured by increasing the persistence of the excited circuit beyond a certain point; reduction of resistance to the amount which gives this best condition is helpful, however.

That this general principle applies to radio receivers as well as to transmitters may be seen by consideration of Fig. 6. In this diagram, *A* and *B* represent respectively the closed and open circuits of a spark-type transmitter, and *C* and *D* mark the antenna and secondary circuits of a receiver located some distance from *A* and *B*. If the condenser of *A* is charged and allowed to discharge across the gap, electrical oscillations will be set up in the closed circuit. These will have their frequency determined by the effective values of the capacity and inductance of the circuit, and their damping will depend upon the inductance, capacity and effective resistance. If the circuit *B* has the proper natural frequency, it will be excited violently by the voltages impressed across the inductive coupling, and a comparatively large current will be set up in it; this antenna current will have the frequency of the two circuits *A* and *B*, and a damping dependent mainly upon the effective resistance of the aerial circuit. Waves of this same frequency, and of the damping of *B*, will be radiated and will pass over the earth's surface to the receiving antenna *C*. If *C* has the correct tuned frequency, currents will be set up in it; if the effective resistance is of the proper value, these currents will have the largest amplitude. In the same way as at the transmitter, maximum transfer to the circuit *D* will take place if this final circuit is not only tuned, but is also of the proper persistence.

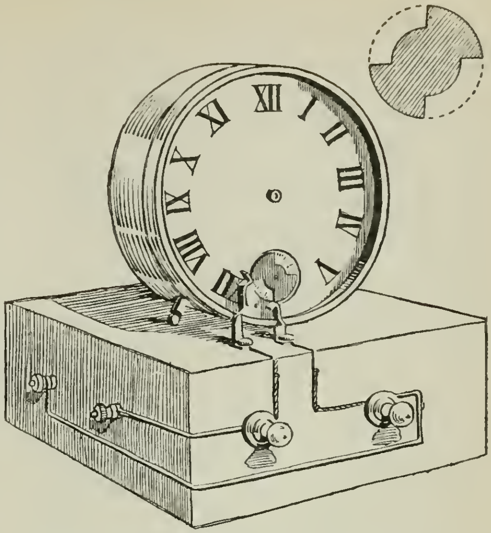
For Those Midnight Serenaders

SOME people live in neighborhoods that are very popular with cats. The fence is the back-yard band stand, where cats of all sizes and vocal abilities assemble and give voice to their woes just as one is preparing to go to sleep. After ineffectively following the accepted plan of hurling shoes, hair-brushes and other missiles at the disturbers, one sufferer decided to solve the problem with the aid of electricity. The plan has worked admirably.

The fence was made of boards separated about one quarter of an inch. Along the tops of these boards he nailed short strips of brass and connected them alternately to the terminals of a small induction coil which had been discarded from an automobile. When the midnight serenaders trod upon these alternate strips, their musical inspiration departed completely, and they themselves followed it swiftly, but quietly. Of course it was necessary to have the coil turned on all night, although the inventor plans to install a clock-work regulator made from an old alarm clock, so that the coil will have to work only during those hours when the night is most hideous. He expects that, in time, the cats will be wise enough to pass the word along to leave his back fence alone.



Would that we could apply this principle to the back-yard band and also to the organ grinder!



The number of sections cut out of the brass disk determines the number of flashes produced

Making a Simple but Efficient Flasher

A FLASHER for low voltage lamps can be made in the following manner: Remove the hands, including the second hand, and the glass from an old clock. Make a small brass disk (this can be done on a lathe), with a hole in the center just large enough to fit snugly on the axle of the second hand. Divide the disk into four parts, and describe a concentric circle, as shown in the diagram. File out two pieces along these lines, as indicated in the diagram. After replacing the second hand and the disk, fasten the clock to a board.

Two brushes can be made from an old clock-spring, after taking the temper out by heating. Screw them to the board in such a position that they touch the wheel lightly. This arrangement and also the connections with lamps and battery are shown in the diagram.

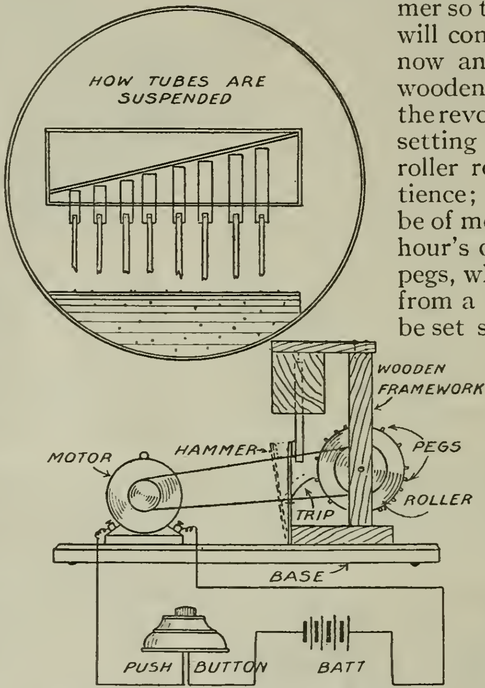
If more flashes are wanted, a greater number of sections can be cut out of the disk. Many different combinations can be produced. Instead of ordinary white bulbs, colored ones can be used, adding greatly to the effect.—JOSEPH KRAUS, JR.

A Musical Electric Door-Bell

AN unusual door-bell, differing from the noisy regular electric bell, is here described. This apparatus may look unpractical and clumsy, but it can be covered up in a neat wooden case, if desired. Procure a small instrument commonly known as the "tubaphone." A tubaphone consists of a wooden rack on which are mounted several pieces of brass tubing cut into different lengths, and properly tuned to give forth the various notes of the scale, when set in vibration. Such instruments are usually sold at fifty cents, the price depending upon the size, etc. Several strips of pine about 2 ins. wide, and 7/8 in. thick are procured to be used in the framework. It is simple to make, and is readily understood by examining the diagram.

The tubes are suspended, as shown, on rings or rubber bands. The distance between the tubes should be at least one inch; the first and last tubes must also be about one inch from the edge of the framework, for placing a support on each side. The base may be of any size desired, but these dimensions can only be determined by calculation, and upon the number of brass tubes used, etc. A roller should be turned out from a piece of pine, long enough, of course, to be within the range of every hammer striking the brass tubes. A shafting attachment on the roller is also to be provided for.

Lastly, the hammers are made of sheet brass, having a length that will reach from the base of the apparatus, to a point slightly above the bottom of the suspended tubes. A hole is drilled in the bottom end of each strip, which is firmly fastened to the base by a round-headed wooden screw. The hole drilled in the upper end of the strip serves to admit a screw holding a wooden hammer-head. A small strip of felt is glued to each striking side of the block. These proceedings, as described, are carried out for the other strips, hammers, etc., along the apparatus. Another piece of brass is fastened to each of the long hammers to act as a trip. It is riveted to the hammer so that its upper end will come in touch every now and then with the wooden pegs, fastened on the revolving-roller. The setting of the pegs in the roller requires some patience; one mistake will be of more value than an hour's description. The pegs, which are obtained from a shoemaker, must be set so that the music will sound correct, care being taken that the higher tubes vibrate in sympathy with the lower notes. With an ordinary motor and push-button, with the connections depicted, the arrangement will be found complete.



The mere pushing of a button at the door causes this apparatus to play a tune

As soon as the button is pressed, the motor will revolve, and, being shafted on to the roller, will rotate it. The pegs will actuate the hammers, and the hammers will in turn vibrate the brass tubes, producing the musical strains, which show that someone is at the door. Such melodies as "Home Sweet Home," may be made and if the folks tire of the same tunes, several rollers may be on hand and changed as often as desired.

Antenna Wire Strength

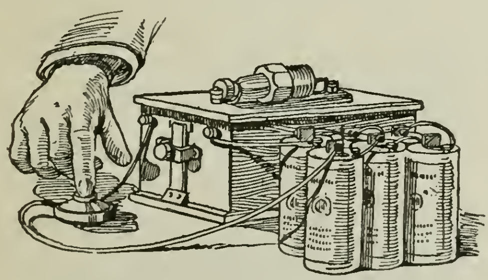
PHOSPHOR bronze antenna wire is practically as strong, for the same cross-section, as the best iron. This is nearly twice the strength of copper and over four times that of aluminum.

An Efficient Spark-Plug Tester

IT is a very simple matter to test a spark-plug by the use of a small spark-coil as shown in the accompanying diagram. By placing the plug to be tested across the terminals of the coil and pushing the button, if the plug is in working order a very bright spark will jump across the gap. If the plug is "dead" the circuit will either remain open or else the current will flow without making any spark.

This method of testing is of particular value in detecting short-circuits. For instance, it frequently happens that the insulation of the plug breaks down at a point above the gap, in which case the explosion caused by a plug in this condition will be weak and result in loss of power in the engine. Such a short-circuit can be detected at once as the spark will jump across at whatever point the insulation is weakest.

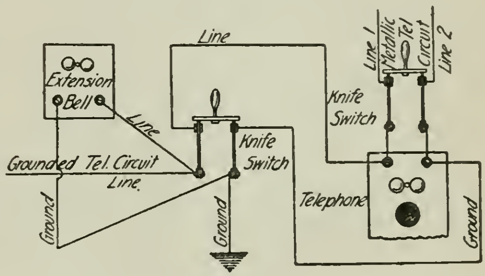
The trouble and annoyance of testing spark-plugs by running the engine may be obviated by the use of this simple method of testing, easily arranged by any experimenter.—H. A. HOOPER.



