All-Wave Receiver—Page 831

25 CENTS

POPULAR MECHANICS MAGAZINE

WRITTEN SO YOU CAN UNDERSTAND IT

SEE PAGE 762

Use ATKINS SILVER STEEL SAWS

Mr. Happy Man Says

"Your Hardware Dealer Sells Them"

SILVER STEEL Hack Saw Blades

Cut SIX Times Longer—TWICE as Fast!

ATKINS "Silver Steel" Hack Saw Blades for hand use will cut *twice* as fast, and last at least *six times* as long, as any other hack saw blade you ever used.

Think what a saving of time, money and effort this means! What it means to do a metal-cutting job in *half* the usual time —to have a hack saw blade that will outlast *six* ordinary blades! "Silver Steel" blades keep their teeth and will not snap.

You should be using these wonderful new blades NOW. Ask your hardware dealer for them. If he cannct supply you, write and tell us what kind of metal you are cutting, enclosing 25c, and we will send you a sample "SILVER STEEL" blade.

E. C. ATKINS & CO., *Est. 1857*
426 S. Illinois St., Indianapolis, Ind.

Leading Manufacturers of Highest Grade Saws for Every Use; Saw Tools, Saw Specialties, Plastering Trowels, Machine Knives, Grinding Wheels and Files.

Popular Mechanics Magazine

200 E. Ontario Street, Chicago, U. S. A.

H. H. WINDSOR, Founder — H. H. WINDSOR, Jr., Editor and Publisher

London: Hachette & Cie., 16-17 King William Street, Charing Cross, W. C. 2 — Paris: Hachette & Cie., 111 Rue Reaumur — Melbourne: Gordon & Gotch 509-513 Little Collins St.

ISSUED MONTHLY — SUBSCRIPTION: — SINGLE COPY, 25 CENTS

In United States and its possessions, also Canada, Cuba, and Mexico, per year, postpaid - $2.50
To all other countries in the Postal Union - - - - - - - - - - - 3.00
All subscriptions are discontinued at expiration. Please examine the date printed on your wrapper.

Entered as Second Class Matter Sept. 15, 1903, at the Post Office at Chicago, Illinois, under Act of March 3rd, 1879.
Entered as Second Class Matter at the Post Office Department, Canada.

Vol. 49 — No. 5

Contents for May, 1928

Special Features

[Continued on Page 4]

[Contents—Continued]

AMATEUR MECHANICS

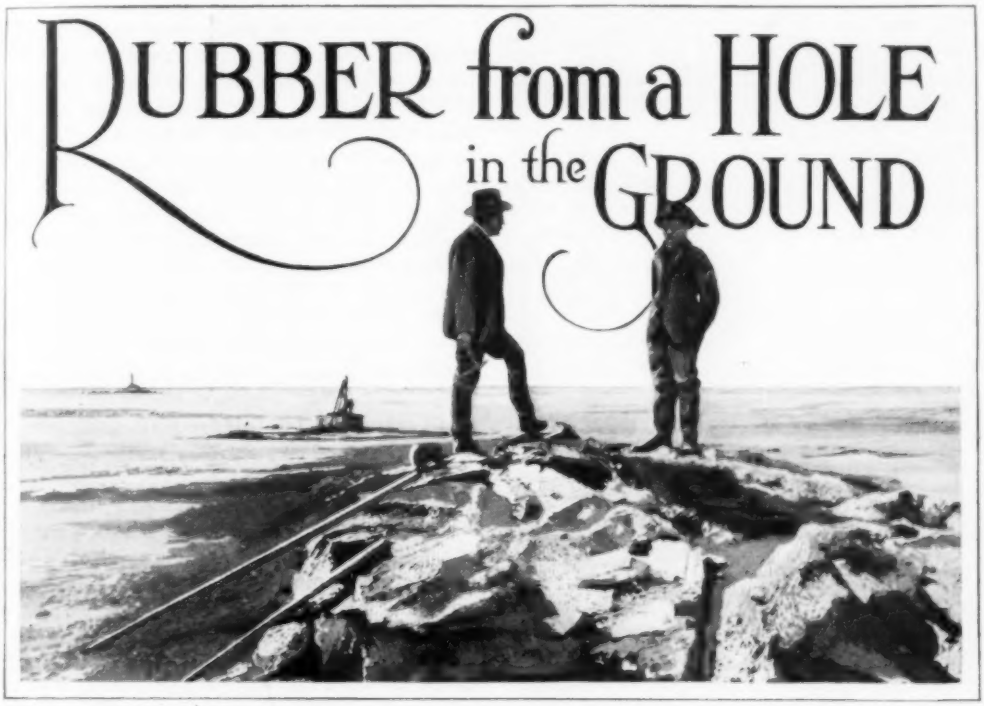
SHOP NOTES

[Continued on Page 4]

Popular Mechanics Magazine
REGISTERED IN U. S. PATENT OFFICE
WRITTEN SO YOU CAN UNDERSTAND IT

Vol. 49 MAY, 1928 No. 5

RUBBER from a HOLE in the GROUND



Bitumen Vent, or Crater, at the Edge of Great Salt Lake; the Thick Liquid It Exudes, When Combined with Reclaimed Rubber, Produces a Material for Hard-Rubber Articles

By H. H. DUNN

AUTOMOBILE tires, battery boxes, running-board mats, all produced from beneath the waters of the Great Salt lake, are the latest contributions of science in the world-wide search for new sources of rubber and for rubber substitutes. From shafts, six feet in diameter, sunk with steel caissons to depths of 125 to 140 feet, about 2,000 acres of an unusual deposit of bitumen on the northeastern shore of the western arm of the lake are being drained.

The resulting product is a black, viscous, molasses-like liquid, consisting of 99.9 per cent of "saturated sulphur oil created by the decay of fossil remains, and sealed into clay beds of this region," according to a bulletin of the United States geological survey.

This bitumen, the only deposit of its kind in the New World, is cleared of its impurities and combined with reclaimed rubber from discarded automobile tires and inner tubes to form a rubber "remake," or substitute, which has been found to fulfill all demands on battery boxes, switches, corners, and similar things of hard rubber. Made into automobile tires, it is claimed to be better than any reclaimed tire on the market. It is not as good as new rubber for tire manufacture, however, but is considered superior to any of the rubber substitutes.

For hard-rubber articles, ranging from battery boxes to combs, it is claimed to be superior to rubber from the point of cost, since the bitumen-rubber can be produced

at about one-fourth the price of standard crude rubber. As to wearing qualities, insulation, and similar factors, the hard rubber made from the bitumen-reclaim is declared equal to that made from the best vegetable rubber.

The amount of rubber required to make one automobile tire is equivalent to the production of two rubber trees through two whole years. Rather more than 200,000 tons of automobile tires are discarded each year in the United States. Of this, about fifty-five to sixty per cent can be reclaimed to the point at which it can be used successfully to mix with the bitumen base, in the now virtually fixed ratio of sixty pounds of bitumen to fourteen pounds of old-tire reclaim.

The Utah deposit of bitumen is one of three known beds of this material, two of which are in South America. The two latter are thirty-nine to forty-four per cent pure, requiring extensive operations to clarify them and bringing the cost up to a prohibitive mark. The Salt lake deposit, so far as tapped, is virtually ready for use. The Utah deposit is described by the geological survey as follows:

"The occurrence of this asphaltic substance appears, so far as now known, to be restricted to the shallow portion of Great Salt lake one-fourth to one mile from the present shore line, immediately southeast of the Rozel hills. It there exudes through the unconsolidated material on the bottom of the lake, and bubbles up into the water in the form of hollow spherical or tubular masses, one to two inches in length, and of threads and hairs, six to eighteen inches in length.

"The source of these seepages appears to those who have prospected this ground to be a bed of asphalt, two or three feet thick, which is encountered eighty feet below the present lake bed, and an underlying series of asphaltic beds, three to five feet thick, which alternate with beds of clay to a depth of 140 feet at least."

More recent surveys indicate that the actual area underlaid by this bitumen covers about 3,000 acres, most of which is now under about five to ten feet of water, though at the time of the accidental discovery of the deposits, in 1861, they were largely above high-water mark, Great Salt lake, in the intervening sixty-seven years having risen until now the bituminous bed is almost covered.

From the time of General Conners' visit until about twelve years ago, this remarkable bed of bitumen lay idle. Then an effort was made to find petroleum there, and several test holes were sunk. It was found, however, that the maximum depth

Pulling a Rope of Crude Bitumen from One of the Wells; the Material, Practically Pure, Possesses High Viscosity and Great Ductility, as the Picture Shows

to which oil-well drilling equipment would penetrate the bituminous limestone was eight feet. No oil was found and the project was abandoned. About five years ago, prospectors going over the same terrain found a black, thick liquid, about the consistency of tar on a very cold day, slowly flowing out of the five-inch casings in the holes which had been drilled for oil. Bubbles through this heavy and virtually odorless liquid indicated that subterranean gases were forcing it out. Tests in several laboratories, showed it to be unlike any other asphaltic or petroleum product in the United States.

Within the year, a new method of mining this bitumen is being tried successfully. Holes, six feet in diameter, are dug with the aid of steel caissons dropped through the water. These shafts are sunk to points below the several beds of bitumen. The caisson wall is then tapped, at the level of the bed, and barrels placed below the tap holes. Into these the bitumen flows more rapidly than the gas will raise it to the surface of the ground. It is, of course, impossible to pump the product from the beds. When the barrels are filled, they are lifted out of the caissons and are ready for immediate shipment to the makers of reclaim rubber.

Owing to the high altitude of Great Salt lake, and the low temperature of the water and land during the winter, this bitumen can be produced only in the summer. Steam pipes, however, are being sunk with the caissons, and will be forced into the beds of bitumen in order to soften it and assist the flow into the barrels.

MOVIE "TRICK SHOTS" PRINTED FROM STRAIGHT FILM

Enlargements, unusual effects, close-ups, and other special pictures, can be printed directly from a straight film in an apparatus that is expected to be of great aid to commercial and amateur movie producers. It saves the taking of special pictures, enables the proper arrangement and matching of close-ups and other scenes and permits a wide range of so-called "trick" effects. For instance, in a film of African game animals, the subjects in the original were so far from the camera, that they could not easily be distinguished. The printer was used to make enlargements of them from the straight film, the new reel showing the animals as though

Samples of Motion-Picture Effects That Can Now Be Printed Directly from Straight Film

they were but a few feet from the instrument. In a picture of a swimming meet, a diver was made to appear as though springing from the board, then his feet touched the water, he rose again in the air and landed back on the diving board. All these effects were taken from the original film which simply showed the subject in the usual action. Large films may be reduced for use in home projectors and small ones enlarged for the big machines.

Container of Tear Gas Releases Fumes When Safe Is Tampered With

GAS GUARD FOR SMALL SAFES TO FOIL BURGLARS

Adapted to installation in small safes, a tear-gas container releases its baffling fumes should anyone attempt to tamper with the combination. A sufficient quantity is provided to assure that an intruder will be driven from the room.

BATTERY-OIL-ELECTRIC ENGINE TO SPEED SWITCHING

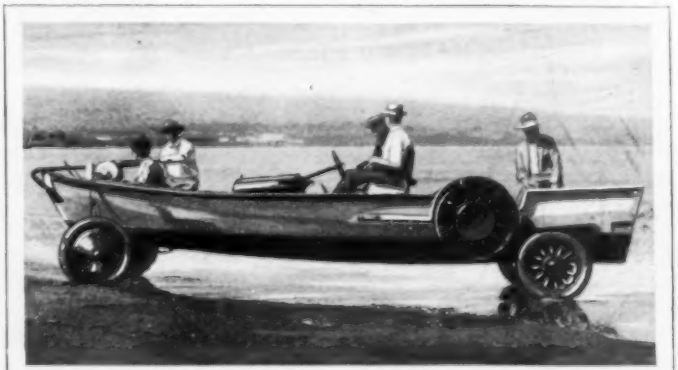
For service in its freight yards, a locomotive recently purchased by the New York Central railroad can be operated in four different ways, either by storage batteries alone, from the batteries and engine generator together, from a third rail or from an overhead collector. This wide choice of operating methods was installed because the engine is for duty in yards that are not wholly electrified as well as in those that are, and also for service through city streets. The storage battery has 218 cells and weighs seventeen tons. It is charged by a 300-horsepower engine, connected directly to a 200-kilowatt generator. The locomotive is over forty-six feet in length and weighs about 128 tons in working order.

RUST IN AIRPLANE CURBED WITH BOILING OIL

To preserve the steel-tube framework of airplanes from deterioration by rust, a special oil treatment is administered after the frame is assembled. Small holes are bored in the parts and boiling linseed oil is injected under heavy pressure. The flow is continued until the oil begins to squirt out of special openings provided for the purpose. About twelve gallons are required for the average modern commercial airplane. After the oil bath, the oil is drained off and the holes sealed with rivets.

SEAGOING AUTO BOAT TO AID GEOGRAPHIC SOCIETY

Scientists of the National Geographic Society have been experimenting with an automobile boat in their research work off the Hawaiian islands. The craft is sixteen feet long and is propelled by light steel paddle wheels, two feet in diameter. These are turned by a small automobile engine. The outfit makes twenty-seven miles on land and two miles in water.



To Aid the National Geographic Society Explorers; Boat on Wheels That Can Travel Land or Water

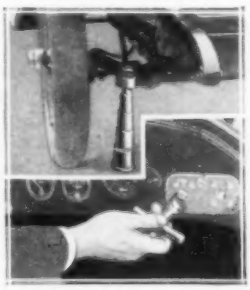
BARLESS ZOO HAS ELECTRICALLY HEATED ROCKS

Model of Barless Zoo and Grounds Being Prepared by Chicago Zoological Society, and Architect Edwin H. Clark with Model of Bear Pens

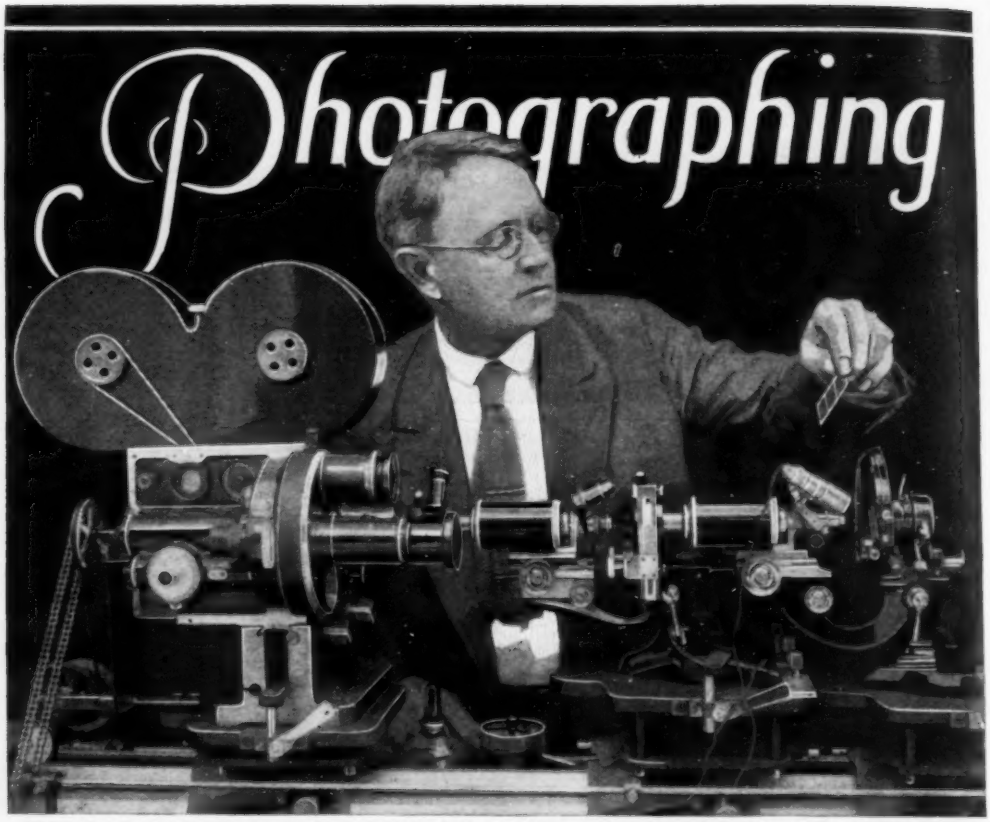
A community kitchen, completely equipped hospital, ultraviolet-ray glass and many other luxuries, are being provided for the animals and insects that will inhabit Chicago's 196-acre barless zoo. It is the first project of its kind in the world to have been planned and laid out as an entire unit, before actual construction. Provisions are being made for more than 3,600 animal specimens and 200 species of insects. The insect department will feature ant colonies in glass houses, where spectators may study the interesting habits of the inmates, and glass-sided hives for the bees will show how they store their honey and arrange the comb. So far as possible, natural surroundings will be furnished the animals. Instead of being pent up in cages, many of them will have large, open play yards, equipped with pools and rocky retreats. No bars will surround them, as high walls and moats will be so constructed as to prevent escape, yet not interfere with a view of the animals from the outside. The rocks for the pens are being made from cement and granite on a wire base. An aged appearance is obtained by a sandblast treatment. It is planned to introduce resistance wires in some of the rocks to keep them dry and warm in damp weather. This scheme has been followed with great success in a foreign zoo where a number of monkeys are kept in comparative freedom. The grounds have been laid out to provide ample space for parking automobiles near the main exhibits. The animal city has its own light, power, water and sewer system, and part of it will be completed this year.

FOUR-WHEEL AUTO-JACK SYSTEM CONTROLLED FROM DASH

Permanently installed on the axle of each auto wheel, steel hydraulic jacks are controlled from the dash so that the driver need not get out of the car to raise or lower them. According to reports, the system has been tested on practically all kinds of roads and has proved satisfactory. Any one or all the wheels are raised simply by inserting a key wrench in a control panel on the dash.



Photographing



This Slowest of Slow-Motion Cameras Will Take One to Thirty Pictures a Week, Magnifying the Object as Much as 100,000 Times; It Is Geared to a Motor

SINCE the beginning of time men have sought the secret of life, without much success until the inventive genius and patient research of Arthur C. Pillsbury, combined with the motion-picture camera, recently revealed the activity of the life unit in flowers, which bears a striking resemblance to that of animals. And now it has become possible for chemists to build the life unit identical in every respect, save one, with nature's own creation. That one exception is the activity which is life itself.

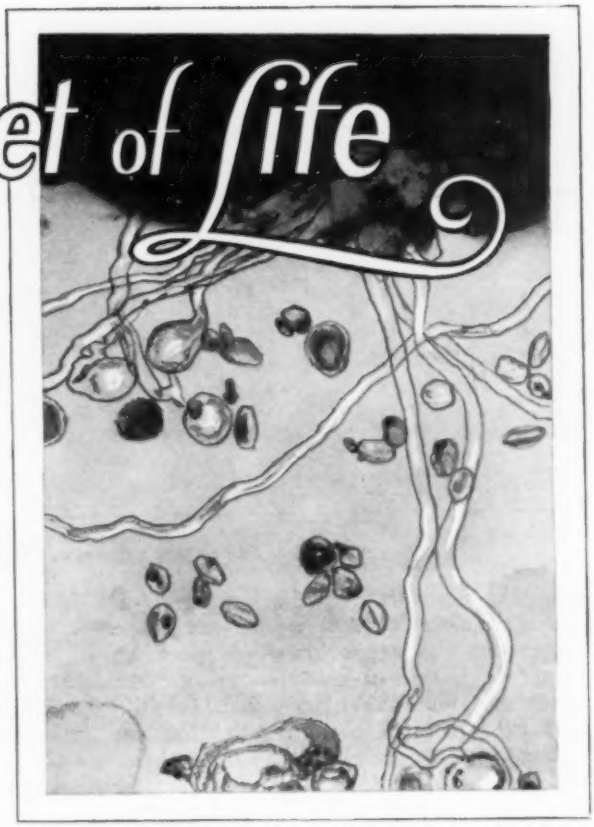
In his laboratory in Yosemite park, where Mr. Pillsbury has been engaged in research work both for the government and on his own initiative, the naturalist has succeeded for the first time in the history of science in obtaining a motion picture of the unit representing the life principle in a grain of flower pollen. And, so far as is now known, there is but one kind of flower which produces pollen that contains a life unit that can be photographed alive. That is the spider lily, a native of the Hawaiian islands.

It had been Mr. Pillsbury's ambition, for years, to photograph alive that smallest spark of life, the smallest known living thing. With ingenious mechanical contrivances of his own invention, he photographed, or attempted to photograph, the life unit of every plant that came under his observation. It could not be done because the life unit within the tiny grain of pollen—invisible to the eye—invariably was the same color as the pollen itself.

But while on a trip to the Hawaiian islands, Mr. Pillsbury began the study of the spider lily. Within its pollen he discovered a red life unit, and he knew that at last he was to see the thing that put life into plants and trees at work.

Carefully he gathered the pollen, which can be seen only when in clusters, and painstakingly separated the microscopic grains or cells. By previous experiments

the Secret of Life



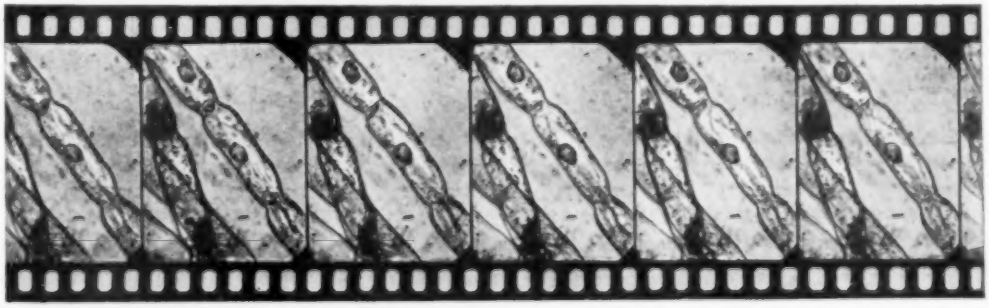
Swirling Particles within a Grain, Photographed to Show Pollen of One Plant Combining with Another Flower

he had discovered that the pollen remained as though it were asleep unless it was saturated with a proper solution containing sugar. Into a drop of the sugared solution, on a little glass slide, Mr. Pillsbury placed the invisible grain of pollen and then set his remarkable cameras for the great experiment.

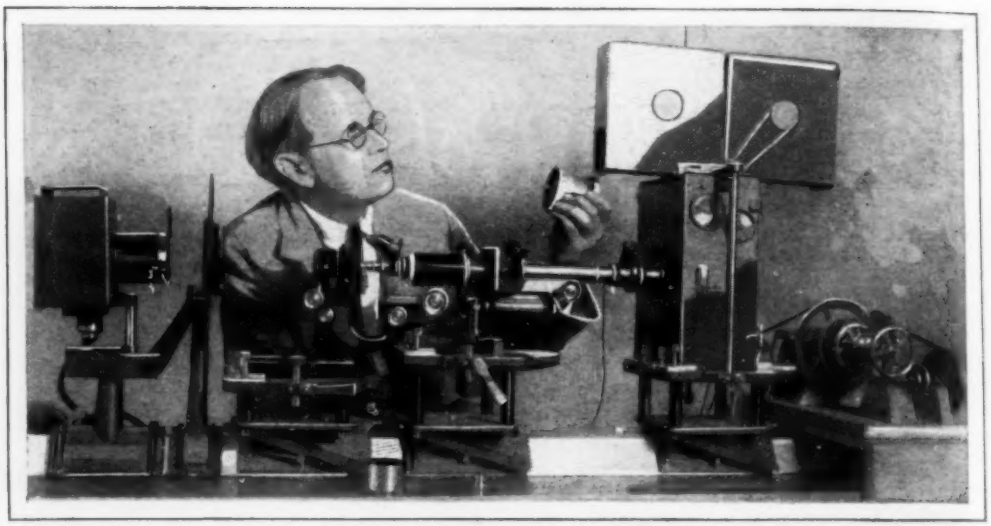
Within a few hours the grain began to swell. It reached the point where an outer skin burst along the egg-shaped surface. The clockwork camera, photographing the image of the cell rather than the cell itself, revealed that within another hour the second, or inner, skin began to emerge from the pollen grain and convert itself into a squirming vein which moved frantically up and down in the drop of water and through which, very shortly afterward, crept the tiny spot which was the life unit, seeking the stigma of another flower with which to join and so produce a new flower in the plant world.

It took a camera and equipment that could magnify 100,000 times to get that picture. An average man, shown on the screen magnified to that size, would be about 133 miles tall. That gives some idea of the power and fineness of photographic equipment necessary to do such work among the unseen mysteries of life.

The equipment was not available when Mr. Pillsbury began his experiments. Indeed the necessity for such cameras and lenses had not been felt until the naturalist himself created the need. First he had to devise a clockwork mechanism control-



A Six-Foot Man Would Be 133 Miles Tall If Magnified as Much as the Invisible Grain of Pollen; the Life Unit Is the Dark Spot in the Vein, Here Photographed Alive for the First Time



With His Motor-Driven Camera the Botanist Can Compress into a Minute of Movies the Growth and Action of Flowers over a Period of a Week or More

ling the exposures of the camera film, and then a device that would crank the camera at the proper rate of speed to compress within a minute the growth which may have taken a week. Then the vexing problem of obtaining lighting apparatus of a proper kind had to be solved.

To regulate the speed of the camera he employed a motor which drives an elaborate system of selective gears and pulleys by means of which he can take as many as thirty snapshots a second or only one in a whole week.

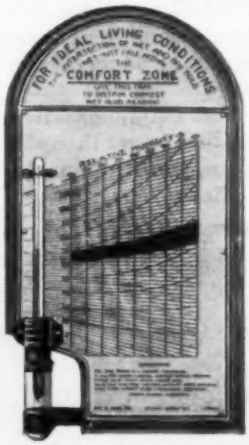
Having got that far, Mr. Pillsbury ran into the difficult situation of not getting good pictures of some of his subjects because light was shining through them rather than on them. There was no adequate dark-field illuminator made, so the naturalist again became a mechanical engineer and retired to the laboratories of Leland Stanford University to design and produce his own.

Out of a piece of brass with a silvered interior he contrived a small device to attach to his camera that would cut off all direct light rays but so reflect the rays as to make them shine with equal and proper brilliance on all sides of the object to be photographed. But all of his subjects are living and some cannot be seen under ordinary light. To stain them would kill them. So Mr. Pillsbury got around that by devising a system of differential light filters, in varying colors or wavelengths, each fitted to a particular subject.

And so it has become possible to reveal movements and secrets of life that heretofore have been one of the profoundest mysteries of existence.

WET AND DRY THERMOMETER COMBINED IN ONE

Both wet and dry-bulb thermometer readings may be taken from a single tube in a combination gauge that quickly indicates the relative humidity of the air. The dry-bulb reading is taken in the usual way. To find the relative humidity, the bulb is moistened in a very simple manner by means of an attachment to the instrument and fanned with a small paddle, also included with the thermometer, until the mercury drops to the lowest point it will move. This gives the wet-bulb reading. At the intersection of the lines marking the wet and dry temperatures, the relative hu-



midity is obtained. This is indicated by percentage figures on one margin of the card. For the further service of the user, a section of the gauge is colored to show a "comfort zone" within which lie the most satisfactory temperature and humidity conditions. Using the thermometer takes but a few seconds.

DYNAMITE STORED IN BIG TREE IS WELL PROTECTED

The twisted, hollow trunk of a huge "cream of tartar" tree, near a mine in South Africa, has been converted into a safe storage house for hundreds of pounds of dynamite, needed for blasting. The manager of the mine discovered the tree while looking for a site on which to construct a magazine for explosives. A wooden door was fitted into the natural opening, shelves were provided fastened with brass nails to reduce the likelihood of sparks, and the tree was then insulated with a lightning rod. Before entering the storage house, workers stop at a "changing room," where they put on special slippers, free from iron.

BOAT RUN BY HAND LEVERS INSTEAD OF OARS

Working hand levers back and forth turns the propeller and so runs the boat, in an apparatus that can be fitted to almost any small craft. Less skill is required to operate this system than oars, and the exercise also develops the muscles.

Boat Driven by Propeller Which Is Turned by Pumping Hand Levers, Much Like a Railroad Handcar

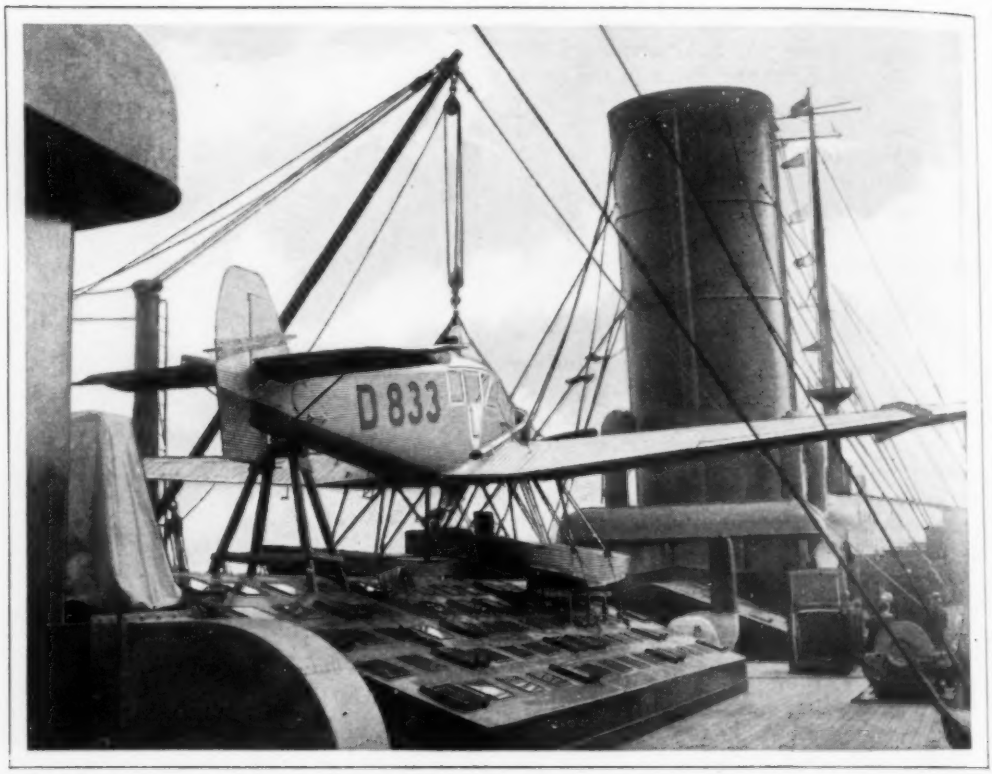
Amplifying and Improving the Tone of the Violin through Metal-Horn Attachment

COMBINATION VIOLIN AND HORN PRODUCES FULL TONE

Fitted with a horn attachment, a violin is said to have a much fuller and rounder tone than the usual instrument. The soft quality the wood produces is said not to be destroyed, though the horn is of metal.

SUPER-SUBMARINE TO CRUISE EIGHT THOUSAND MILES

Equipped with ten torpedo tubes and possessing a carrying capacity of thirty-two torpedoes, the huge submarine "Redoutable," recently launched at Cherbourg, France, will have a cruising radius of 8,000 miles. Its tanks will hold sufficient fuel to enable it to remain from its base for two months. Besides the torpedoes, it is armed with a five-inch deck gun, a two-inch anti-aircraft piece and a half dozen machine guns. Its engines develop 6,000 horsepower and it has a submerged speed of twenty-three miles an hour.



Ready for Trips to Ports Where the Steamer Cannot Dock; Seaplane on Deck of the "Columbus," to Accommodate Passengers Who Wish to Call at Remote Places

SEAPLANE CARRIED ON LINER FOR PLEASURE TRIPS

Ports where the steamer "Columbus" is unable to dock on its West Indian cruises, may be reached in a seaplane which is carried on the deck for the benefit of passengers desiring to take side trips through the air. It is quickly lowered and can land near the ship for easy reloading.

TIMESAVING CLAMP FOR HOSE ALSO USED ON RADIO

Adjustable to many sizes of hose, a quickly attached clamp, now on the market, exerts equal pressure around the entire circumference. Its chief feature is a special screw which engages with the end of the band slipped under it in such a way that the clamp can be securely tightened with a few turns of a screwdriver. The unit is well adapted to use in radio construction as a ground clamp and for various other electrical purposes.

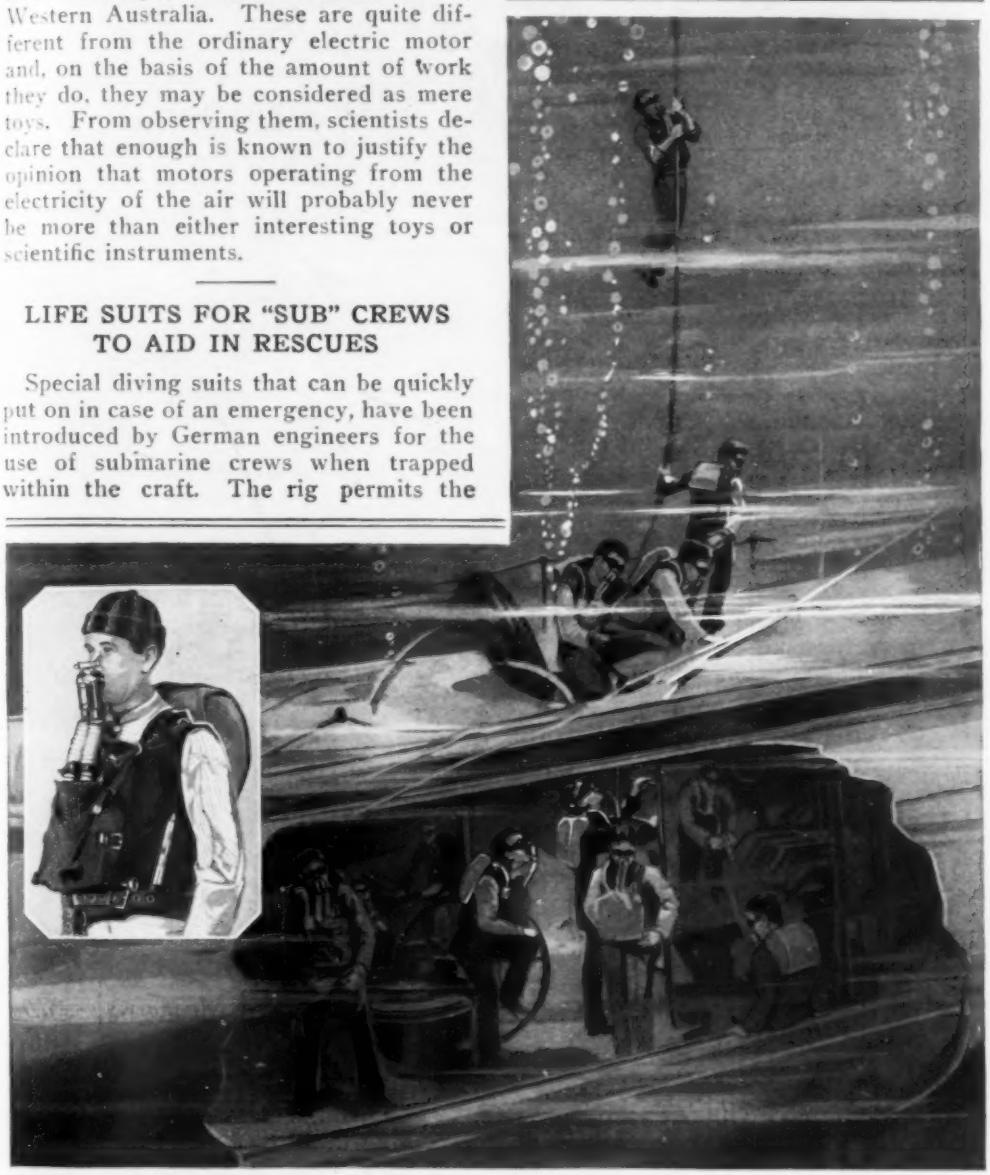
AIR'S ELECTRICITY TOO FEEBLE FOR PRACTICAL POWER

There is electricity in the air and hundreds of inventors, lured by the idea of something for nothing, have attempted to make use of it. But if a collecting antenna for the atmospheric electricity covered the whole state of Wisconsin, only about one ampere of current would flow at the dangerously high potential of 20,000 volts, and, in terms of ordinary electric power, this output of power would be worth only about $1 an hour, researches by the department of terrestrial magnetism of the Carnegie Institution, at Washington, have shown. Such an antenna, the height of that of the Arlington, Va., government radio station but covering the entire earth, would collect only enough elec-

tricity to cause a steady current of not more than 1,000 amperes to flow from the antenna to the earth. Some of the most efficient atmospheric-electricity motors thus far invented are scientific instruments called "electrometers." They have been in constant operation for several years at the observatories of the Carnegie Institution at Washington, D. C., near Huancayo, Peru, and near Watheroo, Western Australia. These are quite different from the ordinary electric motor and, on the basis of the amount of work they do, they may be considered as mere toys. From observing them, scientists declare that enough is known to justify the opinion that motors operating from the electricity of the air will probably never be more than either interesting toys or scientific instruments.

LIFE SUITS FOR "SUB" CREWS TO AID IN RESCUES

Special diving suits that can be quickly put on in case of an emergency, have been introduced by German engineers for the use of submarine crews when trapped within the craft. The rig permits the wearer to rise to the surface where he can float for an indefinite period, protected from the water by his apparel. In addition to these suits, a telephone buoy is released from the submarine, rises to the top by compressed air, and is available for connection with ships above so that direct contact can be had with men still imprisoned below.



Close View of Diving Mask for Submarine Men, and Drawing to Show How the Crew Might Escape from Sunken Craft after Adjusting Their Special Suits

ROMANCE OF GASOLINE AND ELECTRICITY TAKES

Once the Pride of the Volunteers, Chicago's First Fire Pump, the "Eagle," Now Is in a Museum

New Automatic Ladder Raised and Lowered by Power in a Fraction of the Time It Took to Crank the Old Type Up by Hand

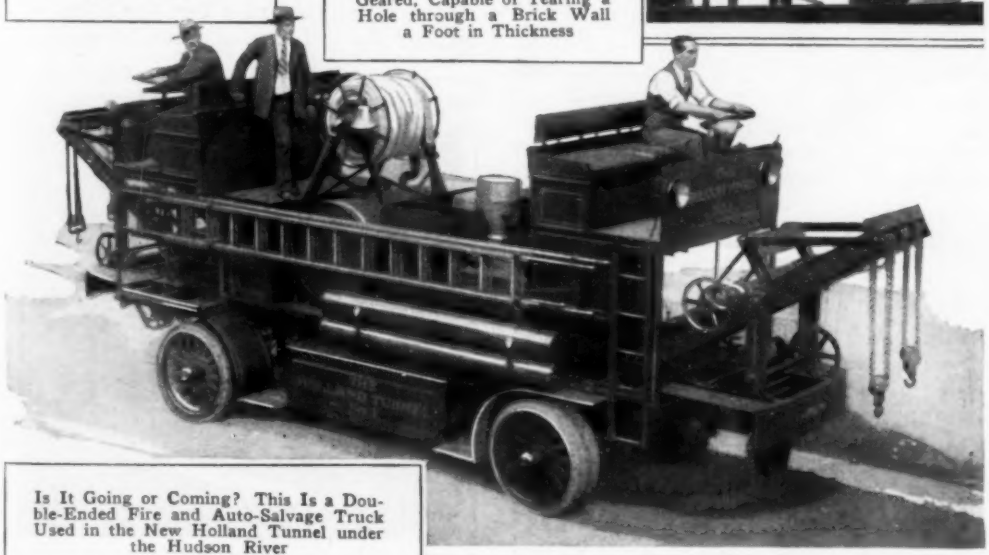
With a "Rescued" Damsel over His Shoulder, a London Fireman Pauses to Telephone the News Eighty-Five Feet Down to the Street

PLACE OF DEPARTED GLORIES OF THE FIRE HORSE

First Gasoline Replaced the Horses, and Then It Took the Place of the Steam Engine; So, Prancing Steeds and Showers of Sparks Have Departed Forever from the Glories of the Fire Run

This Combination Pump, Ladder, Chemical Truck Takes the Place of Three Horse Outfits

Modern Nozzle, Mounted and Geared, Capable of Tearing a Hole through a Brick Wall a Foot in Thickness



Is It Going or Coming? This Is a Double-Ended Fire and Auto-Salvage Truck Used in the New Holland Tunnel under the Hudson River

"Tusko" in Heavy Bonds before Being Moved to Winter Quarters; the Big Elephant Behaved Perfectly during the Trip

ELEPHANT MOVED IN CHAINS TO PREVENT ESCAPE

Keepers took no chances recently when moving "Tusko," a ten-ton circus elephant, from its steel pen to winter quarters. The animal was shackled with 450 feet of strong chains, leaving it just enough freedom to walk. Its trunk was also bound in chain armor and three other elephants were used as an escort to curb any show of temper. "Tusko" gave no trouble.

RADIO WAVES PENETRATE ROCK FIVE HUNDRED FEET

That radio waves will penetrate rock strata to a depth of 500 feet and more, was shown by tests conducted under the supervision of the bureau of mines in Colorado. In one demonstration, strong reception was obtained at a depth of 220 feet from a Denver station, fifty miles away, and in another, "mushy" results were received at a depth of 550 feet. This reception, however, was about as good as could be had above ground at the time, for conditions in general were unfavorable. The test was made 200 feet from the main shaft in a cross-cut. A pipe came down the shaft and followed the cut up to eighty feet from the observation point.