This apparatus is especially valuable for testing short-circuits

Connecting Dissimilar Telephone Lines

THE diagram shows an arrangement for connecting a grounded and a metallic telephone circuit so that the same telephone can be used on either or both lines. When the switch is left open on the grounded telephone circuit, the extension bells remain grounded and rings are received. When this switch is closed and the switch on the metallic line is opened, the telephone is cut in on the grounded circuit and conversation can be carried on over that line. If both switches are left closed, rings are received simultaneously on both sets of bells, and conversation is possible over the combined circuits not only from the telephone in the diagram but between any other stations on the two circuits. Thus, either circuit can be used independently of the other, or at this station the other telephones can be switched back and forth if that service is desirable. This will be found advantageous on many rural lines connecting with magneto switchboard exchanges. It will also be of use on private party lines.—J. G. ALLSHOUSE.



The same telephone can be used on a grounded and a metallic telephone circuit with this arrangement

Connecting Wires With Tinfoil

PERHAPS a number of readers experience trouble in making a good wire connection when solder is not at hand. They will find the following method very efficient, especially with aluminum wire.

Scrape about 8 ins. of the wire to be connected. See that all the dirt, corrosion, and grease are thoroughly scraped off. With the aid of pliers, twist the wires together very tightly. A piece of tinfoil, about an inch wide, should be lapped over the connection twist. The tinfoil should be lapped together as tightly as possible, without tearing and then pressed with the fingers. After this proceeding one or more layers of tape are stretched over the tinfoil, so that corrosion, rain, etc., will not affect the connection. The tape is pulled very tightly, to insure a good connection of the tinfoil with the wire. It is well to paint it with asphaltum.

It should, of course, be understood, that this expedient should be resorted to only when solder is not at hand.

Money Prizes for Radio Articles

We want you to tell our readers how you have overcome your wireless troubles. Every radio operator, amateur or professional, has encountered difficulties in building or using his apparatus. Many different people are bothered by the very same problems day after day. It will help you to learn how others worked to get successful results, and it will help others to learn how you succeeded.

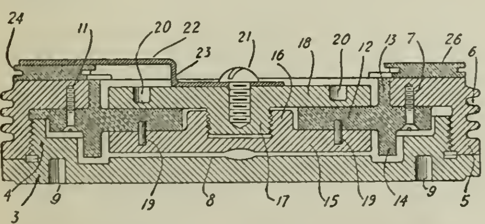
For the two best articles describing how you overcame troubles in building, operating, adjusting or repairing any radio instrument or group of instruments, we offer first and second prizes of $25.00 *and* $15.00 *respectively. The prizes will be awarded to the two writers whose articles, in the opinion of the Editors, will prove most helpful to the readers of the magazine. The Judges of the Contest, who will be the Editors of the* Popular Science Monthly, *will select the prize-winning manuscripts from those which conform with the following conditions:*

CONDITIONS OF PRIZE CONTEST

1. *Manuscripts must be typewritten, and on one side of the paper only.*
2. *Illustrations must be on sheets separate from the manuscripts.*
3. *Articles must be addressed to the Radio Prize Contest,* Popular Science Monthly, 239 *Fourth Avenue, New York, and must reach that address before June* 15, 1916, *in order to be considered.*
4. *Manuscripts which do not win prizes may be purchased for publication, at the option of the Editors and at the usual liberal rates.*
5. *The decision of the Judges, which will be announced in the August,* 1916, *issue, is to be final.*
6. *Each manuscript must be accompanied by a letter containing criticisms and suggestions as to the wireless section of the* Popular Science Monthly. *The merit of these letters will not be considered in awarding the prizes, but their suggestions will be taken as indications of what types of articles are of the most value to our readers.*
7. *If contestants wish to have their manuscripts returned, they should send postage for that purpose.*
8. *Articles should not exceed* 2,000 *words in length. If you cannot present your information in an article of that length, write several articles, each on a different phase of the subject, and each independent.*

Unit Type of Plate Gap

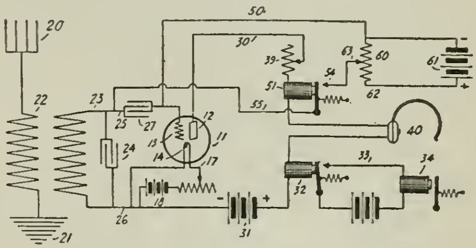
A NEW type of unit quenched spark-gap is shown in the illustration, which is taken from 1915 patent No. 1,163,568 issued to F. G. Simpson. This gap is of the plate type, but differs from the ordinary plate quenched gap in that damaged sections may be removed without deranging any of the rest of the apparatus. Each unit contains a pair of sparking surfaces, one of which is formed by the upper side of plate 3 and the other by the lower face of 15. These opposing surfaces are machined to be perfectly plane and parallel, and are mounted by the use of the clamping members 5 and 18. The two plates are kept apart mechanically and electrically by the insulating piece 12. The details of mechanical construction are clear from the diagram; it should be noted that the spacing of the gap depends upon the distance that 3 is screwed into 5, and not directly upon the thickness of the insulating separator. Stops 24 and 26 are provided to keep air spaces between adjacent pairs of plates, and with the flanges 6 in the outer metal piece, aid in keeping the gap cool. The required number of sections, such as illustrated, are grouped to form a complete gap, and connection from the inner plate of one unit to the outer of the next is made through the strip 22.



The mechanical construction of a quenched gap unit of the plate type

Preventing the Audion from Choking

MANY operators have noticed when they are using the audion detector that there is a tendency for the grid to charge too rapidly and "paralyze" the bulb. In times of severe static this effect may be very annoying, since when the paralysis sets in, all signals stop. It is possible to discharge the grid, and thus to place the detector in operation again, merely by placing the fingers across the small stopping condenser in the grid circuit; sometimes, even, the bulb will automatically regain its sensitiveness in a second or two after charging. Occasionally, however, there are found very high vacuum tubes which



This special audion circuit overcomes the tendency of the grid to charge too rapidly and paralyze the bulb

will not free themselves of this paralyzing charge. If atmospherics are strong and frequent it is sometimes impossible to read a single word without interruption.

One remedy for the paralysis is to shunt the small grid condenser by a very high resistance, which permits the charge to leak off and so prevents all but the strongest impulses from affecting reception. This scheme is used a great deal, but at times is not entirely satisfactory for the reason that when the charging surges are intense, it is necessary to reduce the shunting resistance to so low a value that the sensitiveness of the audion is spoiled. In U. S. patent No. 1,127,371, issued during 1915 to G. W. Pierce, there is shown a new way to do away with the interruptions due to charging. The drawing shows the invention, which is based upon the observation that when the audion is paralyzed the "B battery" current in the telephone circuit is reduced practically to zero.

Referring to the diagram, the antenna 20 is seen to lead to ground 21 through the primary 22 of a receiving transformer. The secondary of this instrument 23, is shunted by the tuning condenser 24, and the terminals carried to the audion grid 13 through condenser 25 and to the filament 14 in the usual manner. Battery 18, acting through variable resistance 17, is used to light the filament; and battery 31 supplies the telephone current through recording relay 31, telephones 40, discharging relay 51, ballast resistance 39 and plate 12 of the audion bulb. The contact of the discharging relay 54, may be arranged simply to short-circuit the condenser 25, or (as in Fig. 1), actually to place upon it an opposing charge from battery 61, regulated by the potentiometer 60. The recording relay 32, ·operates the sounder 34. It should be noted that both relays are of the back-contact type, which close their local circuits when the current through their magnets is reduced or interrupted.

The operation of the receiver, with weak or moderate incoming signals, is exactly like that of the simple audion. Unless impulses of sufficient strength to paralyze the tube are received, the relays do not close. As soon as a violent impulse arrives, however, the large positive charge assumed by the grid chokes off the flow of current from battery 31, and the armatures of the two relays spring back and close their contacts.

The discharging relay reverses the grid charge and, in this way, permits the audion to regain its normal sensitive condition immediately; the recording relay causes a click of the sounder. Evidently the system of connections shown allows the reception of strong signals by listening to the sounder, yet prevents interruption of the receipt of messages of single violent impulses. It is, of course, necessary to adjust relay 51 to contact very quickly, so that the brief click caused by each closing will not interfere with the reading of messages.

The Non-Synchronous Rotary Gap

THE effectiveness of this popular type of gap depends mainly upon the adjustment of the electrodes and the speed at which the disk is driven. While with it, the absolutely clear note of the synchronous type cannot be obtained, the adjustment should be such that a comparatively even tone may be secured. The somewhat "raggy" spark given by this gap is not entirely disadvantageous, as it is very effective in working through certain kinds of static. With regard to the speed at which the disk should be driven: although a high speed will naturally increase the shrillness of the note produced, there is a considerable loss in radiation at very high speeds, owing to the fact that there is not sufficient time between the sparks in which to charge the condenser to its highest voltage. The use of too many points on the disk amounts to the same thing, and should be very carefully guarded against.—N. A. Woodcock.

Wireless Log of 8KY								1915
Date	Sta Cld	By	Time	Pri.	Sec.	Var.	Clg.	Remarks
Dec 8	QST	NAA	11.55A	10-10	8	72	0	Time signals
	WEA	WEE	4:20P	3-5	3	5	2	
	NAA	NAX	9.45P	12-9	9	60	3	Official
	QST	NAA	9:55P	10-10	8	69	3	Time & Weather
Dec. 9	8KY	8AY	8.20A	1-6	2	0	0	

A neat and complete record of messages received can be kept in this manner

A Wireless Log for the Amateur

THE experience of listening is much more valuable if a careful record is kept on some such log as that illustrated. The abbreviations used in the heading are translated as follows: Sta. Cld., station called; Pri., primary of loose-coupler; Sec., secondary of loose-coupler; Var., variable condenser; Clg., coupling. This log was used with a navy-type coupler, and complete entries made on the following plan: For example, take the third note, in which N. A. A. was called by N. A. X.; the 12-9, under Pri., means that the best signals were received at the twelfth point of the multi-turn switch and the ninth point of the single-turn switch. The numbers, under Clg., give the length of the coupling in inches. In a coupler which has a slider instead of switches on the primary, the slider-rod may be calibrated. This simple chart is easily handled and from it many interesting observations can be drawn.