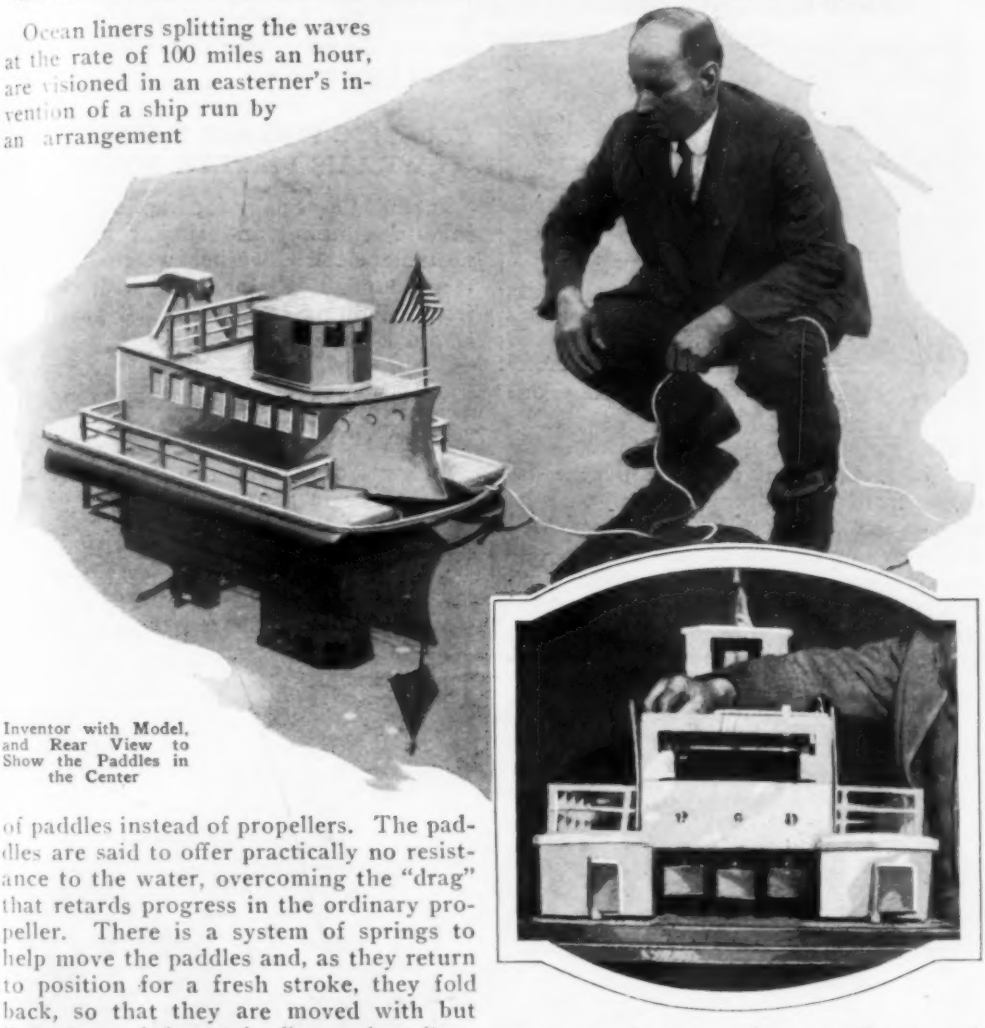
SOUND-MEASURING GAUGE AIDS TUNERS

Sounds are now accurately measured by a gauge that shows the number of vibrations and their wavelength, for the aid of piano and other instrument tuners, teachers and workers in the field of sound generally. It consists essentially of a brass tube with a hollow piston rod inside that terminates in an ear piece. An air chamber is thus formed, and sounds entering it cause a certain response which is detected on the ear unit. By a simple mathematical formula, the number of vibrations in that sound can be determined. The gauge may be set to respond to different tones, as when tuning a piano, and will measure the buzz of a bee, the chirp of a bird or the sound of the human voice.

Tuning a Piano with Aid of Gauge, Seen on Shelf above the Keys; It Accurately Measures Sound

SHIP WITH SPRING PADDLES TO DEVELOP SPEED

Ocean liners splitting the waves at the rate of 100 miles an hour, are visioned in an easterner's invention of a ship run by an arrangement



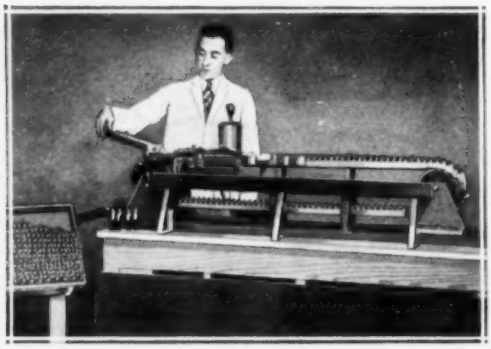
Inventor with Model, and Rear View to Show the Paddles in the Center

of paddles instead of propellers. The paddles are said to offer practically no resistance to the water, overcoming the "drag" that retards progress in the ordinary propeller. There is a system of springs to help move the paddles and, as they return to position for a fresh stroke, they fold back, so that they are moved with but little loss of forward effort. An oil or gasoline-burning engine furnishes the power. Besides this feature, the craft is to be mounted on two buoys on either side of the hull to reduce the tendency to roll in high seas. A model of the ship, on which a patent has been obtained, is said to have performed satisfactorily.

RADIO "EAR AND BRAIN" TO AID SECRET BROADCASTING

Radio conversations without the fear of eavesdropping are promised in an electrical "ear and brain" apparatus recently demonstrated. A distorted record of human speech was made on a phonograph disk by transforming high-frequency tones into low frequencies. The result was an unintelligible gibberish. While these sounds were issuing from the record, an electrical "ear" was held in front of the horn. It was like the pick-up transmitters used in broadcasting studios, and carried current into another electrical unit, the "brain," where the tones were restored to their proper frequencies. The original speech, easily understood, was heard from a number of loud speakers to which the brain was connected. When the ear was withdrawn, the loud speakers stopped and the garbled language was heard as before.

SEALING BOTTLES WITH GLUE SAVES U. S. THOUSANDS



Machine Which Seals Bottles with Ordinary Glue Instead of the Usual Wax

Using glue instead of wax to seal bottles of preparations sent out by the department of agriculture, a chemist in the bureau of animal husbandry has effected great savings for the government, as one man can do work that formerly required ten. Another of his inventions is a rubber stopper as a substitute for those of cork. To extract liquid from the bottles, the rubber is pierced with a needle. The hole seals up automatically after the needed quantity has been withdrawn, thus preventing the remainder of the liquid in the bottle from spoiling.

ELECTRIC WASHER IS PORTABLE, WEIGHS FIFTEEN POUNDS

Intended especially for fragile garments, infants' clothing and similar articles, a portable electric washer weighs but fifteen pounds. It is operated with current from a lighting socket, has few parts and is said to do thorough work.

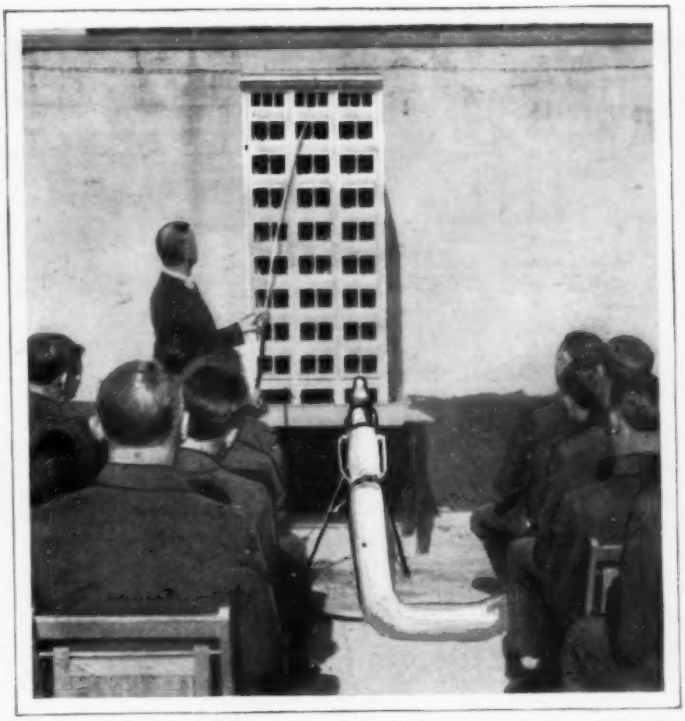
DANCES ON ROULETTE FLOOR WIN PRIZES FOR COUPLES

Patrons of a New York grill have a chance to win a prize at the end of the dances, for the floor is marked off in a spiderweb pattern with numbers corresponding to those on a wheel of fortune which is spun and stops with the music. The couple standing on the number winning on the wheel is awarded a prize.

Unusual Method of Distributing Prizes to Dancers, the Winner Standing on the Number Indicated by a Wheel Which Spins as Long as the Music Is Being Played

FIREMEN'S SCHOOL HELPS REDUCE LOSSES

There are many tricks to fighting a fire and most of the effective ones are taught student firemen in Los Angeles at an outdoor "college" that makes special use of models to illustrate the lessons. For instance, should a blaze break out in the upper floors of a skyscraper, where is the best place to direct the streams of water? The instructor, employing a small hose, shows that the flow will do the most good if it is thrown against the ceiling of the floor on which the fire is burning. As it strikes, it spatters and spreads farther than it would if simply shot in through the windows in a hit-or-miss fashion. Besides demonstrating the best practices in combating fires, the school teaches the use of the latest forms of apparatus and many other essential points.



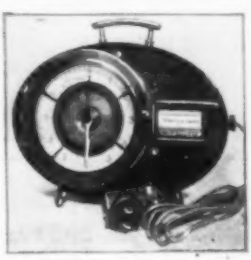
Skyscraper Model Used in a Firemen's School to Demonstrate the Best Methods of Fighting Blazes

STONE "SPONGE" FOR GOLDFISH SAVES CHANGING WATER

Water in the goldfish bowl will remain fresh and healthful for three months or so by placing a chunk of special chemical rock at the bottom. About half a pound to a gallon of water, is the proper proportion. The rock absorbs various impurities and produces the effect of an attractive grotto in the bowl.

MEMO CLOCK TURNS ON RADIO, ELECTRIC STOVE OR IRON

Almost as efficient as a human companion, an electric clock, devised by an eastern inventor, is equipped so that it can be used to turn the radio set on or off any time during the twenty-four hours, switch the electric stove, iron or other appliance into operation or shut off the current and also remind the owner of important engagements at any hour. This is accomplished by means of a memorandum attachment at the side and an alarm bell which rings for a few seconds at any time set. A small card, noting the appointment, appears on the front of a small cylinder. As many as twenty-four of these reminders can be put on at one time and set so that they will appear automatically in proper order whenever desired. The alarm bell can be used with or without the time-switch arrangement that operates the electric appliances, or with the memorandum attachment.



¶In proportion to the size of their bodies, insects have larger wings than birds.

America

By J. EARLE

EVERY day and every night commercial airplanes, operating on regular routes, carrying mail, and in some cases express and passengers, too, are flying far enough over the United States to equal a trip around the world.

On Jan. 26, 1928, the post office department had 8,711 miles of contract air-mail routes in operation and another 3,362 miles, to be started as quickly as planes could be delivered and landing fields prepared. That is a total of 12,073 miles, and the trip of a single plane each way every day would total more than 24,000 miles of flying. But some of the routes are covered twice daily, and the New York-Chicago airway, a distance of 712 miles, is flown both day and night, and frequently, to use a railroad term, the mail travels in "sections," for more than one

Spreads its Wings

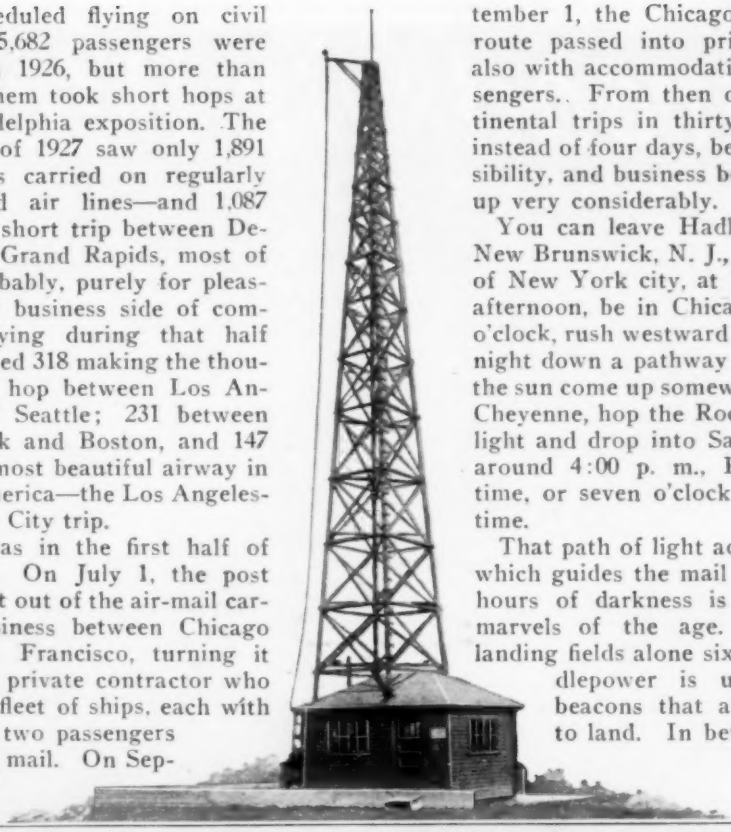
MILLER

plane is necessary to transport the load. Other countries in some cases have longer air routes—France operating one of 4,000 miles from Paris to Senegal—but the United States leads the world in both total mileage and volume of mail carried. A single one of the thirty-four contract mail routes last year carried more mail than all the air lines of Germany combined.

With the world's greatest regularly scheduled air traffic, the United States, however, has been slow to turn to the air for passenger transportation. Within the last year, or roughly since Lindbergh climbed aboard his plane alone and started his flight for Paris, there has been a marked change. After years of waiting, the land where the airplane was born has begun to try out its wings, and found they are safe.

In scheduled flying on civil airways, 5,682 passengers were carried in 1926, but more than 3,500 of them took short hops at the Philadelphia exposition. The first half of 1927 saw only 1,891 passengers carried on regularly established air lines—and 1,087 made the short trip between Detroit and Grand Rapids, most of them, probably, purely for pleasure. The business side of commercial flying during that half year showed 318 making the thousand-mile hop between Los Angeles and Seattle; 231 between New York and Boston, and 147 over the most beautiful airway in North America—the Los Angeles-Salt Lake City trip.

That was in the first half of the year. On July 1, the post office went out of the air-mail carrying business between Chicago and San Francisco, turning it over to a private contractor who started a fleet of ships, each with room for two passengers as well as mail. On September 1, the Chicago-New York route passed into private hands, also with accommodations for passengers. From then on transcontinental trips in thirty-one hours, instead of four days, became a possibility, and business began to pick up very considerably.



You can leave Hadley Field, at New Brunswick, N. J., just outside of New York city, at 12:15 in the afternoon, be in Chicago at seven o'clock, rush westward through the night down a pathway of light, see the sun come up somewhere around Cheyenne, hop the Rockies at daylight and drop into San Francisco around 4:00 p. m., Pacific coast time, or seven o'clock, New York time.

That path of light across the sky which guides the mail through the hours of darkness is one of the marvels of the age. At twelve landing fields alone six billion candlepower is used in the beacons that aid the ships to land. In between, every

The Nerve Center of the Far-Flung Air Lines Is the Radio Room; Guiding Wireless Beacons Are Already Being Tried on the New York-Chicago Run by U. S. Engineers

The Passenger Cabin in the Boeing Planes on the Chicago-San Francisco Line Have Seats for Two Passengers

Right, Loading Mail and Passengers in a National Air Transport Plane; Left, a Golfer Arriving; Each Passenger Is Allowed to Carry Twenty-five Pounds of Baggage Free

The Pilot Checks In His Cargo of Passengers on His Logbook; People, Mail and Express Are All Carried by the N. A. T.

twenty-five miles, a revolving searchlight sweeps a pencil of light across the sky from dusk to dawn to point out the way, and at intervals of three miles or so, smaller flashing lights serve to mark the aerial highway.

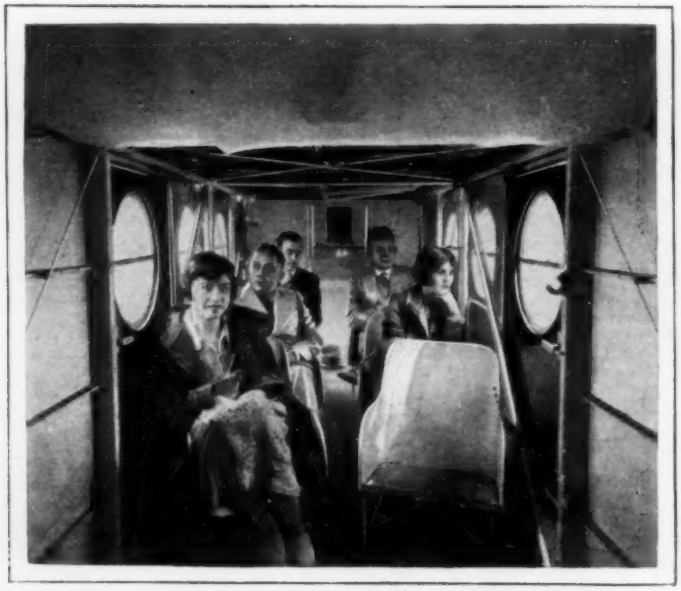
The regular and emergency landing fields, the beacon lights for night flying, and the testing of pilots and airplanes have all been so perfected that an accident on any regularly established airway is a rarity. The insurance companies have recognized this fact by amending their policies to pay the same benefits for aerial accidents, on regular commercial routes, as they do for death met in such ways as falling downstairs in your own home, slipping on a banana peel, or being run down by an automobile.

Insurance benefits, however, do not cover accidents while a passenger in the war-time plane of a gypsy flyer. It is in such pleasure-hopping machines that the majority of the 165 accidents listed in the first ten months of 1927 occurred. And of these 165, it is significant that 146 were planes which had not been licensed by the government as safe ships for inter-state flying, while 132 of the pilots were likewise unlicensed.

The pilots who are licensed for the regular commercial routes are the pick of the country. A pilot is never ordered out. His own judgment is the last resort, and if he believes the weather unsuited for flying, the mail must be forwarded by train. That doesn't mean that the flyers do not take risks, for they do when mail only is involved. If the weather is bad, the mail may be flown, but any prospective passengers are left on the ground.

The Pilot Sits Far Back toward the Tail, with Roomy Mail and Express Compartments Filling the Space between Him and the Engine; Start of a Flight at Hadley Airport

From the Canyons That Lead North from the Battery, at the Tip of Manhattan Isle, to the Towering Skyscrapers That Line the Chicago River Is Nearly a Thousand Miles, but Just a Comfortable Afternoon's Ride on the Transcontinental Planes; Hopping Off from Hadley Field, New Brunswick, N. J., after Lunch, the Passenger Alights in Chicago in Time for Dinner, or He Can Continue Westward through the Night and Be in San Francisco at 4:00 p. m., Next Day



Comfortable Chairs and a Roomy Cabin Make Air Traveling Pleasant; This Is the Interior of a Ten-Passenger Douglas

Take a typical winter night at an airport. The phone rings and the field manager lifts the receiver.

"McGinn, at LaPorte," comes the message. "I'm down here, ice on my wings. Fog over everything. Can't get through."

"Train your mail," the manager directs, and hangs up.

Three other pilots are lounging around the clubroom, waiting for mail from the east to arrive in Chicago before taking to the air. With Pilot W. S. McGinn reporting down, prospects for taking off appear slim, the talk turns to bad weather, and the evening's "ground flying" begins. When aviators talk shop, it goes by the name of ground flying.

"Looks bad," comments Pilot Addems, one of the trio. "Worse even than that freak snowstorm that got me last week." Visitors ask for the story.

Addems was westbound from Cleveland, flying at 1,500 feet. At McCool, Ind., he picked up the beacon light clearly, and everything seemed safe for the few minutes' run into Chicago, when suddenly he sped into a blinding snowstorm.

The compass chose that moment to go bad, but Addems kept flying on, though he couldn't see beyond his wing tips. He had been going long enough to have passed Chicago, so came down in hope of sighting a landmark. At 250 feet he did see something—the cold, black water of Lake Michigan, indicating he was miles to the north of his course.

Completely lost, not knowing how far out over the lake he was, his gasoline gauge showing but five gallons in the tank, he settled lower, turned on one of his wing-tip lights and pointed it down toward the water to catch the drift of the waves. On the strength of their direction and a wind observation he had made before striking the snowstorm, he turned left and climbed a few hundred feet. A few moments later he sighted the shore, then the blast furnaces at Gary and landed, with less than a quart of gasoline left. As the story is finished, the telephone starts to ring again.

"This is the field at Lansing," comes the message. "A plane just passed flying west. Think it's McGinn, as LaPorte and McCool report he hopped off again. Better light up for him."

Opinions of the weather are hastily revised. If McGinn could get off again, the weather must be improving, so the San Francisco and Kansas City mail is loaded and the pilots take off. In the meantime there is no trace of McGinn. The half-billion-candlepower beacon is burning in a vain effort to penetrate the fog. An hour later his ship comes in, with another hair-raising report.

Everything went well until after he had passed Lansing, at the southeastern edge of Chicago and almost within diving distance of the mail terminal. Then he ran into fog, and ice began forming on the edges of the wings. He did a quick bank, in an effort to turn and get back to the Lansing field, but could not get out of the fog. Next he started to climb over it, but the gathering ice threatened to bring the ship down. He had dropped all but two of his landing flares, and was saving those for the last emergency—if it should

Loading Express in One of the Big Monoplanes on the N. A. T. Line, Which Was First to Sign a Contract with the American Express Company

Banks Are Heavy Users of the Fast Air Mail, For Every Day Saved in Moving Money Cuts Costs

This Big Three-Motored Keystone Plane, Carrying Ten Passengers, Has an Insulated Cabin to Keep Out the Heat of the Tropical Sun, For It Flies the Caribbean Route

become necessary to make a parachute descent.

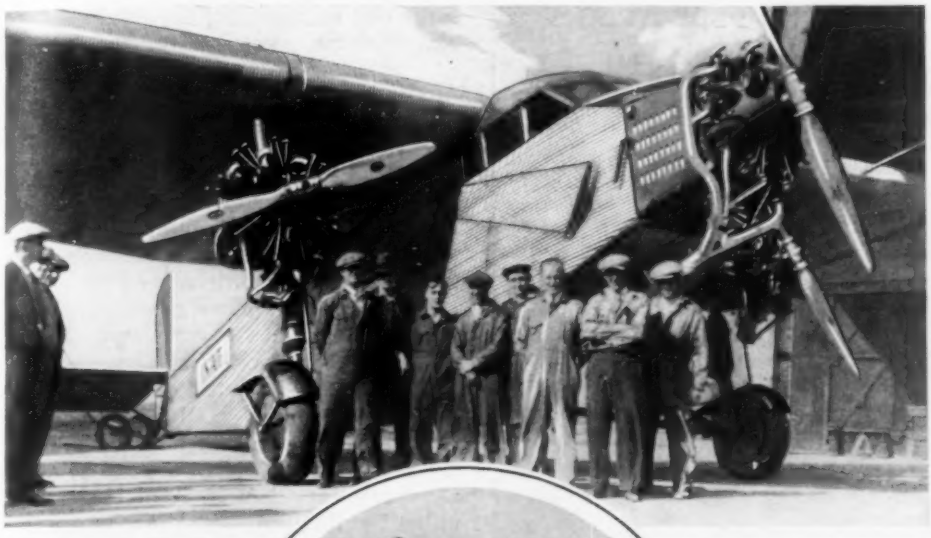
Finally, he dropped them, but the fog was so thick they failed to illuminate the ground. Then McGinn began loosening his safety-belt buckle, preparatory to stepping off into the mist. At that moment he sighted a pink glow—above him. Pink lights don't glow in the sky at midnight. The only possible place for it to be, he reasoned, was on the ground. The answer was that he was flying the ship upside down—and didn't know it!

Opening the motor wide, he succeeded in getting enough speed to climb a bit and straighten out, right side up. The glow could only be South Chicago or Gary steel mills, and from there he could set his course for Chicago. He had been lost an hour.

The pay of a pilot varies according to the work he does. Night flyers get more than daytime aviators. One airway operator, figuring the expense of operating the average commercial plane, costing $12,000 to $14,000 and engined with a Wright "whirlwind" motor, such as Lindbergh uses, fixes the bill at 35.28 cents per mile. Of that 7.5 cents is the pilot's pay and .6 cent the state insurance carried on his life. The biggest item is 8.6 cents per mile for depreciation. Then comes five cents a mile for gasoline and oil, 4.83 cents for office expenses, and 2.41 cents for advertising and selling, while the cost of the two terminal fields is charged up at the rate of 1.3 cents each per mile the plane is flown.

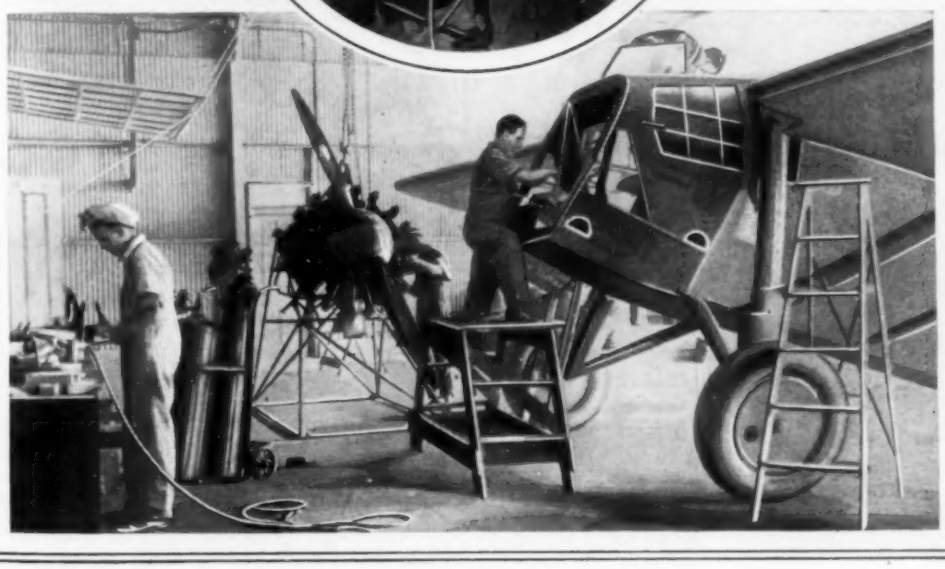
Private or commercial planes can be bought in about any price class desired. One of the air-trade papers lists forty-four manufacturers who are in production with seventy-two different types of ships, listing from $695 to $40,000, according to size.

During the first month of 1928, according to Major Clarence M. Young, director of aeronautics of the department of commerce, one-third of the industry alone produced 1,525 planes, with 1,239 unfilled orders on the books. It took nearly a quarter of a century after the Wright brothers' success at Kitty Hawk for the United States to find its wings, but once found they are being used to good effect.



Ground and Aerial Crew of a Sight-Seeing Bus, Above; This Big Three-Motored Ford-Stout All-Metal Ship Is Used to Carry Visitors over Chicago Both Day and Night, Making Regular Scheduled Flights; the Sight-Seeing Business Is a Lucrative Side Line at Most Flying Fields, Drawing Customers from the Thousands Who Flock to Watch the Arrival or Departure of the Air-Mail Planes

Modern Thick Wings, Which Have Replaced the Old-Time Bamboo and Cotton Affairs, Provide an Excellent Place to Hide the Plane's Gas Tanks, but Make a Step-ladder a Necessary Adjunct for the Filling-Station Attendant; Below, Changing Motors on the Air-Cooled Ships Is an Easy Job, For the Engine and Propeller Lift Off in One Piece, and a New One Is Quickly Substituted



TENT PITCHED ON LIGHT POLE PROTECTS PEDESTRIANS

Portable Tent to Shield Pedestrians, with Side Raised to Disclose Workmen

To guard persons on the sidewalk from flying fragments of iron, workmen on lamp-post standards in Philadelphia, rigged a canvas tent, about eight feet in diameter, to the pole on which they were engaged. The plan proved successful during an extensive overhauling of the standards, and the work was further expedited by a special platform, made in two half circles, on which the men rested.

ELECTRIC-ALARM WALL CLOCK NEEDS NO WINDING

Forgetting to wind the alarm clock will have no unpleasant results with an electric unit an eastern inventor has introduced, for it requires no winding, merely to be set at a time when the person wishes to be called. It operates without noise, save when the signal is sounding, and rings for fifteen minutes. A large dial surrounding the operating knob simplifies the task of setting the alarm.

FIRES WITHOUT MATCHES

Under favorable conditions, it took about three minutes to make a fire before the days of matches, but if the fuel was damp, half an hour or more was required. Cigaret lighters are a comparatively recent invention, but contrivances similar to them, even if far more complicated, were in use more than 100 years ago. In 1786, a "portable fire box" was introduced. It contained a small bottle of a phosphorous compound and small sulphur-tipped matches. When a match was dipped into the bottle and withdrawn quickly, it usually burst into flame. Until 1835, the familiar lighting outfit for the average home was the tinder box. In the seventeenth century, a tinder-box pistol fired by an alarm clock was introduced.

CARBON AND RIBBON TESTER FITS IN POCKET

Comparative tests of typewriter ribbons and carbon paper are easily made with a pocket-size unit now on the market. Impressions are taken on a roll of paper, sixty-five feet long, held on a reel. Steel type, actuated in somewhat the same way as the characters on a typewriter, but by means of a crank, make the test impressions. The outfit weighs only a pound and is durably constructed.

RARE MEDICAL ELEMENT FOUND IN SMELTER DUMP

An extensive search for a plentiful source of germanium, a rare chemical element, has ended successfully in one of the least expected places, the scrap heap of a copper smelter. Dr. Jacob Papish, of Cornell university, has found the substance in concentrated form among the

waste which remains after copper has been extracted from a certain mineral. While no wide use for the element has yet been found, it is believed to have medicinal properties, and already has been employed in the treatment of anemia. Chemists believe that, now an abundant supply of germanium is available, work will be found for it to do. This was the case with vanadium, radium and other rare materials. Dr. Papish discovered the substance when the mineral was subjected to extremely high temperatures. A spectroscope, by which the peculiar light emitted by the element was detected, aided in finding and identifying it.

AIRSHIP WITH ALL-METAL BAG TO BE RUN BY STEAM

Interest has been aroused in an airship, now under construction in California, for it is to have an all-metal bag and the propeller will be run by a steam turbine. Besides these features, it will have a landing elevator and other characteristics not ordinarily found in aircraft of this type. The method of propulsion is said to differ from that of the usual ship. The propeller creates a vacuum immediately before the bag with the result that a stream of air, flowing around the ship, pushes it forward.

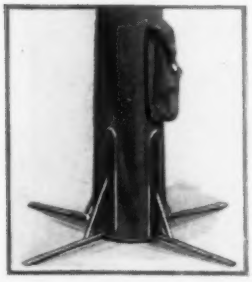
Framework of a Metal Dirigible under Construction in the Hangar, and a Model of the Ship, with Its Designer; the Builders Work from the Movable Platform in the Foreground

Built like an Auto Gasoline Pump, This Filling Station Supplies Cigar Lighters

FILLING STATION FOR LIGHTERS LATEST SMOKERS' AID

For the accommodation of owners of cigar and cigaret lighters, a filling station, modeled after a gasoline pump, has been introduced. Maintained in some convenient shop, it is a time and trouble saver and makes it unnecessary for individual users to purchase supplies of lighting liquid, which is likely to be wasted by evaporation or by getting spilled.

FOLDING LEGS ON GOLF BAG SERVE AS CADDY



Golfers who do not wish to hire a caddy have a convenient bag at their disposal in a unit equipped with folding legs that hold the bag erect when wanted and then shut up close to the sides so as not to interfere with walking or carrying. The feet are controlled by a push rod and do not damage the greens in any way.

¶T-shaped metal hangars for the private plane owner have been introduced.

SOUND-ABSORBING MULTIPLE WALLS TO IMPROVE RADIO

Walls of several layers instead of one, are playing an important part in improving radio reception and in reducing unpleasant echoes in auditoriums. Engineers, working on the problem of better acoustics, have found that a single perforated partition, set a short distance from the main wall, greatly improves the acoustics of a broadcasting studio, and that three layers of glass of different thicknesses are also effective. Each piece has its natural frequency and sounds of a similar pitch would be transmitted. Sounds that get through the first layer are stopped by the second, while any that leaked through the latter would be stopped by the third. Sounds of high pitch are largely absorbed by layers of felt, porous tile or wood fiber mixed with felt. If the wall is covered with felt and then, an inch away, a piece of perforated building board is placed, the low-frequency sounds are much more completely absorbed. Still better is the effect of two layers of building board, with two air spaces.

ANGULAR CAR-STEERING WHEEL RELIEVES FATIGUE

As a substitute for the usual round automobile steering wheel, an angular one has been introduced to spare the driver the fatigue that results from grasping a curved wheel and to make it easier to guide the car. The chief advantage of the new shape is that it permits the hands to assume a more natural position, there is less necessity to grasp the rail tightly, thus decreasing the strain on the wrist and fingers, and the angles enable the operator to push and pull on the wheel so that but little effort is required to turn it. An additional feature is that the circumference of the wheel may be enlarged without cramping the driver, as the half toward the seat may be removed and replaced with a slightly curved bar of wood, which allows the driver abundant room and easier entrance and exit.

Movie Trucks in Europe Display Films to Street Crowds through Screens in the Truck Bodies

MOVIE THEATERS ON WHEELS REACH STREET CROWDS

The influence of the motion picture has been extended in Germany and Austria by means of automobile theaters, displaying the films on the side of the truck from projection machines within. The cars visit various towns and cities and show the pictures to crowds that gather. When bad weather prevents the open-air display, the machines are taken to a store or other convenient interior. The autos are also equipped with loud speakers.

BETTER AND CHEAPER LIGHTS SHOW ELECTRIC PROGRESS

Today we are receiving thirty times as much artificial light for the same amount of money as we did 100 years ago, illumination experts estimate. Authorities say, that, for the last century, the average home has spent approximately $24 per year for lighting. On this basis, the sperm and tallow-candle user enjoyed some 10,000 candlepower-hours, kerosene and illuminating gas yielded 15,000 candlepower-hours, and improvements in these systems afforded 60,000 candlepower-hours. But the latest electric lights give 300,000 candlepower-hours for the same amount of money. The price of a postage stamp a day pays the difference between good and poor lighting in the average home.

RUBBER BOOTS FOR DOG KEEP MUD OUT OF HOUSE

Rubber galoshes have been introduced for dogs, to keep their feet warm and dry and also to prevent tracking mud into the house Here is "Peter Pan," pet of Ted Clark, President Coolidge's secretary, stepping along in his rubber boots.

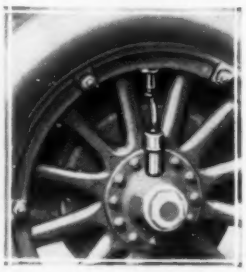
Rubbers for the Dog's Feet Solve the Problem of Mud Tracked onto the Carpets

GORILLA-MAN ADDS TOUCH OF REALISM TO MOVIES

Realistic Movie-Gorilla Costume, with Mechanism in the Head and Limbs to Reproduce the Actual Movements of the Beast; Faking Wild Animals Is Becoming a Film Art

The costume is usually incidental to the actor, but in the case of a gorilla disguise, used by Freddie Humes, a motion-picture performer, the big mask is almost as important as the operator himself. Inside the huge costume, Humes is able to reproduce the movements of a real gorilla with remarkable realism, due to the special mechanisms by which the disguise is operated and controlled. One of the most important parts of it is, of course, the horrible head with its large teeth and lips and fierce eyes.

TIRES PUMPED AS AUTO RUNS KEPT AT RIGHT PRESSURE



Stopping the car to inflate the tires is no longer necessary with an automatic pumping unit installed on the hub. As the wheel turns, air is forced into the tire and when the correct pressure is reached, the air is sent out through another valve so that the tire cannot be overinflated. When the pressure falls below the correct point, a valve opens and the air again flows into the tire. This attachment insures against unnecessary wear on the tires by keeping them at the proper pressure at all times, and, in case of a slow puncture, the pump will often keep sufficient air in to permit running to a service station, or to the destination, before repairs need be made. The unit can be set to give just the pressure required for all the tires, is not difficult to install, and tests have shown that it operates successfully for long periods without attention.

CARNATION THAT CHANGES HUE GAINS BEAUTY IN FADING

Instead of becoming less attractive as it withers, a carnation, produced in England, assumes a delicate gray color, more beautiful than its shade when fresh, according to reports. It is a medium-size blossom with heliotrope stripes.

RADIO WAVES RELIEVE CANCER IN MICE AND CHICKENS

By the use of high-frequency electricity, close in wavelengths to the short waves employed in radio communication, the public-health service has obtained interesting results in the treatment of cancer in mice and chickens. The animals, afflicted with tumors artificially acquired in the laboratory, were improved by being subjected to exposures of oscillating electricity produced by vacuum tubes similar to those in radio sets. The frequencies ranged from 8,300 to 135,000 kilocycles per second, or wavelengths below about forty meters. The most effective frequencies were found to be about midway between the extremes used. Some of the mice suffered a shriveling of the ears and tail, due to the current, but many were perfectly normal after the process that had a helpful effect on their cancers. Workers conducting the tests make it clear that the method is still in its early experimental stages, and that such treatment of human beings is probably far in the future. The dosages of electricity were much greater than could possibly be received from radio broadcasting, hence radio, as now known, will not aid in the treatment of cancer.

KNIFE AND MEAT SAW IN ONE LATEST KITCHEN AID

Two useful implements are combined in one in a meat knife with a saw on the upper edge. It is especially adapted for camping use as well as for the kitchen. Saw blades are easily renewed when necessary and can be tightened with a screw adjustment.

¶The Popular Mechanics Bureau of Information offers its free service to all readers of this magazine. Names and addresses of manufacturers and dealers in articles described, and any other details in our possession, will be promptly furnished.

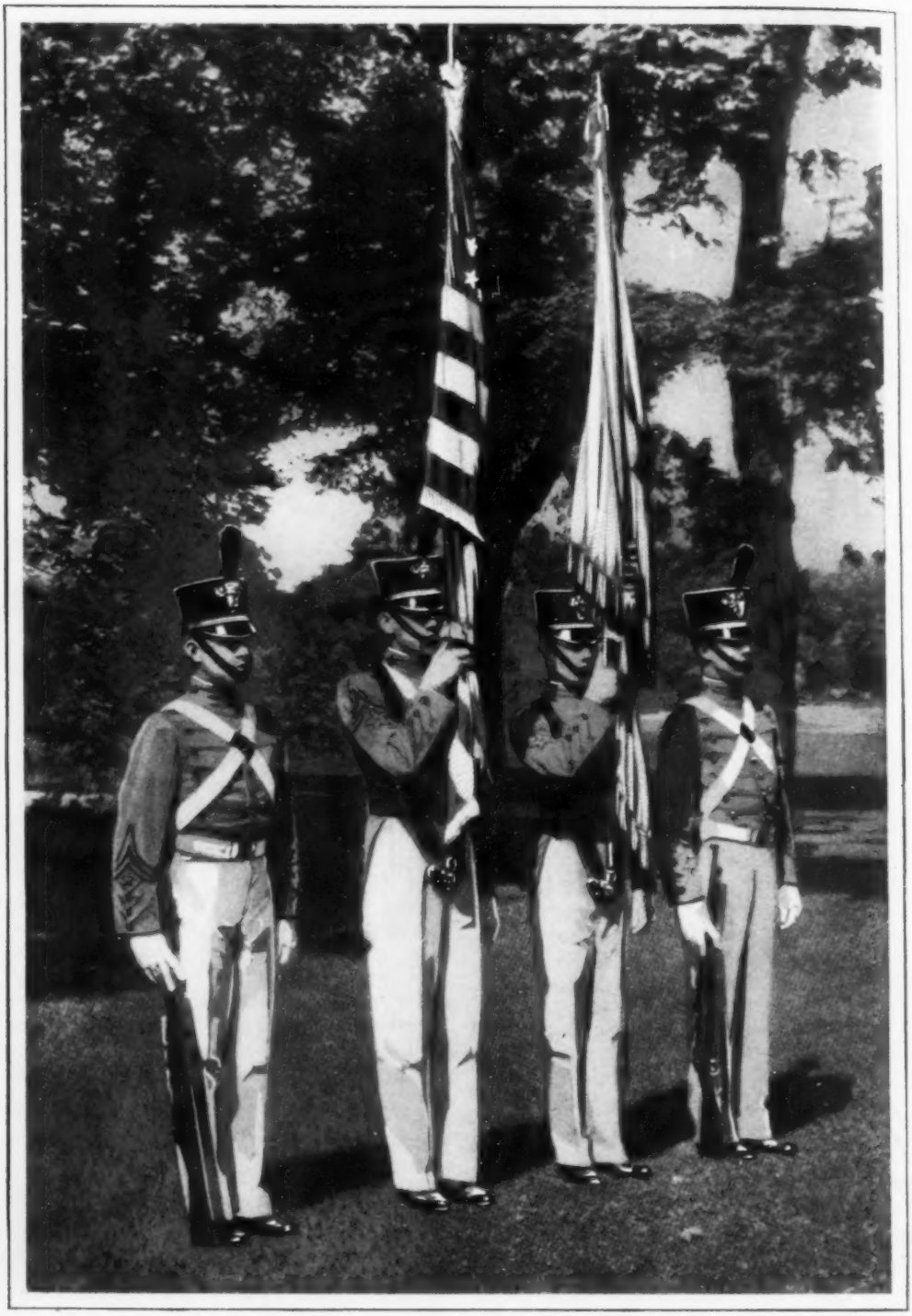
Directing Tourists to the Big Lumber Mills in Marshfield, Oreg.; the Wooden Traffic Guide That Advertises Town's Industry

WOODEN MAN AS GUIDE POST ADVERTISES INDUSTRY

Lumbering is one of the chief industries in Marshfield, Oreg., and travelers are apprised of the fact by a huge wooden man pointing to the mills. The figure is as high as a house, and is constructed of boards manufactured in the town.

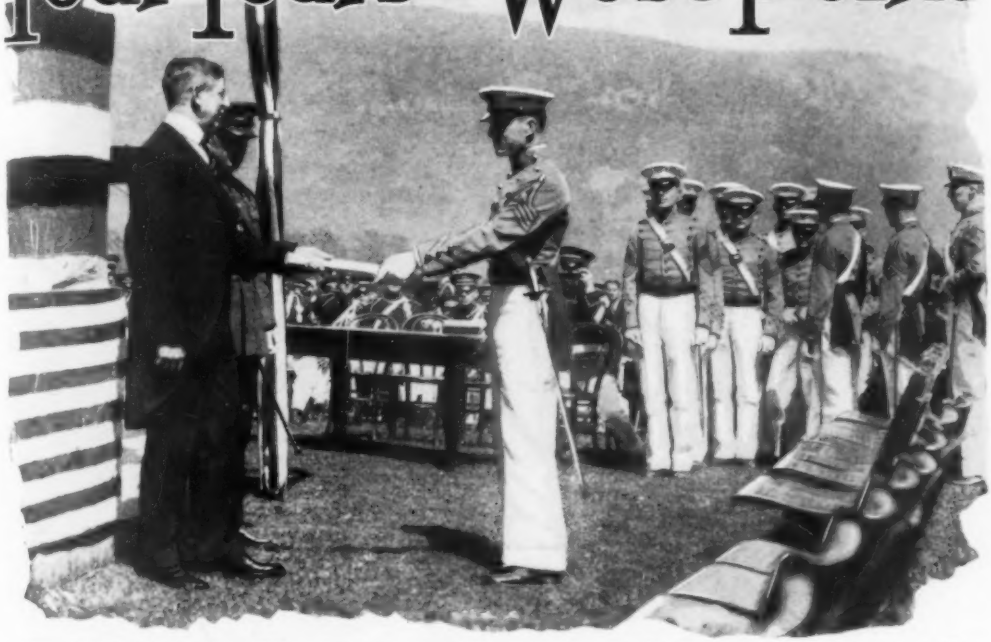
AIR-INFLATED AUTO BUMPER TO DECREASE DAMAGE

To minimize the likelihood of damage to either auto in case of a head-on or rear-end collision, a western man has devised an air-inflated bumper to be used in place of the ordinary steel units. It is simply a section of heavy hose, six or eight inches in diameter, vulcanized at each end and holding about forty pounds' air pressure. A valve of the kind used on tires is provided for inflating the bumper.



The Color Guard at West Point, with the American and Military-Academy Flags; the Dress Uniforms, with Their Crossed Belts and Gray Coats, Have Come Down from Washington's Army

Four Years at West Point



The Cadet's Biggest Day, When the Secretary of War (in This Case Dwight F. Davis) Hands Him a Diploma and He Is Ready to Go Out in Life as a Second Lieutenant

II—The Last Two Years

BACK from his first vacation—more than two months having been spent at home—the future army officer enters his third year as a second-class man, for classes at the military academy, as at Annapolis, grade down from the top. Regulations are a bit less strenuous, week-end leaves are obtainable, and Saturday night hops are the rage.

There is no relaxation, though, in either work or discipline, but some promotions are available. When he sews on his two stripes of gold lace as a second-class man, and his two of black braid as class emblems, he becomes eligible to selection as a sergeant. If he wins one of the places, he takes his position in the three battalions of four companies each which constitute the famous cadet corps.

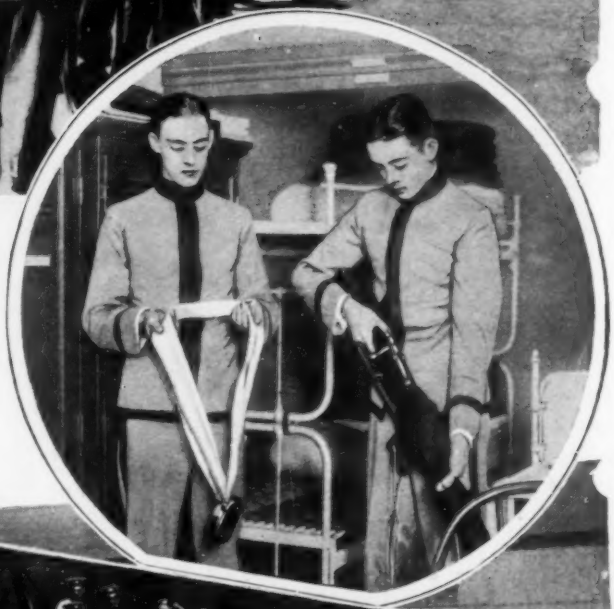
Another year, and another stripe of gold and stripe of black on his sleeve, and he is a senior. Work and play remain the same, with the added duties of the rank of captain, lieutenant or first sergeant of the corps. In turn the senior becomes officer of the day, and special attention is devoted to developing the qualities of leadership.

With the coming of spring there is one important relaxation in discipline. Instead of being put to bed at taps, he is allowed to sit up until midnight pouring over his books for the final examinations.

Physical examinations are given before he enters, and each year during the course, but with the approach of June week the seniors get one final physical test to determine their fitness to become officers.

June week is the grand climax of the four-year grind. Every night there is a hop, friends and relatives and sweethearts crowd the hotels of the near-by village. There are no more guard tours, but a final graduation parade the day before commencement.

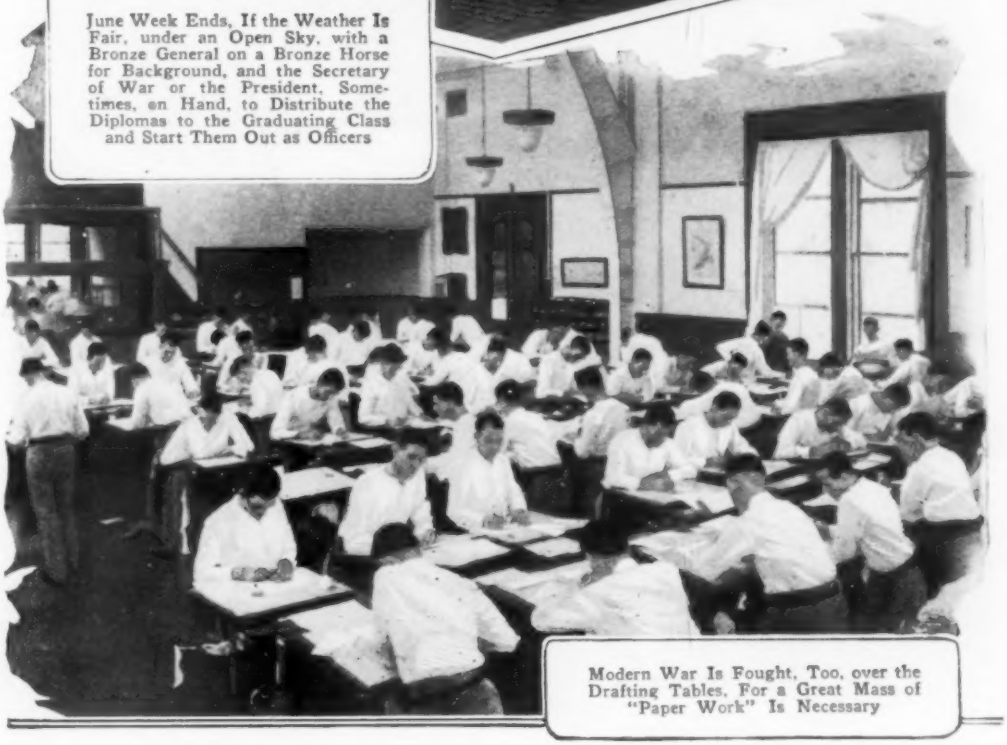
The next day graduation exercises at Battle Monument, a diploma, and a full-fledged second lieutenant, U. S. A., has been made.



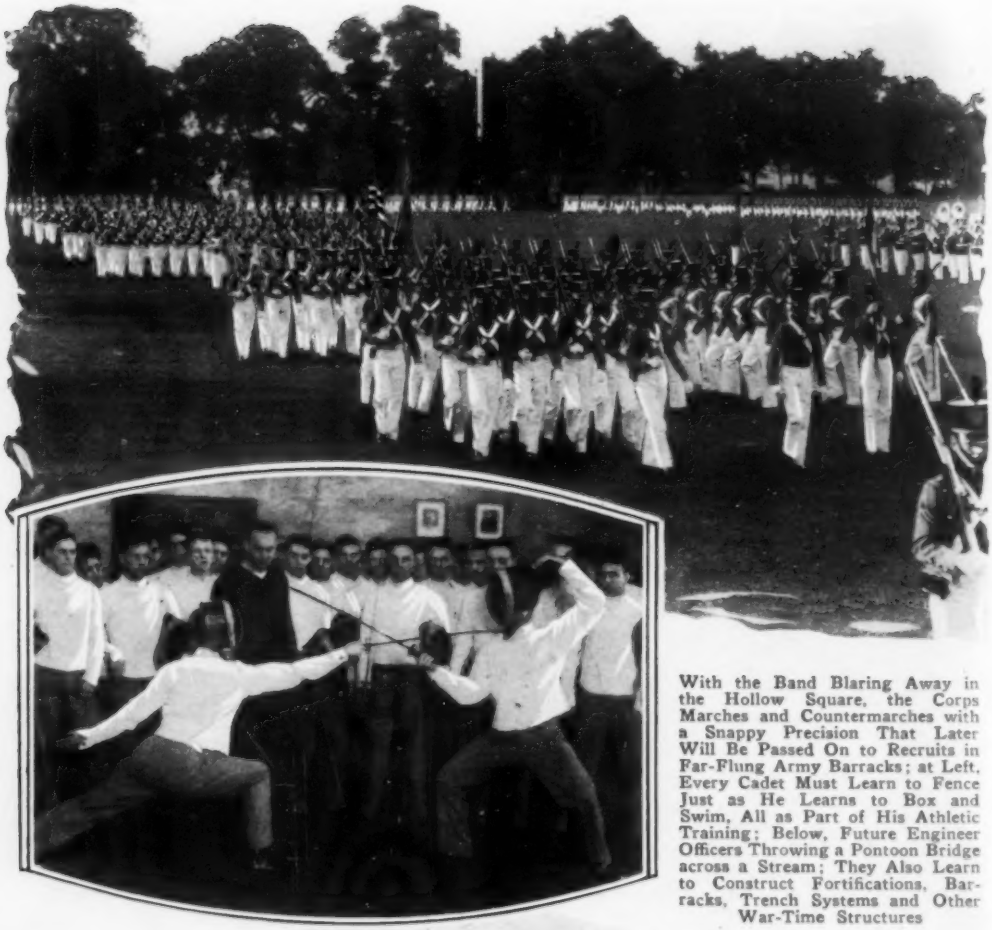
Future Generals in the Rough Being Taught to Stand Erect with Heads Up and Shoulders Back; Upper-Class Men Take the Plebes in Hand Even Before Their Uniforms Have Been Issued and Try to Instill the Rudiments of That Smartness That Has Made the Corps Famous throughout the Land; at Right, Assembling and Inspecting Equipment Preparatory to Departure for New York for the Parade That Preceded the Annual Army-Navy Football Game, Before Differences over Eligibility Arose

Getting Acquainted with an Army Bomber; a Group of Cadets Take an Air Lesson at Mitchell Field

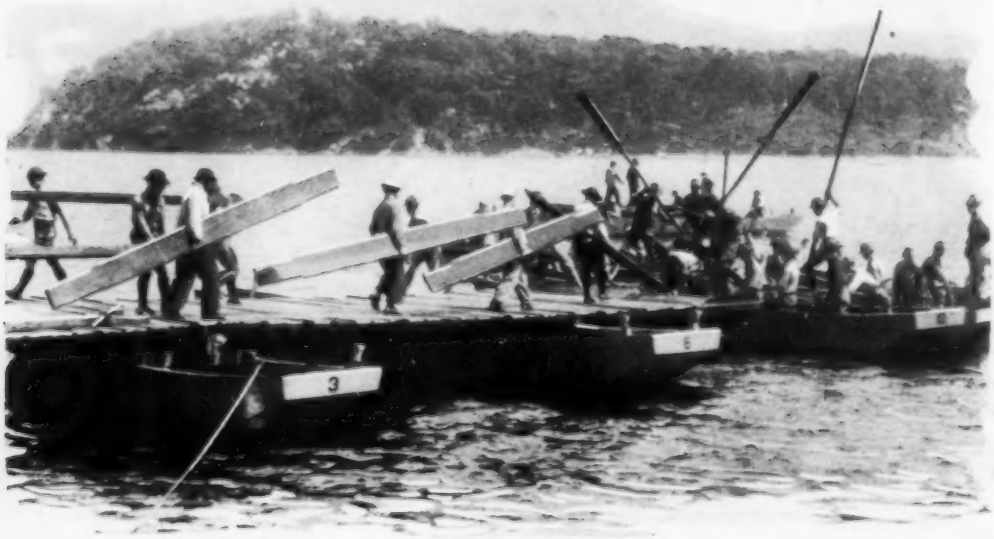
June Week Ends, If the Weather Is Fair, under an Open Sky, with a Bronze General on a Bronze Horse for Background, and the Secretary of War or the President, Sometimes, on Hand, to Distribute the Diplomas to the Graduating Class and Start Them Out as Officers

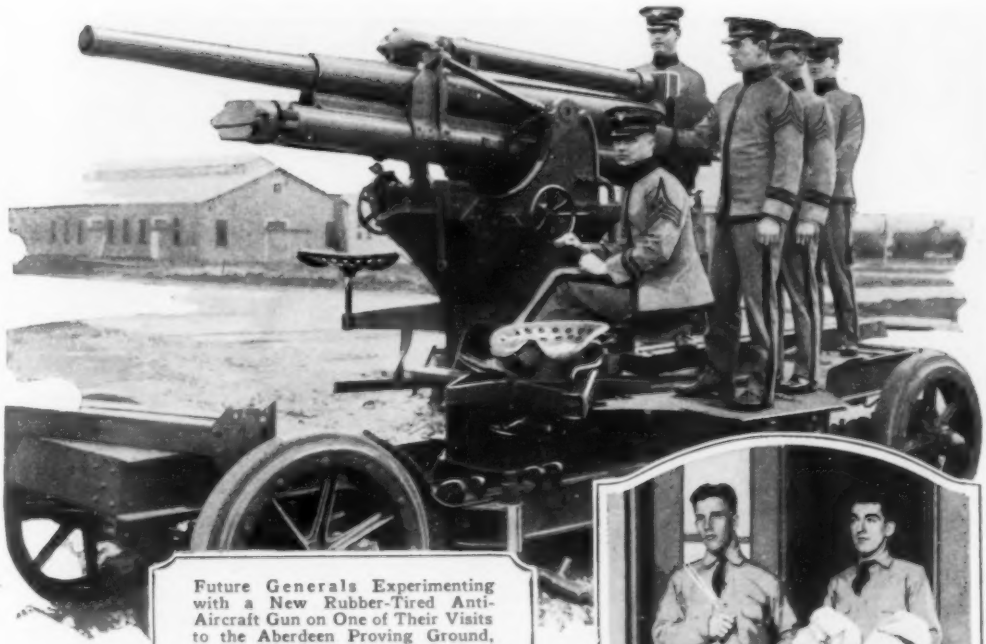


Modern War Is Fought, Too, over the Drafting Tables, For a Great Mass of "Paper Work" Is Necessary



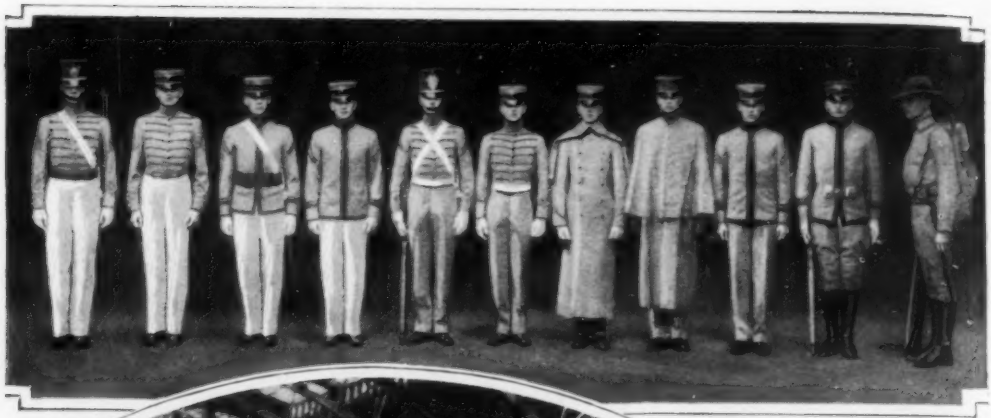
With the Band Blaring Away in the Hollow Square, the Corps Marches and Countermarches with a Snappy Precision That Later Will Be Passed On to Recruits in Far-Flung Army Barracks; at Left, Every Cadet Must Learn to Fence Just as He Learns to Box and Swim, All as Part of His Athletic Training; Below, Future Engineer Officers Throwing a Pontoon Bridge across a Stream; They Also Learn to Construct Fortifications, Barracks, Trench Systems and Other War-Time Structures





Future Generals Experimenting with a New Rubber-Tired Anti-Aircraft Gun on One of Their Visits to the Aberdeen Proving Ground, Where They Get a Chance to Watch the Weapons of the Future Being Tested; at Right, Plebes Delivering Laundry to Upper Classes

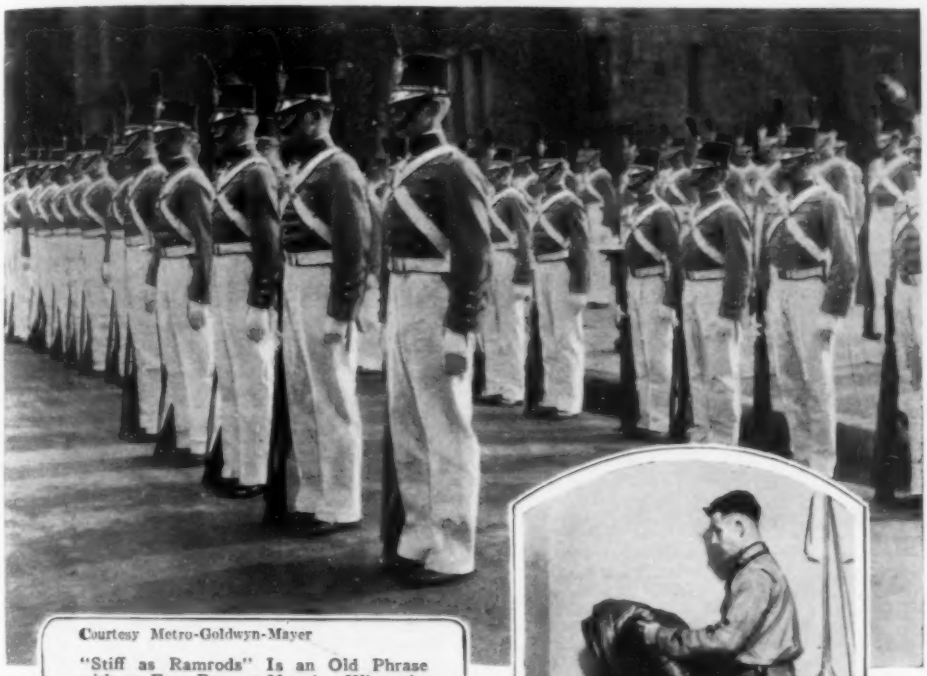
A Trio of Hurdlers at Track Practice; the Army, Like the Navy, Believes in Every Man Having a Part in Athletics; There Are No Confirmed Side-Line Cheerers in Either School



What the Well-Dressed Cadet May Wear for Various Occasions; It Takes Eleven Different Outfits, as Shown Above, to Equip Him for His Various Duties, and to These May Be Added the Ever-Useful Dungarees for Such Special Occasions as Riding inside an Oil-Spattered Battle Tank or Tinkering with the "In'ards" of a Refractory Motor Truck; at Left, the Enormous Riding Hall Provides Space to Teach Every Cadet to Be a Finished Horseman. For an Officer Must Ride and Stay on His Horse over Any Kind of Ground

Courtesy Pathe-De Mille

A Battery of Fieldpieces Barking on the Heights above the Hudson, Where Ruder Cannon Held the Hills in Revolutionary Days



Courtesy Metro-Goldwyn-Mayer

"Stiff as Ramrods" Is an Old Phrase with an Ever-Present Meaning When the Corps, in Dress-Parade Uniforms, Lines Up on the Drill Field for Inspection; Right, There Is No Maid Service

It Takes a Couple of Squads at the Long Ramrod to Push Home the Giant Shell of One of the Big Coast-Defense Guns

War Has Become So Scientific a Subject That the Cadet Who Cannot Master Higher Mathematics Soon Disappears from West Point; Above Is a Section of the First Class Watching a Bit of Blackboard Work; at Right, Daily Inspection of Quarters, When Every Article Must Not Only Be in Its Place, but the Whole Effect Must Be One of Scrupulous Neatness

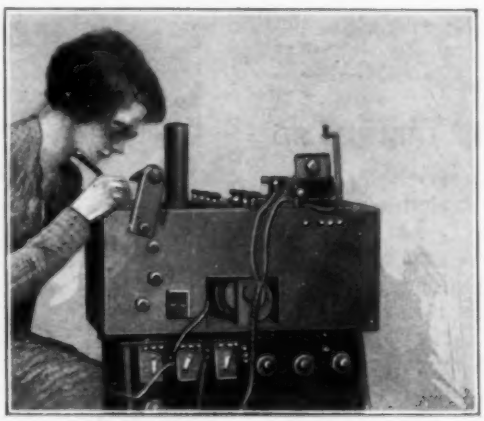
There Are Enlisted Men at West Point, and among Their Duties Is That of Getting the Future Officers Out of Bed; the Reveille Crew Is Appropriately Named the "Hell Cats"

INCREASE SPAN OF HUMAN LIFE THIRTY-EIGHT YEARS

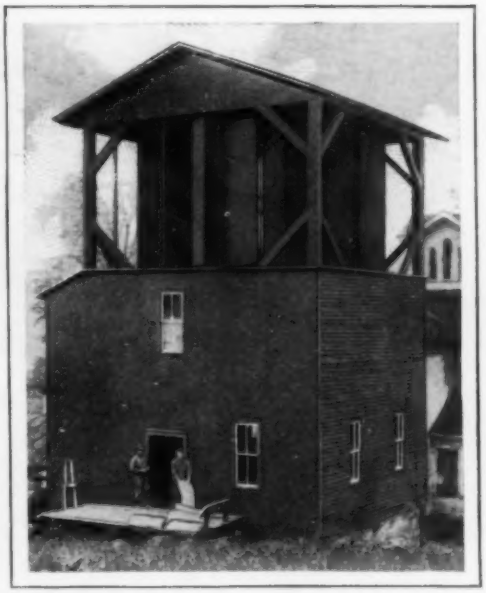
Since the sixteenth century, the average span of human life has been increased from twenty-one to fifty-nine years, according to data presented by the Pennsylvania department of health. Better living conditions, more effective ways of combating and controlling disease and more extensive health education are the chief factors responsible for this lengthening of life. Research has shown that during the period from 1501 to 1600, the average life span in Geneva was twenty-one years. This is compared with the present average span of fifty-nine years, prevailing in the state of Wisconsin, and accepted as a criterion for the world as a whole. Authorities believe that the span of life will go on increasing as science continues to solve the problems of disease.

STUDY EMOTIONS OF CHILDREN WITH ELECTRIC REGISTER

As an aid to persons entrusted with the instruction of young children, an electrical instrument introduced by a professor at the University of California, "takes pictures" of the emotional response of the youthful subjects to various stimuli, such as fear, joy, etc. The apparatus operates on somewhat the same principle as the "lie detectors" which have been employed by police departments. Connections are made to the child by small wires leading to silver plates in the sole and in the ankle of the shoes. A sudden disturbance of the child's mind may cause an increase or decrease in skin moisture, with a consequent variation of the electrical conductivity of the subject. This change is noted on a strip of paper. With the help of the register, the professor believes, harmful tendencies in the child may be recognized and counteracted during its education.



Electric Register That Gives an Index of a Child's Response to Various Emotional Stimuli



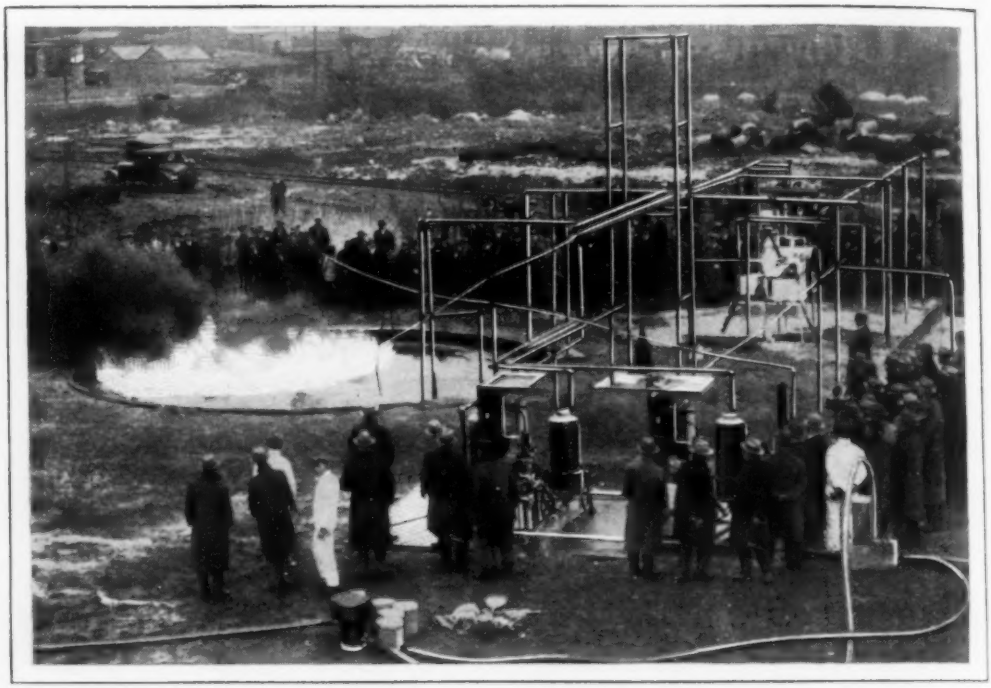
Where Shutters Replace the Customary Wheel; Odd Windmill on New York Farm, in Use Forty Years

WINDMILL RUN BY SHUTTERS GIVES LONG SERVICE

Housed inside a cupola and regulated by means of shutters that open and close, a windmill on a New York farm has been in use for more than forty years. The wheel can be shielded from the wind when the operators desire to shut it off, by closing the shutters.

RADIO "DETECTIVE" ON METER TRAPS CURRENT THIEVES

Radio is employed in catching electric-current thieves in a southern city. A miniature broadcasting unit is concealed within the meter and, in case of tampering, it sends out a continuous wave that may be detected by special receivers. It also registers an indication of the theft for the meter readers.



Foam-Dispensing Apparatus in Foreground; the Preparation Is Being Applied to a Pool of Blazing Oil during a Test; the Flames Were Smothered in a Few Seconds

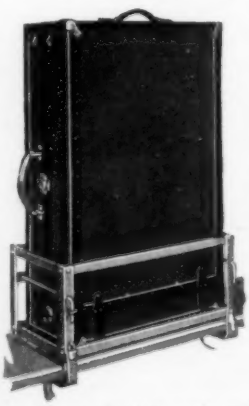
FOAM BLANKET SMOTHERS FIRE IN OIL STORAGE TANK

An effective method of extinguishing fires in oil tanks and similar places, has been developed by spreading a blanket of a foam preparation over the blaze, cutting off the supply of oxygen. The foam is made by a special powder, mixed with water, the substance being directed over the burning material through pipes. It is quickly administered and has the additional advantage of preventing the spread of the blazing liquid.

SNAKE MYTHS ARE DISPROVED

Snakes that roll themselves up like hoops and pursue their victims with the speed of race horses, do not exist, but are simply one of the myths that have grown up about the reptile world, scientists declare. "Stinger" snakes that spear their prey and cow-sucking snakes are likewise creatures of fables, the bureau of biological survey reports, and it also has been proved, by repeated tests, that a rope laid on the ground will not keep snakes from crawling over and reaching a person sleeping on the ground within the barrier. The use of plants, like mountain ash, snake gourd and horseshoe geranium, does not repel snakes. It has also been found that the reptiles are immune to several of the poisonous gases.

CARRIER LOCKS AUTO LUGGAGE AND FITS ANY CAR



Adjusted to the running board of any automobile, a luggage carrier is fitted with a means for quickly locking a trunk or case to its frame, so that the article cannot jar out or be stolen. The rack is held to the running board with clamps and the locking unit is cushioned with soft rubber so that no damage is done to the car or to the trunk.

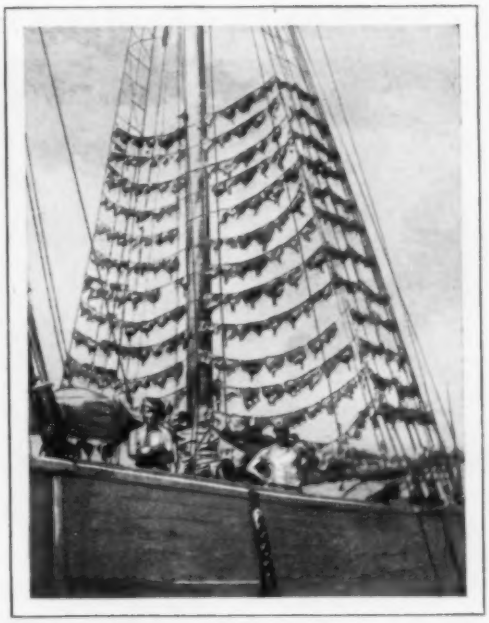
TWO-COLOR GLASS GOGGLES HELP IN FACING LIGHTS

Special dark glasses have been introduced for the help of sportsmen, auto drivers and others who must often face glare and strong light. They are composed of two wedge-shaped pieces of glass fused together, the upper part being of a dark gray-brown color and the other clear. When encountering a glare, the wearer simply lowers his head and looks through the top of the goggles until the offending light has passed, when he raises his head and enjoys clear vision through the uncolored portion of the lenses.

TRACK MOWER CLEARS WEEDS FROM RAILROAD LINE

A motor-driven machine to keep the weeds and grass cut alongside the railroad track has been developed by a Minnesota company. The mowing equipment is driven by a five-horsepower gasoline engine, and the machine is towed by any small gasoline-driven handcar. The cutting bars are carried on two I-bars, which can be adjusted for close or distant cutting. When the bars are fully extended, with the cutters run out to their ends, the knives will reach thirteen feet from either side of the tracks, and they can be raised or lowered to fit any contour of the banks. The knives cut five and a half foot swaths at each passage, and in heavy weeds, the outfit can make four miles an hour, cutting close to the track, or three miles an hour fully extended. Three men are required, two to operate the mower and one to pilot the towing handcar.

Keeping the Weeds in Check along the Railroad Right of Way; the Knives Reach Thirteen Feet on Either Side of the Track



Ship's Rigging Put to Novel Use; Drying Fish at Sea Helps Protect It from Dirt

FISH DRIED ON SHIP'S RIGGING TO SAVE EXTRA HANDLING

Curious use is made of the rigging of a fishing schooner, putting out from Havana, Cuba. Instead of taking the catch ashore for drying, the fish are hung on the lines of the rig where they are safe, comparatively free from dirt and exposed to the sun at all times of the day.

LAMP-POSTS BROKEN BY AUTOS COST CITY THOUSANDS

To replace lamp-posts broken by careless automobile drivers, costs New York city more than $17,000 a year, according to official reports. Last year, 345 posts were ruined or damaged in Manhattan, 134 in Brooklyn and fifty-four in the Bronx. The costs are generally collected from the offender or, in case of a fatality, from his estate, when the cause of the accident is found to be bad driving for which the killed operator is to blame.

PERMANENT RESIDENTS OF THE NATIONAL PARKS

The Little Daughter of the Superintendent of Yellowstone with Two of Her Playmates; the Fawns of the Park, like Their Elders, Can Be Fed from the Hand

Four Generations of Mountain Rams Sunning in the Snow Fields of Yellowstone Park

Week-Old Buffalo Calf, and an Antelope Kid Being Introduced to the Feeding Bottle by Chief Ranger Sam T. Woodring. Left; Below, a Stag Pauses on the Alert

Children of the Yosemite Valley Grow Up with Deer for Pets

Center Photos, Courtesy Nat'l Park Service; Left Bottom Photo by J. V. Lloyd

GETTING READY TO ENTERTAIN SUMMER TOURISTS

Above and at the Right Are Some of the Friendly Bears of Crater Lake Park, Where Mama Bears Solve the Food Problem by Taking the Children to the Cook to Be Boarded

The Holdup Bears of Yosemite and the Yellowstone Haunt the Roads and Stop Tourists in Search of Candy and Other Delicacies to Which Civilization Has Introduced Them

This Yosemite Bear Showed Dislike for Jazz, but Waved His Head Solemnly from Side to Side When Operatic Selections Were Received

Top and Right Center Photos © Fred H. Kiser; Bottom Photo by J. V. Lloyd

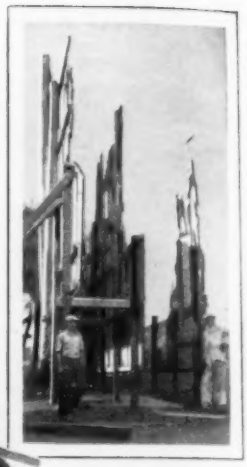
BILLBOARDS LIKE STAGE SETS GIVE BETTER DISPLAY

Billboards constructed after the manner of stage scenery have been introduced, the arrangement giving a better perspective, regardless of the angle from which the board is seen, although the front view is intended to be the best. The first boards of this type were made in three units, but larger numbers are possible, a chief advantage being that the display gives the impression of depth by this means. The plan also permits unusual lighting effects, and changes can be made in one of the sets without affecting the others.

Three-Section Sign That Gives Realistic Perspective; Arrangement of the Units Is Seen at Upper Right

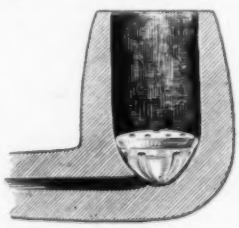
MAKE STEEL AT COST OF IRON BY NEW PROCESS

Development of a process for the manufacture of steel without the necessity of coking coal, and at a cost not in excess of that required for the manufacture of pig iron, has been announced by the American Research corporation. Energy hitherto wasted in the blast furnaces and various chemical interactions are harnessed to supply the necessary heat, and other conditions, for the making of steel. The iron ore is first converted into "sponge." This is chemically treated, put into a special retort, then melted and finally alloyed to produce the steel desired. The process can be executed in single production units, permitting a great saving in fuel, according to officials of the corporation.



CONE IN BOTTOM OF PIPE BOWL INSURES COOL SMOKE

Inserted at the bottom of the tobacco-pipe bowl, a perforated aluminum cone is said to keep the filling dry down to the last crumb, so that the smoke is cool, free from strong juices and more fragrant. The cone does not interfere with the draft, effects economy and makes the pipe easier to clean.

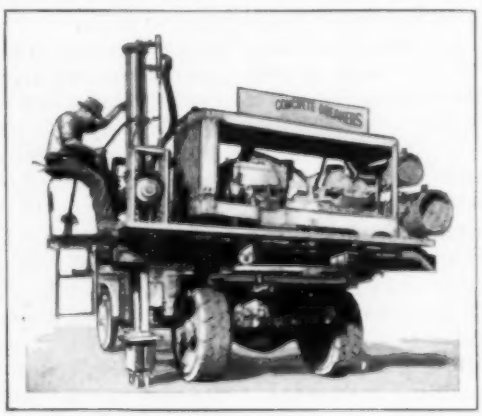


SCIENTISTS STUDY "AIR BUMPS" TO AID AVIATORS

"Air bumps," which often play tricks on flying craft, are receiving careful study at the hands of weather-bureau experts. Ordinarily, the bumps are localized, and a seasoned pilot flies through them without difficulty. Not long ago, however, the air-mail service between Cleveland and New York, in both directions, was interrupted by forced landings, necessitated by the extreme roughness of the air. Two pilots had to battle for their lives. Pilot Smith's altimeter recorded tremendous fluctuations in altitude through the shifting of powerful air currents. He would have been thrown from the cockpit but for the straps that held him in. Experts ascribe bumpiness of this nature to two causes. One is the contrasting temperatures at different altitudes when the air is heavily loaded with moisture. The condensation and convection thus brought about, create sudden changes in the warmth or coolness of the air and establish vertical air currents which result in bumpiness. A contributory cause is the similar effect of mountain ridges.

TURNTABLE PAVING BREAKER SPEEDS STREET WORK

Ditches six inches to ten feet wide can be cut with the aid of a turntable pavement breaker which has been devised to expedite and simplify street work of various kinds. Only two men are required to operate it and the breaker may be run on the street while hammering up the sidewalks, a valuable feature, as in many cities the roadways are being widened by slicing off the walks. The adjustments for the turntable are so exact that the swing of the hammer to one side or another may be regulated within a fraction of an inch.



Concrete Breaker That Turns on a Table for Reaching a Wide Radius on Street Jobs

Handy Cabinet for Ties, Collars and Studs Is Built into the Wall to Save Space

BUILT-IN TIE AND COLLAR RACK LATEST SPACE SAVER

One of the latest developments in avoiding waste space in apartments is a built-in cabinet for collars and ties. It contains racks for keeping the articles in a neat and orderly manner, there is a drawer for collar buttons and on the door of the case is a small mirror.

SAFETY-BUTTON ELECTRIC IRON REDUCES FIRE PERIL

To decrease the likelihood of fires from electric irons, a button control has been added to an iron of recent manufacture. As long as the button is depressed, the current remains on, but it is shut off as soon as the thumb releases the button. The arrangement does not interfere in any way with the normal operation of the iron.

Beware

Rubber Bathing Caps, Extended to Cover the Face, Offer One Solution to the Problem of Too Much Sunlight

By CRAG DALE

SUNSHINE is life, but it also leads to harmful physical effects, despite all that has been said and written about its great curative properties.

On golf course, swimming beach, tennis court and baseball lot, every year much harm is done to lovers of outdoor sports through sunburn, and in many instances the injury is greater in its ultimate effects than is the increased muscular power that is gained by the exercise.

Beware of sunburn!

Naturally anyone who ever has been badly sunburned realizes the inconvenient pain that follows, but, until very recently, it was not definitely known that the burn seriously impaired any organs of the body. Sunburn was taken as a matter of course, a necessary part of the tanning process that was bound to result from continued exposure to outdoor sunlight. And it was generally thought that the process was beneficial. So was it once thought that the bleeding of ailing persons was always useful in overcoming any disease.

Under the direction of Dr. A. C. Carlson, of the University of Chicago, Dr. Marie Hendricks has been carrying on minute experiments with sunshine and ultra-violet rays in a successful effort to determine whether overexposures would have injurious effects. Dr. Carlson announces that in every instance where overexposures have been applied to animals that consist of only one cell, that animal died quickly. The effect simply was the destruction of the cell. These experiments led to similar investigations on animals composed of many more cells, and even with humans. And the positive results are but now being made public.

At Northwestern university similar researches are being carried on by Dr. W. T. Bovie and Dr. A. C. Ivy, one of the leading physiologists of the country. Both of them confirm Dr. Carlson's findings, and Dr. Ivy goes even a little farther with the theory that sunburn has harmful effect upon the adrenal gland, one of the most important ductless glands of the human body.

The immediate effect of sunburn on humans, explains Dr. Carlson, is the injury to the deep skin tissue.

"That injury," he said, "is nothing less than the destruction of the body cells in the area affected by the burn. Immediately following that destruction, a poison is formed in the body, with the result that the victim of the sunburn suffers great depression, both physical and mental.

"The worst kinds of overexposures are those that burn the eyes. The eyes are very susceptible to sunburn, especially if the sun is reflected from water, concrete or sand. The tissue of the outer surface of the eye is very thin and the blood lies

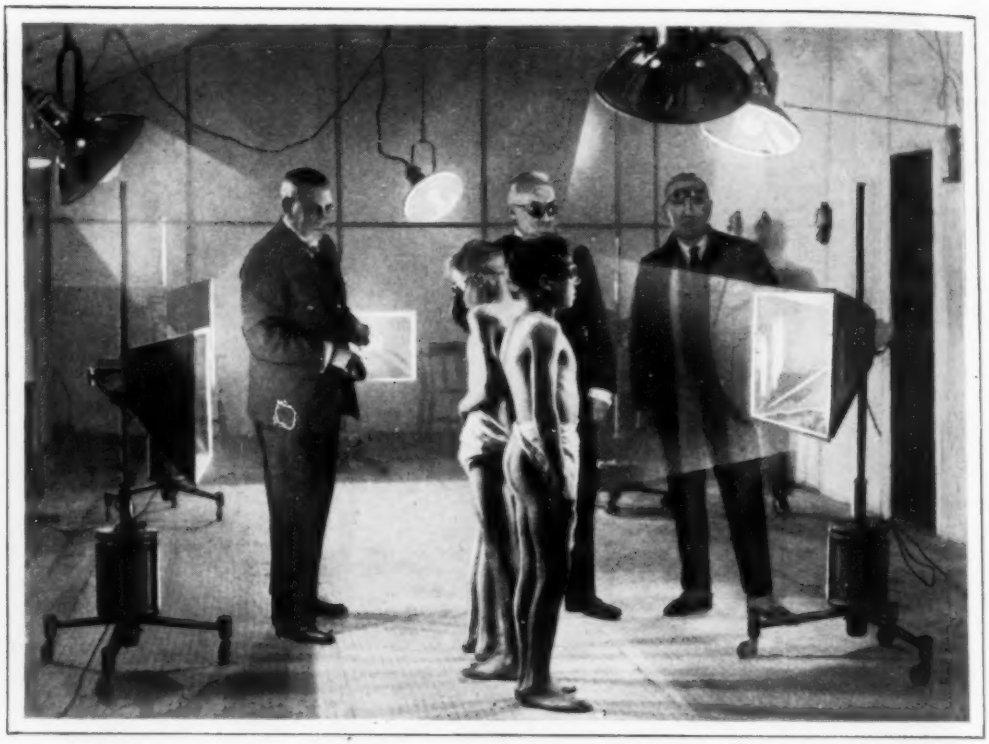
Artificial Sunlight Is Proving Beneficial in Treatment of Many Diseases, But Must Be Carefully Regulated to Avoid Harming Both the Patient and the Nurse through Burning

quite close to the surface. The ultraviolet rays easily penetrate into the blood, and when that occurs, there is a chemical change in the blood itself. We do not know the exact nature of that change, but we do know that the new or different blood compound quickly lowers the blood pressure in every case, and produces a quite undesirable shock, which, in extreme cases, might result in death."