Quenched Gap Damping

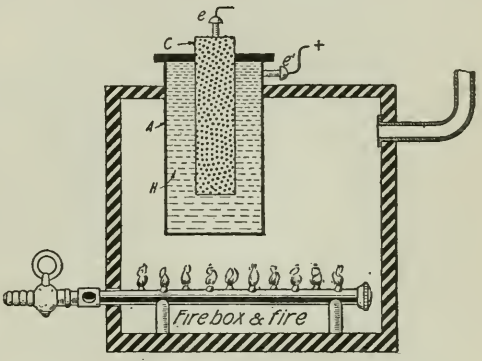
A GOOD quenched gap set will give decrements as low as 0.03, for which value there are over 75 waves to the train.

The "Ideal" Battery

By A. R. MacPherson

TO the experimenter in the field of electro-chemistry there is much unexplored knowledge which in time will prove of inestimable value to the chemistry of commerce, particularly in the methods of generating electricity through chemical actions, which at the present day, though apparently satisfactory, are very inefficient. There are scores of patents on devices for generating electricity chemically, but the majority are lacking in the fundamental principles necessary to the attainment of an efficient commercial product.

The primary cell to be realized is one in which carbon and oxygen are the elements consumed, a much greater amount of energy being obtained if these two elements unite, with the production of an electric current. No other form of energy, such as heat or polarization, to impair the efficiency of the cell, would be manifest. The problem is to find an electrolyte which will dissolve the carbon as ions and to construct the necessary oxygen electrode; thus, the two opposite poles of the cell would carry on the reaction through the intervening electrolyte and no local action would be produced. All of the energy of the cell would be dissipated if the carbon and oxygen acted directly on each other.



View showing Jablockkoff's cell arranged over a furnace

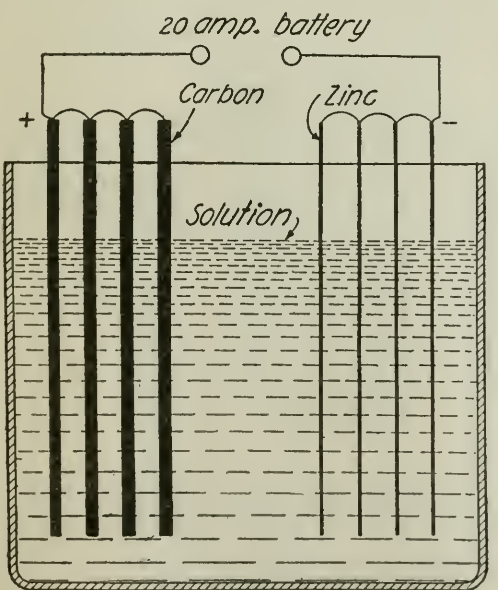


Diagram illustrating the arrangement and connections of plates for oxidizing process

The author has carried out a series of experiments in this field involving the production of an electric current through the action of an electrolyte on zinc plates, the carbons forming the positive pole. Only the carbon plates were acted upon, in that the oxygen stored up within the pores of the carbon was set free, this action considerably increasing the current strength of the battery.

The oxygen was impregnated in the pores by an oxidizing process in which the battery of carbon and zinc plates was immersed in a solution consisting of chromic acid, chrome alum, and sulphuric acid, the plates being connected in parallel to an outside source of current giving about twenty amperes. After allowing the current to run through the cells for fifteen or twenty minutes the battery was removed from the solution, washed, and immersed in the electrolyte, which was a simple salt solution. The E. M. F. produced for a short period was more than double the strength of the regular action in which the carbons had not received this oxidizing treatment. It is probable that the salt solution acts on the zinc, releasing hydrogen, decomposing the salt, and at the same time setting free the oxygen in the carbon plates. The fact that the carbon plates can be treated continuously by this process without impairing their efficiency seems to indicate that the oxygen does not unite with the carbon, but is simply stored up within its pores.

This type of battery indirectly illustrates the chemical action of a more ideal cell, but is lacking in some of the necessary fundamental principles; the method employed is inefficient, and the results obtained do not measure up to the applied forces.

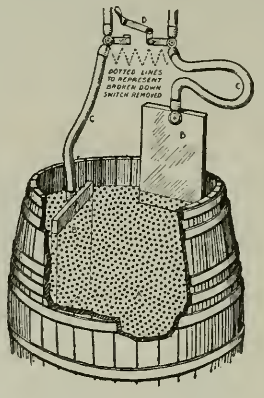


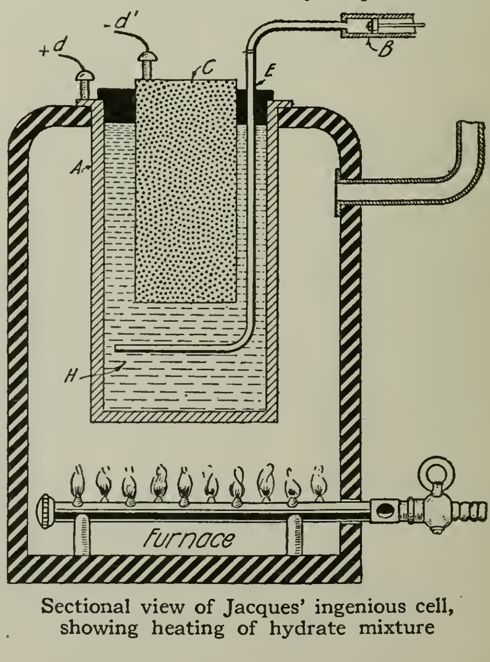
Diagram showing cell arrangement on a large scale

There are certain chemical substances which might prove, by analysis, to be adaptable in an application of this kind. Platinum "black," for instance, possesses to the highest perfection the power of promoting combination between oxygen and other gases, absorbing over two hundred times its volume of oxygen, the oxygen simply condensing in the pores where it may be available for combination with other gases. An organic compound known as linoleic acid possesses the peculiar property of absorbing oxygen from the air in large quantities, forming a solid substance. The properties possessed by these two compounds simply illustrate the many possibilities lying dormant in the chemical world which on application to the field of electro-chemistry might prove invaluable.

It may be of interest to note several attempts that have been made in the past on this idea. Jablockkoff in 1880 constructed a carbon oxygen cell using a fused salt as an electrolyte, the carbon being immersed in melted potassium nitrate, the positive electrode being iron. Thus, the oxygen was supplied in the form of a nitrate, but this was not successful as the carbon was brought into direct contact with the oxidizing substance, and it was necessary to keep the cells at a temperature of several hundred degrees.

In 1896 W. Jacques patented a cell which was constructed of an iron pot containing a melted mixture of potassium and sodium hydrate into which the carbon dipped. Oxygen was made to unite with the carbon through the intervening electrolyte, by blowing air against the iron pot which formed the positive pole, and thus producing an electric current. But this was not successful as the salt was changed to a carbonate, and also a certain amount of direct oxidation of the carbon took place.

Thus it is evident that the problem of constructing an efficient cell of this type is far from being solved, as it seems almost impossible to find a substance which will dissolve carbon, and thus create a direct transformation of chemical energy into electrical energy. But if some ambitious experimenter with a thorough knowledge of chemistry would go after the solution of this problem with the same persevering research that Edison employed in his experiments with the incandescent light, there is every reason to believe that he would attain success. And the reward would be well worth the effort, as the present commercial world is waiting for such an efficient device that will fulfill all of the necessary requirements.



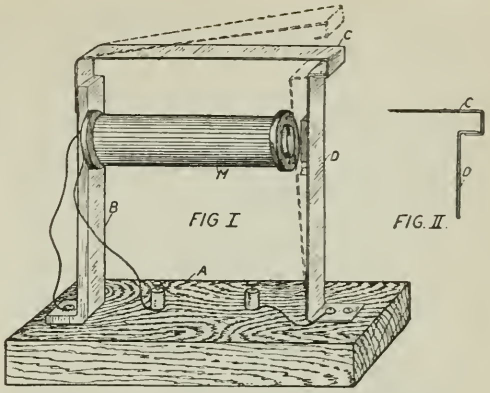
Sectional view of Jacques' ingenious cell, showing heating of hydrate mixture

The Construction of an Automatic Battery Circuit-Breaker

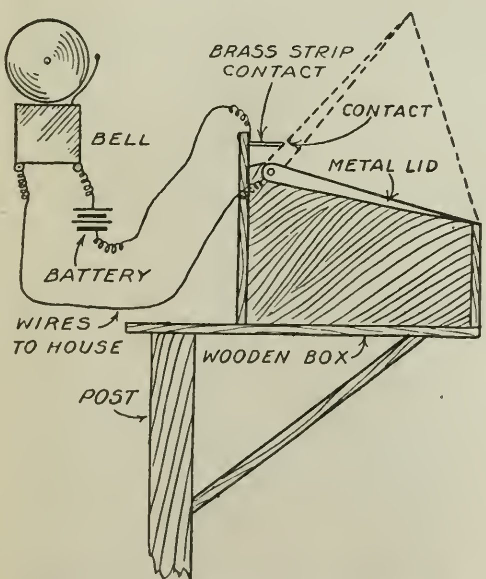
AN automatic circuit-breaker and its operation are depicted in the accompanying diagrams.