Just how the ultraviolet light affects the blood is an unsolved puzzle, but Dr. Bovie suggests that the effect is a secondary action following the destruction of the surface tissue of the skin. Blood, he points out, is of the same ruby color as the glass used in the photographer's dark room, to shut off all but the red waves while plates are being developed. Nature apparently has provided man with a flowing sheet of liquid ruby glass to protect the interior of the body from the penetration of the more injurious light waves. But when the skin is burned, and the tissue destroyed, the blood stream must carry off the waste material, while furnishing food to build up new tissue. It is these impurities in the blood stream—some of which may be beneficial while others are decidedly harmful—that apparently do the damage.

Science has yet to find why the system may benefit through destruction of some of the surface tissue in the process of tanning. The apparent effect is to stimulate the system and tone it up so that it becomes more able to combat disease. One of Dr. Bovie's associates, suffering from periodical outbreaks of boils which resisted all efforts to suppress them, was finally cured by exposure to an ultraviolet lamp. Within a week the boils had disappeared. The only probable reason lay in some change in the blood stream which toned up his system to attack the infection.

Overexposure to one of the intense artificial ultraviolet lights, such as a mercury-vapor arc in a quartz globe, however, is a serious thing. Describing the effects,



Ultraviolet Lights, under Proper Supervision, Furnish Carefully Regulated Doses of Sunlight, but in Inexperienced Hands They Are So Dangerous Doctors Oppose Their Use

Dr. Bovie says that after such exposure he has been forced to stay in bed for several days. "I thought I would die—and kept wishing I would," he explains. Curiously enough, the sensations, even to the wish to die, were exactly the same as those experienced by an investigator in a southwestern university who a few years ago experimented with poisonous spiders to determine the effect of their bites. In each case the poisons apparently had the same physical and mental effects on the sufferers.

The manner in which the poison that is produced from sunburn is eliminated from the body is one of the reasons why it is so harmful—harmful even to the point of a pronounced anemic condition in the system of one who exercises constantly. Dr. Carlson has found that the elimination of that poison directly affects the kidneys and liver, putting an added burden on those organs and perhaps on the spleen.

Dr. Bovie thinks that too much exposure to sunshine or to violet rays in infancy, or in the early years of growth, may well be expected to dwarf an individual. In support of his belief, he cites the difference in stature between the natives of the tropics and of the temperate zones. He also points out that all known pygmies are black or bronze, indicating generations of exposure to the sun's heat and its ultraviolet rays.

"It is certain," he explains, "that exposure to sunlight increases pigmentation —tanning or coloring of the skin. It should be obvious that the greater and longer the exposure, the heavier will be the pigmentation, which is nature's armor against attacks of ultraviolet rays.

"Too much exposure certainly brings about a pronounced depression, even in people who live in the temperate zones. That depression, in all probability, has much to do with glands in the body that affect growth."

It is the naturally increased quantity of pigment, or coloring, in the skin of brunettes that makes them less easily sunburned than blonds. The pigment itself acts as an absorbent of ultraviolet rays.

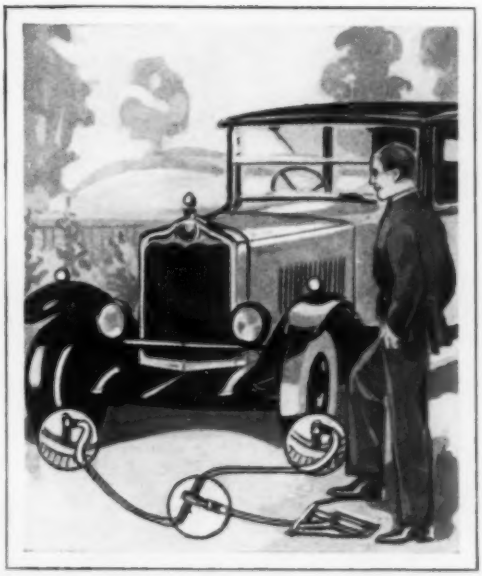
"The skin blisters," comments Dr. Carlson, "because of the heat under the outer layer. It makes the deep skin sweat or 'cry,' as it is called in the medical profession. The inability of the sweat to get through the outer skin is what causes the blister. That and nothing more. The burn will have killed the outer skin, of course, and as it is dead, it begins to be pushed away by the natural processes of skin repair. That is when the peeling begins. Part of the dead skin goes into the system as poison, and part of it vanishes into the air as scurf. The remainder is that which a victim of sunburn sees as strips of dead skin.

"As a matter of fact there is very little difference between a sunburn and any other kind of burn. Both are to be avoided.

"The man who starts out to play golf in the sun for the first time would do well not to expose his arms or his neck for more than five minutes at a time for several days," said Dr. Carlson.

"There are a few people who never tan. They are out of luck so far as being able to expose their skins is concerned, and I think it would be better for them to take their exercise in the shade unless they wear protective covering."

An Ultraviolet Lamp, Which Delivers the Healing Rays into the Mouth through a Quartz Tube



Pumping Both Tires at Once: Pressure Is Read on Gauge at Junction of Tubes

PRESSURE EQUALIZER FOR TIRES HELPS REDUCE WEAR

Automobile tires are easily inflated to exactly the same pressure with an equalizer that has been introduced in England. This insures safer and easier driving and a saving of rubber. Less time is required to inflate the tires as two can be blown up in about the same time as one. Air is supplied to two tires simultaneously, as there are valve connections to both from a main tube. Pressure may thus be quickly equalized and when the pump is used, both are inflated alike. A gauge reading is taken from a valve at the point where the tubes to each tire join. The pump is operated by a foot lever.

LINEN AND SNAKE-SKIN SHOES POPULAR AMONG WOMEN

Some 500 different kinds of materials are used in the manufacture of women's shoes, according to an official report of the industry. Linens of several varieties, satins and woven fabrics of many sorts are used, while calf, cow, goat, horse, snake, lizard and alligator skins are in great demand. In Belgium, shoes with wooden soles are still popular, although the all-wooden styles are little seen outside of Holland.

© E. L. Fowler
Twenty-Foot Bronze Clock That Is Kept Timed Electrically with Observatory Thirty-Five Miles Away

EXACT TIME ON SPLIT SECONDS TOLD BY HUGE CLOCK

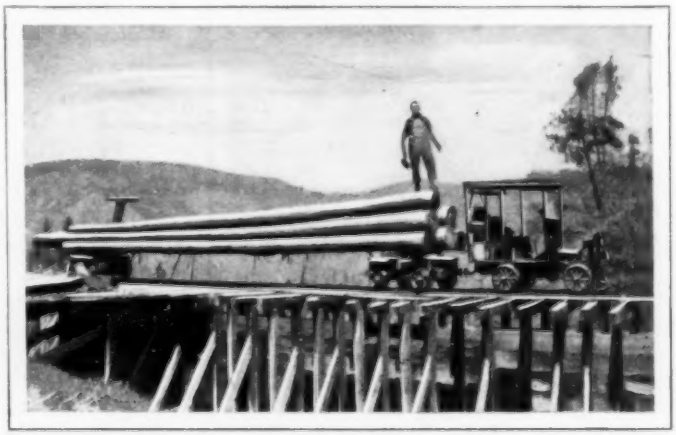
Correct time, to the fraction of a second, for every second of the day, is registered on an enormous clock installed on the outside of a Chicago office building. It is electrically connected with the observatory of the Elgin National Watch company, thirty-five miles away, where time is taken directly from the stars. The big clock thus is kept in perfect unison with the most exacting instruments known to science, and marks the longest installation of a synchronized system of this kind in the world. A special feature of the dials is that the passing of each second is accompanied by the flash of a red light. There are sixty flashes to the minute, successive lights gleaming one by one around the entire dial on each face. The quarter minutes are marked by the glow of a white light. There is thus no question as to whether the clock is running. The huge instrument is twenty feet high and is valued at $50,000. It is inclosed in a handsome case and weighs eight tons.

UNUSUAL STREET LIGHTS USED FOR COVERED SIDEWALKS

Street lamps of unusual design have been installed at Brawley, Calif. They were designed to overcome the problem created by arcades built over the sidewalks throughout the business district to protect merchandise and pedestrians from the heat and sun. Ordinary lamps would leave the sidewalks darkened at night. So, a special type of light was designed, having a post with two arms, each supporting a light. One arm extends out over the street and the other over the sidewalk.

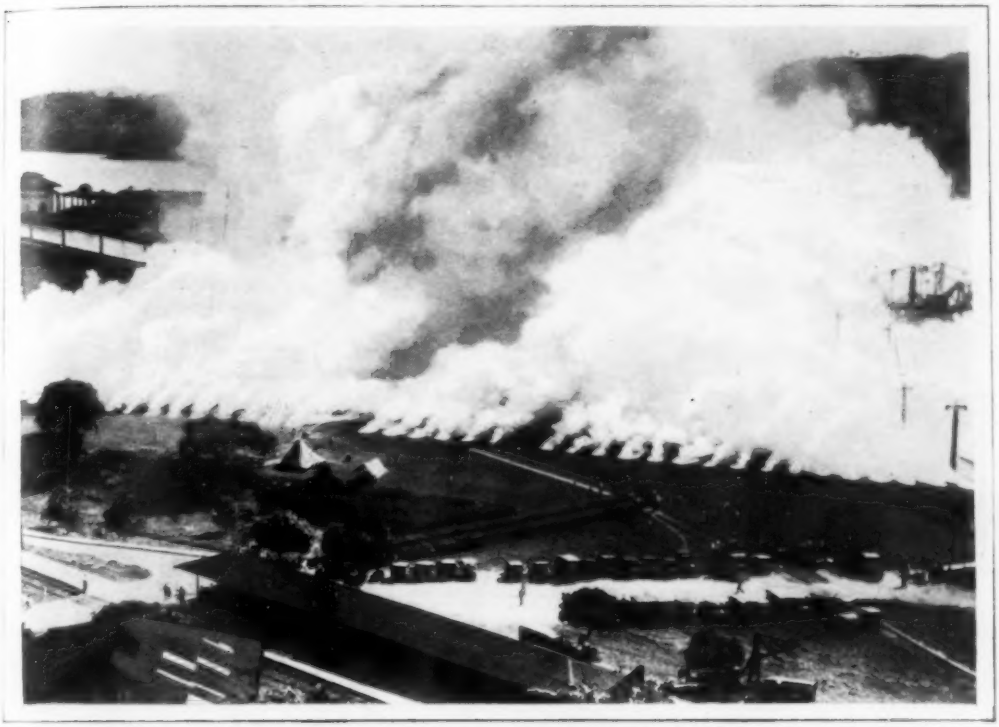
RAILWAY ON FLUME USES AUTO TO HAUL LUMBER

Double service is obtained from a flume in California that carries water to a power house and is also the "roadbed" for a railroad used for hauling lumber and an occasional passenger. The line is constructed on top of the flume and has an automobile truck for its engine. Because of the extremely sharp curves, it was necessary to limit the wheelbase of the car to forty-eight inches, and the ordinary wheels were replaced by flanged ones, set to a thirty-six-inch gauge track. The speed is limited to ten miles an hour and the line is sixteen miles long.



One of the Oddest Railroads in the World; It Is Built on Top of a Flume and the Engine Is an Old Motor Truck

SMOKE SCREEN GUARDS PANAMA FROM AIR ATTACKS



Spreading a Chemical Fog over the Panama Canal Locks; How the Smoke Screen Appears from the Air, Hiding Buildings and Land to Confuse the Flying Sharpshooters

Man-made fogs of chemical smoke have been devised to protect the locks of the Panama canal against attacks from the air. The accompanying official United States photograph shows how the chemical service laid down an almost impenetrable smoke screen during recent maneuvers, to demonstrate how a protective blanket of fumes could be drawn over the vital sections of the canal in case of an assault by enemy planes.

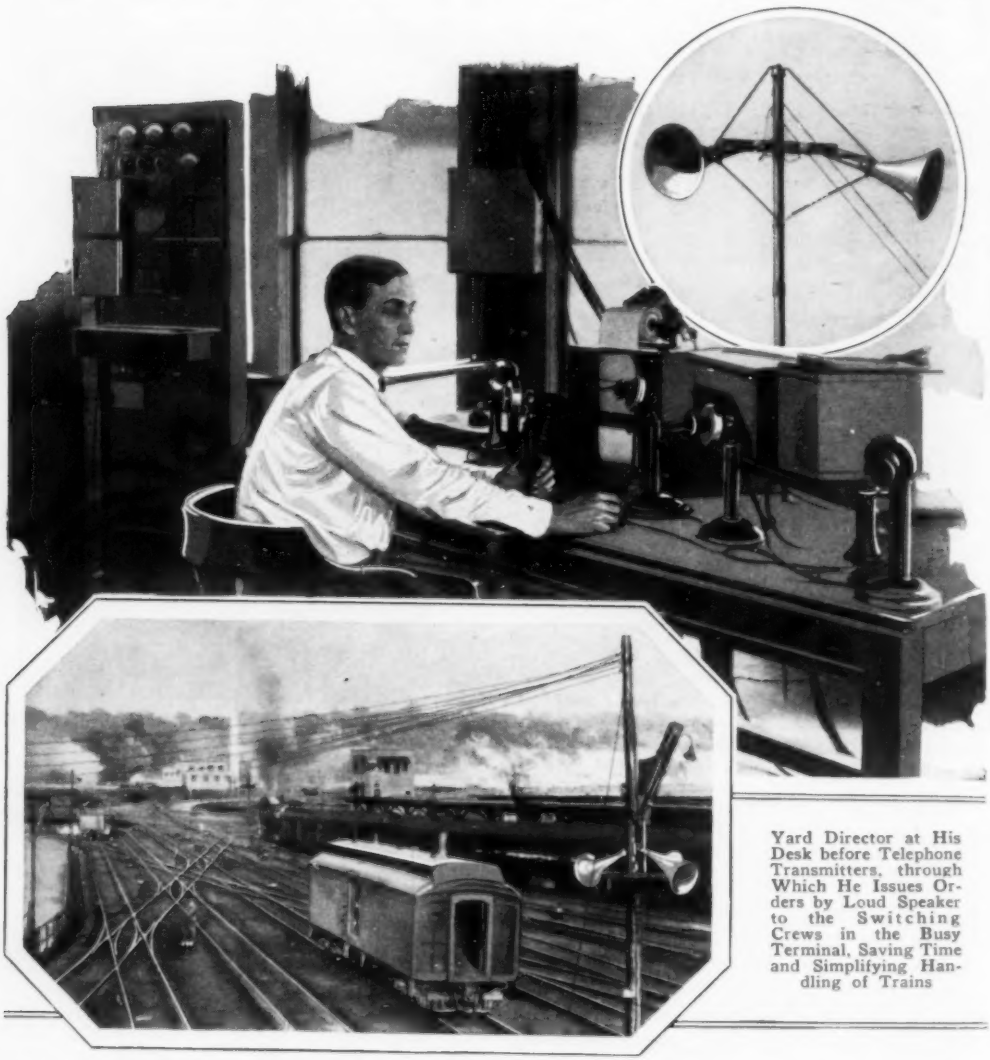
POT LETS PLANT ROOTS BREATHE AND WILL NOT BREAK

Far better development of plants is said to be attained in a special pot now on the market. Instead of clay or similar substances usually employed, it is constructed of a soil-forming material that is porous, will not break easily, and is intended to maintain the correct moisture content. The roots will not bind or mat, the danger of overwatering is eliminated, and the temperature is evenly preserved, as the pot does not radiate heat so quickly as clay, the manufacturers assert. By dipping it in various substances used to stimulate growth, the best development of the plant can be realized.

RAZOR STROPPER KILLS GERMS WITH ANTISEPTIC SOLUTION

To keep the razor strop in a sanitary condition, an antiseptic solution is applied from a little holder mounted on the housing within which the strop is wound. As the razor passes over the surface treated in this manner, it also is exposed to the germ-killing substance, to reduce the likelihood of infection.

LOUD SPEAKERS SPEED UP TRAINS IN SWITCHYARD



Yard Director at His Desk before Telephone Transmitters, through Which He Issues Orders by Loud Speaker to the Switching Crews in the Busy Terminal, Saving Time and Simplifying Handling of Trains

Train dispatchers in the union-station yards of St. Paul, Minn., have been given a mighty voice in a loud-speaker telephone installation, whereby orders can be issued from an office some distance away and distinctly heard by the switchmen where the trains are moving. Thirty-two projectors, or horns, are placed at strategic points along a "bottle-neck" stretch of track about half a mile long. The system is essentially the same as that used in amplifying public addresses and has been found of great aid in handling the more than 600 trains that pass through the busy terminal daily. Before the loud-speaker outfit was installed, the yard director had to walk to a window to give his orders.

GAUGE THAT SHOWS ALTITUDE REGISTERS SMALL CHANGES

Differences in elevation as slight as six inches are recorded on an altimeter intended especially for surveyors, aviators and others when the use of more elaborate instruments is not practical. Readings are indicated on a dial, a hand moving according to the varying air pressure.

METAL IS MADE TRANSPARENT BY ELECTROPLATING

The process by which a German scientist is able to produce various metals in sheets so thin they are transparent is one of electroplating, it has been revealed. A solvent base, such as rock salt, is used. After coating it with graphite or other conducting material, the current is applied and a thin film of metal deposited. The base is then removed by dissolving it in water. To handle such thin sheets without damage, a heavy metal ring can be placed on the base, so that it supports the plated film and keeps it taut after the base is removed.

PORTABLE OXYGEN OUTFIT AIDS TREATMENT OF DISEASE

Oxygen treatments are given with good results, it is claimed, through the use of a portable outfit which can be wheeled to the patient's bedside and accurately controlled. As the oxygen mixture passes to a hood, covering the patient's head, it is cooled by ice, and impurities are removed from the air by means of a chemical substance acting as a filter.

For Beneficial Oxygen Treatments While in Bed; Portable Outfit with Its Tanks, Cooler and Filter

Illustrating Size of Huge Statue of Christ; the Hand in Comparison with Figure of the Sculptor

LARGEST STATUE OF CHRIST FOR SOUTH AMERICA

What will be the largest statue of its kind in the world is to be erected in the bay at Rio de Janeiro, a huge figure of the Christ, 100 feet high. It is the work of the Polish sculptor Landowsky, and its tremendous proportions are evident from the accompanying photograph of a detail of the hand.

VERTICAL BEAM ON LIGHTSHIP TO GUARD RIVER MOUTH

To guide vessels into the mouth of the Columbia river, a brilliant vertical searchlight is planned for a lightship at the entrance. It would be of 100,000 candlepower and visible for fifty miles in clear weather, it is estimated. The roll and pitch of the ship would help attract attention to the beacon, and in cloudy weather, the beam, shining on the clouds and reflected by them, could be seen from a great distance, except in fogs. The present lights on the vessel are visible at scarcely more than five miles.

Gambling with Death

Navy Diver, with Undersea Electric Light in His Lap, Awaiting the Signal to Descend

By JOHN T. BRADY

"AIR is life to a deep-sea diver ordinarily, and lack of it for five minutes usually means death if he is down to any considerable depth.

"But my closest call came from too much air rather than too little," said Tom Eadie, continuing his story.

"And only a toehold saved me from the 'blow-up,' which most divers dread more than any other fate that can befall them.

"So it's hard for me to decide which is the worst feeling a diver can have at the bottom of the ocean. It's terrible to find yourself gasping for breath and to realize that your supply of oxygen has suddenly been cut off either by the fouling of your air line or a freeze-up.

"But sometimes I think it is even worse to feel yourself getting an overdose of air when you are helpless to shut it off or let it out of your suit, for then you are in danger of the 'chute-the-chutes' ride to the surface on a bubble of air that invariably means painful injuries at least—and usually death. I'll tell you about a bad fix of that kind I got into one time."

The speaker was Thomas Eadie, chief gunner's mate, U. S. N., the outstanding hero of the attempt to rescue the men who were trapped in the submarine "S-4" when she foundered off Provincetown, Mass. He was the first man to reach the wreck and determine that there were living men in it, and he was recommended for the congressional medal of honor for saving the life of his comrade "Whitey" Michels, a feat which Rear Admiral Frank H. Brumby, grizzled veteran of the seas, described as "the most deliberate, cold-blooded piece of bravery I have ever seen."

"This game is a constant gamble with death in a way," Eadie philosophized, "for when you go down you never know what's going to happen to you before you come up. So every dive is an adventure, and there's a fascination about the work that makes one forget its risks and dangers."

Eadie then went on, in his matter-of-fact way, to tell of the most harrowing moment of his nineteen years as a diver. He was working on the salvage of the "S-51," sunk off Block island, and had been tunneling a hole under the hull to enable the passage of a chain from one pontoon to another. A welcome signal had come from above notifying him that his hour was up—that is the limit of time a navy diver is allowed to work at a depth of 100 feet—and in response he had stepped on the decompression stage, as the platform is called on which a diver is raised.

"I was in buoyant spirits at the thought of going up," he smiled, "but suddenly I realized that I was getting altogether too

at Sea's Bottom

buoyant for comfort. 'Guess I better cut down on the air,' I thought, and I tried to open the exhaust valve on my helmet that is operated from the inside by pressure of the chin. But the valve was clogged with silt that had worked into it."

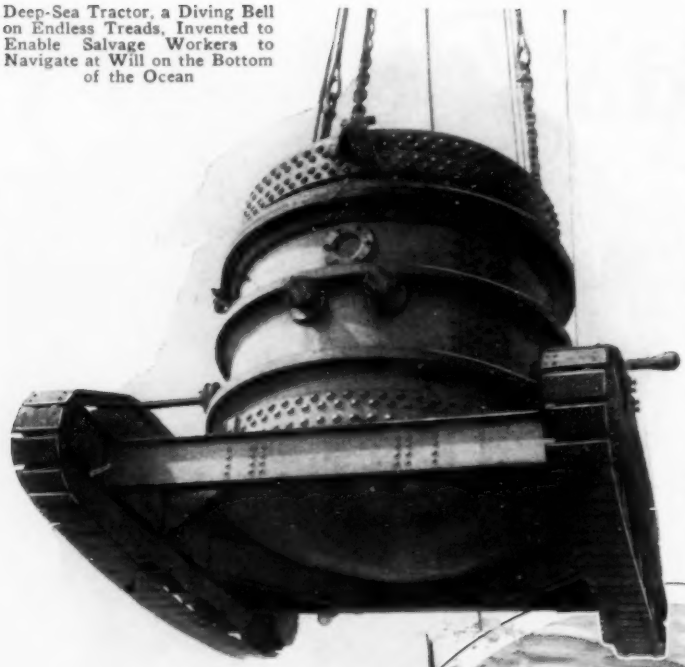
Again and again he jabbed his chin against the mechanism, but it was stuck fast and meanwhile his suit was rapidly ballooning. Soon it would have the buoyancy of a football, and he reached for the air-supply valve in an effort to close it. But he was too late.

Assisting a Diver from the Pressure Tank after Treatment to Prevent the "Bends," and, at Left, Sailors on Duty at the Tank Controls, Slowly Lowering the Air Pressure in Its Interior

"The excess air pressure in my suit suddenly threw my arms out straight from my sides so that I couldn't bend them," he explained, "and at the same time the stronger pressure in my helmet forced me down into the rubber suit as you would force a cork into a bottle.

"I was helpless, yet I knew I must not ascend. I would have shot my length out of water like a jumping fish on reaching the surface. So, as I sensed the 'blow-up' starting, I felt about with my legs, hoping my feet would catch on something that would be strong enough to hold me down."

Now the great danger of the blow-up comes from the nitrogen bubbles that form in the minute blood vessels and tissues of the body when it is subjected to abnormal air and water pressure. And if a diver is not properly decompressed, or brought up slowly from a great depth, in order to allow time for these bubbles to dissipate, caisson disease, commonly called the "bends," occurs, with grave danger of permanent injury or death to the victim. Such was the horrible prospect that Eadie



Deep-Sea Tractor, a Diving Bell on Endless Treads, Invented to Enable Salvage Workers to Navigate at Will on the Bottom of the Ocean

visioned as he kicked out his feet in a last desperate effort to save himself.

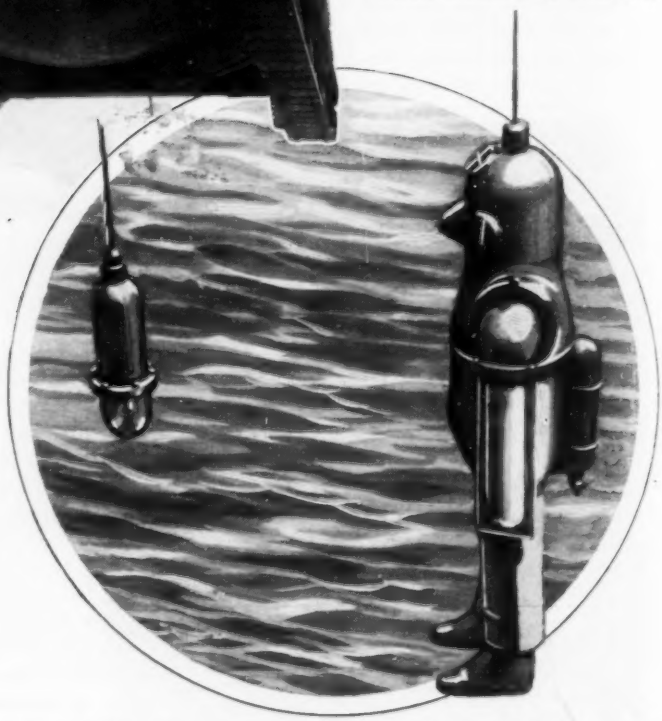
"Luck was with me that time," he went on. "Just as I thought I was done for, the brass toe clip on one of my boots happened to catch in the angle of one of the stage rods and that's all that held me from shooting to the surface."

Then the distention of his rubber suit by more air than it could stand tore it away from the metal breastplate in front, and with the outrush of air from the rent, Eadie gave a sigh of relief. He was at least safe from the blow-up. But a new danger was imminent. His helmet threatened to tear away from his suit entirely.

Deflation of the suit, however, gave him the use of his arms just in time to grab his helmet as it was leaving his shoulders, and he was able to hold it in place until he was finally brought to the surface, pretty much exhausted but still alive.

A group of the corps of divers working on the salvage of the "S-4" were gathered round Eadie on the deck of the "Falcon" as he spoke, and they listened respectfully to him, as usual on the rare occasions that he tells a personal experience.

"Now I'll tell one," announced chief torpedoman, "Whitey" Michels, when Eadie had finished.



Lowering a Diver to the Record-Breaking Depth of 318 Feet in a New Type of Armored Diving Suit, Which Resists the Tremendous Pressure

"Give me the air every time," he began, "and I'll take my chances on the blow-up, now that I've survived it once. I've had plenty of close calls in my years of diving but this last on the 'S-4,' when Eadie came to my rescue as I was passing out for want of sufficient air, owing to a fouled hose

line, was the worst ever. At two o'clock in the morning, I went over the rail of the 'Falcon.' She was then yawing at her moorings in the rising gale and spray was freezing as it struck her deck. I expected to land on the deck of the 'S-4,' but instead I landed on the bottom, and found myself sinking into a bed of mud. I thought I could walk out of it at first, but with each step I took I sank deeper, until I was stuck in the mire up to my waist.

"Then I telephoned the 'topside' to pull me out of the mudhole, and later I learned that it took the combined strength of thirteen men to free me, so you can judge how badly I was stuck.

"Then the cord of my portable light got tangled in the descending line, and, rather than waste more time in trying to release it after two or three futile efforts, I left it where it was and began groping my way along the deck in the inky blackness. Before I had gone ten feet, however, I discovered that my air line had become fouled somewhere and I signaled for help. Shortly after that I must have dropped from exhaustion. At any rate, the next thing I became conscious of was that a diver was helping me to my feet. It was Eadie, and he had gotten up before he had recovered from the effects of a previous dive to come to my aid.

Lowered over the Side on a Platform, a Navy Diver Starts Down to the "S-4," to Attach Air Lines in an Unsuccessful Rescue Attempt

"When he found me I was lying, face down, with my life line and air hose in a tangled mass across my back and pinning me in that position. After he got me on my feet I began to 'savvy' that he was trying to free my air line, but I couldn't help him much. In fact, I was so weak that I couldn't even hold his light for him. I don't remember much of what happened after that, but evidently I took excess air after he had freed me and blew up, for they found me floating around on the surface. They tell me I was like a cold-storage bird when they got me in the decompression tank. Later, I learned that I had been down nearly three and one-half hours and Eadie had been down over two hours in rescuing me."

Eadie then recalled how William Loughman got fouled at a depth of 270 feet while working on the "F-4" at the bottom of

Honolulu harbor, in November, 1915, and how Crilley brought him up from that depth after four hours of the most perilous kind of labor. Crilley also broke the world's record for deep diving on that salvage job by going down nearly 300 feet.

However, improvements in equipment have decreased hazards to a marked degree, and recently a double diving suit has been proposed so that an engineer may accompany the diver, make sketches or observations while submerged and so lighten the diver's task. The outfit is a "twin" affair with a separate steel suit for each man, but the two are joined to permit conversation and to prevent the workers from becoming separated and interfering with each other's operations. Such a rig would be of great service, it is believed, in making a submarine survey or examining a wrecked vessel preparatory to raising. Often the diver's information is incomplete and, if he is not familiar with the engineering factors involved in the task, his reports are likely to be misleading. With a trained man to accompany him, fewer dives would be necessary, it is believed, with a consequent saving in time, cost and risk.

Divers play the most dangerous game in the world, a game that makes the roughest athletic sport look like a "pink-tea" party by comparison, a game that twists and tortures the body and bursts

A French Diver in Full Outfit Ready to Invade the River Seine, and, Below, a Radio Announcer Armed with a 1,000-Watt Lamp, About to Descend to Describe the Sea Bottom

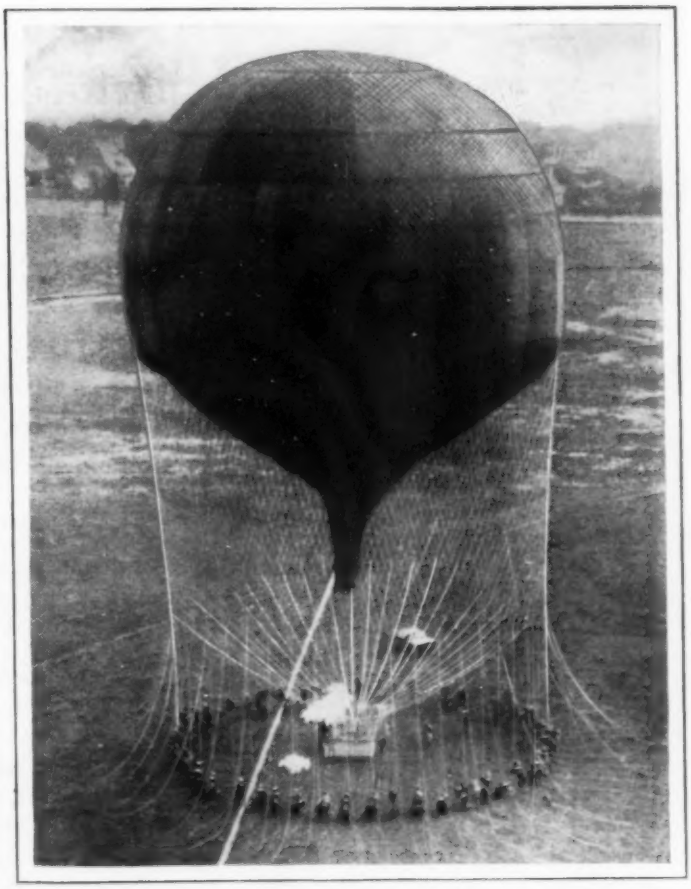
the eardrums, a game that only the most cool-headed, resourceful men, in the prime of their strength, can play for only one hour at a stretch.

NEW INVENTIONS WANTED

Silent lawn mowers and motorcycles, methods of eliminating street noises, and a way to convert sound into energy are among the inventions the world needs, according to a pamphlet "What's Wanted," recently published by the institute of patentees in London. The list includes a number of practical suggestions to inspire an inventor's efforts, such as an unpuncturable pneumatic tire, a simple clamp to hold mixing bowls to the table so that both hands can be used, a non-leaking water tap, an attachment to keep glass stoppers in bottles while traveling, reinforced handles for chinaware and a means of keeping pleats in skirts. Among radio devices wanted is a speaker that will render foreign languages into English.

PAINT-SPRAY OUTFIT IS RUN FROM LAMP SOCKET

Operated by current from a house-lighting socket, an electric spraying outfit is convenient for applying paints or lacquers or for disinfecting interiors. It is easy to clean and operate, and can be used satisfactorily by an amateur. The motor is suitable for direct or alternating current.



Preparing the Balloon Observatory for a Flight; the Huge Bag Is More Than Eighty-Six Feet in Diameter

BALLOON TO SOAR NINE MILES FOR AERIAL RESEARCH

Explorers of the air are to use a huge balloon constructed in Berlin for research work in the upper altitudes. The huge bag is more than eighty-six feet in diameter and has been built to ascend to a height of nine miles.

LOCK HOLDS CAR FROM BACKING IF BRAKES FAIL

Should the automobile start to roll back on a hill because of failure of the brakes, an automatic lock, installed on the differential or transmission, quickly functions, halting the car almost instantly. The unit is easily installed and is said to greatly promote safety in driving while relieving the operator of considerable worry.

To Help the Airman Paddle to Shore Should He Fall in the Sea; Note the Fins for Arms and Feet

LIFE-SAVING SUIT HAS PADDLES TO HELP SAVE VICTIM

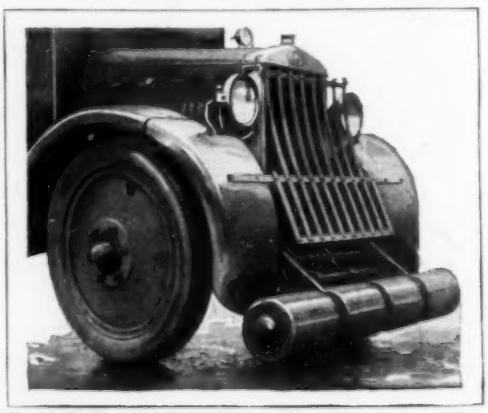
Designed particularly for the use of aviators making long flights across bodies of water, a life-saving suit is fitted with paddles on the legs and arms so that the wearer may push himself along with the least possible fatigue. The suit is made of rubber, cork and wool and the paddles also enable the victim to rest on his back in the water.

BREATHING ROCKS KEEP FIRES BURNING UNDERGROUND

In one of the Pennsylvania coal mines, a fire has been burning for seventy years. Repeated efforts have been made to extinguish it, in order that thousands of tons of anthracite, imprisoned by the blaze, may be taken out, but, so far, all attempts have been in vain. According to Prof. W. Spencer Hutchinson, of the Massachusetts Institute of Technology, one reason why subterranean fires of this nature are so hard to extinguish is that the rocks absorb sufficient oxygen to keep the blaze going. His opinion is substantiated by tests of the gases exhaled from rocks in a deep mine during a period of low barometric pressure. They were found to contain the same amount of helium as the atmosphere. Sealing the entrance to the mine, merely shuts off the oxygen from the opening. Enough is obtained through the soil and rock above to feed the fire. Deep in the heart of a mine at Butte, Mont., a fire is smouldering within a concrete chamber which miners constructed around it in an effort to smother it. This cement "trap" will eventually conquer the fire, it is believed, as practically no oxygen can enter through the walls. Water is effective in combating underground fires, but it often fails for the reason that it cannot penetrate to the heart of superheated rocks where the high temperatures are likely to persist for a long time, because the heat cannot escape.

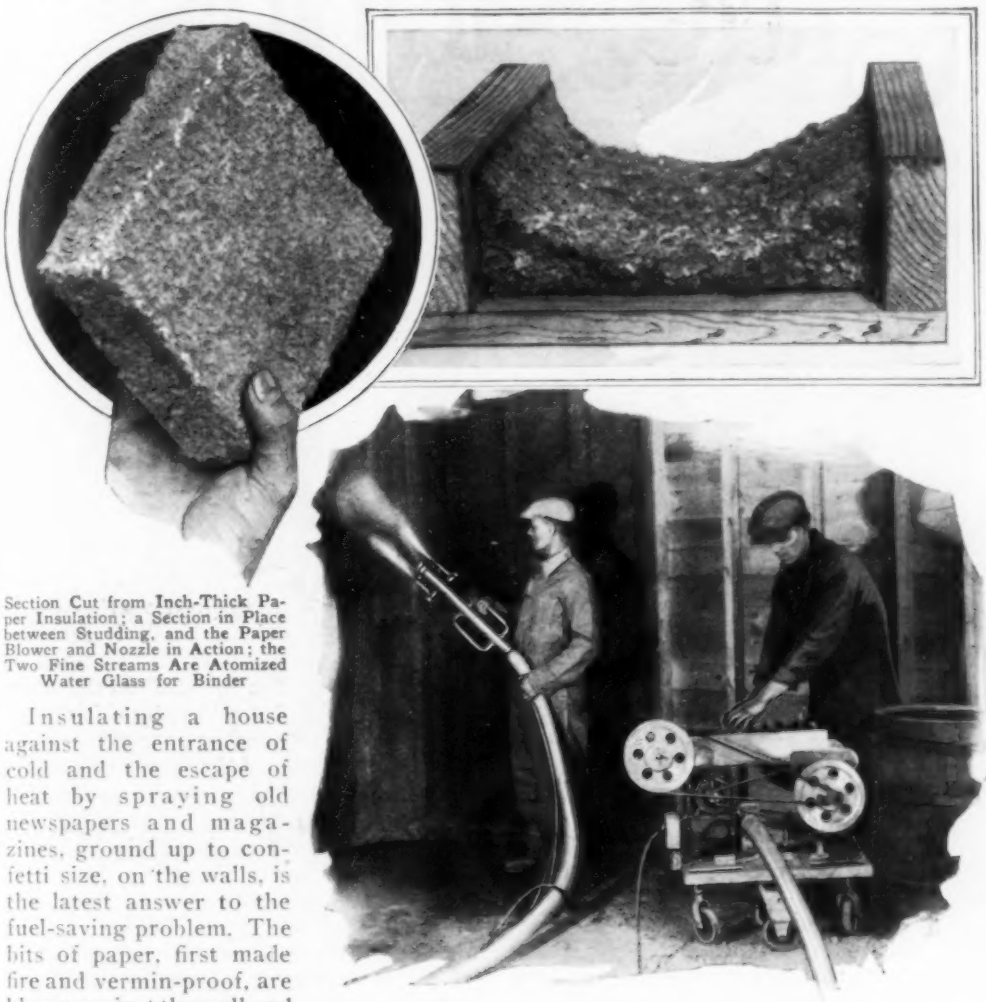
ROLLERS ON AUTO-TRUCK FRONT TO PREVENT ACCIDENTS

Rollers revolving in a direction opposite to that in which the wheels are turning, have been attached to an automobile truck in front, to reduce the likelihood of running over persons. The rolls are intended to lift any obstruction out of the path of danger or catch it on a fender like the cowcatcher of a locomotive.



Front Roller Revolves in Direction Opposite to That of Wheels to Protect Auto Victim

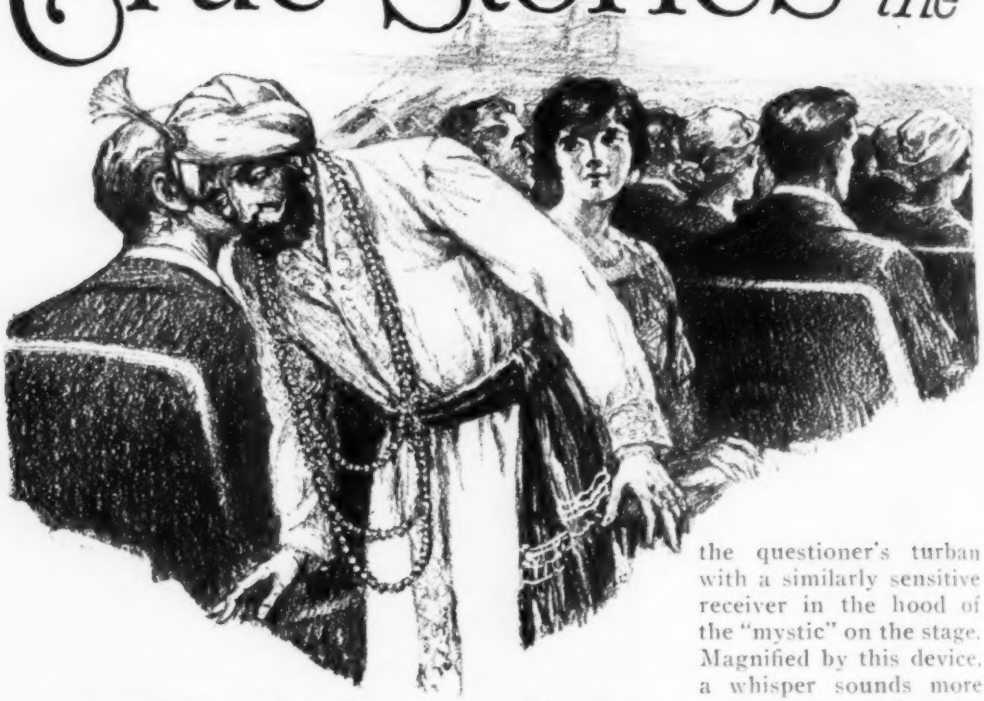
PAPER BITS BLOWN FROM HOSE INSULATE HOMES



Section Cut from Inch-Thick Paper Insulation; a Section in Place between Studding, and the Paper Blower and Nozzle in Action; the Two Fine Streams Are Atomized Water Glass for Binder

Insulating a house against the entrance of cold and the escape of heat by spraying old newspapers and magazines, ground up to confetti size, on the walls, is the latest answer to the fuel-saving problem. The bits of paper, first made fire and vermin-proof, are blown against the wall and bound there by a double jet of water glass. The resulting insulation is a soft, fluffy, woollike layer, which can be built up to any thickness required. Actual installations range all the way from a half inch to the full three and five-eighths-inch thickness of the studding—depending on how much the owner wishes to pay. Because of the fluffiness of the coating, it contains billions of air cells, which make it, according to laboratory tests at Armour institute, an exceptionally good insulator. In an analysis of a typical seven-room two-story house, built in Milwaukee and insulated with the paper preparation, Samuel R. Lewis, consulting engineer, calculated one inch of insulation would cut twenty-five per cent off the fuel bill each season, and two inches would save thirty-two per cent, the insulation being applied to the top-floor ceiling and sidewalls. In applying the paper, which is called "sprayo-flake," a portable gasoline motor drives a combined air compressor and dynamo, the one furnishing air for the water-glass atomizer, and the other current to operate an electric blower that forces the paper against the wall. The compressed air is piped into a barrel of the water glass, and from it the feed line runs to two small jets, set on either side of the spraying nozzle through which the paper emerges.