Referring to Fig. I, *A* is a wooden base 4 ins. by 2 ins. by ½ in., *B* is a brass strip ⅛ in. by ¾ in., bent as shown so as to stand 2¾ ins. above the base. The magnet *M* is 2¼ ins. by ⅜ in. and wound with 4 layers of No. 16 annunciator wire and screwed to *B* at a point 2⅛ ins. above the base. The strips *C* and *D* are of spring brass, 1/64 in. thick by ¾ in. wide, their ends being bent as shown in Fig. II. The strip *D*, has a piece of soft iron *E* screwed fast to it at a point opposite the magnet core. The strip *C* is bent so as to have a tendency to spring up when *D* is drawn into the magnet. The wiring is clearly shown in Fig. I.

In operation, the circuit-breaker is placed in series with the battery and the circuit which is to be protected, close to the battery. Should a short-circuit occur on the line, the excess current flowing through the magnet energizes it more strongly than when the normal current flows, drawing *D* inward, thus releasing *C*, and so breaking the circuit.—E. B. WILSON.



When a short-circuit occurs, the circuit is broken automatically by means of this simple device



When the postman raises the mail-box lid a bell rings in the house

How to Make a Rural Mail-Box Alarm

TO those living in rural or suburban districts, where the mail is deposited in a wooden mail-box by the roadside, the device here described will be of interest. The idea is to have an announcing bell at the house when the mail is placed in the box, and thus make a long wait in the cold unnecessary. An electric bell is put in circuit as depicted, using a dry battery as a source of energy. It is advisable to use a roll of insulated bell tape to insulate the wires properly. Two dry cells will be sufficient for any distance up to 200 ft. Cut a thin brass strip and bend at the center. Fasten to the top-extension of the mail-box and connect with the battery. Replace the wooden cover of the mail-box by a brass or metal one. Both the brass strip and metal cover must, of course, be connected with the house by two separate wires. The wires to the house are simply tacked by staples on to small posts. Following is the modus operandi: As soon as the mailman lifts the lid to place the mail in the box, the metal lid comes in connection with the brass strip and closes the circuit, operating the announcing bell at the house.—WM. WARNECKE, JR.

Japanese Wireless Telephone

THE Japanese Navy is equipped with apparatus for radio telephones, with which wireless speech can be transmitted dependably about ten miles and often three times this distance.

An Electric Weather-Vane Indicator

A WEATHER vane can be constructed as shown in Fig. 1 or an old existing vane can be used to serve the

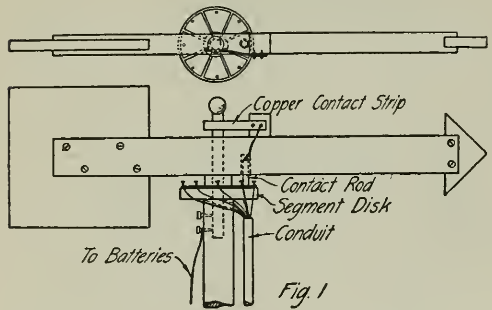


Fig. 1. The ringing of a bell indicates which way the wind is blowing

same purpose. A circular wooden disk 4 ins. in diameter is mounted on the upright of the vane. This disk has eight copper segments fastened to it as shown in Fig. 2. The whole thing is mounted so that the segment marked *N* is pointing to true north; the other segments will then take the proper directions. The direction which the wind is blowing will be indicated by the ringing of the bell, since the circuit is closed when the switch handle is brought around to the point corresponding to the same point on the vane.

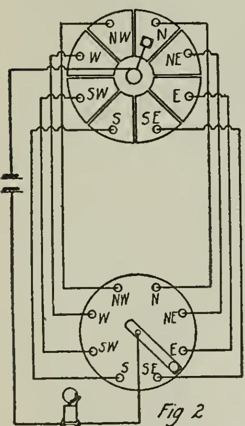


Fig. 2. Diagram of connections

If the direction of the wind is such that the rod is brought in contact with two segments at the same time, it will cause the bell to ring when in contact with both points on the switch. Such a condition indicates that the wind is blowing directly between the two directions indicated by the ringing of the bell. For example, the switch at *N* will cause the bell to ring, and also at *N. E.* The direction of the wind is then *N. N. E.*

By this method the direction of the wind can be more accurately determined than by actual observation and also does not make it necessary to see the vane to determine the direction of the wind. The method of wiring is shown in Fig. 2.—J. M. COHEN.

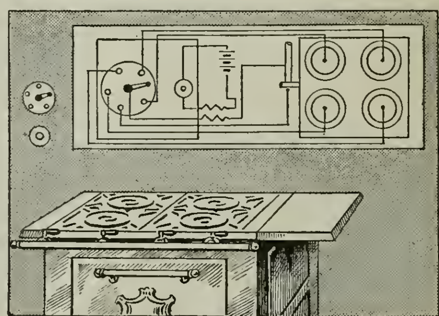
Electrical Lighting Device for the Gas-Range

NO woman appreciates the convenience of an electrical lighting apparatus for the gas-range until she has actually used one. Following is the description of one which is easily made:

In the diagram is shown a 5-point switch and a common push-button installed on a suitable base. For this purpose, a small board can be attached to the wall near the stove. The push-button is connected in series with three or four dry batteries and the primary winding of a spark-coil that will give at least a ½-in. spark.

The battery, the primary winding, the four burners and the proper connections are shown in the diagram. Note the pipe connection to the stove, with one wire from the secondary winding of the coil grounded to the pipe, while the other end of the winding is connected with the center of the 5-point switch. The wires from the switch to the spark-gap at the burners must be well insulated, and at least an inch apart.

The gaps at the burners are made from No. 10 steel wire and insulated from the stove with hard fiber. The steel wire to the gap must come up into the center of the burner from below, so that the flame will not harm the wire or gap. When it is desired to light a burner, simply turn the switch to the proper point, turn on the gas, and push the button.



Any amateur electrician can fit the gas-range with a lighting device

Radio Tower at Tufts College

THE radio tower recently erected at Tufts College, Medford, Massachusetts, is attracting unusual attention. In September, when the tower was completed to a height of over 275 ft., one of the temporary guy ropes parted during a high wind and allowed the tower to topple over. Instead of snapping at some point above the ground the structure pulled away from the sub-base and fell as a complete unit.

It has been shown that the collapse was not due to faulty design, and the tower has been re-erected without important changes.

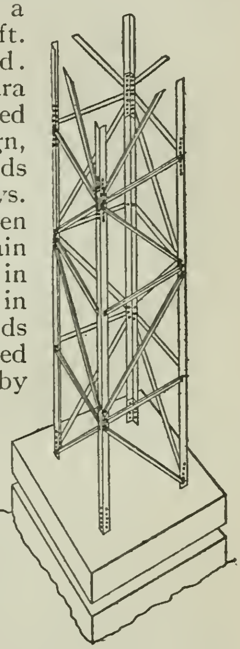
The tower itself is built entirely of angle irons and assembled in the manner shown in the illustration. It is 288 ft. above the concrete base, and 3 ft. 4 in. square in section from base to top. The corner, or upright, angle-irons are 3 ins. by ¼ in., while the diagonal and cross angle-irons are 2 ins. by 3/16 in. The corner angles are each nearly 12 ft. long and, as shown by the diagram, are divided into three sections. The sections are placed directly on top of each other and held together by means of angle-irons fitting inside of the corner angles and extending several inches either side of the joint. These angles are secured by bolts ½ in. in diameter and 1 in. long. This bolt construction is employed throughout the tower, there being no rivets. Washers are not used with the bolts.

The structure is mounted on two concrete bases. The upper base is 5 ft. 4 ins. square and 12 ins. thick. It is to this base that the iron work of the tower is secured. This sur-base rests on four porcelain insulators set so as to leave 5 ins. between the two bases. The lower base is the same size in section as the upper base, but extends 6 ft. into the ground. When the first tower collapsed these two bases pulled apart.

As the tower is not self supporting, the system of guying is of great importance. Three sets of four guys each have been adopted, thus giving 120-degree guying with four guys fastened to each of the three deadmen. These guys consist of stranded steel cable with rope core, the two upper of which are ¾ in. in diameter and the two lower ⅝ in.

After the complete erection of the tower the fourth guy was added to each of the three sets at a point about 75 ft. from the ground. These guys are extra and were not included in the original design, but as it now stands the tower has 12 guys.

The guys are broken up by porcelain strain insulators 5 ins. in length and 3 ins. in diameter. The ends of the wire are secured by a series of Crosby clamps. Twelve-inch turn-buckles are inserted in each set of guys.



Construction details of the tower

The three deadmen are made of concrete and weigh about 25 tons each. On the surface they are 5 ft. 3 ins. square. They are placed 150 ft. from the base of the tower so as to give an angle of 45 degrees to the lower guy, which is placed mid-way up the tower.

The tower was erected aloft, each separate piece being placed in position before another was secured. Temporary guy ropes were used in large numbers during the erection of the second tower, as it was due to insufficient temporary guying that the first structure collapsed.

Harold J. Power, for whom the tower was erected, is a graduate of Tufts College. While there he was president of the Wireless Society, to which organization he has granted the use of the new tower and experimental station.

Many methods of mast construction have been tried, and while a serviceable tower of wood can be built, wood is generally considered inferior to steel.

What Radio Readers Want to Know

Crystal Receivers

W. L. K., Cincinnati, O., inquires:

Q. 1. What is your opinion of the carborundum crystal as compared with other mineral detectors? Are a battery and potentiometer required for the maximum degrees of sensibility? What color is the most sensitive? I have been told that a flat piece of metal is used for making contact. Is this correct?

A. 1. The carborundum detector is not as sensitive as galena, cerusite, silicon, perikon, etc., but for commercial use is more desirable. The adjustment is rugged and not easily influenced by the local transmitting apparatus or heavy atmospheric discharges.

Good results with this crystal can only be obtained by applying a local battery. Generally, one battery cell shunted by a 400-ohm potentiometer fitted with a sliding-contact will permit the necessary control of the current. It is equally important that the current flow through the crystal in a definite direction; the proper direction is best determined by experiment.

Crystals of the dark blue variety are found to be the most sensitive. It is customary to mount the crystal in a small metallic containing cup with some form of "soft metal." A sharp point such as that afforded by a steel phonographic needle with a rigid spring adjustment, is the most desirable.

Safe Towers

G. S., St. Louis, Mo., writes:

Q. 1. I would like to know if I can safely erect a 60-ft. mast for the support of an aerial system if the first 20 or 30 ft. consist of 3-in. gas pipe and the remainder of 2-in. gas pipe.

A. 1. A structure of this design is not recommended unless it is very carefully guyed. Pipe unions should not be used. If a single section of the desired length cannot be obtained, that is to say, if a single 30-ft. section is not available, the mast should be constructed of several sections of the correct diameter to fit inside of each other. The sections should be telescoped for a distance of about 2 ft. and held in position by iron bolts passing directly through the pipe. This construction will eliminate the weakness of reducing couplings and pipe unions. A 60-ft. mast of this type should have two sets of guys. Great care must be exercised in the erection, for iron pipe will not stand a horizontal strain when the sections are of considerable length.

We know that this is a vital matter to amateur experimenters, but obviously in the space at our disposal in this department a complete set of drawings for the construction and erection of a mast cannot be given. Wind-mill towers can be purchased at reasonable prices, and it might be of benefit to you to get into communication with the manufacturers.

Antenna Wavelength

E. B. K., Gulfport, Miss., inquires:

Q. 1. Please calculate the fundamental wavelength of a six-wire aerial, 90 ft. in height at one end, 45 ft. at the other with the flat top portion 150 ft. in length. I believe that its wavelength is in excess of the U. S. restrictions, and should like advice concerning the method of cutting it down to comply with the law.

A. 1. The fundamental wavelength of this aerial is approximately 410 meters which is far in excess of the U. S. restrictions. You are advised to reduce the dimensions of the aerial, making the flat top portion from 50 to 80 ft. in length and the vertical portion from 40 to 60 ft. in height. If it is intended to employ this aerial for the reception of signals from long distance stations, the construction should not be changed, but for the transmission and reception of signals on the restricted 200-meter wave, the dimensions of the complete system should not exceed those last given.

Armstrong Receivers

C. J. G., Chatham, N. Y., writes:

Q. 1. In the December, 1915, issue of the Popular Science Monthly you published a drawing of the Armstrong circuit. Will you please advise if the coils L 2 and L 3, L 6 and L 7, are constructed after the form of inductively-coupled receiving tuners? If not, in what relation are these coils placed?

A. 1. It was intended that these coils be constructed in the form of inductively-coupled receiving tuners. L 2 and L 3 should be so constructed that L 3 may be placed completely inside of L 2. In actual practice L 6 is generally placed about 1 in. from L 7, but under certain circumstances it may be necessary to place them in closer inductive relation.

Sending Transformer and Condenser

L. J. T., St. Louis, Mo., writes:

Q. 1. Please give a minute description of how to build a 1 k. w. wireless transformer suitable for radio work.

A. 1. Assuming that this transformer is to be operated at a commercial frequency of 60 cycles, you are advised to adopt the open core type of transformer because it possesses inherent characteristics peculiarly suitable for radio work. The following dimensions are good for a 1 k. w. transformer to have a secondary voltage of 20,000. The primary core consists of a circular bundle of No. 28 or 30 soft iron wire 3 ins. in diameter by 25 ins. in length. This should be covered with two layers of Empire cloth or friction tape. The primary winding is then covered with an insulating tube of micanite or hard rubber 3/16 in. thickness. The secondary winding consists of 38 pancakes of wire each 1/8 in. in thickness, having approximately 1100 turns of No. 30 S. C. C. wire.

It is preferred to divide this winding into six sections with about six pancakes in each section. These pancakes should be spaced on a fiber disk about 1/16 in. in thickness. If cotton covered wire is employed it should be dipped in hot paraffin just previous to the winding.

The Home Workbench

How to Make an Accurate Sun-dial

THIS sun-dial can be made easily and it will give accurate results. While the variation of time in all parts of the United States will be slight, the most accurate reading will be made between the 35th and 45th parallels of northern latitude as this is the area it is designed to cover.

Any material will suffice to make the dial and style from, and any thickness may be used. But the most neat dial can be made from brass or copper, cut from a sheet or cast from patterns. The parts should be at least ¼ in. thick to be substantial. The degrees of time, as well as the dimensions for making, are shown on the accompanying drawing. Care must be taken that all lines are drawn straight and the dimensions followed closely. After the hours are put on, the spaces can be subdivided into halves and quarters and five minutes if desired. The space left in between the A. M. and P. M. hour divisions is to receive the style and should be just as wide as the style is thick. The best way to mount the style is to tap two holes in the lower edge and bolt through the dial with small machine screws. The style may be ornamented with several hollows cut out, but the top edge or shadow casting edge must be perfectly true. The long vertical end of the style goes at the 12M mark on the dial.

The whole can be erected upon any suitable stand, wood, stone or cement which can be worked up into an ornamental design. The 12 noon end of the style must point exactly north and the other end to the south. Or the dial may be set to local time by waiting until exact noon and then setting the dial accordingly.—B. F. Dashiell.

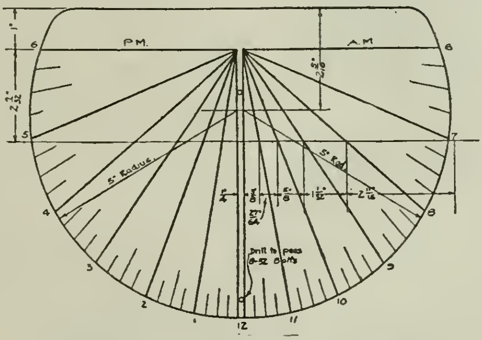


Diagram of sun-dial, showing dimensions for construction and angles for determining each hour mark

A Waterproof Compound

A GOOD waterproof compound can be made if the following directions are carefully observed. It is suitable for any job not larger than an ordinary cellar, or where the water pressure is not too great, and is especially adapted for wells, cisterns, cement ice-boxes, etc.

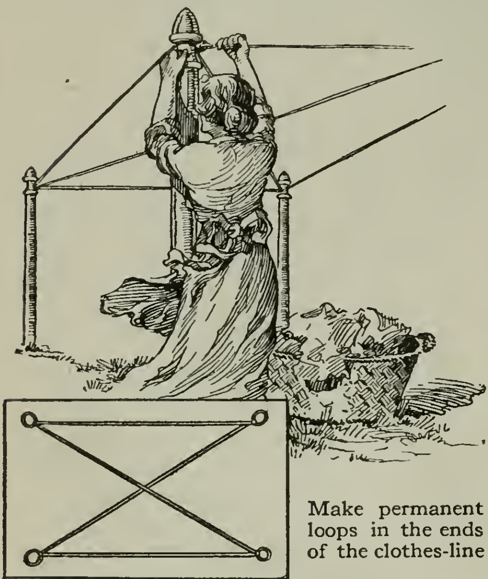
First dissolve soap in water until a good soapy liquid is obtained. This can easily be done by chipping common yellow soap into a wash boiler and allowing it to boil. About one bar of soap to every bucketful of water is enough, but a half bar more will do no harm. When ready to mix, add one bucketful of soap solution to every two bucketfuls of clear water. When applying the mixture, it is essential that it be well troweled. The smoother the finish, the more lasting the result and the better the water-proofing qualities.

How to Mix Stove Blacking

USE vinegar instead of water when mixing stove blacking. The work of polishing will be easier and the polish will last much longer.—C. A. Wolf.

Clothes-Line Suggestions

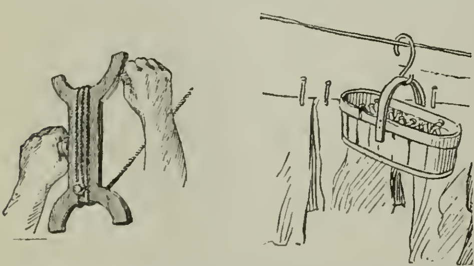
It is stupid for a woman to stoop nearly to the ground every time she lifts a sheet from the basket for hanging up on the line. It is dull to carry the heavy basket of wet clothes all around the yard, or to leave it in one spot and



Make permanent loops in the ends of the clothes-line

take walking tours in a spiderweb path back and forth from basket to line. Besides, it is easy to soil the bottom of the basket if the yard is also a garden. These useless motions are obviated by pulling the basket around upon a little wagon, which is of convenient height.

When comforters and other heavy bedding are washed they do not dry quickly if hung upon a single line. The inside of the folded piece is not touched by sunshine and wind and the texture is too thick for penetration from the outer side. String two lines parallel,



A simple wooden reel and a handy basket to suspend from the line, make clothes-hanging easier

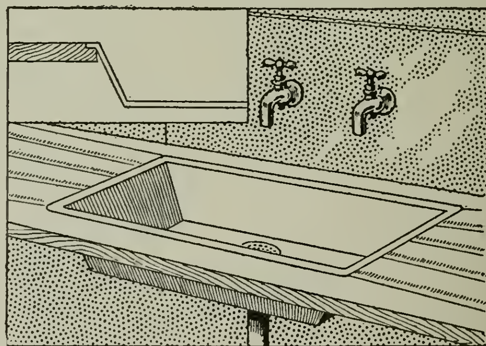
about two feet apart. This allows air to circulate up under the "tent." For dresses also this scheme is very satisfactory.