True Stories of the



By ARTHUR CHAPMAN

"WHISPER your name in my ear, please, and it will be repeated from the stage by the great Oom Ali, who hears all things."

A benign-looking East Indian, in flowing robe and white turban, loiters along the aisle of a theater, bending over here and there to get whispered names. To the amazement of the audience, each name is repeated by another oriental on the stage, whose face looks out of a hood so closely wrapped that it conceals his ears.

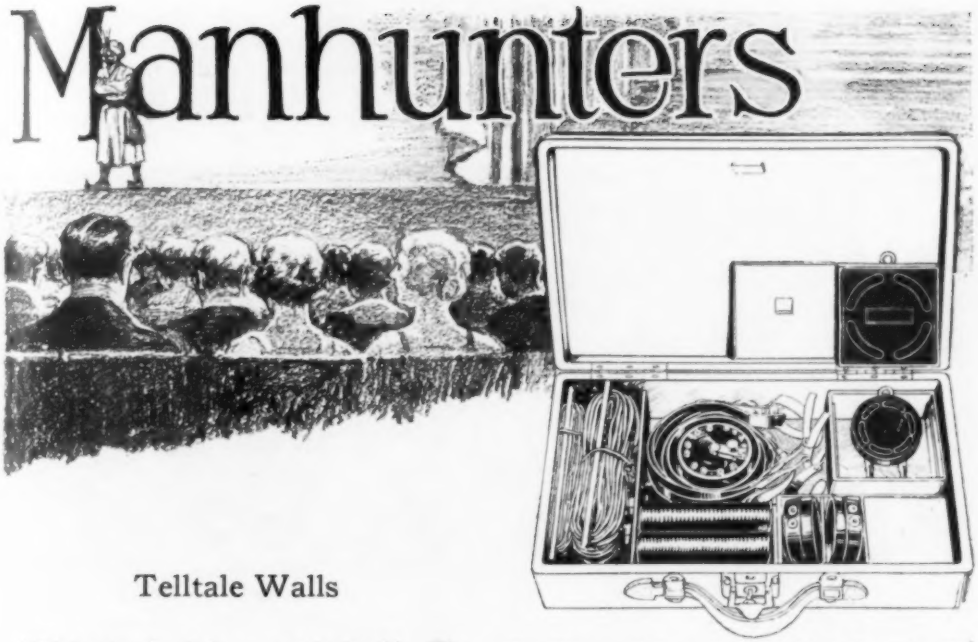
Back to the last seats in the theater, far out of ordinary earshot, the turbaned one makes his way, and names and messages are repeated without fail by the man on the stage. No one in the audience registers more genuine surprise than the persons whose words have been repeated. Clearly there is no "plant" involved, and the mystification is complete.

The audience is not aware that a tiny wire, the color of the carpet, connects a supersensitive transmitting apparatus in the questioner's turban with a similarly sensitive receiver in the hood of the "mystic" on the stage. Magnified by this device, a whisper sounds more plainly in the ears of the man on the stage than it does to the one who is bending over the theatergoer.

There is no enlightening of the audience, which goes home not knowing that it has had a working demonstration of an instrument that has proved to be a potent aid to the law in the capture of criminals of many sorts. A suspected murderer whispers a few incriminating words to a "pal" in their cell; a grafter "pays off" the funds of corruption or receives them in the supposed security of his home or office; conspirators gather to plot the destruction of life and property—and in each case the "mechanical ear," known as the detective dictograph, catches the telltale words and repeats them to stenographers who set down the incontrovertible evidence of guilt.

Detectives who have qualified as experts in the use of the dictograph have achieved convictions under circumstances so difficult that a Sherlock Holmes in real life probably would have confessed himself baffled.

Manhunters



Telltale Walls

"Dick planting" is an art in itself. The detective dictograph receiver is so small that it can almost be concealed in the palm of a man's hand, and consequently it lends itself to all sorts of camouflage. It has been hidden in hats, umbrellas, and even in the cuffs of overcoats on racks; in the folds of window drapery, in chandeliers and desks, waste baskets, sofas, chairs and behind pictures. It has reposed in the center of a vase of flowers; it has been swung down chimneys into fireplaces, in front of which whispered conferences have been held. It has been used frequently in "dummy" telephones, and has been successfully hidden in the bare recesses of jail cells.

The most skillful bit of dictograph planting on record was worked out in the case of a political boss who had to be "seen" before any money was spent for public improvement. Efforts were made to trap him, without avail.

"The only place where he will talk money is in his bedroom," was the constant report.

This precaution on the part of the boss meant that it was going to be difficult to get the sort of evidence that would result in a conviction. The district attorney had called in a noted detective. The first thing done was to put the telephone of the boss

The Dictograph Is a Compact Little Detective That Has Solved Many Famous Crimes

out of commission. When he stepped across the street to call up the telephone company, a man in overalls rushed into the residence, saying that he had been sent to make the repairs. Access was thus secured to the bedroom and the telephone was repaired. Incidentally a dictograph was planted in the bedspring, the connecting wire being wound about the telephone wire and leading outside the house.

The next problem was to fix up the receiving end of the dictograph. There was a vacant store across the street, where a stenographer listened to all the graft conferences that went on in the boss' bedroom. When sufficient evidence had been secured, the boss was called before the district attorney.

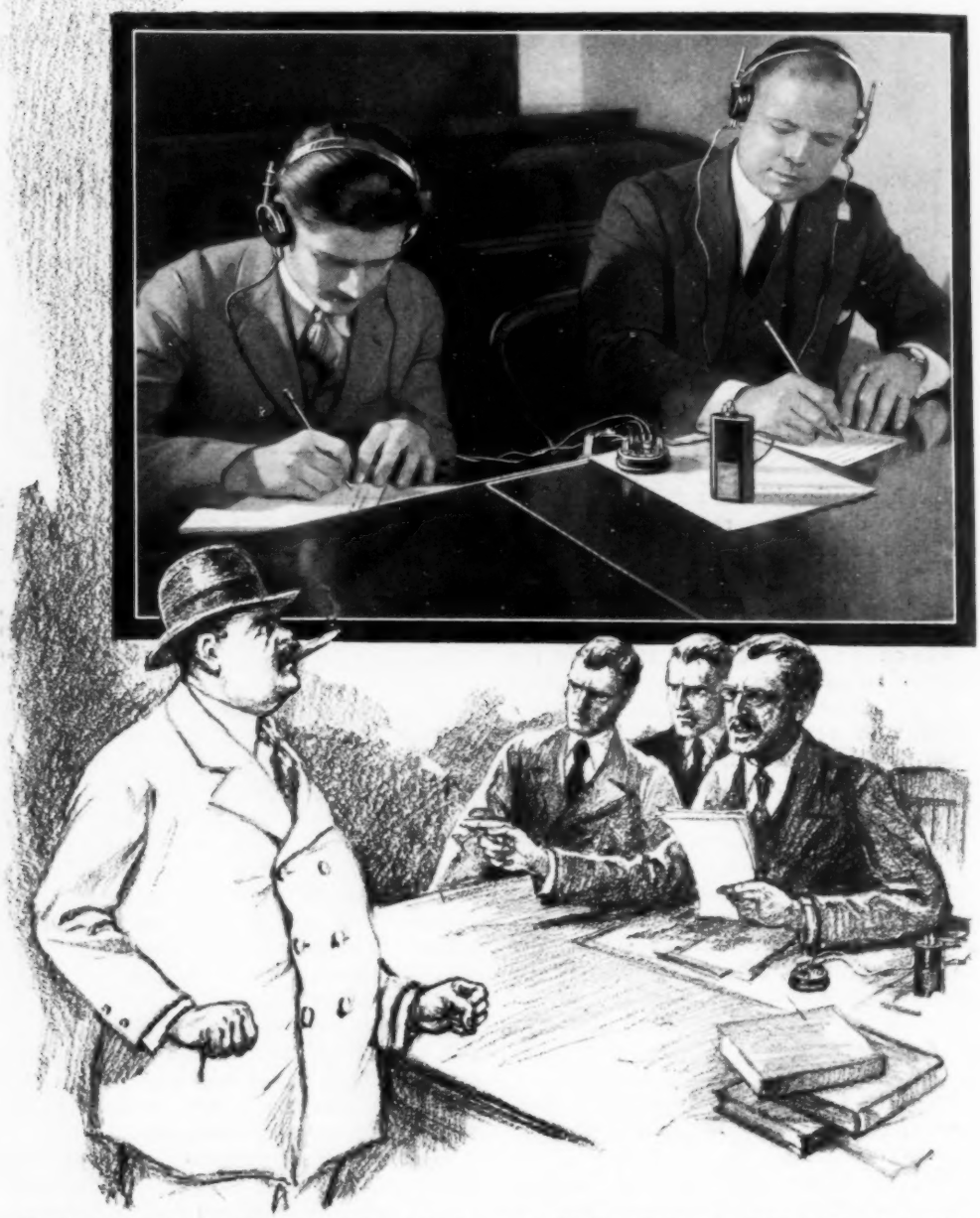
"We know that you have taken money," said he. "We have you, all right, but we are convinced there are men higher up. If we confront you with your own words, will you tell us who is behind you?"

The boss turned green when he read the stenographic notes. He made a confession, implicating several higher-ups, but pressure was brought to bear. He repudiated the confession and went free. The idea was to get the boss again—but how? He was still holding his graft conferences,

but this time not in his bedroom.

"He won't talk graft except in an automobile," was the report.

vited to talk over a "business proposition." The car was driven to the outskirts of town and pulled up at the curb in front of a schoolhouse. The chauffeur was temporarily dismissed. The deal was



Faced with the Stenographic Report of Secret Conferences in His Own Bedroom, a Political Boss Confessed; Above, Two Stenographers Taking Down Duplicate Reports

It looked like a poser, but the answer was finally worked out. The boss was in-

not completed that day, so it was agreed to talk over the final details on the day

"Dick Planting" Is an Art; Even the Waste Basket May Hide the Sensitive Little Microphone

following. In the meantime a dictograph was planted in the upholstery of the car.

Once more the trip was made to the lonely schoolhouse. The car was halted at the curb as before, and the chauffeur was dismissed for a stroll. But, just before he walked away, he picked up a plug attached to a wire which was lying in the grass near the gutter. This was plugged in at the rear of the car, establishing a connection with the dictograph.

The receiving end of the dictograph was in the schoolhouse. Stenographers in the building took down the details of the conversation between the boss and the supposed contractor, who in reality was a detective. After his conviction, the boss' final words were: "I'll never talk again, except in a balloon."

Sales talks, in some cases, are checked up by dictograph. This may happen when salesmen are meeting stiff competition on the road. Big orders are at stake, involving thousands of dollars, and these should not be lost because the opposition is putting up a better line of argument. So, through a skilled agent, the mechanical ear is planted where the sales talks take place, and then the desired comparisons are made. Surety companies, risking large sums of money on the integrity of cashiers and others in responsible positions, often use the dictograph in the necessary checking up on personal habits.

Railroad companies, which are besieged with all sorts of accident claims, make use of the dictograph on occasion. There is the case of a cow, which was killed because it persisted in trying to find grass on the barren right of way of a railroad. Mr. Owner's bill against the road was stag-

gering. It indicated that the cow was an animal of great value—a wonderful milker, a record breaker for butterfat.

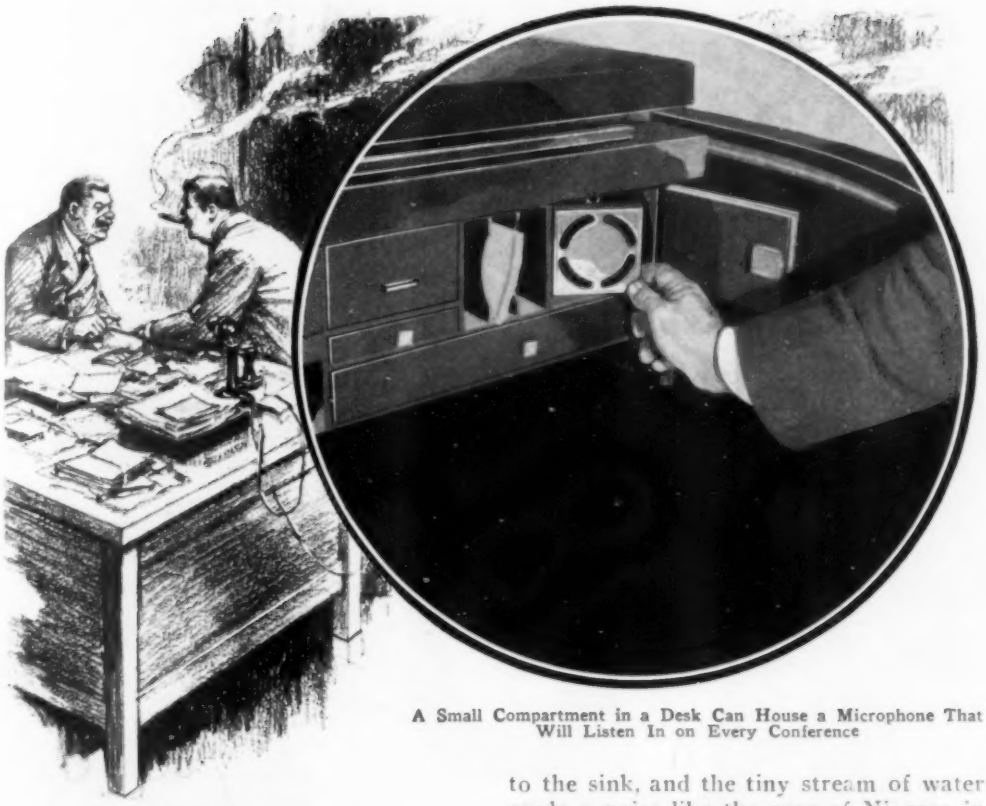
Mr. Owner is invited into the office of the claim agent. The farmer and his wife are cordially received by him, who is a jolly chap—used to be a farm boy himself before he ran away and joined the circus and then drifted into railroad work.

In the middle of a good story, the claim agent is called out of his office. Mr. and Mrs. Owner are left alone for a matter of ten or fifteen minutes. In that time Mr. Owner has jubilantly confided to his wife, in stage whispers, that the case looks like a cinch and they'll be sure to get at least a hundred out of that ornery old cow which was good for nothing but hide and tallow anyway.

To this day Mr. Owner does not know that there was a dictograph concealed behind a calendar above the claim agent's desk. All he knows is that a stenographer brought in a transcript of his whispered words, which would not look good in court, and the damage case was compromised with the claim agent for $26.03.

In criminal cases the detective who uses the dictograph always proceeds on the theory that the guilty person will talk freely to someone who is in his confidence. Any burden of guilt usually becomes too heavy to be borne alone. Perhaps a sus-

The Glee of the Farmer and His Wife When They Thought They Were Cheating the Railroad Turned to Grief, Because a Dictograph Was Hung behind a Calendar on the Wall



A Small Compartment in a Desk Can House a Microphone That Will Listen In on Every Conference

pected murderer is followed from place to place by a detective, who, in the role of a fellow lawbreaker, gradually gains the confidence of his man. The detective boasts of crimes he has committed, and, sooner or later, there comes a time when the suspect confides his own guilt to his supposed pal. Once more the mechanical ear fulfills its mission.

Life dramas, involving months of effort, elaborate stage settings, and the expenditure of thousands of dollars, revolve about the detective dictograph. If this tiny instrument fails at the climax, the whole dramatic structure collapses.

In an eastern city two men were suspected of the theft of a large amount of government bonds. They were put in a cell which had been planted with a dictograph with the idea that they might talk over the crime. The men began conversation in low tones, but one of them stepped over to a water faucet and got a drink. When he came away he left the faucet open. The dictograph was planted close to the sink, and the tiny stream of water made a noise like the roar of Niagara in the ears of the operator, making it impossible to hear what the men were saying. The men were taken to another cell where there was no running water. This time enough of their conversation was heard to establish their guilt.

In another case a dictograph was planted in the desk of a man who was about to put through a fraudulent deal. He suspected a dictograph trap and searched his office carefully—even looking through his desk—without finding the instrument. But, unfortunately for the operator, the suspected individual was not satisfied with the thoroughness of his search. During his entire conversation he tapped his desk with a pencil, preventing any record.

Playwrights have joyfully seized upon the dictograph as something with which to give new "kick" to worn-out dramatic situations, and it has figured in many crook and mystery plays. But nothing seems to equal the real life drama, in which this scientific aid to the law makes true the old saying that "walls have ears."

POLICE TRICKS THAT SUBDUE UNRULY PRISONERS

Over-the-Shoulder Throw, the Come-Along Arm and Hand Grip, a Head Twister and Another Throw; Samples of Strong-Arm Tricks Used by Massachusetts State Police in Handling Prisoners

Massachusetts state police have won wide recognition for their ability to subdue unruly prisoners, and much of their success is due to their skill in executing special locks and holds on their adversaries. Many of these tricks are known to other police organizations and some can be mastered by the layman, after practice, for his own defense. One of the most effective is known as the "come along." It does just what the name suggests, compels a prisoner to accompany his captor. It is an "arm-breaker" hold, obtained by grasping the victim around his right arm and using the right hand to hold the culprit by the wrist. If the prisoner struggles, his arm is likely to be broken at the elbow. A head hold is useful in forcing a man into a cell. The policeman places one of his arms back of the prisoner's head, the other, under the jaw. A twist will usually subdue the most unruly victim. There are two especially efficient ways of throwing an adversary. In one, should the policeman be tackled about the waist, he locks his elbows around the

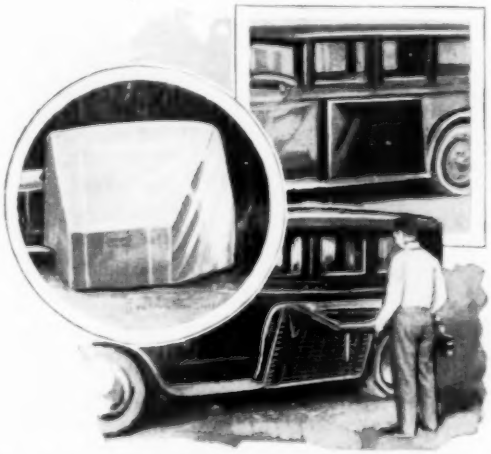
prisoner's arms and over his head. Then, with a quick upward heave, he throws his assailant over his back. The reverse hip lock is a similar maneuver. The attacker is thrown over the policeman's hip and then grabbed by the neck.

GREASE ON TROLLEY WIRES HELPS REMOVE ICE

Overhead wires of electric car lines are made to last longer and ice is more easily shaken from them in winter by keeping them greased. The experiment was tried in Toronto, Ont., where ice-laden wires proved a source of great trouble. It was found that the passage of the trolley wheels readily dislodged the sleet. Besides reducing arcking, the wear on curves was lessened about sixty per cent.

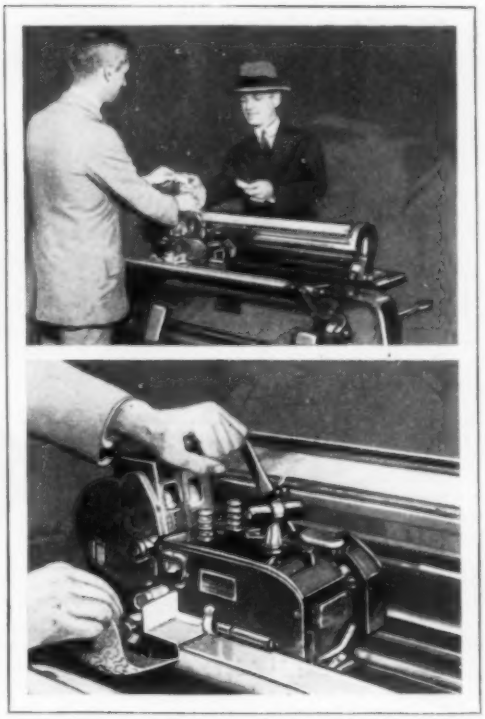
BED ON AUTO RUNNING BOARD SIMPLIFIES CAMPING

Attached to the running board of the automobile without the necessity of boring holes or using tools, a bed is carried like a luggage container and may be easily taken off and used at home at any time as a spare bed for a porch or room. It is rigidly constructed with a frame of angle iron without crossbars, and with it, is a tent canopy for shelter. A dust and waterproof cover protects the bed while on trips



Bed Folded, Covered by Canopy, and Being Extended; It Occupies Little More Space Than the Luggage

and under it is space for extra clothing and other articles.



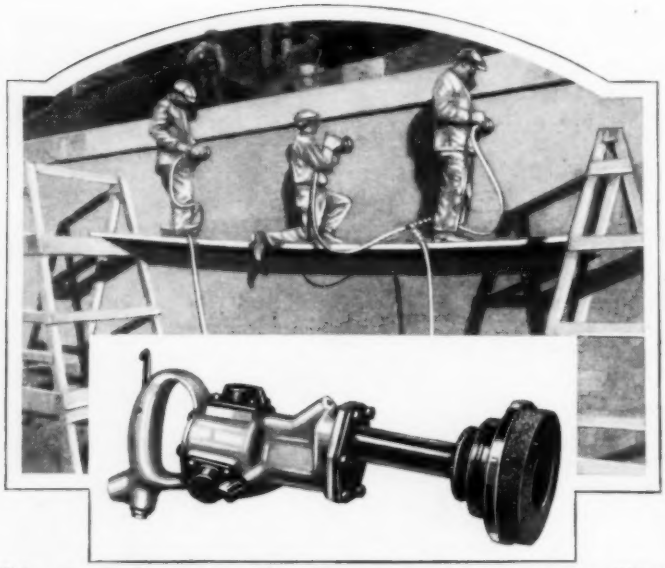
Printing Ticket for Passenger and Close View of the Printer; It Prepares Tickets as Needed

TICKET PRINTER FOR RAILROADS TO REDUCE EXPENSE

Almost every railroad has t' ousands of dollars tied up in printed tickets, but this investment will no longer be necessary, if a printing unit recently introduced proves successful. It prepares the tickets as they are needed, stamping on them the names of destinations, routes and other details. Clerks are also saved the task of additional application of rubber stamps, since the printer performs the complete operation and does it in little time.

THERMOMETER RUNS CLOCK

Energy captured by daily changes in the temperature, is utilized to operate a clock a Swiss engineer has invented. The motive power is essentially a long coiled tube filled with glycerine, connected with a cylinder into which a piston is fitted. When the glycerine is warmed and expands, it forces the piston out of the cylinder and lifts the clock weight. It is expected that this type of instrument will be especially suited for outdoor use.

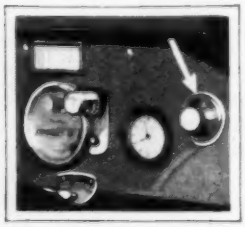


Using the Surfacer, and a Close View of the Unit Showing the Wheel Grinder Operated by Compressed Air

SURFACING TOOL FOR CONCRETE SAVES HAND LABOR

Operated by compressed air, a unit that quickly and easily smoothes concrete surfaces and removes form marks has been introduced to save time and labor. It can be used on either green or old material. An essential part of the outfit is a ring-shaped grinding wheel which is rotated flat on the surface and is kept from tipping on edge by means of a flexible joint in the wheel head. The tool weighs but thirteen pounds and special grinding wheels are provided for finishing and polishing monument and building stone.

KEYLESS DASH LOCK FOR AUTOS HAS LUMINOUS DIAL



Locking the car is as simple and natural a movement as turning the ignition switch with a keyless combination lock recently introduced. It shuts off both the gasoline supply and the ignition by a simple turn of the wrist, the exposed part being installed on the dash within easy reach. The dial, with the numbers by which the combination is set, is illuminated by a phosphorescent substance to serve as a constant reminder to lock the car at night and to make it easy to find. The combination is simple to form, and the lock can be released or fastened in a few seconds.

GLASS BLACKBOARD TO SAVE PUPILS EYESTRAIN

Blackboards of translucent ground glass, illuminated from behind, are proposed by a western professor as a substitute for the usual opaque, black surface, which is difficult to light so that it can be easily seen from all parts of the room. A test with a new board showed that letters on it were distinctly visible without strain, even when a combination of daylight and artificial illumination was used. Erasures were easy and the board could also be employed for the display of stereopticon slides.

MUSICAL DRUM EASILY PLAYED WITHOUT USE OF STICKS

Boys can reproduce the beats of an experienced drummer, it is said, on a drum which is played by a pull-cord mechanism. With little practice most beats can be given accurately.

LIGHTED BADGES FOR CAPS AID MESSENGER BOYS

Messenger boys in London introduced something new in fashions when they appeared with luminous badges in their caps. The signs were of the type that reflect the light, and the letters "Via Marconi" could be seen far away—a considerable improvement over the former brass badges.

Tracking the Weather to it's Lair

Preparing to Release a Pilot Balloon on the Ice Cap of Greenland; the Balloons Often Rise to Heights of Eight Miles or More before Disappearing from Sight

FOUR men, linked to the outer world by the invisible tie of a short-wave radio set, have just finished living through the winter atop the great ice cap that covers unexplored Greenland. They risked their lives to study the weather of the North Atlantic at the spot where it is made, in the interest, primarily, of making future Atlantic airplane flights safe.

The cold winds that sweep across the vast ice fields of the huge island continent make the fogs and storms that were met by every transatlantic flyer, just as they had been met for hundreds of years by every ship that sailed across the northern ocean. When the frigid winds out of Greenland meet the warm airs over the northern curve of the Gulf stream, bad weather follows.

To chart that weather at its source and predict in advance when the ocean lanes would be safe and when flying conditions would be bad, Prof. William Herbert Hobbs, of the University of Michigan, has led two expeditions to Greenland in the last two years, and last fall he left four assistants behind to launch the daily weather observatory on the inland ice cap of the island.

Greenland, despite the fact that it was settled by the Norse Vikings long before Leif Ericsson pushed westward to Vinland in the year 1000, has remained one of the least-known spots on earth. It is only three years since Comm. Richard Byrd flew forty miles inland over the ice cap and came back to report that, once the steep gullies and ice ravines of the seaward slope were passed, the ice field stretched away as smooth and level as a ballroom floor—a perfect landing field for airplanes.

Because of the unbroken mass of ice, the interior is one of the world's coldest places, if not the coldest. Even in midsummer the thermometer may drop to thirty below zero, while in winter Greenland probably is colder even than the north pole.

Housed atop a mountain at the head of the great Sondre Stromfjord, one of the longest and largest fjords in the world, the expedition is but little more than 100 miles from its nearest neighbors at Hol-

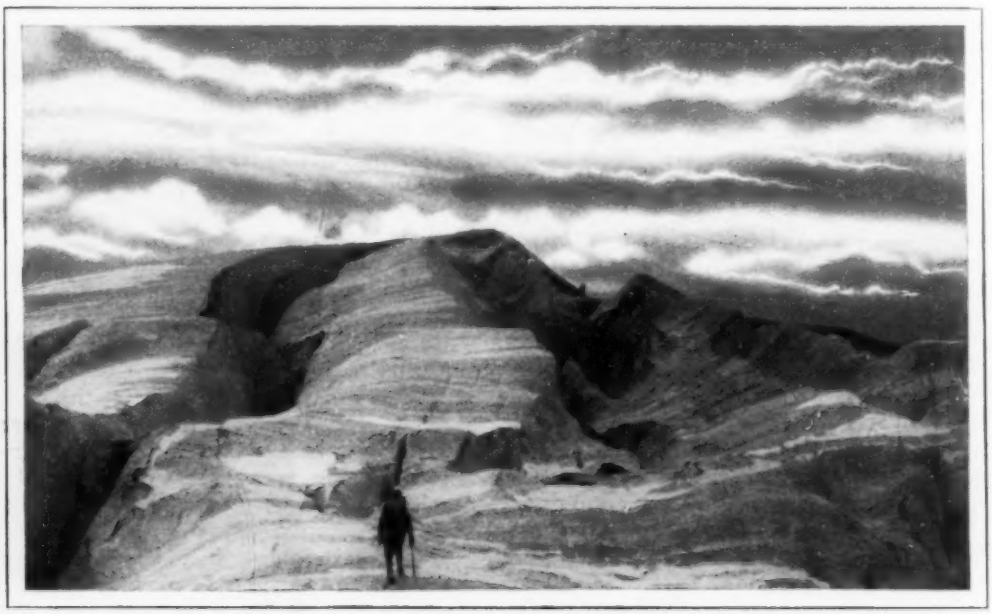
stenborg, a Danish settlement in southwest Greenland. To communicate with the Danish governor there, however, during the long winter night, it was necessary to send messages by short-wave wireless to Prof. Hobbs, who had returned to Ann Arbor, Mich., and he would then relay them by telegraph to New York, cable to Copenhagen, wireless to the Danish radio station at Reykjavik, Iceland, or Angmagsalik, on the east coast of Greenland, and from the latter station they would be in turn relayed to the governor at Holstenborg. On their long-wave receiver, the weather observers could hear the final delivery of their messages to the town a hundred miles away, days after they had started them on the journey of thousands of miles.

To reach their observatory the expedition had to follow much the same route, sailing from New York for Copenhagen to take the Danish government steamer which makes summer voyages to the Greenland colony. From Copenhagen it is a two weeks' trip to Holstenborg. There Prof. Hobbs chartered a little twenty-ton motor schooner to transport the supplies, building materials, dogs and men down the coast. On the way, the party was storm-bound in a small inlet for seven days by a terrific gale, during which two small boats full of supplies, which were being towed astern, went adrift and were only saved at great risk.

Reaching the head of the fjord in midsummer, all the building material, supplies, instruments and other equipment were packed on the backs of the men to the top of a mountain, 1,290 feet in height. The hill top commands the level country for miles around, and a small fresh-water pond, fifty feet below the summit, took care of the water supply.

Because of the terrific winter gales, the permanent quarters had to be designed to withstand enormous pressures as well as cold. A low, rectangular building, with a dome-shaped roof, was erected, banked on the outside by several feet of sod and rocks. Storerooms lined either side, with the living room centered between them, for further protection. The living-room walls were packed with insulating material and lined with water and wind-proof canvas. The only light was admitted through windows in either end, furnished with two sheets of plate glass and an air space between. Owing to the months of darkness in the winter, provision for daylight is not important in the far north.

Before the building was completed, an



This Is the Way the First Few Miles of the Glaciers Look; Back of the Broken Country Is Hundreds of Miles of Smooth and Level Ice on Which Airplanes Can Land with Ease

Two of the Hobbs Party in Their Winter Suits with the Long-Wave Radio Receiver; the Sod-Banked House Is in the Background; Below Is a Summer Tent on the Tundra

eighty-one-mile gale gave a thorough test of its construction. Complete weather recording apparatus, including barographs, thermometers, wind-velocity recorders, and other instruments, were placed in operation by mid-July, and daily ascents of pilot balloons begun. Owing to the height of the mountain top above the interior ice cap, it was often possible to follow the flight of the pilot balloons for nearly twenty-five miles, during which they sometimes rose 40,000 feet or more.

Prof. Hobbs led an expedition inland over the glaciers before returning to the United States in the fall. The ice cap, in summer, is entirely free from snow and, in the region along the coast, was found so pitted with crevasses and studded with hummocks that even light hand sleds could not be drawn, so supplies had to be packed on the men's backs. The going was so rough that only eight miles were made in six days.

The value of Greenland weather information was shown within a few days after the permanent camp was started, when the eighty-one-mile hurricane swept the mountain on July 21. Radio reports two days later showed great storms along the whole Atlantic seaboard. With further observations, it may be possible to send out radio warnings at least forty-eight hours before storms strike the ship and air lanes over the Atlantic.

Prof. Hobbs hopes later to extend the weather survey by exploring the interior of the island continent. Greenland's ice cap is 1,500 miles in length and half that in width. Next to the antarctic ice cap, which Comm. Byrd is planning to explore by airplane, it is the largest and loneliest desert in the world—a desert at an average elevation of two miles above sea level, and without a trace of life.

It is this ice cap that is the real home of the north wind, and not, as many have supposed, the frozen seas around the north pole, for temperatures there are often

Temporary Camp on the Inland Ice, with Prof. J. E. Church, Jr., One of the Four Who Wintered in Greenland, Preparing to Mount the Wind-Velocity Recorder

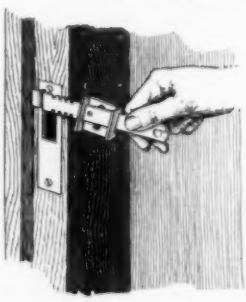
higher than over Greenland. Winds are produced by air currents of different temperatures. The tropics form a vast furnace from which heated air rises, to spread north and south, at high altitudes, toward the poles. When the warm air reaches the Greenland ice, it is sucked down and drained off as through a gigantic shaft. From the ice itself the cold and heavy air spreads out and starts the return over the North Atlantic toward the equator, to be heated again, completing the circuit.

Admiral Peary, who made sled journeys over portions of the ice cap in 1886, 1892 and 1895, found that the cold air was continually slipping down the great ice dome toward the sea, as more hot air was fed in from above. Quite independent of weather changes forecast by his barometer, he found the wind almost invariably blew in the direction of the ice slope.

The same effect can be produced, according to Prof. Hobbs, by a simple experiment. In a glass goldfish globe he placed a copper tank with a dome-shaped top, and on the top fixed a lighted cigaret. The smoke rose in a straight column above the globe so long as the globe was empty, but as soon as cold ice water was poured in, the downward current of cooling air drew it down the slopes of the dome.

When a storm starts eastward from the United States, it will practically blow itself out before reaching Europe, because its energy has been used up on the long trip over the Atlantic. But if it passes south of Greenland when another storm on the ice cap is in full swing, the energy of the latter is poured into the eastward-moving "low" and transforms it into a disturbance whose magnitude, when it reaches Europe, depends directly on the intensity of the Greenland storm.

DOOR IS LOCKED WITHOUT KEY TO FOIL BURGLARS



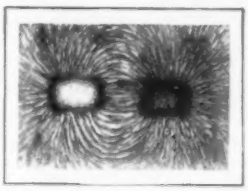
Doors are made secure without keys by a seal slipped between the door and the jamb just above the catch. A curved lip holds it firmly in place, preventing dislodging from without, and the door is kept shut by a sliding brace on the seal, held in slots.

POPCORN IN RAINBOW COLORS HAS BIGGER "POP"

Popcorn with greater "pop" in it, and in yellow, white, red, black, lavender and other hues, has been produced by an Iowa farmer. The results have been obtained by careful selection and crossbreeding of varieties. By mixing stub-rice popcorn with bantam sweet corn, a kind was obtained with 1,000 kernels to an ear only three inches long, and that popped out twenty to twenty-four sacks to the pound. The usual yield is only twelve to fifteen sacks. Some of the prize varieties have been sold for $200 a bushel and as high as $3 a pound for seed purposes.

HOLLOW MAGNETS ARE FOUND STRONGER THAN SOLID

Hollow magnets developed abroad are considerably lighter than the solid type, and the power lasts longer and is greater. In a recent test, a hollow magnet, weighing less than half as much as a solid one, lifted twice as much. The unit is constructed of four thin sheets of metal with no core at the interior. In the solid type, the inner mass exerts a demagnetizing effect on the surface, but this effect is not found in the hollow magnet. A great saving of material is possible with this type—a factor of considerable importance because relatively expensive metals, such as chromium, tungsten and cobalt, are commonly used to increase the attractive power of magnets of the ordinary type.



TOOTH DECAY IS PREVENTED WITH RUBBER PICK

To treat the gums and remove particles of food from between the teeth without injury to the tissues surrounding them, a rubber-tipped pick has been introduced. The flexible part is so shaped that it reaches points that cannot be touched by ordinary means and it is also adapted to the application of a mouth wash or other suitable preparation to areas that may need treatment. A special feature of the unit is that the tip may be adjusted to almost any angle within the metal holder that serves as a handle and also as a case to protect the rubber from dirt. After using, the pick is easily sterilized and extra tips are furnished in sufficient number to last for a fair length of time.

Illustrating Use of the Tooth Preserver, and a Close View Showing How Rubber Tips Are Adjusted

METAL SQUIRREL CRACKS NUTS WITH LITTLE EFFORT

Efficient, and also useful as an ornament, a nutcracker has been introduced. The tail serves as a lever to actuate the jaws between which a hard-shelled nut can be broken with but little exertion on the part of the operator. The cracker is less than six inches high and ten inches long.

INVENTORS SEEKING TO MAKE SUBMARINES SAFE

Upper Left, Float Apparatus to Establish Telephone Communication from Sunken Submarines; Right, Section of Steel Tubing to Reach Craft, and, Below, Model of Food and Water-Supply Tube

Since the sinking of the submarine "S-4," numerous proposals have been introduced toward making craft of this type safer and to afford means whereby persons trapped inside them could be rescued. Among these are an outfit for sending air, food and fresh water to the crew in the submarine while establishing telephone communication with them and a floating apparatus which is to be released from the sunken ship and carry lines to the surface. Another consists of a series of steel sections which can be quickly joined together to make a water-tight tube anchored to the sea floor and used as a tunnel by which men might enter to perform necessary repair work or other tasks incidental to the salvage.

MODERN DIVINING RODS HELP EXPLORE EARTH'S RICHES

Secrets of the earth, inaccessible to the miner's eye or drill, are now revealed to the exploring scientist through the use of instruments that have replaced the "magic

rods" of the unscientific diviners. These aids are in constant use in the quest of oil and minerals, telling the mining engineer where it is advisable to drill or dig. Rocks and other deposits in the earth have been found to have different physical properties which can be detected by suitable apparatus at the surface. Masses of light or heavy materials affect the gravitation of the earth near by and can be detected with a pendulum or gravity balance. Many rocks have different degrees of magnetization and consequently vary the strength and direction of the earth's magnetic field. Refined forms of the compass and similar instruments allow the geologist to measure any magnetic irregularities and speculate upon the cause. Small explosions can be recorded on seismographs to determine the difference in elasticity of the rocks, thus giving a clue to mineral deposits.

MIRROR PINNED INSIDE OF CAR LATEST TRAVEL CONVENIENCE

Fastened to the upholstery on the side of the closed car's interior, a mirror may be quickly adjusted to any position desired and is attached without damage to the material. It is securely anchored so that it does not vibrate unduly and gives a distinct image. One used on each side enables occupants of the back seat to enjoy the glasses without leaning over.

Mirror Attached to Car Interior, and Close View Showing the Fastener

Concrete Observatory Shelter for Life Guards at California Beach; It Is Equipped with Radio Apparatus

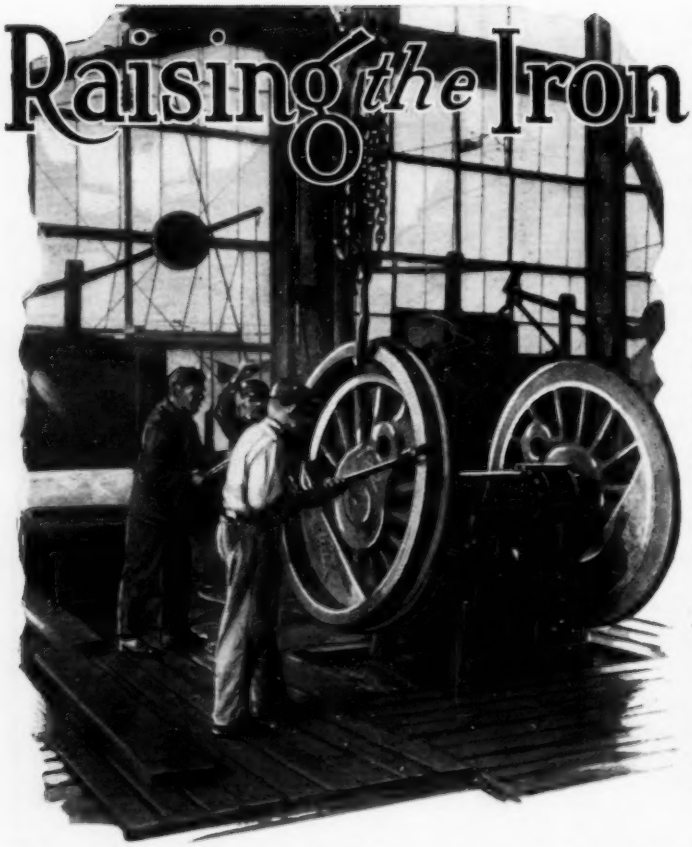
LIFE GUARDS' CABIN ON POST HAS RADIO CONNECTION

Life guards at the Santa Monica beach in California are snugly housed in a small cabin on top of a high concrete post, where they can command a wide view of the ocean. Besides being sheltered from the sun, they also have radio sets for communicating with other stations along the beach. Powerful searchlights protect bathers by night.

MISSING-KEY BOARD SERVES THEATER PATRONS

Keys found in a Portland, Oreg., theater, are hung on a board where patrons can see them and claim their property. "Is this your key?" a sign at the top inquires, and since the establishment of the rack, scores of grateful persons have derived service from the novel installation.

Raising the Iron Horse



Fitting a Red-Hot Rim, Heated to Expand It, over a Locomotive Drivewheel; Cooling and Contraction Assure a Tight Fit

BACK in the days when American industry was young and untried, a discouraged jeweler looking about for a better trade, formed a partnership with a machinist—and thereby one of the greatest locomotive factories in the world was born.