A clothes-pin carrier can be made from a grape basket. Suspend it from the line by a stout wire bent into a loop at each end, and push it along the wire ahead of you.

A small wooden reel on which to wind a rope clothes-line saves the trouble of unraveling the tangles which get in, if it is rolled or looped up in a ball. Permanent loops at the ends of the rope and at intervals, spaced like the distance between posts, will save time and temper in stretching the line and making new knots each week.

A Sanitary Kitchen Sink

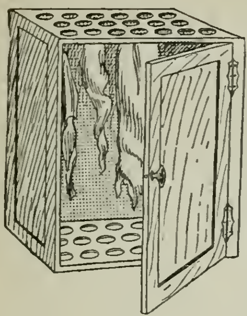
In setting kitchen sinks it has always been a rule to set the sink under the drain-board, and as the drain-board extends over the edge of the sink, it forms a bad place for dirt and grease to collect which no kind of



The close-fitting drain-board prevents the collecting of dirt

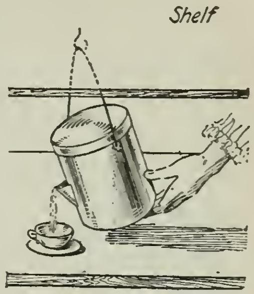
brush or cloth can dislodge. To improve this condition, use a solid drain-board and cut out the center large enough to let the sink through. The flange or rim of the sink will hang on the drain-board about ¾ of an inch all around. Drop the sink into this hole and with a sharp pencil mark around the rim. Rabbet this out about ⅜ of an inch, or so that the rim will go into this rabbet and finish flush with the top of the drain-board. Take thick white lead or soft putty to bed the sink in. This sink will not leak and is sanitary.—Wm. J. Albin.

How to Dry Unsightly Scrub-Rags



THE cloths used to mop the kitchen floor are inevitably stained and unsightly, even when rinsed. To dry them, and still have them hidden from view, bore holes in the top and bottom of a wooden box, stain the outside to match the woodwork and hang it in the warmest place in the kitchen. The warm air rises through the holes and dries the cloths hanging on hooks on the inside. Tea towels and dish rags may be similarly treated.—A. G. VESTAL.

How to Protect Sugar from Ants

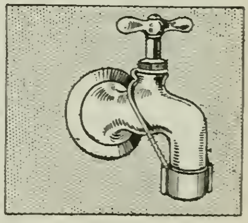


A HANDY receptacle for sugar may be made from an ordinary lard-pail with a tight cover. Cut a slot in one side, a little above the middle, and solder on a spout or lip, made from a scrap of bent tin. The pail may be suspended from a hook on the under side of a shelf above the table. To remove the sugar, the cook simply tilts the pail over a dish on the table. This arrangement effectually prevents ants from molesting the sugar.

A Milk-Warmer Made From a Lamp-Bulb

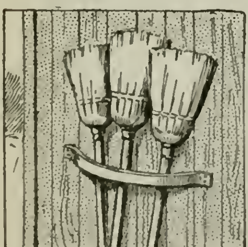
AN electric milk or medicine warmer can be made from a large carbon electric lamp by holding the bulb over a blow-torch and slowly heating the glass as shown in the diagram. The glass should be wiped dry before heating, and if pains are taken in heating the bulb, the soft glass will sag enough to form a basin to hold a small amount of water—WM. HARRIER.

How to Use Old Mantle Supports



THE used supports for Welsbach upright gas mantles can be utilized on a water-faucet as a strainer and also to prevent splashing. Remove the wire ends from the sheet metal part or sockets which hold them; place the cylindrical part containing the screen over the end of the faucet. Hold it in place by reinserting the wires in the sockets in the new and reversed position. Sometimes an extra turn of the wire is required to prevent slipping down. Though this strainer is not fine enough to filter out bacteria, it will serve many uses where particles of dirt and weeds get in the water.—T. GLYNN.

Broom Holder from Barrel Hoop



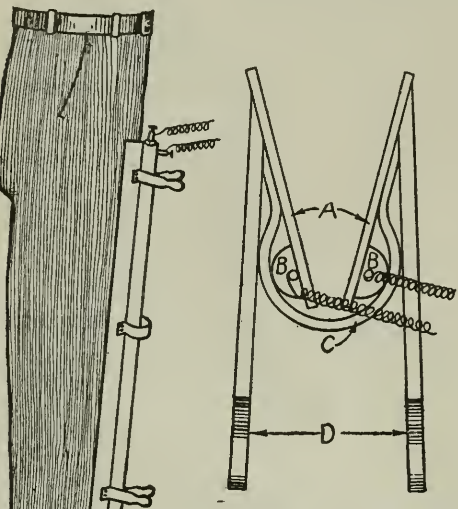
BROOMS, when not in use, should be stood on end. A section of a wooden barrel hoop cut and nailed in place as shown in the illustration makes an excellent holder for three brooms; and the cost is nothing.

Rejuvenating Your Pipe

TO make an old tobacco pipe as good as new, plug the stem with a bit of match, fill the bowl with alcohol, light and let burn. Do this three or four times and the pipe will be as clean and as sweet as when new, without the bother of breaking it in.—L. E. FETTER.

A Quick Creaser

A VERY convenient article for a household is apparatus for creasing trousers in a jiffy. The illustration shows a very light and easily operated device. It is shown in operation at the left. It clamps the trouser leg and is electrically heated by means of two



Trousers can be pressed by electrical heat

coils of wire, running the full length of the apparatus, as shown at *B*, *B*. The clamp *A* clasps the trouser leg. Three springs as *C*, one at each end and one at the middle, furnish the pressure; *D* indicates the releasing handles.

By dampening the trouser leg with a wet sponge and applying this apparatus, a fine crease can be obtained in a jiffy. This apparatus can be applied to the back of the trouser leg as well as the front.

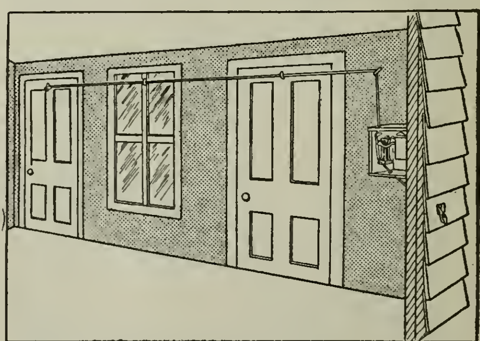
Making the Burglar Call the Police

AN invention soon to be installed in certain government buildings in the South, to make burglars and house-breakers themselves ring up the police calling for their arrest, has been worked out by Louis H. German, Louisville, Kentucky, as the sequel to a narrow escape he experienced from an intended robbery.

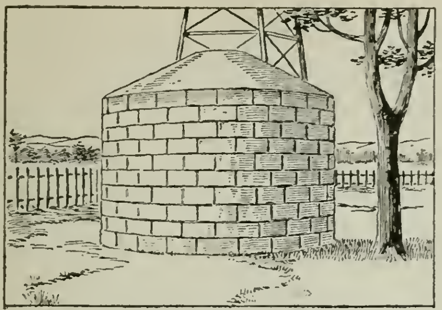
The system involves the automatic sending of the alarm from an instrument concealed in the room or building which has been broken into. This instrument may, for example, be a telephone concealed within a wooden cupboard. An elastic cord is fastened to the receiver (or other suitable alarm-sending element), and to the end of this short elastic cord is fastened a long wire or cord that is run through eyes that are fastened to the tops of doors and to window frames, and its further end hooked fast to the last eye in the end door or window. This wire is put in place by the owner or proprietor before he leaves the room. The telephone receiver hook is held in its place so as to give the alarm when he leaves. For this purpose, a cord is fastened to the hook and run through a hole in the wall to the outside, where it is fastened to a hook or nail.

When the proprietor opens the door, the elastic band attached to the receiver simply stretches without lifting the receiver from the hook, as it is held in place by the taut cord hooked outside the wall. Once he has closed the door and is outside, he proceeds to release this cord from its hook, so that it will slide through the wall inside. The next person who undertakes to open door or window will consequently stretch or strain the wire or cord extending across the doors so it will raise the receiver of the alarm-giving telephone from its hook, as it is no longer held down by the other cord.

In the daytime, the cord that protects the various doors and windows may be withdrawn and stored inside the cup-


By means of this scheme every door and window may be guarded

board that conceals the alarm-sending telephone, and employees and visitors in the building will be unaware of the existence of the automatic burglar-alarm.

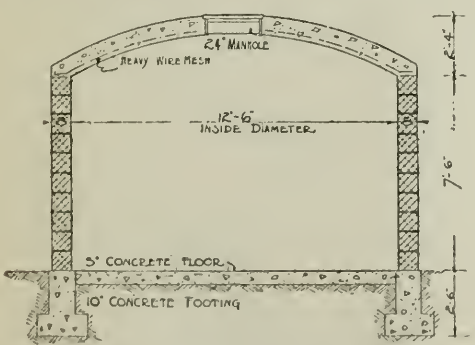


This cistern is made of concrete blocks. Its height is about ten feet

A Cistern of Concrete

THIS cistern, located above ground and on an elevation, makes it possible to have water under pressure in all departments of the farm. Water is pumped into the cistern by the farm windmill, the frame of which can be seen in the illustration. The cistern is built of concrete blocks laid in cement mortar. It is a round structure, the inside diameter being twelve and a half feet, and the height ten. The size is ample for farm use, yet the cost of the improvement is within reach of the average farm owner. The materials should cost about sixty dollars in the middle west.

The foundations and the floor are of solid concrete. Build the foundation walls below the frost line and make them ten inches thick and the floor five inches thick. About 300 blocks will be required for the cistern. When the desired height has been constructed, the next step will be the building of the concrete slab roof or cover. This will be re-enforced with a heavy wire mesh and there will be a 24-inch cast-iron manhole in the center. Build the form work of lumber well supported by timbers and joists. After the concrete has been poured and allowed to harden, the builder can enter the cistern through the manhole and remove the form lumber in pieces. The inside walls should be given a good treatment of cement wash mixed to the consistency of thick cream.

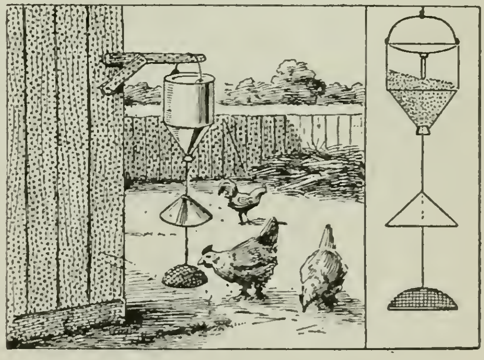


Cross-section plan of the cistern, showing its dimensions

Automatic Feeding-Hopper Built for Twenty-five Cents

PROCURE the following articles at a ten-cent store; a tin pail, a funnel, a pie-tin, and a strainer. The large end of the funnel should be a good fit for the inside of the pail.

Cut out the bottom of the pail and remove the spout of the funnel. Place the funnel in the pail and solder securely. Cut a V in the pie-tin, bring the edges together and rivet or solder them, making a conical deflector. Cut the piece taken from the bottom of the pail so that it will fit on the strainer; fill the strainer with corn and solder the piece on to keep the corn in. A rubber band or light spring and a spool cut in half are also needed.

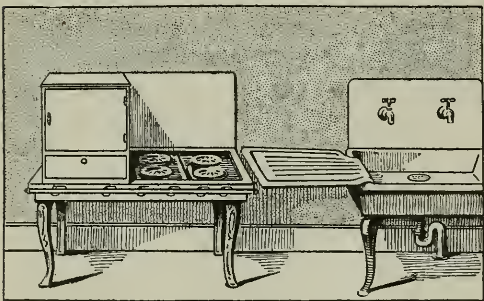


Chickens can be trained to feed themselves by means of this device

From the cover of the pail fasten a cord to a rubber band, also run a long cord from the end of the rubber band through the funnel to the spool valve, then to the deflector, and to the bait bar or strainer. The cord is fastened to the spool by the wooden plug. When adjusting, the plug is loosened; or the feeder can be adjusted by the cord on the cover of the pail.

The Left-handed Woman's Home Appliances

A FRIEND who is left-handed says it is foolish, when she must do her own housework for a lifetime, to put up with the little annoyances that come from using tools and arrangements standardized for normal, right-handed housekeepers.



The left-handed woman should have her kitchen arranged for her own convenience

She has her scissors sharpened the reverse of the usual way. The drainboard in her kitchen is at the left, instead of at the right of the sink. The shelf of her range she had transferred to the left. If she used a cabinet gas-range, with high ovens at the side of the open cooking-burners she would choose a stove with ovens at the left. In hanging up small tools near the place where they are to be used, she locates them at the left, rather than at the right side of the table or counter. The usual location of the spout or lip upon saucepans or skillets serves a left-handed cook well, for they are wrong for the average woman.—A. G. VESTAL.

How to Make Artificial Marble

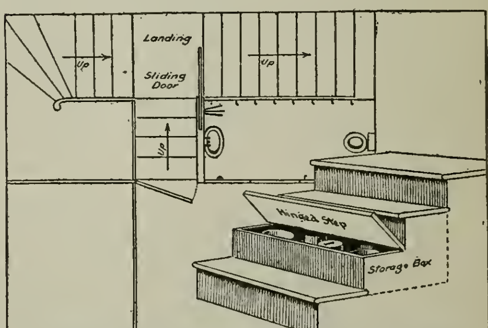
A COMPOSITION closely resembling marble can be made from marble-dust and magnesite. Thoroughly mix equal parts of these ingredients while dry. Make a watery solution of magnesium chloride, strong enough to float an egg. Add the magnesite and marble-dust mixture to the magnesium chloride solution, until a thick, creamy composition is obtained. Pour this into molds of glass. The glass should be washed, polished, and rubbed with a cloth soaked in paraffin oil. The oil gives the appearance of polished marble, when the composition is hard. Twenty-four hours are required for hardening.

If a mottled or veined effect is desired, add dry mineral colors to a small amount of the mixture, and, with a spoon, deposit it in several spots. When the mixture is poured into the molds, which should be from a height of 2 ins., the colored spots will blend with the white mass, forming beautiful veins and flecks. If holes are desired, rods of wood, dipped in melted paraffin, are placed in the molds.

This composition is especially good for electrical switchboards. Clock-cases, table-tops and statuary can also be made from it. Fine sand, or even sawdust, may be substituted for marble-dust. For each pint of dampened sawdust, it will be necessary to use a pound of magnesite.—A. H. WAYCHOFF.

Convenient Stairway

IN a new house having three rooms and hall on the lower floor one compact stairway serves the purpose of two. A hinged door at the bottom of the kitchen branch and a sliding door at the front hall face of the small landing give privacy to either section of the stairway. Warm air is prevented from rising when bedrooms upstairs are being aired. Also the noises downstairs do not disturb anyone who may be asleep or ill upstairs. Another feature is the hinging of the second step from the bottom of the kitchen branch making, beneath it and the third step, a storage space for cooking utensils and dish-drainer, since there is no pantry. This arrangement is a great space-saver.



Much valuable space can be saved by this kind of stairway

The Ideal Home for $5,000

By Geo. M. Petersen

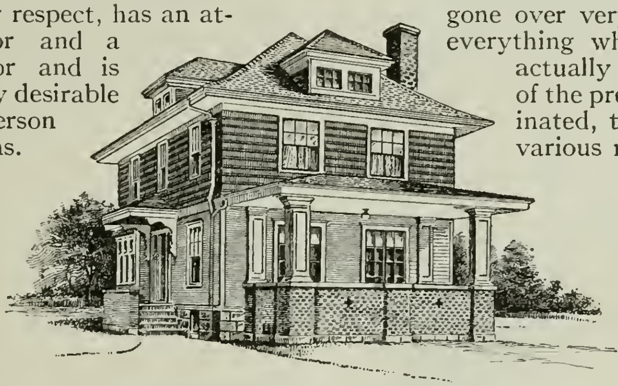
THE ideal home which we will describe this month, is a building in which everything was studied out in advance; in which every dollar was reckoned before the job was started and one which, through attention to details of small things, was kept down to a very reasonable figure. The house is modern in every respect, has an attractive exterior and a pleasant interior and is altogether a very desirable home for the person of average means.

Many persons who are now living in rent are perfectly able to build a home of their own but dread to begin operations because they are afraid that the ultimate cost will far exceed the appropriation. This item of "extras" is, in the great majority of cases, one which causes a great deal of trouble between the owner and the contractor, but if the proper attention is paid to the little things before the contract is awarded there will be no chance for the extra expense.

The cost of the house under discussion was as follows:

Lumber, Millwork and Glazing	$1541.00
Carpenter Labor	705.75
Mason Work, complete	1425.00
Plumbing	425.00
Heating, Hot Water System	400.00
Painting	275.00
Electrical Work	75.00
Decorations and Fixtures	150.25
Total Cost	$4997.00

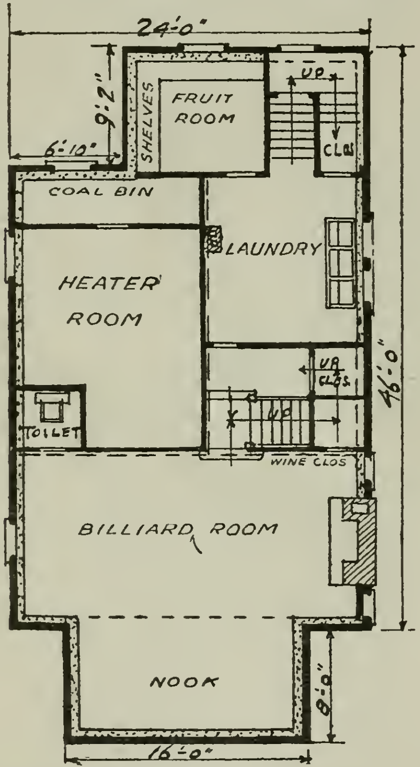
In the first place the plan was drawn and then studied until each room was reduced to the minimum size which could be used and still have it desirable; in this way three feet were saved in the length and two feet in the width of the house. The next step was to figure the framing of the house so as to reduce everything to stock lengths and sizes in order to avoid waste of material and the cost of labor for cutting. Following this the interior finish was gone over very carefully and everything which would not actually add to the value of the premises was eliminated, the finish of the various rooms was gone over thoroughly and another floor plan made for future additions and equipment. The electrical work was then taken up and only such outlets as were actually necessary were provided; the plumbing and heating were also gone over very thoroughly as was the painting. The exterior also received its share of thoughtful attention with the result that not only was a nice sum saved on this item but the appearance of the house was actually improved.


The completed five-thousand-dollar home. Note the spacious closed veranda and the broad cornice

We will now investigate the house floor by floor and see what was finally accomplished.