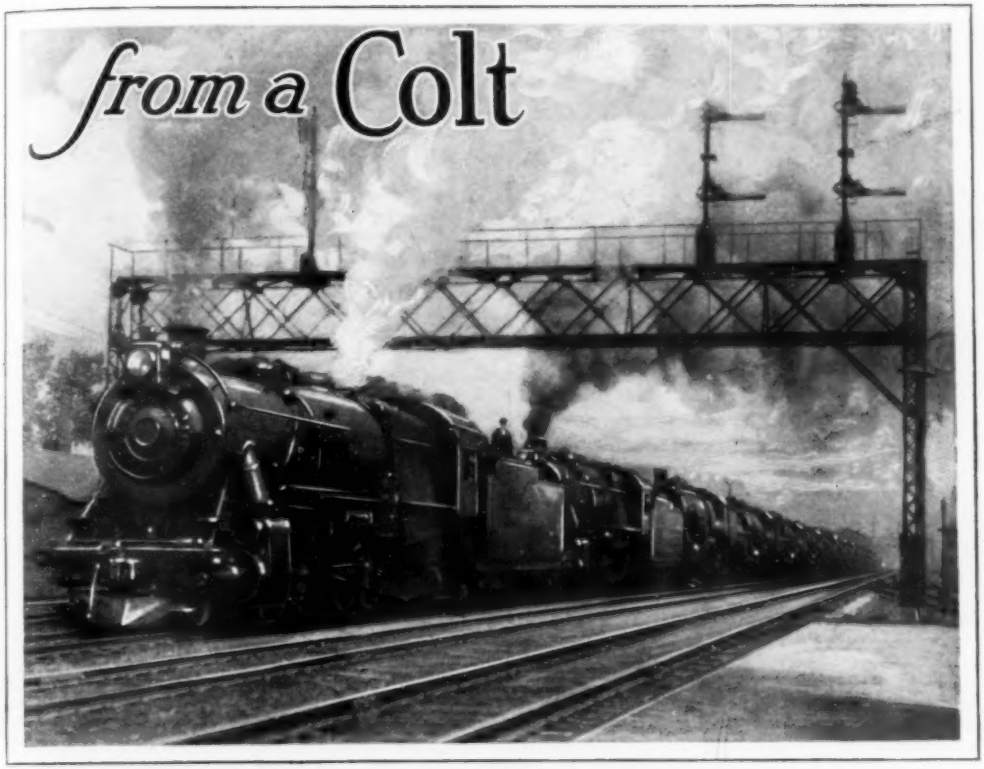
Matthias Baldwin, the jeweler, and David Mason, the toolmaker, didn't start out to make railroad engines, or any other kind of engines. Their plans covered bookbinders' machinery and cylinders for the calico printers of New England's cotton mills. Their first steam engine, a stationary vertical boiler, was born of necessity, for they needed a power plant for their new factory, and it was easier to invent one than to buy it. The engine was such a success that engine building became the major activity of the company, which soon narrowed down to one man, when Mason dropped out.

From the building of low-pressure, small-factory power plants, to a modern 2-10-4 locomotive complete with superheater and booster, is a long step, but Baldwin took it by easy stages. His first locomotive was the original "colt" that grew up to be the "iron horse" in America, for it was a baby-sized affair. The proprietor of the Philadelphia museum dropped in one day to tell Baldwin that Philadelphians were getting excited over reports of the success of steam trains in England. He suggested that a miniature train would draw crowds to the museum, and asked Baldwin to build the outfit.

With nothing but brief descriptions and crude sketches of Stephenson's "Rocket" and other English locomotives to go by, Baldwin turned out his first locomotive, and in the last week of April, 1831, this first engine to bear his name made its trial trip, on a circular track of pine boards reinforced with hoop iron, in the museum building. The Lilliputian locomotive drew two small wooden cars, providing seats for a total of four passengers.

Anthracite coal and pine knots furnished the fuel, and when the first Baldwin steamed along the hoop-iron rails, crowds flocked from a large section of the Atlantic seaboard to see the marvel.

Since that time, Baldwin and his successors in the company that bears his name, have built more than 60,000 full-sized locomotives, including many of the latest marvels of the rails, but none, probably, will ever be the mechanical rival of his first big job, the immediate successor of the museum engine.



A Train of Locomotives, Hauled by Two of Their Number under Steam, Starting across the Country for Delivery to a Western Railroad; the Engines Are Destined for Freight Service

The success of the museum demonstration brought an order from the Philadelphia, Georgetown and Norristown railroad company—a pioneer whose impressive name was only slightly shorter than its six miles of track—for a steam engine to replace the horses that then pulled the coaches over the rails.

An English locomotive had just been imported by another road, and Baldwin obtained an opportunity to inspect the parts before they were assembled. On the strength of that brief inspection, plus his previous experience building the small model, he turned out "Old Ironsides," the yearling of the future "iron-horse brigade."

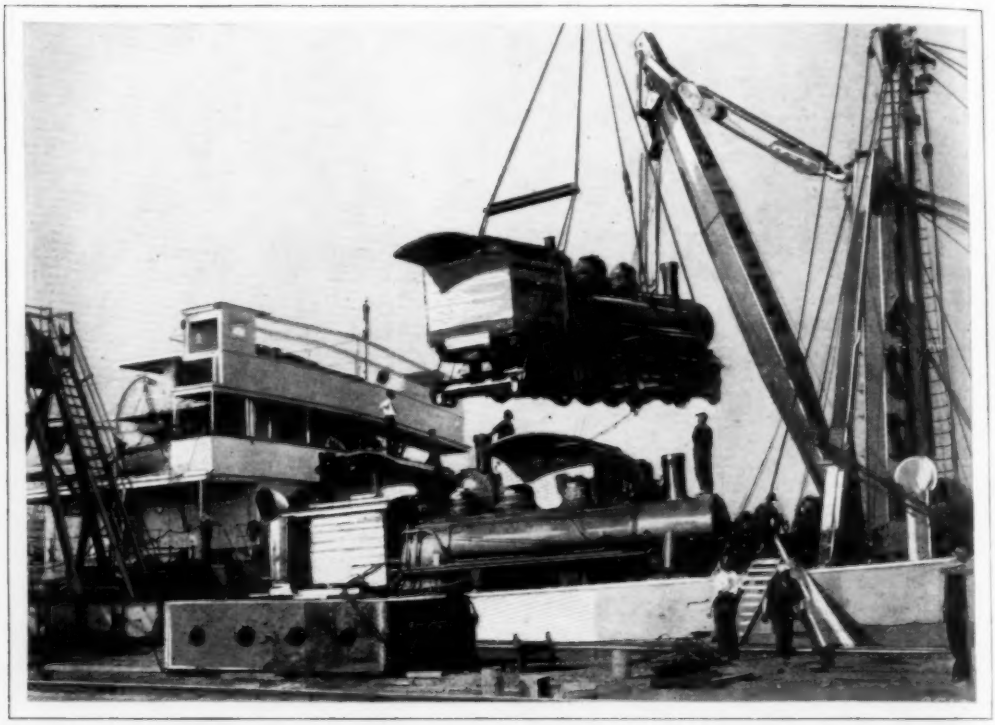
There were practically no tools in America suitable for engine building, and very few competent workmen. These few were blacksmiths, whose training did not extend much past the ability to weld an inch-square bar. Baldwin bored his first cylinders with a tool of his own design—a chisel mounted in a block of wood and turned by hand.

Despite the handicaps, a few days before Thanksgiving, seven months after the trial trip of the museum model, "Old Ironsides" took to the rails and did twenty-eight miles an hour over the bumpy track of the P., G. & N. R. R She was a four-wheeler, capable of pulling a thirty-ton load—a weight equal to about three-fourths the load of a modern average-sized coal car.

"This," said Baldwin, as he delivered the job to the railroad heads, "is our last locomotive."

Time, though, healed the scars of wrestling with that creative problem, and the lure of steam soon had him back in the fold. Just nine years later, he established a record by exporting the first locomotive shipped from the United States. Austria was the original purchaser and the export business, started then, has since grown to enormous proportions, for American locomotives are found all over the world.

The iron horse has changed remarkably since his colt days. The youngster didn't have a cab for the crew, he didn't have air



Loading Locomotives for Shipment to South America; the Engines, with Cabs Boxed, Are Loaded Intact by Special Derricks, and After the Hold Is Filled, Others Are Lashed on Deck

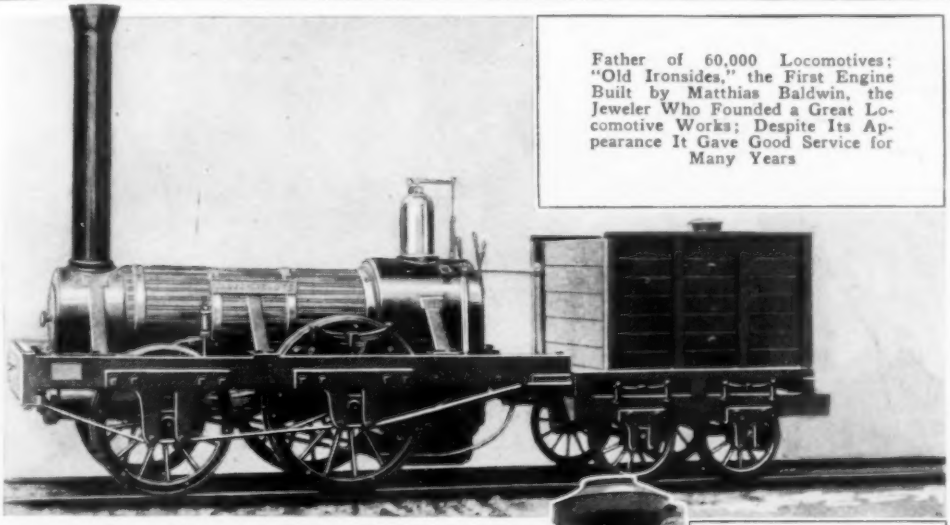
brakes to stop the train, he didn't have leading trucks or a pilot to put them under, and didn't have enough fire box to require trailing trucks, as the little wheels that follow the big drivers are called. His tender was a wooden box on wheels. He didn't have a bell or a whistle, a sand dome, a superheater, a flock of recording gauges, or any of the hundred and one gadgets that no locomotive engineer nowadays could do without.

The early engineer, as he appears in the old prints, was a stately figure standing out in the open, under—if it was a formal occasion—the sheltering brim of a tall and impressive beaver-fur top hat and even incased in a frock coat.

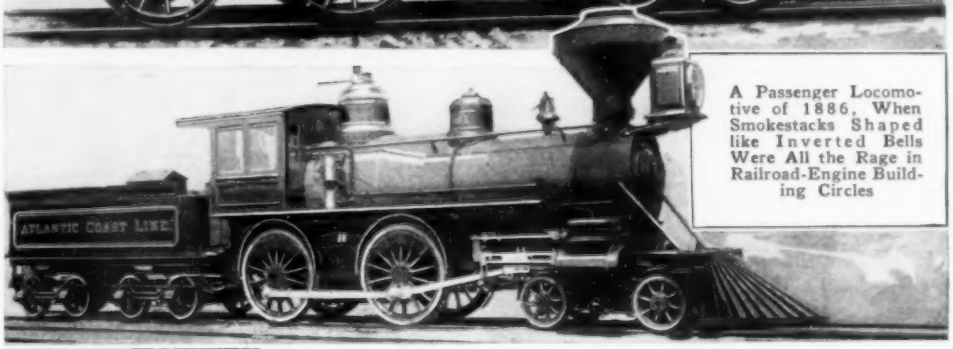
Compare that picture with the modern engineer, sitting at ease, probably on a well-upholstered seat, on the right-hand side of the engine cab. In front of and around him is a multitude of gauges, levers, knobs, wheels and other devices. He even rings the bell nowadays with a small steam engine, instead of pulling a lanyard, as in the past.

Within easy reach is the throttle lever, extending from the back head of the boiler. Just in front of him are two small levers which control the independent and train air-brake valves, and at his left side the long reverse lever sticks up through the floor. On some of the late models, a screw or power gear replaces the big reverse lever. The back head of the boiler is covered with recording instruments, under a shaded electric light. Steam gauges indicate the boiler pressure and steam-heat pipe pressure, and the water column shows the water level in the boiler. An electric pyrometer may be mounted to show the temperature of the steam entering the cylinders. Close to the brake valves are two gauges to tell the condition of the air-brake equipment. A host of small levers and valves control the water injectors, sander valve, bell ringer, whistle, headlight generator, stoker, steam to the train-heating line, and many other things.

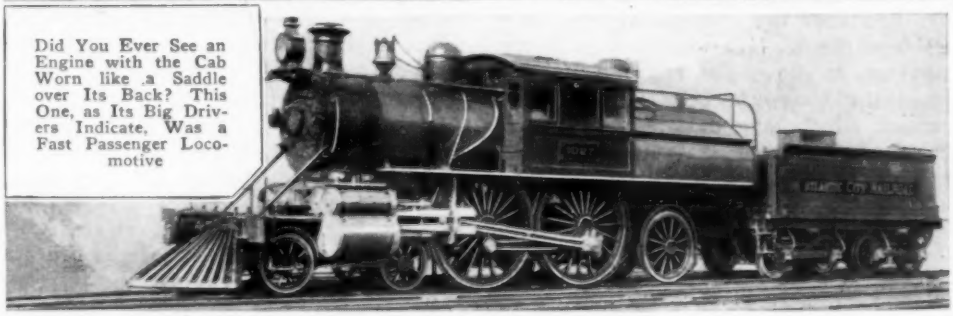
There is one valve that produces the cloud of steam that spurts from the cylinders just before the engine starts. That



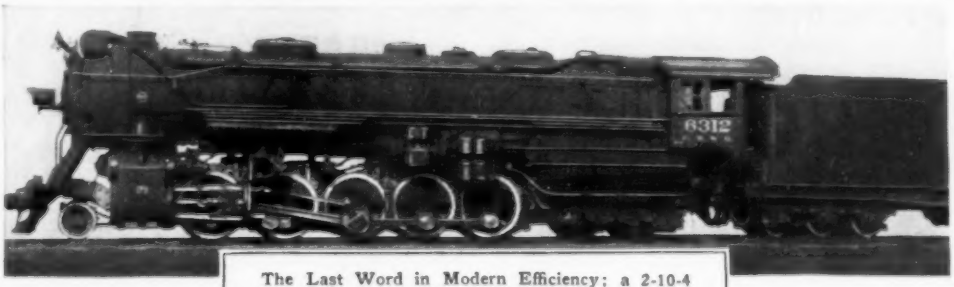
Father of 60,000 Locomotives; "Old Ironsides," the First Engine Built by Matthias Baldwin, the Jeweler Who Founded a Great Locomotive Works; Despite Its Appearance It Gave Good Service for Many Years



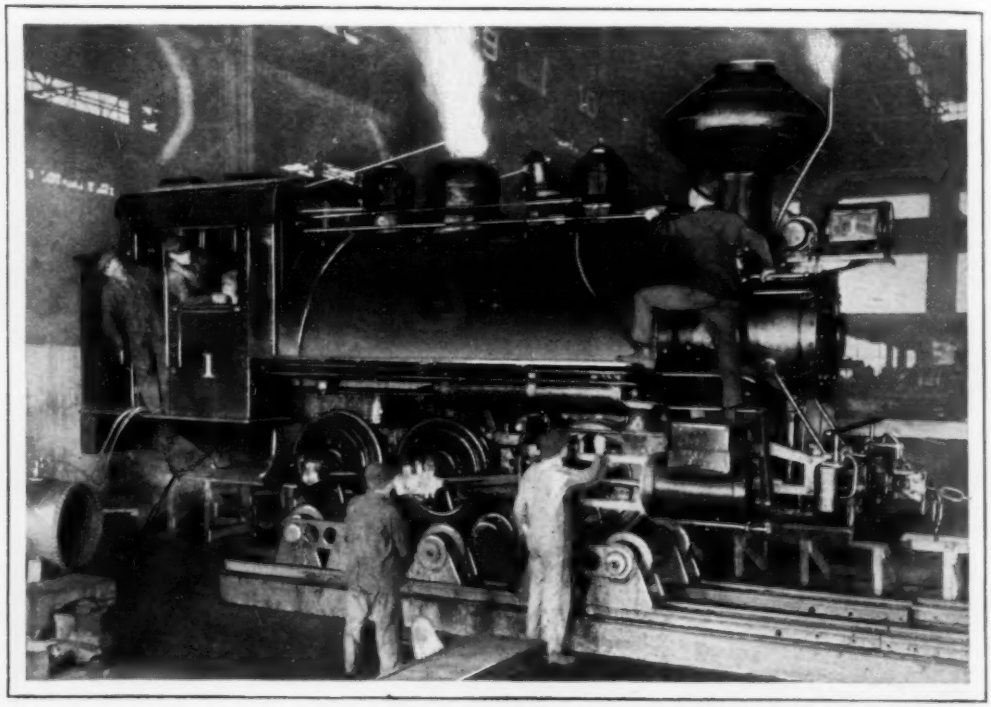
A Passenger Locomotive of 1886, When Smokestacks Shaped like Inverted Bells Were All the Rage in Railroad-Engine Building Circles



Did You Ever See an Engine with the Cab Worn like a Saddle over Its Back? This One, as Its Big Drivers Indicate, Was a Fast Passenger Locomotive



The Last Word in Modern Efficiency; a 2-10-4 Type (Count the Ten Driving Wheels) Built to Haul Heavy Coal Trains



Giving an Industrial Locomotive a "Road Test" on a Roller Track; Moving Parts Are Worn In and All Tests Made in the Shop by This Clever Arrangement

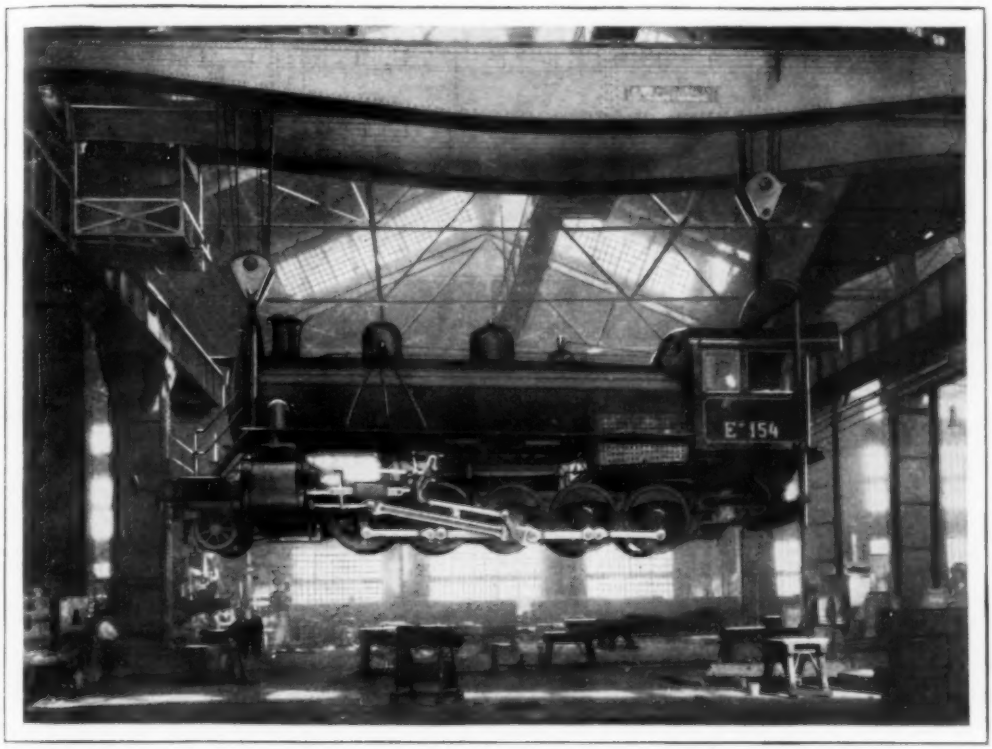
is done to blow out any water which may have condensed while standing still. Another produces the steam that jets from the side of the fire box occasionally. When it appears, it shows the enginemen have opened the blowout cocks to eject any sediment which may have settled at the bottom of the fire-box shell—the lowest point on the boiler.

The first locomotives, like "Old Ironsides," had all their weight on four driving wheels, but as their size increased, to cope with bigger and heavier trains, the four-wheel swivel truck was devised to support the front end of the boiler and guide the locomotive around curves. As additional power was needed more driving wheels were added, and to make room for them, a single pair of pilot wheels sometimes replaced the leading truck.

Higher speeds called for more steam, and to produce it, the fire box became bigger and bigger, so a pair of trailing wheels or a four-wheel trailer truck had to be stuck under that end of the locomotive to carry the added weight. Soon there were so many different kinds of engines, each designed for a specific purpose, that some way of classifying them became necessary and the number of wheels was taken as the criterion. The result is such symbols as "4-6-2" for a Pacific-type passenger locomotive, or, perhaps, "0-4-0" for a switch engine. The figures indicate the number of wheels in each group, beginning at the front of the engine. A 4-6-2 type has four pilot wheels, six coupled driving wheels, three on each side, and two small wheels under the fire box. The presence of a naught indicates there are no wheels in that position. Switch engines, for example, are often built without either pilot or trailing wheels such as the 0-4-0 and 0-6-0 type, in order to concentrate the greatest possible weight on the driving wheels, to give the maximum tractive power. The more weight on the drivers, the more pressure exerted to keep them from slipping when starting.

Locomotives, by the way, are always rated according to tractive power, and not horsepower.

The capacity of the locomotive is really limited by its ability to start a train from



Rail Giants Require Cranes to Handle Them; This One Is a 2-10-0 Switch Locomotive, as the Concentration of Its Weight on Many Small Driving Wheels Indicates

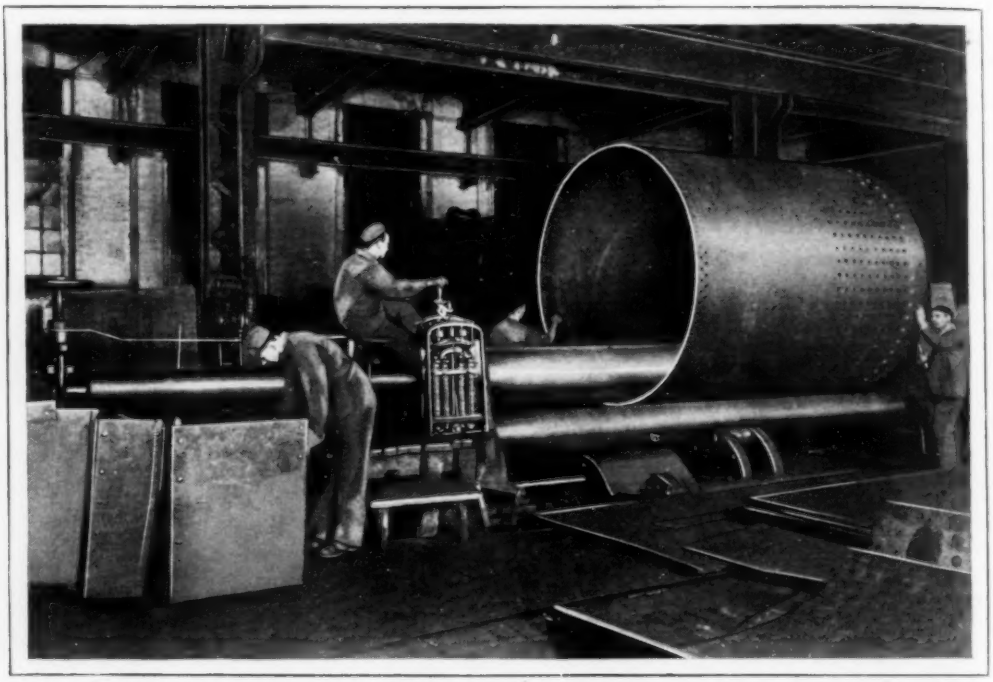
a standstill, so drawbar pull or tractive power is the standard of measurement. The boiler pressure, and the bore and stroke of the cylinders, determine it. Once the train gets up a speed of five to ten miles an hour, tractive power drops rapidly, and continues to decline as the speed increases, while the horsepower keeps on increasing until the boiler reaches its limit in supplying steam.

Railroad men have a very convenient way of determining how fast an engine will go, known as the formula of diameter-speed. Roughly, the maximum speed of an engine, in miles per hour, is the same as the diameter (in inches) of the driving wheels in engines. In other words, a freight locomotive with sixty-inch drivers will make sixty miles an hour at top speed, and a passenger locomotive with seventy-two-inch drivewheels can do seventy-two miles an hour.

Weight plays an important part in measuring what a locomotive will do, for without sufficient weight on the drivers, the wheels will slip on the rails and the formula of steam pressure, bore and stroke as a measure of tractive force ceases to work. In designing modern locomotives, the engineers plan to have approximately four times as much weight on the driving wheels as the tractive power needed. A Pacific-type passenger engine, to develop 40,000 pounds' pull at the drawbar, needs about 160,000 pounds on the drivers.

The bigger and better boilers and fire boxes of recent years have made it possible to add a third cylinder to heavy-duty mountain-type freight locomotives. The extra cylinder is mounted under the front of the boiler between the two cylinders of the conventional engine, and the front axle is forged with a crank, to which the piston rod is connected.

Another device to increase the starting power of freight engines is the booster, a small engine mounted under the tender and supplied with steam from the locomotive boiler. When a big train is to be started from a standstill, the booster is cut in and the engineer takes advantage of the tender's weight on its small-diameter

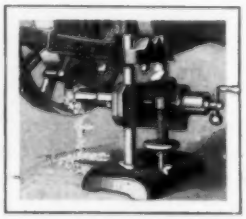


Heavy Steel Plates Are Bent, Drilled and Riveted by Mammoth Machines, in Contrast to the Painstaking Hand Labor Which Built Matthias Baldwin's First Engine Long Ago

wheels to develop considerably more pull.

While locomotives are classified according to the number and arrangement of their wheels, certain general types have acquired a special name associated in some way with the use to which the first of that type were put. Thus a Pacific type follows the general lines of long-haul, fast passenger engines, first developed for the western ends of the transcontinental roads. The Mikado 2-8-2 type got its name from the fact that the initial order was for the Japanese Imperial railways' heavy-freight service. These two, with the six-wheel switcher class, are the most commonly used, but many others have been developed for special service. There are Mallets, named after the inventor, compound Mallets and compound engines in general, meaning locomotives which first use the steam in high-pressure cylinders and then use it again in low-pressure cylinders; big 2-10-4 engines, giants of the roads, and even articulated locomotives, so long that they have to be jointed to get around the curves.

AUTO BRAKE DRUMS REFACED WHILE STILL ON CAR



Without removing them from the car, the brake drums can be refaced and trued with a simple unit that is said to function to an accuracy of one-thousandth of an inch. It is placed under the axle like a jack, the cutting member adjusted, and the automobile's motor is used to rotate the brake drum. The weight of the car holds the unit rigid so that there is little likelihood of chatter.

REINDEER HERDED BY AIRPLANE TO SAVE TIME AND LABOR

On some of the big arctic stock farms, airplanes are being used to herd the reindeer, according to reports. In two hours, one man can accomplish as much as seven in a much longer time in locating the animals and driving them together.

MELT ICE FROM RADIO WIRES WITH ELECTRIC "TOASTER"

By shooting electric current of high amperage through the antennæ of the naval radio station at Arlington, Va., engineers prevented the formation of ice on the wires during the latter part of the winter, thus saving costly breakages and interruptions in service. A special switching apparatus, functioning somewhat like an electric toaster, was devised for the process. To melt the ice, the antennæ were disconnected from the transmitter and transferred to other connections through which a circuit of 240 amperes was passed for ten minutes. The heat thus generated was sufficient to melt the ice, and then the wires were switched back to the transmitter set and service resumed. By means of special equipment, record was kept of the temperature at the ground and at the wires overhead so the operators would know when to apply the "toaster."

RIDING POLE ON MOTORCYCLE LATEST OUTDOOR SPORT

Pole riding has been introduced as a novel recreation by an English motorcycling club. The pole is attached to a special carrier, somewhat like a sidecar, and while one passenger clings to the elevated rear end, another sits at the other end to keep it from tipping up. The riders attempt acrobatic stunts while the driver of the motorcycle varies the amusement by riding over rough roads, and the like.

Enjoying a Rough Cross-Country Ride on Motorcycle and Swaying Pole

Machine That Measures the Strength of Hair before and after Marcelling

MARCELLED HAIR IS TESTED TO REVEAL STRENGTH

Does marcelling the hair or exposing it to other treatments make it brittle? A sensitive instrument, recently introduced by a research engineer, is said to answer the question with accuracy. It shows the strength and other qualities of the hair before and after the process and is also adapted to testing delicate wires.

"COSMETICS" FOR CHEESE

The art of make-up has been suggested for the cheese industry, but contrary to its usual function, it is to make the cheese look older. Chemists of the university of Wisconsin, seeking a way to prevent "slippery-rind" cheese, a condition that often results after the product has aged for some time, have reported that a preparation of lampblack, mixed into the paraffin coating of the cheese, removes the trouble. The outside will have much the same appearance as though it had aged in the usual manner.

Folding Movie Screen for Portable Film Projectors Can Be Carried in Own Case

FOLDING HOME-MOVIE SCREEN QUICKLY SET UP

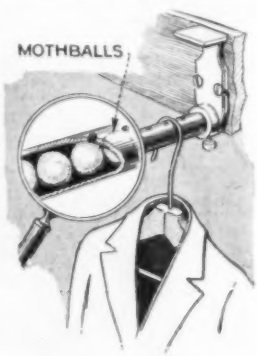
For the convenience of those who have home-movie projectors, a folding screen that can be set up or taken down in a few seconds, has been devised. It is inclosed in a handsome collapsible frame and the screen itself is on rollers so that it is instantly reeled up without the chance of crinkling or breaking. The frame base is rubber-protected, to prevent scratching furniture, and the screen stands alone. It is furnished in two surfaces, one of a metallic nature, that is said to reflect the maximum amount of light without haze and covers the greatest possible angle of vision, while the other is made of thousands of tiny glass globules imbedded in a special composition. This is said to eliminate all glare and affords a soft and pleasing effect.

MAGIC INSPIRED PRIMITIVE ART OF EARLY AMERICANS

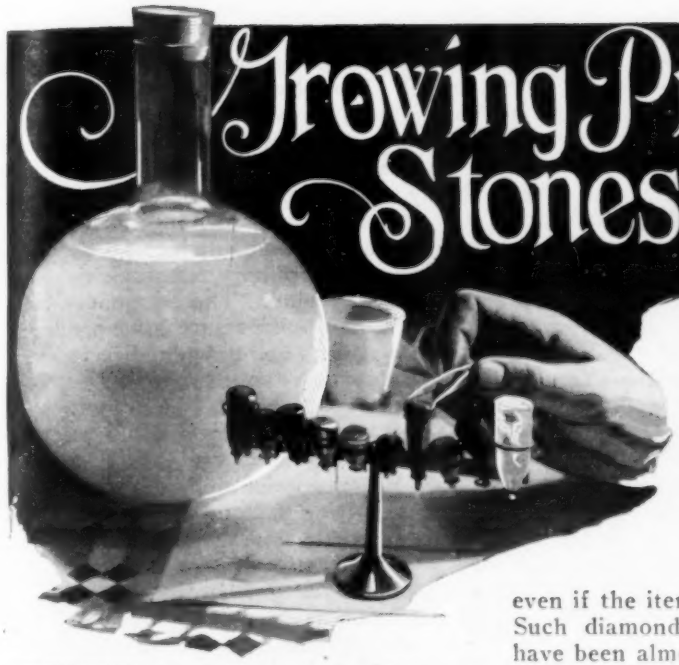
Like the cavemen of Europe, prehistoric Americans carved and painted pictures of animals and men to help in working magic, scholars declare. Mountain sheep and other animals, recognized in some of the early American art exhibits, were probably painted in connection with rites designed to make the herds of animals increase and so insure a plentiful supply of food. Other pictures marked the sites of water holes and important spots. Some of the moon-faced, angular figures of human beings scratched on the rocks are dancers in ceremonial rites and others appear to be deities. In Nevada and eastern California, explorers have found picture puzzles of angular design and elaborately drawn. Judging from the fact that they are sometimes found deeply buried beneath old mineral deposits, these are extremely ancient and their true meanings have, so far, not been interpreted.

CHEMICAL IN CLOTHES HANGER HELPS PREVENT MOTHS

Besides affording space for thirty to forty hangers, a garment rack now on the market holds moth balls or other chemicals in solid form to protect the fabrics. A compartment in one of the rods keeps the balls from getting lost and the fumes escape through openings. The hanger is adjustable to different lengths and may be attached with ordinary wood screws.



Growing Precious Stones



How the Jewels Look as They Come from the Fire, and Rack Containing Ruby and Sapphire "Boules" Uncut and Unpolished; in the Background Is a Container of Solution from Which the Jewels Are Prepared

GROWING precious stones that are more perfect even than nature can make them, and finally producing a gem that will be entirely new, is the task that George Everett Marsh, chemist by night and packer by day, has set himself and his associates, E. Menzel and Frank E. Challis. Already he has wrested from nature the secret of rubies and sapphires which he makes with a brilliance and clearness that vie with nature's best effort.

And his dream gem! On that they are at work. He thinks that it will be two-colored with a beautiful, fiery yellow center which slowly changes to ruby-red around a circular border. He almost has it now, but there still are some chemical and physical obstacles that must be overcome before he can offer it to the world.

These gems are not imitations, but are "grown" from the very substances nature uses to create her own rubies and sapphires, and these substances are made into one crystalline mass, called a "boule," perhaps weighing as much as 100 carats. There are only two gems which Mr. Marsh does not make. He can make the diamond, but at such high cost that the natural jewel is cheaper.

"It would take approximately 2,500 tons of iron to make one carat of diamond," explained Mr. Marsh. "You readily can see how impracticable such a process would be. Why, it would be almost impossible to provide facilities to melt the iron, even if the item of cost were overlooked. Such diamonds as have been produced have been almost microscopic in size and of no commercial value."

The other gem which is not made is the emerald. It is easy enough to obtain the raw materials for emeralds, but the element which contains the green coloring for the crystal invariably turns red under the heat necessary to fuse the substances. Any other color element that might be used—so far as is now known—would not have a close enough kinship to the basic emerald crystal to join with it.

The success Mr. Marsh has had in making synthetic stones is largely the result of his application to a hobby. He had received a scientific education at Massachusetts Institute of Technology, and even then had begun to turn his attention to the possibilities of creating gems. Shortly after he left college, his career as a chemist seemed doomed through the fact that a friend influenced him to join the office staff of one of the packers in Chicago. Immediate financial returns were more tempting, and Mr. Marsh, temporarily, put chemistry out of his mind.

But not for long. The search for the unknown was too great a lure to be ignored, and he set up a complete laboratory in the basement of his home. For twenty-one years he has worked in that laboratory at night. Three years ago he finally conquered the ruby and the sapphire, and

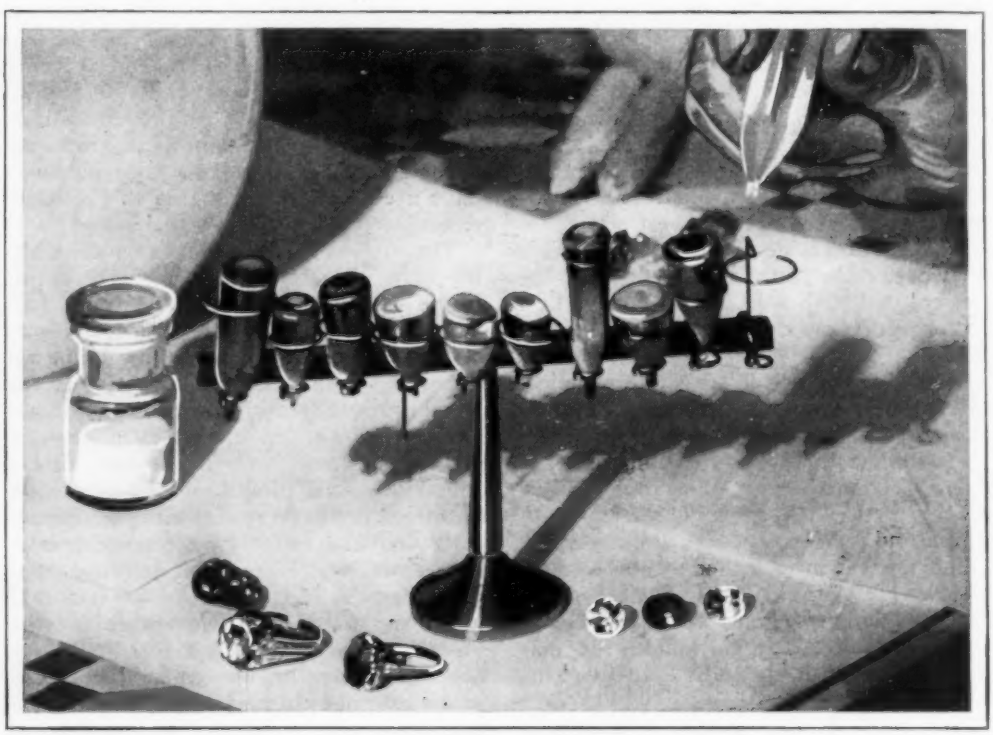
now they have become regular commercial jewels which may be had in almost any jewelry store in the country.

To begin with, Mr. Marsh knew from his chemistry lessons, that crystallized alumina is the white sapphire of nature. As early as 1837 small crystals of white sapphire had been produced synthetically, but the problem of getting gems of adequate size and of the color desired has just been solved by this enthusiastic chaser of jewel rainbows.

It had been assumed that the blue of the sapphire was caused by the presence of cobalt oxide. Nobody had ever found cobalt in a sapphire, but since cobalt oxide was used to give the blue color to glasses, enamels and glazes, its presence in the gem was taken for granted. Yet every synthetic sapphire was marred by an unnatural cloudiness. After eight years of patient effort, the blue sapphire was successfully analyzed and not a trace of cobalt was found. The color was due to the presence of a very small percentage of ferric oxide and a form of titanium. That was the real birth of the synthetic sapphire so far as its chemistry was concerned. The physical aspects of its creation offered no less handicap to its commercial production than had the chemical.

In his nights of research, Mr. Marsh finally worked out the process and the apparatus, in which his own ingenuity played so great a part, and in which so common a thing as an ordinary telegraph ticker is unexpectedly vital. The equipment consists of a high-temperature flame produced by ordinary gas and oxygen, directed vertically downward onto a small rod of aluminum oxide which is used as a pedestal on which to grow the stone. The pedestal is mounted on a movable rod which permits quiet and perfect control of the tip of the pedestal in relation to the flame. The blowpipe is so constructed as to give an absolutely symmetrical flame, and the pedestal is at all times in the axis of the flame.

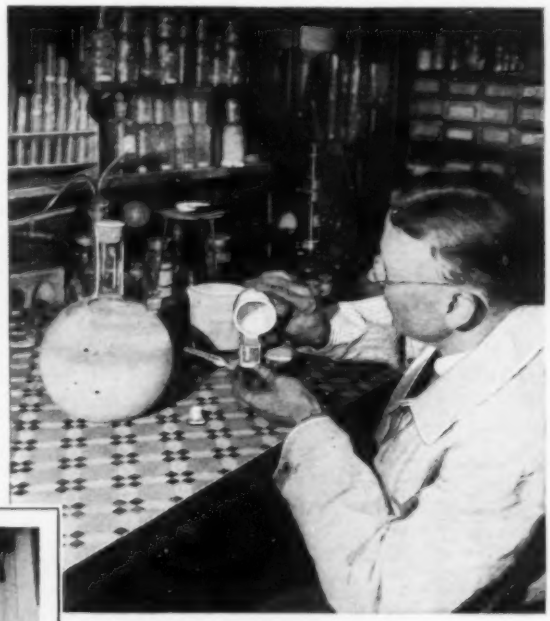
In the oxygen tube of the blowpipe, there is a cone-shaped chamber which contains the materials, in fine powder, that



Close View of the Uncut Jewels Contrasted with Set and Unset Sapphires and Rubies, Which Were Grown in the Basement Laboratory from Chemicals

are to be fused into the crystal of sapphire or of ruby. This chamber is constantly and rapidly vibrated by the use of a motor-driven telegraph ticker which strikes against the upper side of the cone. In that manner the even, free flow of the powder to its proper spot on the pedestal is definitely assured.

To conserve the heat, Mr. Marsh invented a cylindrical shield of alumina, insulated with asbestos. He now has decided to abandon the asbestos because of its shrinkage under the terrific heat—2,050 degrees centigrade—to which it is subjected. A small

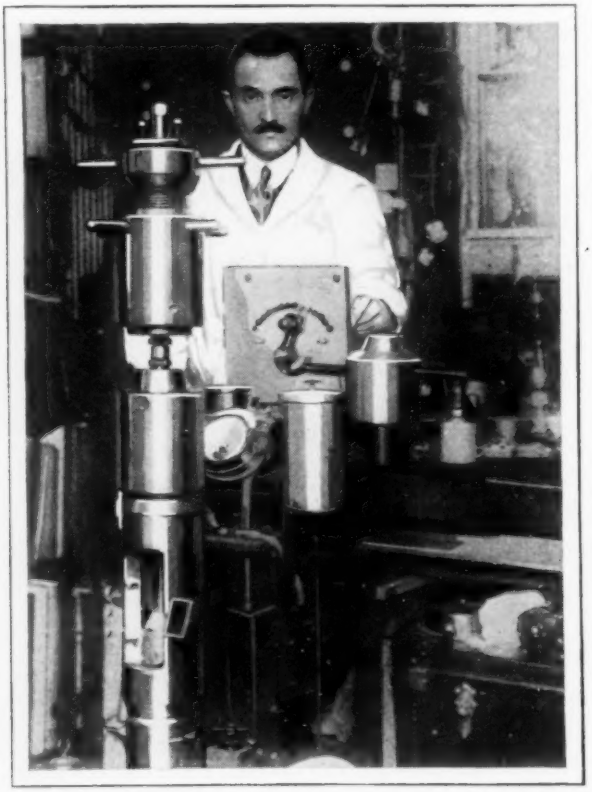


Mr. Marsh Preparing Chemical Mixture and at the Furnace; He Is Inspecting the Flame through a Shielded Telescope

slit in one side of the shield enables the operator to watch and control the growth of the crystal.

In the beginning of the creation of a jewel, the molten powder is permitted to become a part of the pedestal for the first few moments of its growth. Then a small round particle of crystal is developed and gradually widened out. As the crystal grows, vertically, the rod or pedestal is lowered. The speed of growth is rather slow, being about three to ten carats an hour, according to the gem and its color. The raw materials for both sapphire and ruby are alumina and the oxides—ferric for sapphires and chromic for rubies—which must be of the highest possible purity. The mixture of the raw materials must be absolutely uniform. Ruby material is prepared by dissolving alum of the highest purity in distilled water, adding a quantity of chrome alum to provide the chromic oxide. The amount of chrome alum to be added depends entirely upon the depth of the color desired. Every color and shade has its own chemical composition and its own characteristic set of internal strains under crystallization.

The imperfection in natural crystals may be caused by specks of foreign material or cloudy spots. Small crystals of other materials may appear, or the natural gem may have cavities or canals containing gas and water, or bands or zones of color. Most of these imperfections frequently are so small that they can be seen only under the microscope; nevertheless they go to establish the fact that natural stones rarely are flawless. Synthetic stones as made in the basement laboratory have none of those defects.



© Henry Miller

James Basset, French Scientist, Who Has Developed Process for Making Diamonds from Coal; Intense Pressure Is Employed to Effect Crystallization

Concerning his work, Mr. Marsh says:

"The chemist can surpass nature working in her Burma (India) laboratory, where she turns out the highly prized pigeon-blood rubies, worth $2,000 a carat, or her darker rubies with a purple tinge that she makes in her Siam laboratory. The production of the golden-rose sapphire—an exceedingly beautiful and rare gem found almost nowhere except in the possession of the maharajahs of India—would remain forever unknown to the world at large had it not been for the magic of chemistry.

"It gives one pause to think that a fifty to 100-carat ruby or sapphire crystal now can be cut into a gem after a few hours of growing—a growing which took nature eons of time to produce."

Mr. Marsh is not particularly interested in the commercial exploitation of the jewels he makes. Every crystal produced from his furnace is sent abroad to be cut and then resold in the United States. The fashion of today, which decrees colorful jewelry to match feminine gowns, has made a great demand for synthetic gems. But Mr. Marsh desires to devote his future time, not to manufacture so much as to the creation of another gem—one which nature, so far as known, has overlooked.

FOUNT PROLONGS LIFE OF TYPEWRITER RIBBONS

An ink fount for reinking typewriter ribbons, while in use, and which, it is claimed, will extend the life of a ribbon as much as twelve times, besides making uniformly inked work possible throughout that period, is being marketed by a Chicago manufacturer. Two of the founts are attached to the machine, one at either side, the ribbon feeding through them before passing under the type bars. Only the lower half of the ribbon is inked, the pigment spreading upward, so that it is evenly distributed through the upper section, which is in use. After a thousand letters have been written, it is claimed the last will be of exactly the same color density as the first. Designs suitable for all types of standard typewriters are to be produced.

SLIP CUP ON UMBRELLA GRIP HOLDS RIBS TOGETHER

In place of the familiar tie flap to hold the ribs of an umbrella together when it is closed, a slip cup which is part of the handle grip has been introduced. It slides down over the tips of the ribs which fit in a slot on the cup. The unit is made of attractive material and is decorated to match the rest of the grip.

slow, being about three to ten carats an none of those defects.

SAFETY PROMISES GREAT FUTURE FOR FLYING

Aviation today is as safe as any other form of modern transportation, states the current report of the Daniel Guggenheim fund for the promotion of aeronautics. According to Harry F. Guggenheim, president of the fund, the airplane of the future will be safe even under adverse conditions. In 1927, the British imperial airways carried 52,000 passengers over 2,500,000 miles without a mishap. In 1842, eight English railroads carried 10,508 passengers 3,562,338 miles, but with a number of mishaps and fatalities. Up to the last of February this year, planes of the National Air Transport had flown more than 1,500,000 miles in this country with but one fatality and no injuries. Prizes totaling $150,000 have been offered by the Guggenheim foundation for developments in safer aircraft.

Building a Subway in Berlin; the Tunnel Sides and Top Are Constructed of Steel and Concrete After Channel Is Excavated

SUBWAY BUILT IN DEEP DITCH TO SAVE TUNNELING

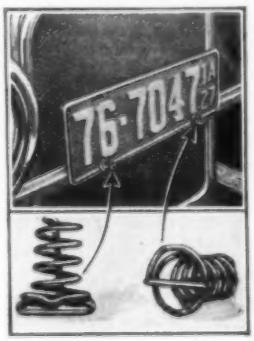
Instead of boring a tunnel to construct a subway, engineers in Berlin first excavated a deep channel, erected the forms for the inclosure and then filled in around the tube. This method is considered practical when no great depth is necessary and when the character of the ground permits easy digging.

HUMIDIFIER WITHOUT A MOTOR SAVES ELECTRIC CURRENT

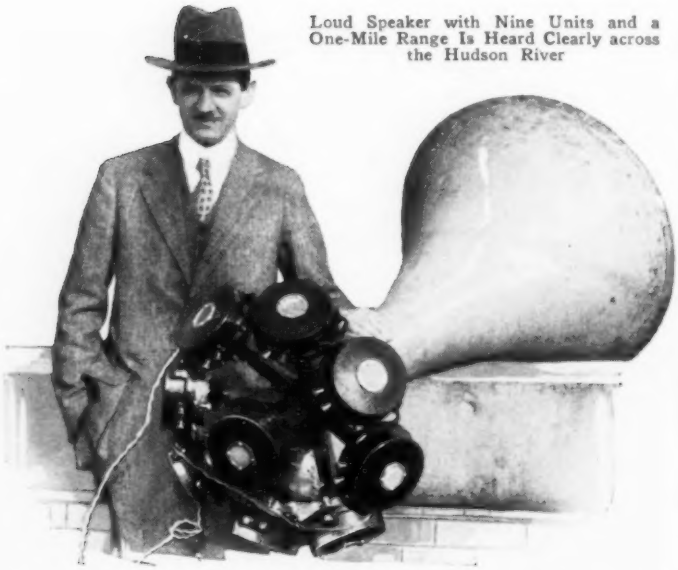
For keeping cigars or other merchandise moist, an electric flasher humidifier, now on the market, is operated without a motor, reducing the initial cost and the expense of upkeep. A special bulb is screwed into the holder basin around a wick that absorbs water from a container below. As the bulb flashes on, the heat causes a more rapid evaporation of the water and spreading of the moisture. It is necessary to operate the humidifier only two or three hours a day to keep the stock in good condition.

LICENSE-PLATE SNAP FASTENER ELIMINATES BOLTS

Instead of attaching the automobile license plate with bolts or screws, it may be securely fixed in place with spring snap fasteners made of strong wire. They are easily connected, given a quarter turn to tighten them, and remain firmly in position. An enamel prevents them from rusting.



furnace is sent abroad to be cut and then of the grip.



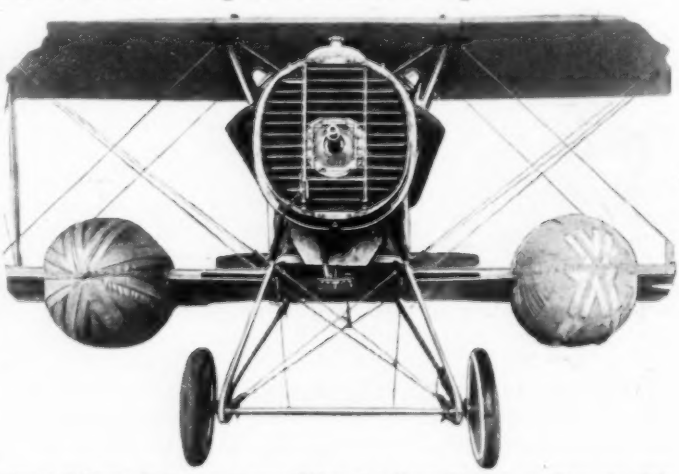
Loud Speaker with Nine Units and a One-Mile Range Is Heard Clearly across the Hudson River

LOUD SPEAKER THROWS VOICE MILE IN THE AIR

Commuters ferrying across the Hudson river to New York recently were startled when a giant voice, speaking clearly and distinctly, asked a mysterious and unidentified Mr Schwartz if he could hear the speaker plainly and followed the question with a booming "Ha! ha! ha!" that rattled the window panes on the distant New Jersey shore. The giant speaker, with a mile range, was atop the Bell building in New York, and R. W. King, the expert in charge of the demonstration, stood at a telephone on the Jersey shore, a mile away. Each time he spoke, the electric waves traversed the river bottom by cable and were delivered to the speaker on the roof. The voice, amplified to a giant tone, came winging back through the air, seconds later—slowed down to the speed of sound so the effect was much like an echo. The speaker units themselves are unusual, for the diaphragms are of very light aluminum, around which is wound a coil of thin aluminum wire, finer than thread. The current passes through the coil and vibrates the sheet of aluminum owing to the fact that the thin coil lies in close proximity to the iron pole pieces of the field magnets. The instrument is designed primarily for public-address systems, and the like.

BALLOONS IN WING OF AIRPLANE TO KEEP IT AFLOAT

Successful experiments with small inflated bags attached to the lower wing of land planes, for the purpose of keeping them afloat if forced to descend on water, have been carried out at the air station at North island, San Diego, Calif. The balloons, which are not large enough to interfere seriously with the speed of the plane, are built onto the lower wing on either side of the fuselage and provide enough buoyancy to keep the airplane above water. Experiments are also being made with another type of float bag, carried in the cockpit in a deflated condition, and filled from a high-pressure gas cylinder in emergency by simply opening the connecting valve. It has the advantage of offering no resistance in flight

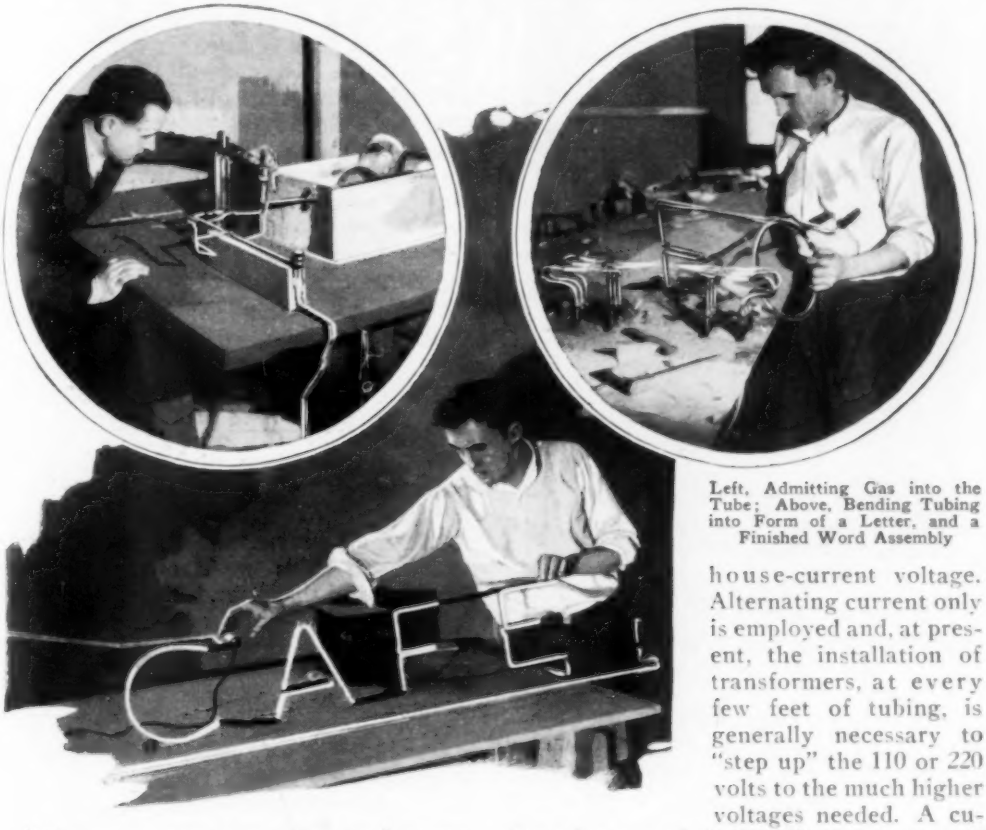


Small Balloons Built into Lower Wing of a Navy Biplane, to Keep the Ship Afloat in Event It Is Forced to Descend on Sea

to keep the stock in good condition.

them from rusting.

COLD LIGHT FROM RARE GASES RIVALS THE SUN



Left, Admitting Gas into the Tube; Above, Bending Tubing into Form of a Letter, and a Finished Word Assembly

Not many years ago, neon and argon, two gases found in the air, were unknown, but today they are of increasing importance in electrical illumination. Advertising signs and other units are being made in large numbers of glass tubing filled with neon or a mixture of these gases. When electric current of high voltage is passed between conductors at opposite ends of the tube, a brilliant glow is produced. The neon alone gives a reddish light, neon and argon together with mercury produce blue. The light has great fog-penetrating powers, it is a "cold light," and only a fraction of the current is needed for a sign as compared with that burned by a bulb unit of equal size. So brilliant is the neon light that it is plainly visible in bright sunshine when ordinary electric lamps are hard to distinguish. There is promise that this form of illumination may be adapted to home use with an outfit that can be operated on ordinary house-current voltage. Alternating current only is employed and, at present, the installation of transformers, at every few feet of tubing, is generally necessary to "step up" the 110 or 220 volts to the much higher voltages needed. A curious feature of the installation is that, if the sign has been properly constructed, the gas will last for an indefinite period. The making of a sign of this type requires great skill. One of the most important steps is to obtain as complete a vacuum as possible in the tubing. The air is pumped out after the tubing has been bent to the required shape and the conductors installed. When the air is exhausted, the gas is let in, whereupon the tube is cut off and sealed.

NEEDLE TO MEND STOCKINGS KNITS UP RUNS

Fashioned like the knitting units employed in weaving stockings, a special needle for mending runs is easily used and effectively conceals the damaged area. No additional thread is necessary as the strands of the stocking supply sufficient material for the mending.

Window Pane Transformed into a Picture Gallery; Sketches on the Glass Hide Soiled Surface

PICTURES PAINTED ON WINDOWS TO SAVE WASHING

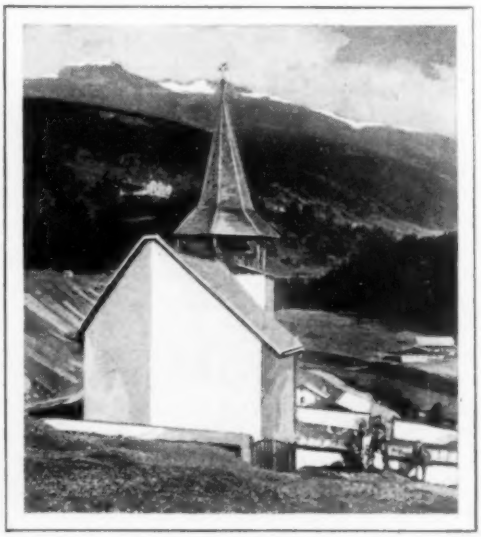
Members of an art colony in Boston have solved the question of keeping some of their windows attractive. Instead of having to wash the glass constantly, they merely use a paint brush now and then, for the panes are covered with decorative designs of wide variety and color. The plan is especially well suited for windows that are not greatly needed to admit light, and even painting the glass does not shut out all the illumination, as there are open spaces in the designs.

COAL IS TESTED WITH X-RAYS TO REVEAL BEST GRADES

X-rays have been applied in France to the testing of coal for purity in order to determine for what purpose the various grades are most suitable, an important matter in several industries, as, for example, coke production, briquette making and the like. There are two methods, one of which can be used to test lumps up to five to six inches in thickness as well as coal in powder form, while the other applies particularly to the latter. The first is based on the fact that the rays penetrate the carbon more readily than its common impurities so that the foreign substances leave darker shadows in the X-ray picture. The other method serves to determine the ash content of the sample and takes advantage of the fact that gases are made electrical conductors when X-rays are passed through them. Introduced into a gas-filled tube, connected with a source of electrical current, the coal specimen offers an additional resistance varying with its purity, and the passing current is measured by a suitable ammeter. In both cases, a standard of chemically pure carbon is used for comparison.

CHURCH TO SPLIT LANDSLIDES PROTECTS VILLAGE

In a Swiss village where landslides are not uncommon, the back of the church has been constructed as a V-shaped wedge to split an avalanche that might come against it. The walls are of unusual strength and thickness. Another effective means of guarding towns from landslides is to build strong stone walls on the mountain sides to interrupt the earth and snow masses. Flat shelves scooped out of the steep declines, also are efficient in halting a slide. In many instances the roofs of the houses are built at the same angle as the hill behind them so that an avalanche will pass over them.



With Its Back to the Hills to Hold Landslides in Check; Swiss Church That Protects Village

How Your Eyes Fool *You*

By DONALD A. LAIRD
(Psychological Laboratory of Colgate University)

THE eye is able to distinguish about 30,000 colors, if used properly. But most people have difficulty even in matching two reds.

A large mid-western printing concern would have saved several thousand dollars on a single job last year if they had used a machine recently invented at the Massachusetts Institute of Technology for matching colors with scientific accuracy.

When the Hawk Sweeps Down on His Prey, It Is Motion and Not Color That Attracts Him. For His Eye Is Most Sensitive to Movement

But the machine had not been invented at the time, and they matched colors by the unaided eye. An order for great quantities of calendars had been placed by a company with the specific demand that their trade-mark be reproduced in the exact colors under which it was registered in Washington, and they refused to accept the shipment. The color looked right in the printers' plant, but it was obviously not right when examined in daylight by the customer.

Anyone is apt to make the same mistakes, and they may be as costly in the long run as the printers' error. Never do we see colors correctly unless we follow certain simple precautions; that is why counterfeiters are easily snared. They may make a perfect engraving of the spurious bills they are going to print, but the color will almost always trap them. Ultraviolet rays are especially useful in detecting the spurious bills by altering their entire color scheme in comparison with the genuine bill.

Everyone knows that colors appear different under various kinds of light. Yellow, for example, is invisible and appears black unless there are some yellow rays in the light that falls upon it. Along the north shore of Chicago is a new theater designed after the Spanish manner to the last detail. When the lights are on, it is resplendent with red and yellow painted designs. When the pictures are being shown, the eye can see just red and black designs; the yellow fades away the instant the lights are down. Why? When the pictures are being projected only a few red exit lights are burning in the auditorium. There are scarcely any yellow rays in these lights, so the yellow paint is invisible, that is, the yellow looks black, while the red stands out more brilliantly.

We have all had experience of this nature. I remember a friend who was very conservative and wore only blue serge suits. A few years ago when there was a

Science Has Solved the Color-Matching Problem by Producing the Special Light That Makes Colors Appear as They Will in Actual Daylight

vogue of purple-colored suits for men, he bought one, thinking all the time it was blue serge. His eyes were perfect, but in the light in the store the material had looked like the conservative serge he had wanted. As soon as he wore the suit out of doors, the real color was apparent.

You or I might have taken the suiting to the front of the store and examined its color in daylight that came in the street door, to find the real color. As stores have become gigantic organizations, however, there is not enough outside light to make this possible. But science has provided a substitute.

In one department store there are hundreds of small bronze electric fixtures on the counters. These look like desk lamps, but have been especially engineered with a color filter placed below the electric bulb to give colors the appearance they have in the daylight.

This is as far as a store can go in assuring that we will see the colors correctly, but unless we know how to use our eyes we are still likely to make some ludicrous, and possibly costly, mistakes.

There is contrast, for example. If we have been looking at a green color and then turn our eyes to a red, the red will look redder. Or, in case we have the red and green side by side, both colors will be intensified, the green will be greener, the red will be redder. This is why a red-headed girl who is sensitive about her hair should avoid green hats. A blue hat, on the contrary, will tone down the redness by this contrast phenomenon.

This illustrates two other precautions to follow in gauging colors, whether in personal clothes, or tempering, or mixing paints. One is that for three or four minutes before judging a color, the eye should not look at any color. A medium gray is the best to look at to prepare the eye for a correct estimate. The other precaution is that no other colors should be in the range of the eye while we are trying to judge a sample color. Looking at a large piece of gray felt or blotting paper prepares the eye for a correct match, and is also the best material on which to place the colors being matched. Any other colored paper is likely to be disastrous.

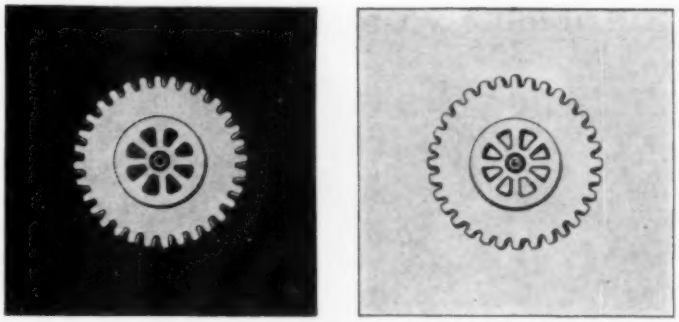
Only the central part of the eye, directly back of the pupil, is sensitive to color. When we look "out of the corner" of our eye, we cannot sense colors, but we detect motions better. The precaution that follows from this is to look squarely at the color to make sure that the eye focuses its image on the central part of the retina.

It has long been known that the Greeks used to paint their marble statues to give better effects. They also used to paint their temples. This was to add to the illusion. Objects look larger when they are red. The large woman, accordingly, should not wear great amounts of this

Close the Left Eye, Fix the Right Eye on the Black Dot, Move the Page Slowly Away, and, About a Foot from the Face, the Automobile Will Disappear, Being Focused on the Eye's Blind Spot

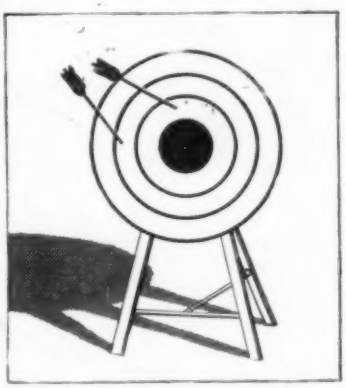
color. But a package in red will look larger than it really is. In early morning and late evening the sun looks larger than at noon; this is partly because it is predominatingly red at these periods of the day.

The red sun also looks closer than at noon when it is yellow. Red is known as an "advancing color," that is, red objects appear closer than they really are. Blue objects, on the contrary, appear farther than they actually are: blue is a "retiring color."



Two Gears in Exactly the Same Shade of Gray, Yet the Background Makes the One on Black Lighter, Apparently

A small room or hallway should not be painted red or green. These colors, the red especially, give an appearance of the walls coming toward the eye and make the place look smaller than it is. Blue walls will appear to add several square feet of floor space in a hallway by the illusion they create of bringing the walls farther from the eye.



Clip This, Mount It on a Sheet of White Paper, Stare at It While You Slowly Count Twenty-Five; Then Look at the Blank White Paper and See an Afterimage in Which the Original Black Lines Appear Either Gray or White

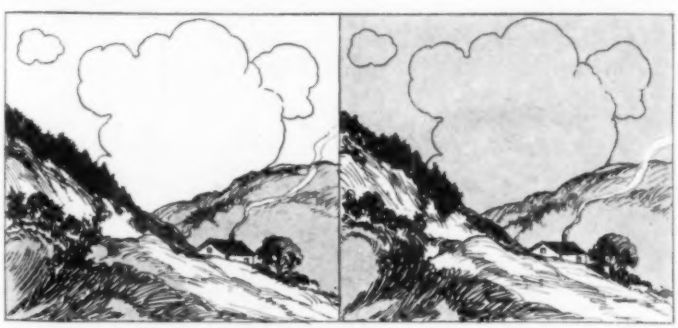
Another interesting contrast between red and green is that a room decorated in red appears warmer than one of green or blue. Of course, the thermometer does not change because of the color, but it seems so to us. The reason for this peculiar deception is not known, but the deception itself is worthy of consideration.

Summer slip covers for furniture, or summer drapes, should be of blue hues to make the house more livable in the hot months. A red rug, in contrast, will add to the comfort of a home in winter by making it appear warmer. A general rule is to use reds in rooms with a northern exposure, blue and green in those facing south. I know of one man who adds a blue electric bulb to his fixtures in summer, while in winter its place is taken by a red bulb. Some theaters make similar changes.

Blue is also a more soothing color than red, which is known as an exciting color. In hospitals you will find very little use made of red colors except to mark exits. Blue or green is a good color for a study or bedroom.

In the language of color, rose is an inviting color which suggests health, beauty and affection. Yellow is a cheerful color and suggests happiness. Purple is a royal color, suggestive of luxury, dignity and mystery.

The study of color is being applied daily to furnish more soothing and efficient office interiors, better light in factories and hospital operating rooms, and the wide range of new tints in lacquers for autos.



The Sky at the Left Appears Broader and Deeper Than the One at the Right; the Same Illusion Applies to a Hall Finished with Blue Walls

UNDERSEA WONDERLAND IS REVEALED BY CAMERA

How Explorer Beebe Looked While Taking Movies under the Sea; Making a Note on Sheet of Zinc, and a Batfish

Further marvels of the deep have been discovered by William Beebe, director of tropical research of the New York Zoological society, who recently explored a submarine wonderland off Haiti, telephoning his observations to his secretary in a rowboat, and making notes with a pencil on small sheets of zinc while he walked among coral reefs. He wore only a swimming suit and a special diving helmet. With a steel-inclosed camera he was able to take motion pictures of the weird world about him. He descended, on one occasion, to a depth of sixty feet with his simple equipment, and averaged two or three hours a day below water for a period of four months. It is easy to dive in this manner, Mr. Beebe declares. The sensation of wetness is not pronounced, he says, as the diver is wet all over. Walking is not difficult. Among the interesting things he observed were strange fish that could change their colors swiftly, sponges that weighed hundreds of pounds, batfish with fins like human hands to help them walk about the floor of the ocean, and other species equipped with lights on long tentacles to guide them through the submarine darkness.

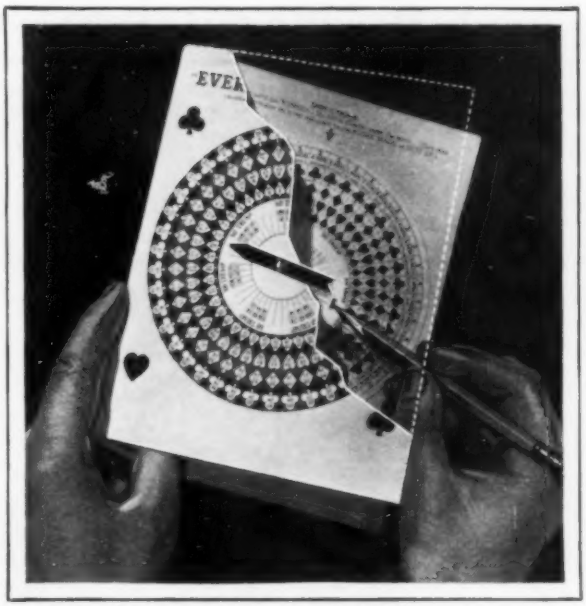
"FORTUNE TELLER" FOR AIRMEN REVEALS FLYING FITNESS

Careful examination of candidates for the army air corps is necessary, for training the men is a costly process and, if a man is physically or mentally unfit to become an aviator, the instruction is wasted. To help determine whether they will

the Same Illusion Applies to a Hall Finished with Blue Walls

lacquers for autos.

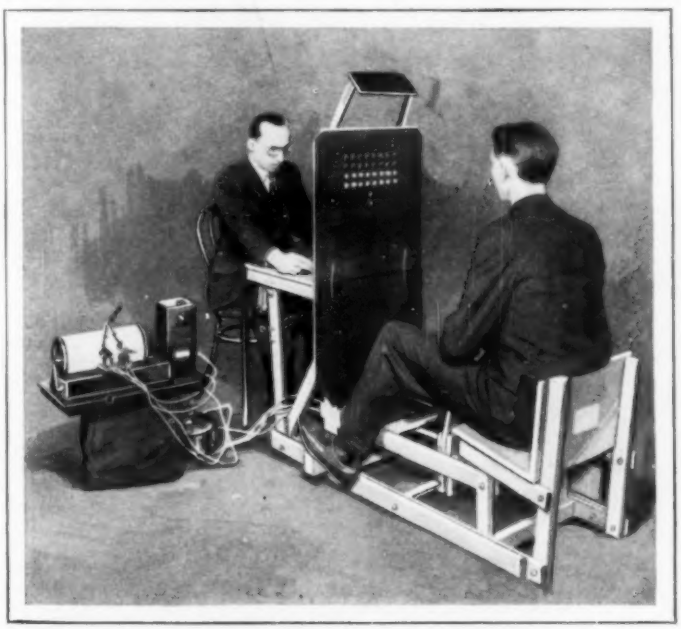
succeed or fail, use is made of an ingenious testing outfit, a "fortune teller" that is said to have revealed qualifications with great accuracy. The subject sits in a seat like that of the average plane, grasps a control stick and watches an assortment of electric bulbs on a board in front of him. When one of the red lamps glows, the candidate is supposed to shift the stick as rapidly as possible to another position. The time he takes to complete the maneuver is exactly registered, and as other lights appear, he is required to make other movements with the stick. At the end of the test, a graphic record of his performance is afforded the examiners who can judge with fair accuracy if the subject possesses the innate "air sense" and responsiveness to changing conditions so necessary in flying. At the flying school at Brownsville, Tex., the apparatus has received a thorough trial. Men whom the outfit revealed as probable "flying failures" were allowed to take the course, but in practically every case, they did not make good in the actual operation of a plane.



Bridge-Score Card with Top Surface Cut Away, to Show Magnet That Governs the Arrow

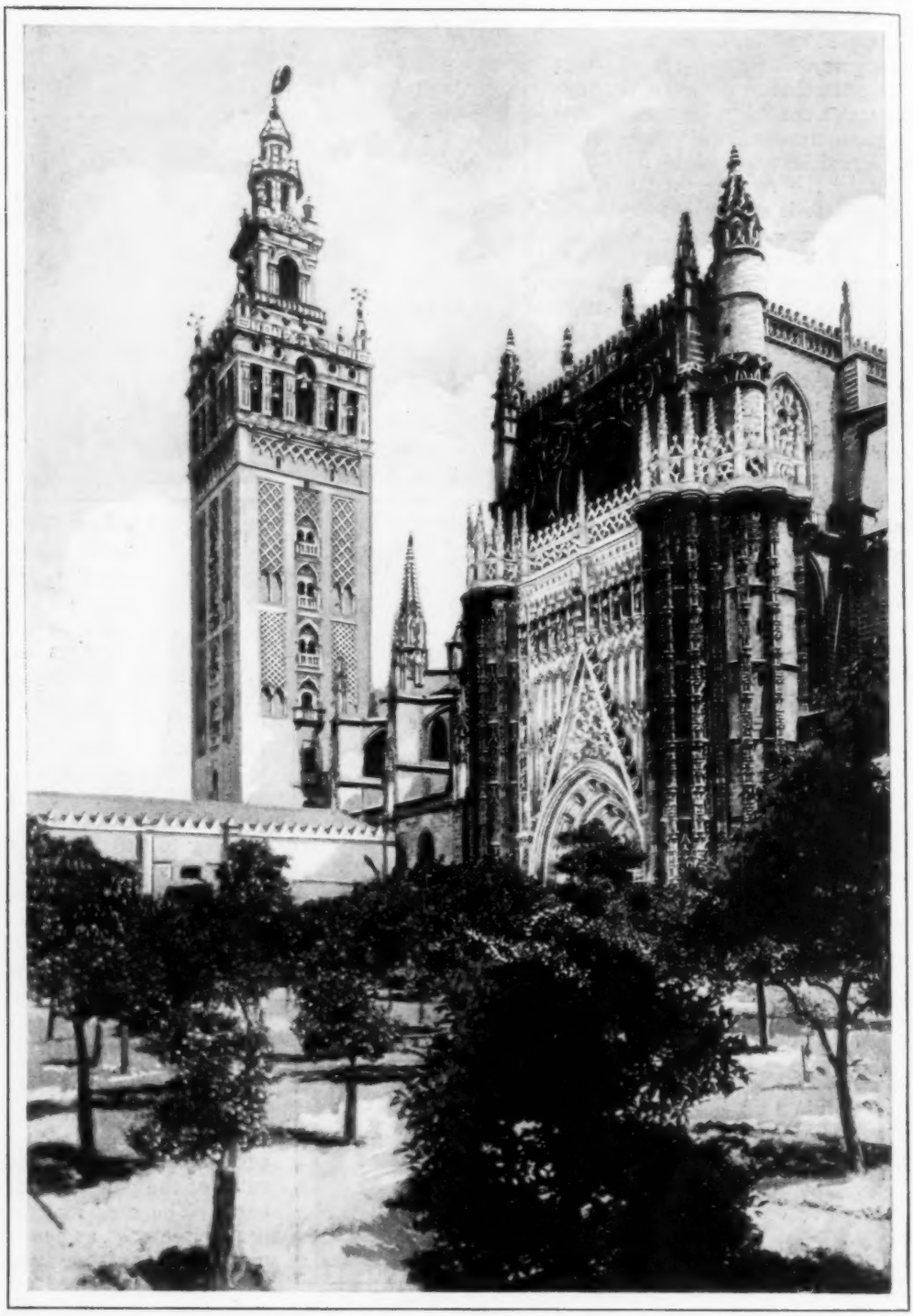
AUTOMATIC BRIDGE-SCORE CARD ELIMINATES FIGURING

Both the trick and honor scores are automatically computed for bridge players on an indicator that saves calculating in the usual way. It consists of a folded card with the key on the inner surface. This is simply a round disk marked according to the tricks and honors scored. It is turned until the proper division is opposite an arrow, then the outer leaf is folded down over the disk. A magnet in the leaf bearing the key sends an indicator around to a place on the outer table opposite the right score for any suit. The device also has a score card on the inside and rules of the game on the back. The card may be used repeatedly, as pencil markings on its waxed surface can be wiped off with a damp cloth.



As Lights Show on Board, Candidate Responds with Movements of the Controls Similar to Those in an Airplane

HISTORIC SEVILLE TO SEE TWO WORLDS UNITE



trols Similar to Those in an Airplane

IN SPAIN'S "IBERIAN-AMERICAN" EXPOSITION

Spain Will Get Together Again with Her Lost Colonies of the New World Next October, When the Iberian-American Exposition Opens in Historic Seville; the Event Is Expected to Draw Thousands of Visitors from Both North and South America to View the Exhibits and See the Famous Buildings of the Ancient Spanish City; on the Left Is the Patio of Oranges, with the Cathedral and Giralda Tower, the Latter One of the Most Beautiful Buildings of Moorish Spain; the Cathedral Is Built on the Site of the Ancient Moslem Mosque; Above, the Palace of Ancient Art of the Exposition, and, Below, the Plaza

Illuminated Club Helps Paris Policemen Direct Traffic at Night; It Has Red and White Bulbs

POLICE CARRY LIGHTED CLUBS TO DIRECT TRAFFIC

To assist in directing traffic at night, Paris policemen are carrying lighted clubs, somewhat like the illuminated baton of an orchestra leader. They are equipped with a red and a white bulb, both supplied with current from batteries attached to the policeman's belt. A switch exposes either of the lights desired.

AIR VENTS IN MILK-CAN TOP HELP PREVENT SOURING

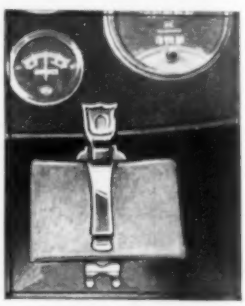
Small openings in the sides of the neck of a milk can, now on the market, permit the outside air to pass over the contents and also allow the natural heat of the milk to escape. The holes are so small that dirt is not likely to blow in, and the openings can be closed simply by twisting the lid. The vents also expedite the drying of the can when it has been set aside after steaming.

WAR WAGED ON FISH PIRATES TO PROTECT SALMON

Pirate ships have disappeared from the seas, but along the Columbia river and off the coast of Alaska, a type of freebooter is busy, seeking the silver salmon instead of the golden treasure of old. Like his predecessor, he operates with stealth and cunning, finding the dark hours of the night best suited to his purposes. His craft is usually black in color, long, low and rakish, and he carefully pads his equipment with rubber to prevent making unnecessary noises. To combat the fish pirate, the authorities are using power and steam tugs, equipped with machine guns, range finders and powerful searchlights. Convicted offenders are fined from $100 to $500.

CLAMP TO HOLD AUTO LOGBOOK FITS ON DASHBOARD

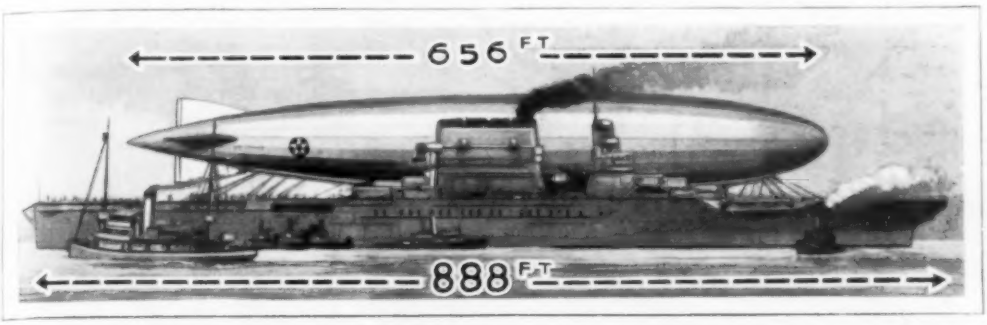
For keeping a record of the mileage made, when tires and oil were changed, and other data, a convenient auto logbook is fastened to a clamp attached to the dash. The holder is so adjusted that it can be swung back out of the way when the book is not in use or may be taken off altogether simply by releasing a thumbscrew. The book is especially handy for entering data in case of an accident, as it is within easy reach and is not likely to become lost. The clamp may also be employed to hold maps and other papers which must be consulted during a journey.



OIL FROM GRAPE-SEED WASTE USED IN MAKING PAINT

Adapted to almost all kinds of paints, varnishes, linoleums and for illuminating purposes, a cheap oil is extracted from grape-seed waste by a process developed in Italy. The average yield is said to exceed thirteen quarts to each thirty-three pounds. Seeds of the black grapes give more than those of the white varieties.

SHIPS OF SKY AND SEA MEET IN LANDING TEST



Composite Photograph Showing How the "Los Angeles" and the "Saratoga" Met in Successful Landing Test for the Airship While Both Craft Were in Motion

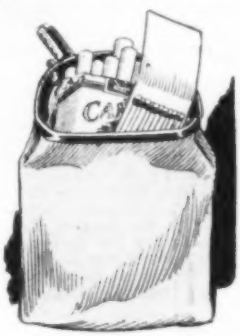
For the first time in history, a dirigible was landed on the deck of a sea vessel recently when the "Los Angeles" was moored to the "Saratoga," the navy's huge airplane carrier, during a test off Newport, R. I. Men in charge of both craft were required to exercise the greatest care and skill in accomplishing the feat, but it was done without mishap and indicates that the airplane carrier will have value not only as a traveling landing field for planes but may be used to service dirigibles and transfer passengers at sea. The two craft met while both were in motion.

THOUGHT A CHEMICAL PROCESS NERVE TESTS INDICATE

Proof that thinking is a chemical process is expected to come from experiments performed by Dr. Ralph Waldo Gerard, of the University of Chicago. He has demonstrated, for the first time, that nerve impulses result from an oxidation process, accompanied by the production of heat. His findings, it is believed, will help to clear up a controversy which has been going on among scientists as to the nature of nervous impulses. One school has held that it is a physical reaction, the other, that it is an oxidation process. Dr. Gerard tested the living nerves of frogs by subjecting them to 280 electric shocks per second. By means of a sensitive measuring apparatus, he found that the passage of one impulse through one fiber produced one-millionth of one-millionth of a heat unit. Measurement of the oxygen consumed and the carbon dioxide thrown off proved that these quantities corresponded to the heat produced. The conclusion was that the nerve gets its energy from the burning foodstuffs. So delicate is the process, however, that the energy used in a nerve to produce a single twitch of a muscle of the same weight, is 5,000 times less than the energy developed in the muscle. In a frog's leg, the muscle gives off one million times as much energy as the nerve which stimulates it. The nerve acts as a "fuse," each section setting off the next until the last "explodes" the muscle. Dr. Gerard found that the nerves contain enough oxygen to remain sensitive for hours of continuous stimulation without receiving a new supply of gas, but that this is slowly replenished from the blood after each impulse.