A Basement Complete in Every Detail

In the basement we have a billiard room eleven feet wide and twenty-two feet long, which has a nook fourteen feet wide and seven feet deep, in which may be placed a card table and some easy chairs for the onlookers. The floor of these rooms is of No. 2 common yellow pine, seven-eighths of an inch thick laid over 2 by 4 No. 2 hemlock sleepers which are laid on top of the concrete cellar floor. The tongues of the boards in this floor were painted with white lead and oil before they were driven together and the sleepers were covered with a waterproof building paper before the floor was laid. The reason for these steps was to protect the room from dampness. The waterproof paper protected the under side of the flooring and the paint in the joints protected the room from any dampness which might have entered through the floor. The floor was then stained to imitate oak and given a coat of shellac and



Plan showing dimensions and arrangement of rooms in the basement

another of good floor varnish. The walls and ceiling of these rooms are plastered with one coat of patent wall plaster applied directly to the stone on the exposed walls and on lath on the inside wall and ceiling. The fireplace at the end of the room was built of selected common brick and provided with a rough hemlock plank for a shelf. The stairway to the first floor hall was built of yellow pine and provided with a stock handrail and 1¾ by 1¾ spindles, all stained to match the floor.

At the left of the billiard room a small toilet is provided with a vent out under the steps leading to the front door. Back of this toilet is the heater room where the hot water heater was installed. The coal bin was located immediately in the rear of the heater room. To the right of the heater room we find the laundry with a three-part cement laundry-tray and in the rear projection we have a fruit room with a sand floor, on which the sand is three feet deep to allow for vegetables being planted during the winter months, to prevent them from decaying during the winter months. A small closet is provided under the rear stairs in which are kept the wash boiler, pails and other rough household utensils. A small wine closet is also provided under the stairs to the billiard room, and another closet is built between the billiard room and the laundry. The partition around the stairs is plastered the same as the billiard room and all plaster was painted a light tan to harmonize with the oak floor and woodwork.

An Attractive Entrance Hall

Entering the house from the front entrance we come into a vestibule, which is provided with a tile floor and birch trim, stained mahogany, and then into the main hall. This hall is finished throughout in plain cut red oak, with the exception of the front stairs which are birch and white wood finished with mahogany treads and white enamel risers. The doors leading from this hall to the living room on the right hand, and the dining room on the left hand, are glazed French doors which open into the rooms. The living room is finished in North Carolina pine, polished with a forest-green stain which makes a very pleasing and restful finish. The entrance from the veranda to the living room is through two pairs of French doors located as shown on the first floor plan. The dining room is also finished in North Carolina pine, polished with a rosewood oil stain which makes a very attractive and rich-appearing finish. The dining room is also provided with a window seat in the bay window. A china closet is afforded at either end of the seat. The radiator for the room is placed under it. The dining room is not finished with any paneling or ceiling-beams but only with a ten-inch high base and a chair rail.

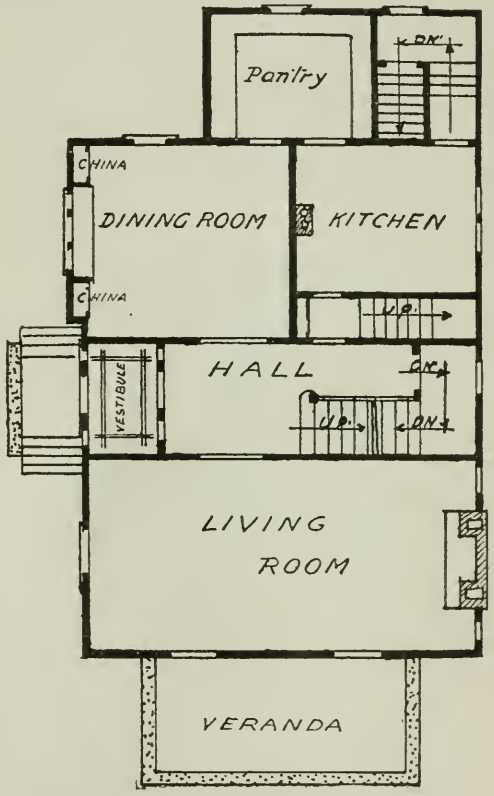
The kitchen and pantry are done in natural-finished yellow pine and the pantry is equipped with cupboards on two sides and a counter across the end. These cupboards are provided with sash doors, drawers, tilting flour-bin, cutting-boards, tin closets, etc., which are very essential to the workings of the culinary department. The only connection between the kitchen and the dining-room is through the pantry, so that there is a double door between the kitchen odors and the dining table. The rear stairs go up to the landing between the first and second floors, where they join the main stairs to the second floor.

All floors throughout the first floor with the exception of the vestibule, kitchen and pantry and rear entrance hall, are of ⅜-in. "select" oak. The kitchen and pantry floors are of ⅜-in. yellow pine and the vestibule floor is of tile. All the wood floors are stained a medium dark oak and then shellaced and varnished.

Economy of Space Observed

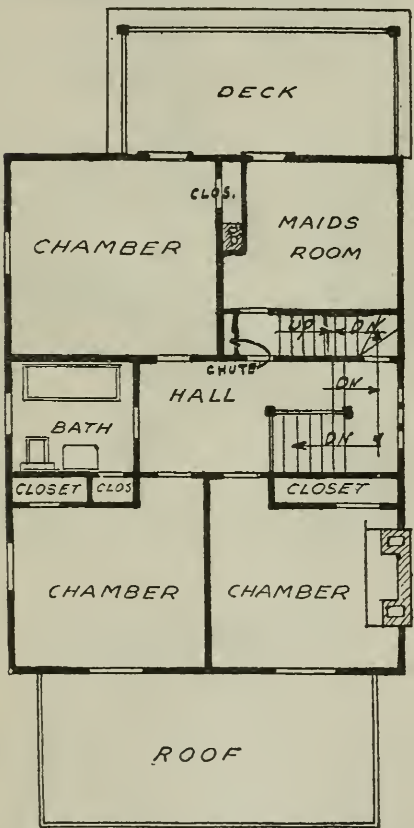
On the second floor we find a hall, four bedrooms, bathroom and a rear veranda. The bathroom is finished in white enamel with a tile floor and hard plaster wainscot marked off to imitate tile. This wainscot is also white enameled. There is a small linen closet opening off the bathroom and a medicine case built in the partition over the lavatory. The balance of the woodwork on the second floor is white enameled on white wood with the exception of the doors which are of unselected birch, stained mahogany. All the upstairs floors are of "select" oak ⅜-in. thick and finished with a light stain, shellac and varnish. All closets are provided with shelves and hook strips and the mantel is provided with a built-up pine shelf as is the one in the living room. The attic stairs lead up over the rear stairs and are off the main hall. The rear porch is covered with canvas and is accessible from either of the rear bedrooms.

As will be noted from the picture, the exterior of the house is sided half way up and shingled the upper half. The siding is painted a light lead color while the shingles are a deep brown, the trim being white. The ceiling of the veranda as well as the plancier of the main and dormer cornices is plastered with stucco on wood lath and makes a very pleasing effect. The appearance of the house is also greatly improved by the small lights in the upper sash of the windows and the dormer windows, which are broken out of the roof on the front and two sides. The chimney extends up the outside of the house all the way and, while it adds to the cost of the building to run up an exposed chimney of this size, it also adds greatly to the looks. The shingles on the upper part of the building are laid in alternate courses of six inches and two inches, while the siding is laid three inches to the weather.



Arrangement of rooms on the first floor. Note the large living room

This makes up a house that is fit for anyone to live in and at a price within the reach of almost anyone in this day when it is so easy to obtain money on first and second mortgages. There are other designs which may be built at the same price, or even less, and perhaps are more desirable than the one illustrated herewith, but this plan is used as an example of what can be done when economy is the rule of the day and the owner will consult with the planing mill-man, the mason contractor, the electrician, the painter, the plumber and the heating contractor instead of leaving everything to the architect, who in many cases, although fully able to draw beautiful pictures and artistic plans, is



The bedrooms on the second floor are all located conveniently near the bath

totally unfamiliar with building conditions at the time the house is to be erected and in all probabilities could not tell you what the sizes of stock materials are.

For instance, it is a common occurrence for architects to lay out a building which will call for a stud of such a length that perhaps a foot and a half will have to be cut from each one. Practically all lumber, both dimension and boards, come in even feet such as 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, with a different price on nearly every length so that a plan calling for an 18-ft. 6-in. stud for instance, would require the owner to pay the long price for a 20-ft. stud and then pay a carpenter 50 cents to 70 cents an hour to cut it down to size. The most economical sizes to use are from 12 to 16 ft.

Useless Expense Should be Avoided

Also in the matter of electric light outlets and plumbing the owner can generally save money by consulting the man who will do the actual work unless he is positive that he has an architect who is perfectly capable of cutting out all the surplus expense without spoiling the effect of the finished house. Now the builder is being run by the architect who wants to try out some theory at someone else's expense. He incorporates this theory and that idea into the builder's plan, tells the builder that the house can be put up for so much money and collects his fee. Along comes Mr. Millman to put in his figure for the lumber and millwork. He sees this, that and the other thing in the specifications and a plan with a lot of knick-knacks on it and immediately shoots his price up to cover items that are indefinite or questionable. It is not up to him to make suggestions to the owner or he will get in bad with the architect, and the owner is liable to get provoked because he has not asked for any advice. The owner becomes discouraged and drops the matter until a friend whispers in his ear. He digs up the old plan, calls on Mr. Millman and asks where the expense could be cut. He is shown a few items which will reduce the cost several hundred dollars and with a new courage, he goes after the other contractors until he is surprised to find that he has not only kept the cost below his estimate, but has, in many cases, greatly improved the arrangement and appearance of his house. The opinion and advice of the man who is to do the work is far more desirable than that of some cub architect.