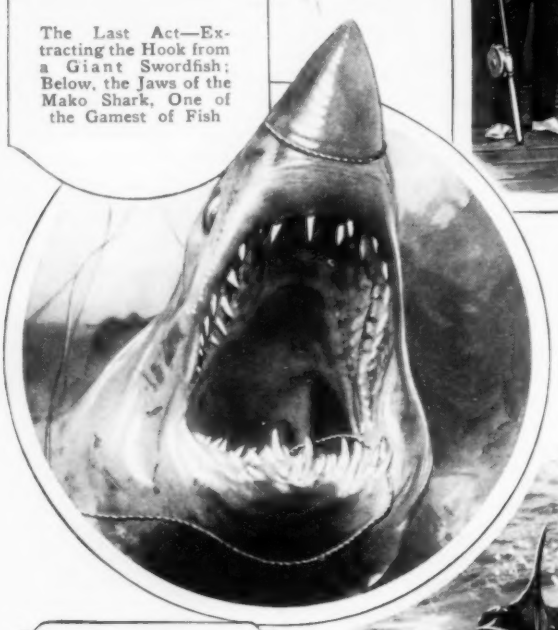
RUBBER POCKET FOR BATHERS KEEPS ARTICLES DRY

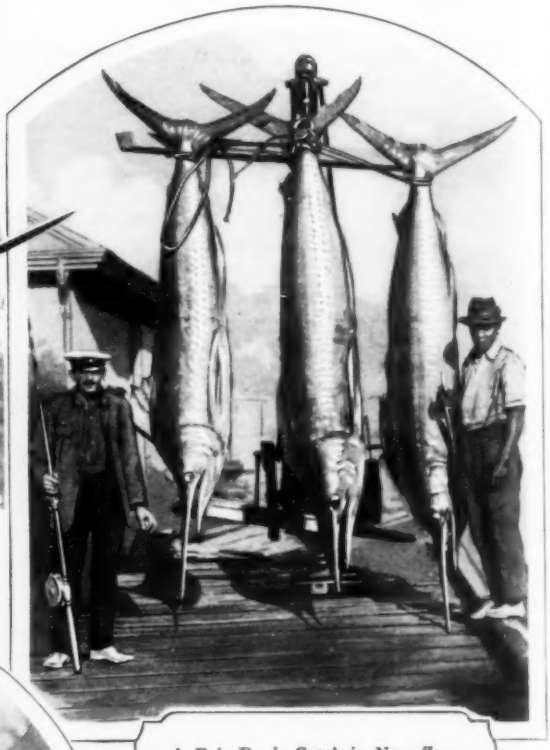
Necessary articles, such as matches and handkerchiefs, may be carried while swimming in a rubber pocket recently introduced for the bathing costume. It has a specially designed lock to foil thieves and is said to be entirely water-tight. It is made in various styles and colors to match the popular types of suits.



FIGHTING MONSTERS OF FISHERMEN'S PARADISE

The Last Act—Extracting the Hook from a Giant Swordfish; Below, the Jaws of the Mako Shark, One of the Gamest of Fish



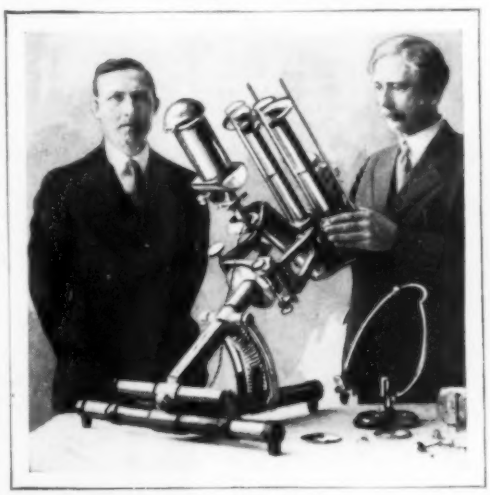


A Fair Day's Catch in New Zealand, Where Zane Grey and Other Famous Anglers Go for Ocean Sport; These Three Swordfish Were Taken on Rod and Line, and Not by Harpooning

The Bay of Plenty and Bay of Islands, on the Northern Coast of New Zealand, Abound in Fighting Fish; in the Latter Bay, Zane Grey Took a 1,000-Pound Swordfish, the Largest Ever Caught by Rod and Line; at the Right Is the Final Chapter in Such a Capture

GAUGES MEASURE SUN'S HEAT FOR WEATHER DATA

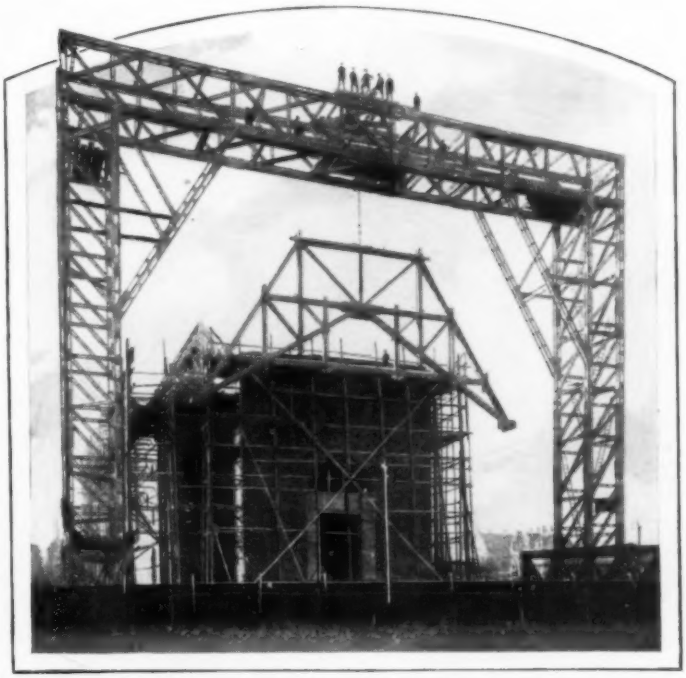
Although the sun is about 93,000,000 miles away, scientists are able to estimate its heat with the aid of special instruments. Two of these, invented by Dr. Charles G. Abbot, secretary of the Smithsonian Institution, and made by Andrew Kramer and L. B. Aldrich, of the institution's staff, have been sent to the Australian observatory at the new capital city of Canberra. They are similar to those used in other observatories in various parts of the world and are being used to determine the relation between solar radiation and weather. One is a pyrheliometer which measures the heat received from the sun at the surface of the earth. A sunbeam is admitted through the tiny aperture and, as the heat is absorbed by a small blackened disk, the effect of the rays is recorded on a special thermometer. The other instrument is a pyranometer which measures the intensity of brightness of the sky or any part of it, as the area around the sun. By determining the brightness of the sky, it is possible to gauge the transparency of the atmosphere. With this unit, readings that formerly took three hours to obtain can be made in about ten minutes.



Courtesy Smithsonian Institution

At the Right, Dr. Abbot with His Assistant, Inspecting Instrument to Measure Sun's Heat

¶Our Bureau of Information will answer all questions regarding articles in this magazine.



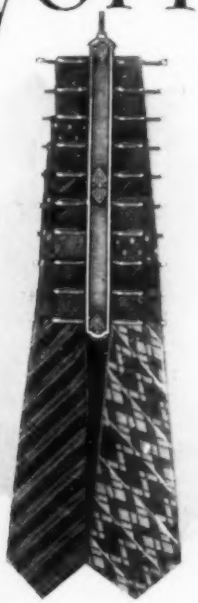
Where Wooden Beams Did the Work of Steel; Huge Traveling Crane That Handled Trusses Weighing Ten Tons Each

BIG TRAVELING CRANE OF WOOD LIFTS HEAVY TRUSSES

To swing the ten-ton trusses of a German church into place, engineers constructed an enormous traveling crane of wood instead of steel. It had a span of more than 114 feet and was over ninety-eight feet high. Fir timbers, fastened together with steel pegs, were employed, and considerable engineering skill had to be exerted in constructing the crane, to allow for the right amount of bending under the heavy weights lifted and wind stresses, and to place the timbers so that strains would not be exerted at right angles to the fiber.

To Save Work

Combination Brushes and Rinser for Washing Dishes Lightens This Unpleasant Task; There Is a Steel-Wool Scrubber for Sticky Plates; the Water Is Forced with Considerable Speed through Knife-like Openings in Nozzle for Effective Cleaning and Rinsing



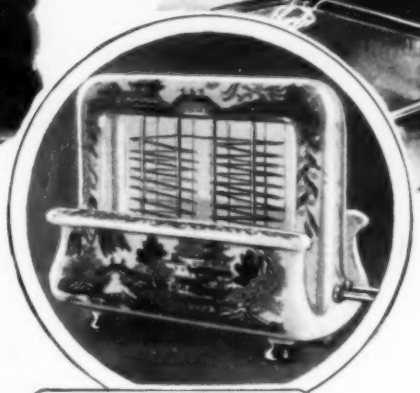
Each Necktie Is Kept in Plain Sight and Hangs Flat in This Convenient Wall Rack for Twenty or More

Urn That Burns Wood Alcohol to Purge Air of Smoke; Perfume May Also Be Sprinkled on the Wick, if Desired

Aluminum Kettle Has Flat Top for Warming Plates or Other Articles; at Right, a Timesaving and Lasting Memorandum Roll for the Wall

in Your Home

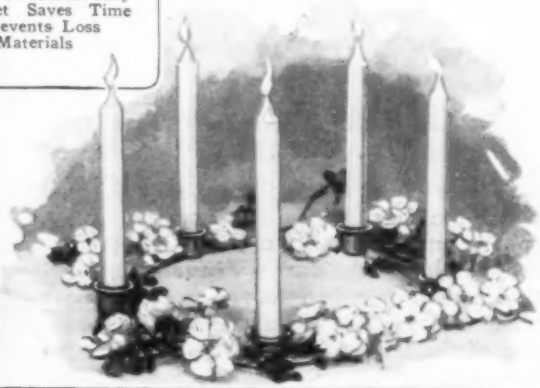
Sanitary Double Bag for Soiled Clothing Saves Confusion as Well as Steps



China Bread Toaster for the Table Is More Decorative and Will Not Tarnish; Metal Parts Are of Stainless Steel and It Is Easy to Clean with a Damp Cloth

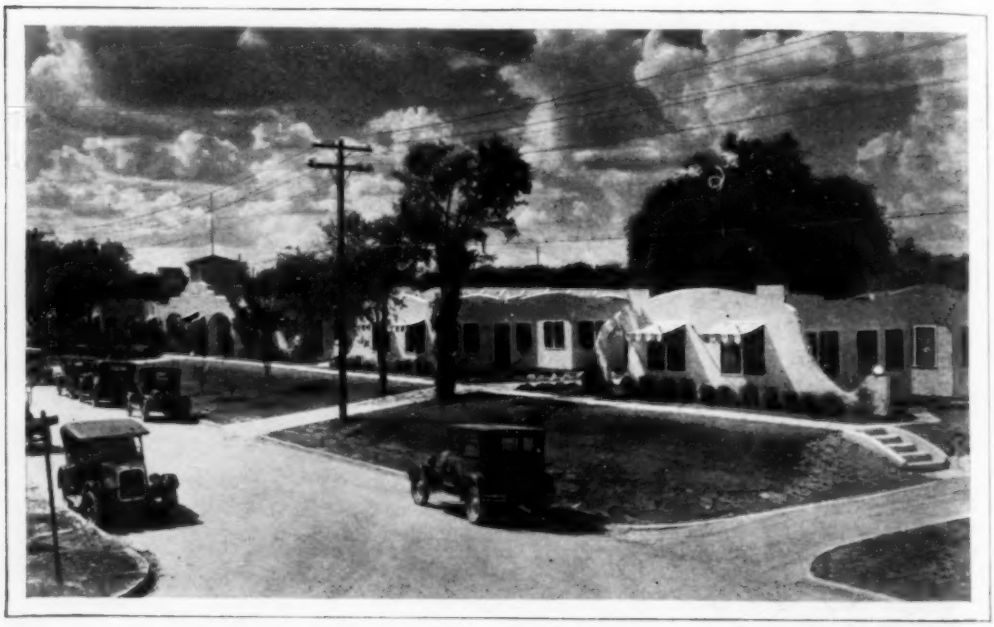
Lifting Rack for the Aluminum Roaster Makes It Easy to Remove the Contents and Reduces the Danger of Dropping the Meat or Other Articles

Below at Left, Spool Rack Attachable to Almost Any Workbasket Saves Time and Prevents Loss of Materials



For a Candle Halo around the Birthday Cake or Other Decoration, a Loop of Holders Mounted on Wire Is Quickly Adjusted

ALL COMFORTS OF HOME IN AUTO TOURISTS' CAMP



Comfortable Quarters for Automobile Tourists in San Antonio, Tex.; the Building Consists of a Number of Individual Apartments, Furnished with Most of the Conveniences of a Luxurious Hotel

Electric lights, gas, hot and cold running water, refrigeration and almost all the conveniences of an up-to-date home are provided for travelers in an automobile tourist camp at San Antonio, Tex. It consists of a series of small apartments, each an individual unit and with its own equipment, so that families may have full privacy. Linen, kitchen utensils and other articles are supplied and all at a moderate cost. The rates are considerably cheaper by the week or month.

COMPASS AND BELT LATCH ADD TO AIR SAFETY

A new type of airplane compass, in which the "card" is the outer surface of a sphere, and a new form of safety belt latch that eliminates the danger of fumbling for the fastenings, when forced to leave the plane by parachute in an emergency, are two of the latest aids to flying. The new compass has less tendency to be deflected by the pitching and spinning of a plane, and gives a more accurate reading in any position. The spherical card is floated within a hollow ball, eliminating the usual gimbals, and because of the construction of the instrument, it can be mounted flush with the instrument board, instead of projecting from it. The bull's-eye glass front also acts as a magnifying lens, greatly enlarging the figures and making the instrument easier to read. The safety belt, instead of a buckle, has a post with a hole through it. The post projects through any one of a series of eyelets, and a cotter pin, attached to a short lanyard, which in turn is fastened to the belt, passes through the hole. To unfasten the belt it is only necessary to grasp and pull the lanyard.

METAL SOUND POST FOR VIOLIN IMPROVES TONE

Marked improvement in the tone of a violin is said to be attained by the introduction of an aluminum sound post installed between the top and back. It strengthens the body of the instrument besides increasing the beauty of the sound.

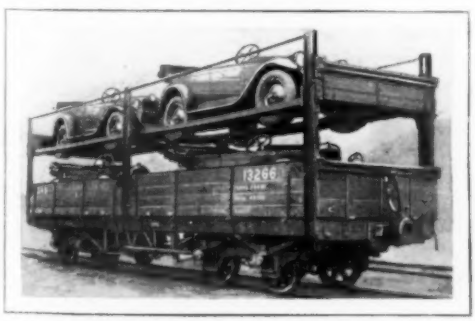
X-RAYS DISTINGUISH "CULTURE" PEARLS FROM GENUINE

By means of X-ray tests, natural pearls can be distinguished from the "culture" varieties. This latter kind is usually made by placing a spherical particle under the shell of the oyster and allowing the mollusk to deposit the shell substance around it, resulting in the pearl. The X-ray photograph reveals this spherical center which is not present in the pearl formed wholly by natural methods. The culture variety is not to be confused with the artificial pearl, which usually is simply a bead of some sort coated with a preparation made from essence of pearl, a fish-scale product. Acid tests reveal the nature of this kind or the coating may be peeled off with a knife.

Skating on Chemical Substance Which Is Said to Be as Slippery as Ice; It Is Poured on a Wood Base and Is Soon Ready for Use

DOUBLE-DECKED RAILWAY CAR SPEEDS AUTO SHIPMENTS

To facilitate the shipment of automobiles in South Africa, a double-decked railway car has been introduced. It holds the cars securely in place to prevent damage while en route, is easily loaded and unloaded and reduces the train length.



Safe and Rapid Delivery of Motor Cars in South Africa Is Afforded with Double-Decked Railway Units

"HOT ICE" FOR SKATING RINKS TO KEEP YOU WARM

"Hot ice" has been invented recently by a Berlin, Germany, chemist for use on the floor of skating rinks. The ice looks like hoarfrost, and has a melting point many degrees above the temperature at which ordinary ice melts. The inventor claims that, exercising on this ice, skaters will feel quite warm even if they are wearing scanty clothing, or a bathing suit. A new skating rink at Breslau will have the first floor to be made of this material. It is poured onto the wood where it "freezes," or sets hard in a few minutes.

DRAWING MAP OF THE STARS TAKES FORTY YEARS

After forty years of patient work, astronomers at the Oxford and Greenwich observatories have about completed a huge map of the heavens. More than 15,000,000 stars were photographed and 30,000 charts were prepared, which are to be assembled and printed. Nineteen observatories in various parts of the world co-operated.

gimbals, and because of the construction besides increasing the beauty of the sound.

ORNATE LAMPS FOR BOULEVARD TO GIVE STRONG LIGHT

For More Artistic Street Lamps; Ornate Lights for Los Angeles Boulevard Give Brilliant Glow

Highly decorative electric lamps have been adopted for a boulevard in Los Angeles as part of a plan to improve the appearance of the city. Besides being the most ornate yet installed there, they are among the largest and will make it one of the best lighted in the city.

PULVERIZED-COAL LOCOMOTIVE SAVES LABOR

An interesting new type of steam locomotive, burning pulverized coal, is being tested in Germany. Outwardly, it resembles a standard locomotive but for the striking design of the tender, which is entirely inclosed and, in the place of a coal bunker, has a boiler-shaped, horizontal tank carrying the powdered fuel. By the operation of a few valves, fuel is conveyed by an ingenious attachment from the tender into the fire box, in order there to be burnt without any residue or smoke. Any low-grade fuel, such as coal dust and refuse, rough lignite or peat, can be employed for the pulverized-coal locomotive, resulting in a twofold profit, the simplifying of the operation and leaving the high-grade lump coal free for other purposes. The use of pulverized coal also does away with any risk of ignition by the projection of sparks.

AIRPORTS OVER RAILWAY YARDS TO STIMULATE AVIATION

Construction of platforms over railroad yards for the use of airplanes in landing and taking off, is being considered by some of the lines entering New York. According to aviation experts, the idea is entirely practical, since it has been demonstrated that planes can be handled safely within small landing areas, the success of the battleship airplane carrier being due largely to that fact. It is also planned to erect a landing "field" on top of one of the modern skyscrapers in New York.

CAB DRIVERS CALLED BY RADIO FOR HOTEL GUESTS

Guests at a Chicago hotel are not annoyed by the whistling of the doorman for taxicabs, as a loud-speaking telephone system, utilizing radio apparatus, has been installed. From his post, the attendant calls out the name of the person who wants his chauffeur, or signals for a cab, and the voice is broadcast from loud speakers at the cab stand.

Summoning a Cab from Hotel Lobby by Radio Telephone; Loud Speaker Is Installed near Stand

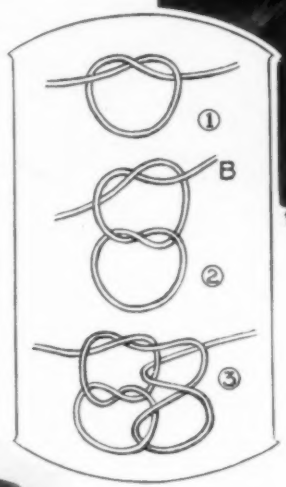
unloaded and reduces the train length.

world co-operated.

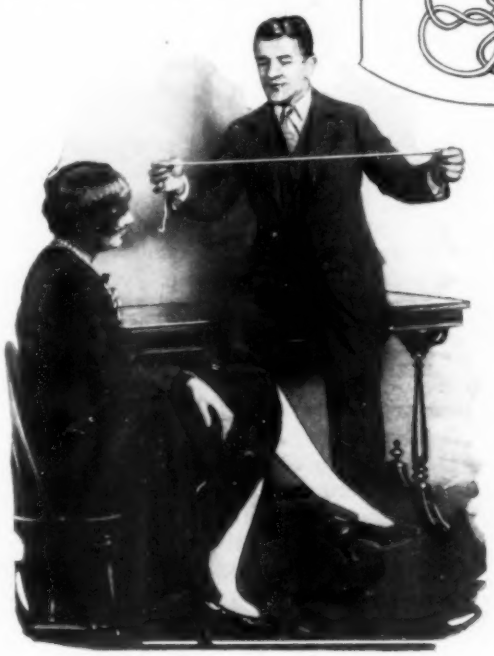
Easy Tricks with String

TAKE a piece of string. All string tricks start that way. Take a piece of string. Tie a single overhand knot in it as shown in the picture. Tie another knot in it as shown below. Then twine the end B through both knots. Now, if you will pull gently on both ends, the knots will magically disappear. Magicians call it the "Dissolving Knot." Besides being a quaint bit of mysticism, it is the best of a dozen answers to that archaic riddle: "When is a knot not a knot?"

Take a piece of string. Tie the two ends together to make a loop. Ask a spectator to hold a pencil upright in his hand, and loop the string over the



The Dissolving Knots, a Magician's Trick That Anyone Can Perform by Tying the Knots as Shown in the Diagram at the Left



end of the pencil as shown. Next loop the string over your left hand. Grasp the string at the point A, and loop it once over your left hand to form Fig. 6. Take the double string at the point B, and drop it over the end of the pencil. There! The trick is finished. By pulling the string at the point C, Fig. 4, the loop will obligingly slip away from the pencil. That one might be said to answer the question: "When is a loop not a loop?"

How is this?

The performer takes a piece of string. He ties several knots on it and seals it in an envelope. On several slips of paper the performer writes various numbers called out by the audience. A spectator selects one of these, and the remaining slips are burned—this in order to prevent any deception. The spectator then unfolds his slip, and finds written on it the number 4. The envelope is unsealed and the string taken out. On it is found four

When Is a Loop Not a Loop? One of the Mystifying Effects That Is Easy When You Know How to Manipulate the String and the Pencil

knots—the exact number as was written on the slip selected by the spectator!

That's what you would call a good trick. And it's dead easy. Take a piece of string. On the string tie four knots. Seal the string in an envelope. Sit down several feet away from the audience and request someone to call out a number. "Seven?" "Thank you!" And right there you put in the master touch, for instead of writing a 7 you really write a 4. You write 4's on all of the slips regardless of what is called out, but be sure that someone calls a 4 before you finish.

Need I explain further? The spectator naturally picks a 4 in his "free choice," since there "ain't nothin' else but 4's." By burning the remaining slips you destroy some very telltale evidence.

The next one is called the "Slave Bangle."

Take a piece of string. Have a spectator tie your wrists with the string—an end to each wrist—leaving about twenty inches of string between your hands. The next step is to exhibit the Slave Bangle, which may be any ring large enough to slip over your hand. Pass it out for examination. Explain to the audience that the stunt is to get the bangle onto the string without untying the wrists. After receiving the ring back you walk to the far end of the room. When you return, the ring is daintily hanging on the string, and your wrists must be untied before the Slave Bangle can be removed.

The explanation of this one is simplicity itself. You have two rings—exactly alike. One of these you have previously slipped over one hand and hidden up under your coat sleeve. When you turn your back to the audience, it is a simple matter to slip the original ring into your pocket, and then slide the hidden ring down onto the string. And there you are! Another mystery!

Here's another knot that is not a knot!

Take a piece of string. Tie three knots on it as shown by A, B and C, Fig. 7. You will notice that the right end of each knot is on top, while the left end is under the string. That is important. Gather the knots in your left hand as shown in Fig. 8. Slip the end Y through the whole

the string taken out. On it is found four

Four Knots in a String, a Hatful of Slips with Numbers, and the Spectator Chooses the Right One

bunch, as shown by the dotted line. Ask the fair spectator to blow hard. Pull the ends X and Y, and the knots will melt away.

Of course, no article on string tricks would be complete without a "Cut and Restored String," so....

Take a piece of string. Insert the string into a sealed envelope, the ends of which have been cut off. Have two spectators hold the ends of the string as shown in the lower photo on page 823. The problem, in this case, is to cut the envelope in two without destroying the string.

To perform this little swindle, you must previously prepare the envelope by cutting a long slit in the back of it as shown in Fig. 10, extending from one edge of the envelope to within one-half inch of the other edge. If the front of the envelope is always kept upward, your audience will be none the wiser of this. The actual cutting is done with a pair of scissors and in two quick snips. On the first snip, cut into the envelope about one inch, being careful not to cut the string. Withdraw the scissors. When inserting the scissors for the second cut, push the point over the string and down through the prepared cut in the back of the envelope. Then the final snip—and there you are!

It would be a good stunt, don't you think, to take off your coat while your thumbs were tied together? Yes? Well, listen!

Take a piece of string.. ..Hold the string in your hands as in upper photo, page 824, palms to the audience. Then turn your hands over and clasp your fingers together—that is, all the fingers but the right in-

dex, and this one you secretly insert in the loop of string as shown to the right.

Mystery of the Slave-Bangle Trick, Above and at the Left, and Below, a Photo and Diagram That Explain How the Vanishing Knots Can Be Blown Away

After that clever little piece of work, you can allow the spectator to tie your thumbs up as tightly as possible, and still have enough slack to disengage your thumbs and remove your coat. That, of course, you do in an adjoining room, coming in with the coat over your arms and your thumbs still tightly tied.

Tricks with string, or rather with light rope, were in their heyday in the sailing-ship era, but many of what the sailors called "tomfool" knots have been relegated to the list of forgotten accomplishments.

If you have a fairly large and thin silk handkerchief, you can do a trick that is even more clever than if it were done with string, besides being much easier. The trick is to hold the handkerchief in one

hand and with a flip of the wrist tie a knot in the cloth. With a bit of practice it can be done so rapidly that the audience cannot detect how the knot materializes. Here is the way: Starting slowly until you have mastered the movements, hold your right hand out, with fingers extended and thumb raised, and over the first finger drape the handkerchief, which is first folded into a narrow strip, an inch and a half or thereabout in width. The cloth is draped across the fingers so that both ends are approximately equal.

One Way to Cut a String and Then Restore It Is to Use This Prepared Envelope

Now double the third and little finger to clasp the handkerchief within the palm, and fold the thumb down against the cloth, until the thumb tip touches the bent joint of the third finger.

Next turn the hand sharply, the thumb revolving toward the right. This will cause the loose end of the handkerchief to swing upward, and at the top of the swing the thumb is extended under it, holding it to form a loop. The first and second fingers are then bent down to catch the loose end, hanging beneath the little finger. They draw it up and through the loop, and the knot is tied.

Repeat the trick slowly until you learn the sequence of moves, then begin to speed it up. When completely mastered, the folding of the third and little fingers, the lowering of the thumb, and the turning of the hand to flip the end up for the loop all occur simultaneously.

Several pages back we told of a trick done with a pencil and a loop of string. Here is another, using the same paraphernalia. Take a piece of string, bore a small hole

Want to Take Your Coat Off with Your Thumbs Tied Together? Here's How

through the pencil, a quarter inch or so from one end, pass the string through, cut and tie the ends together to form a loop, slightly shorter than the length of the pencil. Now invite anyone to pass the loop or pencil through a buttonhole of your coat, and draw the pencil through the loop to finish attaching it to the coat. It seems impossible, because the loop is shorter than the pencil, so how can the latter be passed through without cutting it off?

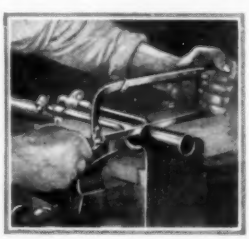
The answer is simple. Spread the loop of string over the cloth around the buttonhole, draw the buttonhole through the loop, pass the pencil through the hole, and the trick is done. Or you can reverse the process and take it off. Be sure to call the attention of the audience not only to the fact that the loop is shorter than the pencil, but that the pencil is longer than the loop. While they are analyzing that, you can do the trick.

CHOP PHONE BOOKS INTO BITS TO MAKE PULP FOR PAPER

When telephone directories become obsolete, they are usually gathered and sold to waste-paper companies for conversion into pulp and the manufacture of new paper. They are torn in two lengthwise, then chopped into small bits in a powerful machine and finally churned in a vat with chemicals that help prepare the material for suitable pulp.

SUPPORT TO HOLD VISE WORK HELPS PREVENT DAMAGE

When small objects are held in a vise, it is often necessary to apply such great pressure that damage to the article is likely to result. This is said to be avoided by using a special support recently introduced. It is quickly attached to the jaws of the vise and forms a strong rest against which enormous force can be applied without the danger of slipping or marring the work. The support is firmly held with clamps and springs of piano wire.



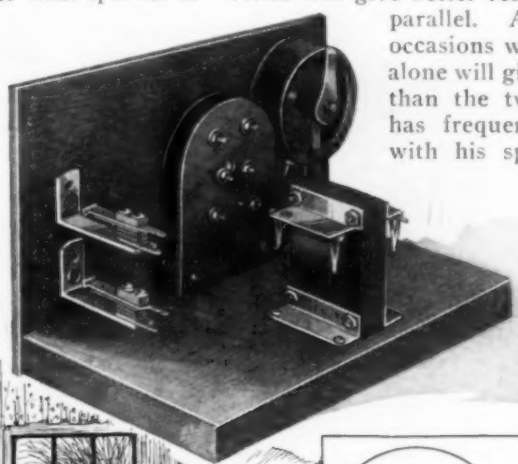
Control Unit Aids Reproduction

By HERBERT C. McKAY

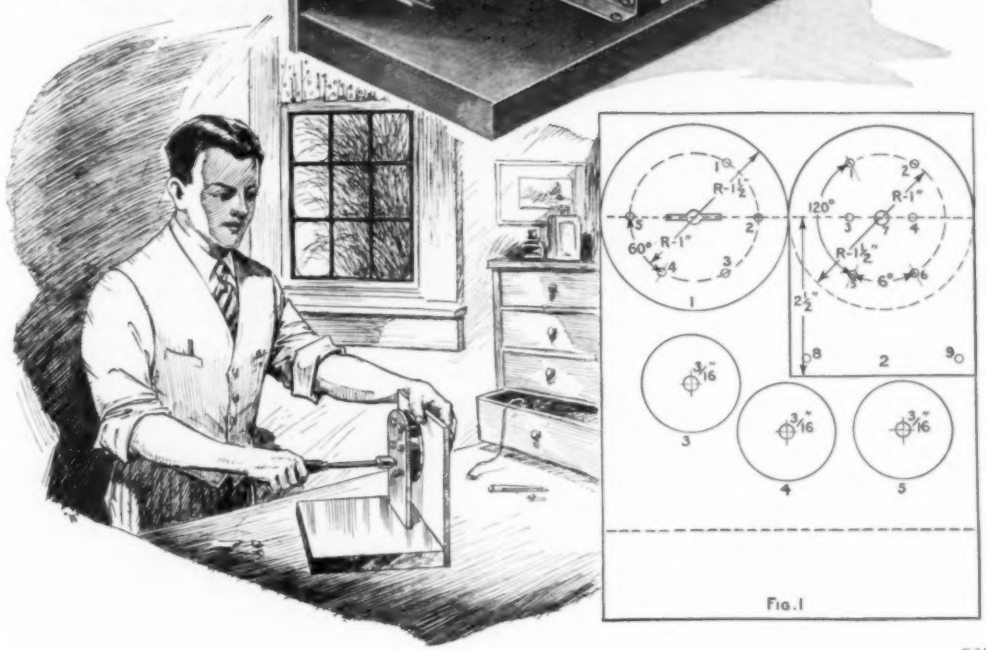
FEELING the need of some simple control to improve reproduction without changing the receiver in any way, the writer built the little device described and illustrated in this article, and obtained excellent results. Quality in radio reproduction depends on several factors, some of them, as, for instance, lack of good modulation at the broadcasting station, atmospheric disturbances and interference of local nature being beyond the set owner's control. Most of the large broadcasting stations are now developed to a point where they do send out programs of quality from an engineering standpoint, but the average radio receiver with speaker is not able to reproduce them faithfully.

This article will not deal with the receiver circuit. There are, however, several things that the average owner can do to improve reproduction at the speaker itself. It is questionable if there is a single speaker capable of absolutely pure reproduction of the full range of the human voice and orchestral music, although this undoubtedly will come. Fortunately there are several types of reproducers available, covering different ranges, and two speaker units may be combined so that the effective range of one covers the dead spot of the other. It is possible then to combine the two to provide quality reproduction at comparatively small cost.

In order to do this, the two speakers cannot be hooked to the set at random. There are times when a connection in series will give better results than one in parallel. Again, there are occasions when one speaker alone will give a better effect than the two. The writer has frequently found that, with his speakers, the an-



Above, Control Unit Partially Assembled, Showing the Relative Position of the Parts



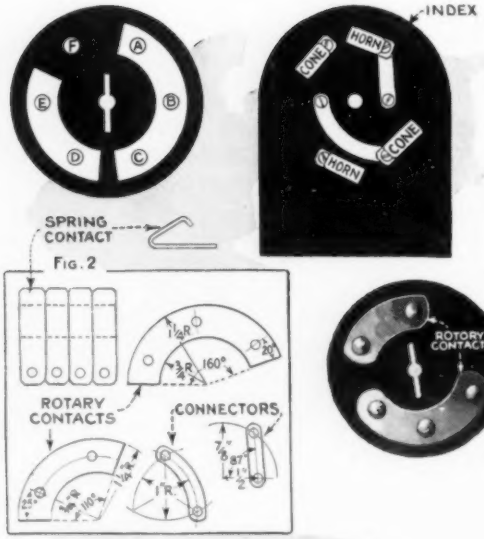
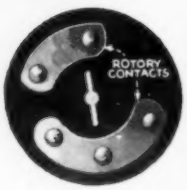


FIG. 2



high-voltage d.c. being harmful to the speaker, an output transformer is included in the control device and adds greatly to the handling range of the speakers; similarly, a volume control for the horn alone is provided and, last but not least, a volume control for the set where there is none, a variable resistance of 500,000 ohms being employed for this purpose. With these needs in view the control unit here described was found to meet all requirements.

In the construction, the sizes are of no great importance. The panel may be cut to

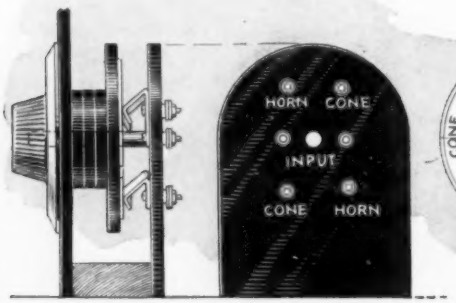


FIG. 3

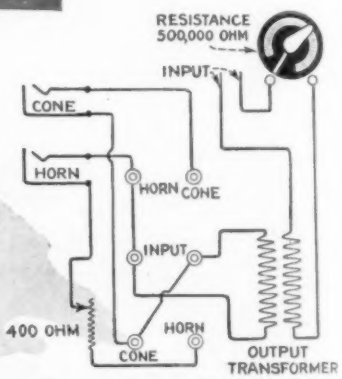


FIG. 4 WIRING DIAGRAM

Construction Details and Schematic Wiring Diagram

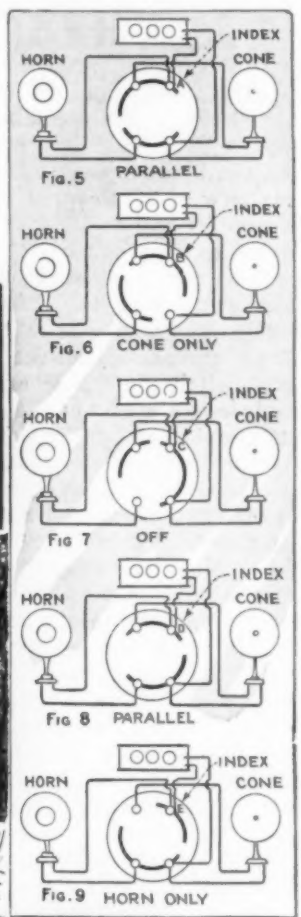
nouncer's voice came in sharper and more distinctly with the horn alone, when experimenting with a combination of cone and horn. This is true of any music or sound of sharp-cut quality. On the other hand, an orchestra, violins and vocal music came in best with a combination of both horn and cone, while, on organ music, the cone alone was best. This will not hold true with all sets and speakers, and the best combinations can only be found by trial. A variable-control device is required for these instant changes, and it must incorporate parallel, series, horn alone, cone alone and on and off switches.

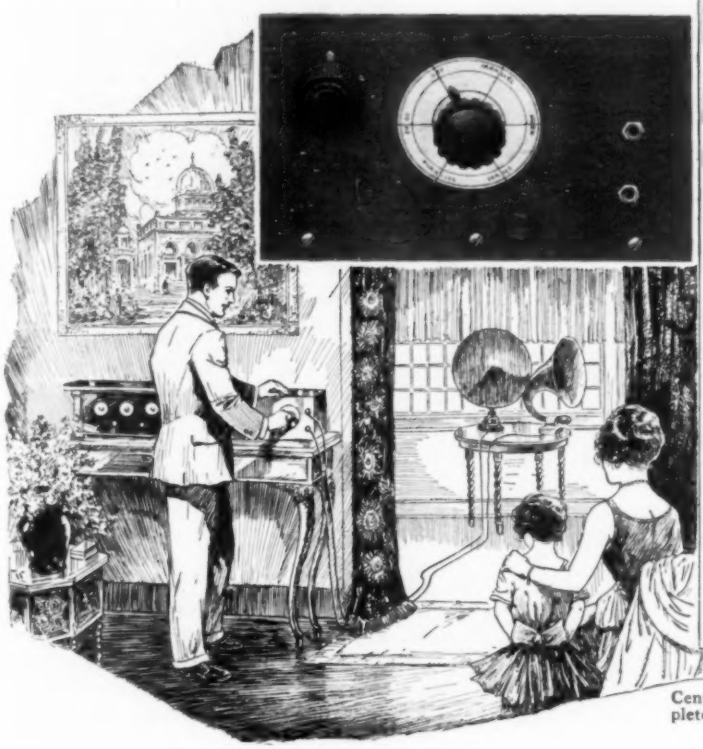
Another point in the modern use of radio is that the owner frequently wishes to move the speakers about the house and, therefore, the control device should be portable. It is common practice to use power tubes and high B-voltage. This fit any small cabinet at hand, or the instruments mounted in the set cabinet or in a cabinet-speaker if available. The simple layout is shown in the rear-view photo on page 825, the rotary pole-changing switch at the center, two single open-circuit jacks at the left and the 500,000-ohm variable resistance at the right on the front panel. The output transformer, which may be any of the modern types, is shown on the baseboard directly behind the rotary switch. The materials required for the switch are: a small rheostat knob, a piece of 3/16-in. rod, 2 in. long and threaded at one end for 1/8 in.; a piece of 1/8-in. bakelite or hard rubber, 6 in. wide and 8 in. long; a strip of thin copper sheet, 2 in. wide and 10 in. long; five split-shank copper rivets; six 6-32 by 1/2-in. machine screws; fourteen 6-32 hexagon nuts; twelve washers for the screws; two pins,

3/64 by 3/4 in., and a disk of white cardboard, 3 in. in diameter.

The rubber or bakelite is cut as shown in Fig. 1; the switch base (marked 2) is 3 in. wide and 4 in. long, with one end cut on a 1½-in. radius. Seven holes are drilled in the base, as shown in No. 2; six for the 6-32 screws and the center hole for the 3/16-in. shaft. The rotary plate (No. 1) is a disk of the same insulating material, 3 in. in diameter. Six holes are drilled in it; five for the copper rivets and one for the shaft. Note that the shaft hole is slotted for the driving pin. Disks 3, 4 and 5 are 1½ in. in diameter with 3/16-in. center holes, and serve only as thrust washers to insure positive contact between the rotor and stator of the pole-changing switch. Four spring contacts, two switch plates and two connecting strips are cut from the copper strip as shown in Fig. 2; smooth all rough edges with a fine file and sand the surfaces. It may be necessary to flatten the strips to remove the curl formed by cutting.

We are now ready to assemble the rotary switch, but little comment is needed here, as the illustrations in Fig. 3 are self-explanatory. If difficulty is encountered in locating the holes in the copper connectors and contact plates, the switch base and rotor may be used as templates. The stator spring contacts are screwed to the stationary plate and bent over to make good wiping contacts on the rotary switch plates, as shown in Figs. 2 and 3. The contact plates are riveted flat to the rotor disk, as shown in Fig. 2. At a point 5/8 in. from the threaded end of the 3/16-in. rod, drill a 3/64-in. hole through the rod. Cut a pin, 3/4 in. long, to fit this hole and insert it in the shaft; this pin engages the slot in the rotor. Now place the three small washers 3, 4 and 5 upon the plain end of the shaft, insert the shaft through the hole in the front panel, and fasten the rheostat knob in such a position that the pin prevents





Center, Front Panel Partially Completed, Showing the Switch Knob and Cardboard Disk in Position

more than 1/32-in. play in the assembly. The rotary plate is then placed on the shaft, and the unit is ready for mounting.

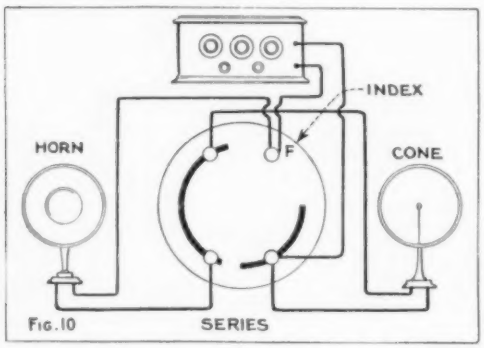


Fig. 10

A block of wood, 1 in. wide and from ½ to ¾ in. thick, according to the thickness of the bakelite or hard-rubber disks, is used as a base spacer for mounting the unit, holding the assembly to the baseboard. This block is screwed in position and the assembly will then look like the side view at the lower left in Fig. 3. The 3-in. white-cardboard disk is prepared as shown to the right of the side view; the knob is removed from the shaft on the front panel and the disk pasted to the panel. Now make six marks with a sharp file or similar tool on the edge of the rotary switch plate, five of the marks directly opposite one of the rivets, while the sixth is placed opposite F in Fig. 2. Letter each of these stations A, B, C, D, E and F, as shown, after which make an index mark on the edge of the stationary plate at the point indicated in the illustration at the right. Now turn on the rotary disk opposite the index mark, which is the cone-only connection. Place the rheostat knob in position with the pointer just over the mark "cone" and secure it with the setscrew, and the switch is completed.

The 500,000-ohm variable resistance and two single-circuit jacks are mounted on the front panel approximately as shown in the photo on page 825. The writer suggests that a 400-ohm potentiometer be mounted at the upper left on the panel in the vacant space above the jacks. The potentiometer is used like a rheostat, by employing the lever connection and one side of the resistance, and places this resistance in the circuit on one side of the horn jack, as shown in the wiring diagram, Fig. 4. It will be seen that the output of the set is controlled by the 500,000-ohm resistance at the input of the unit, passed into the output transformer, then delivered to the mid-contacts of the switch, and from there to the horn and cone jacks. The 400-ohm resistance controls the horn volume independent of the cone and receiver volume.

Figs. 5 to 10 show the method of using the control unit for the various combinations better than a written explanation, so little further comment is necessary. For the benefit of those interested, it may be said that the set used by the writer is an eight-tube superheterodyne of standard design with transformer-coupled a.f. amplification; with the unit described excellent reproduction has been obtained.

Valve on Battery Tester Prevents Dripping

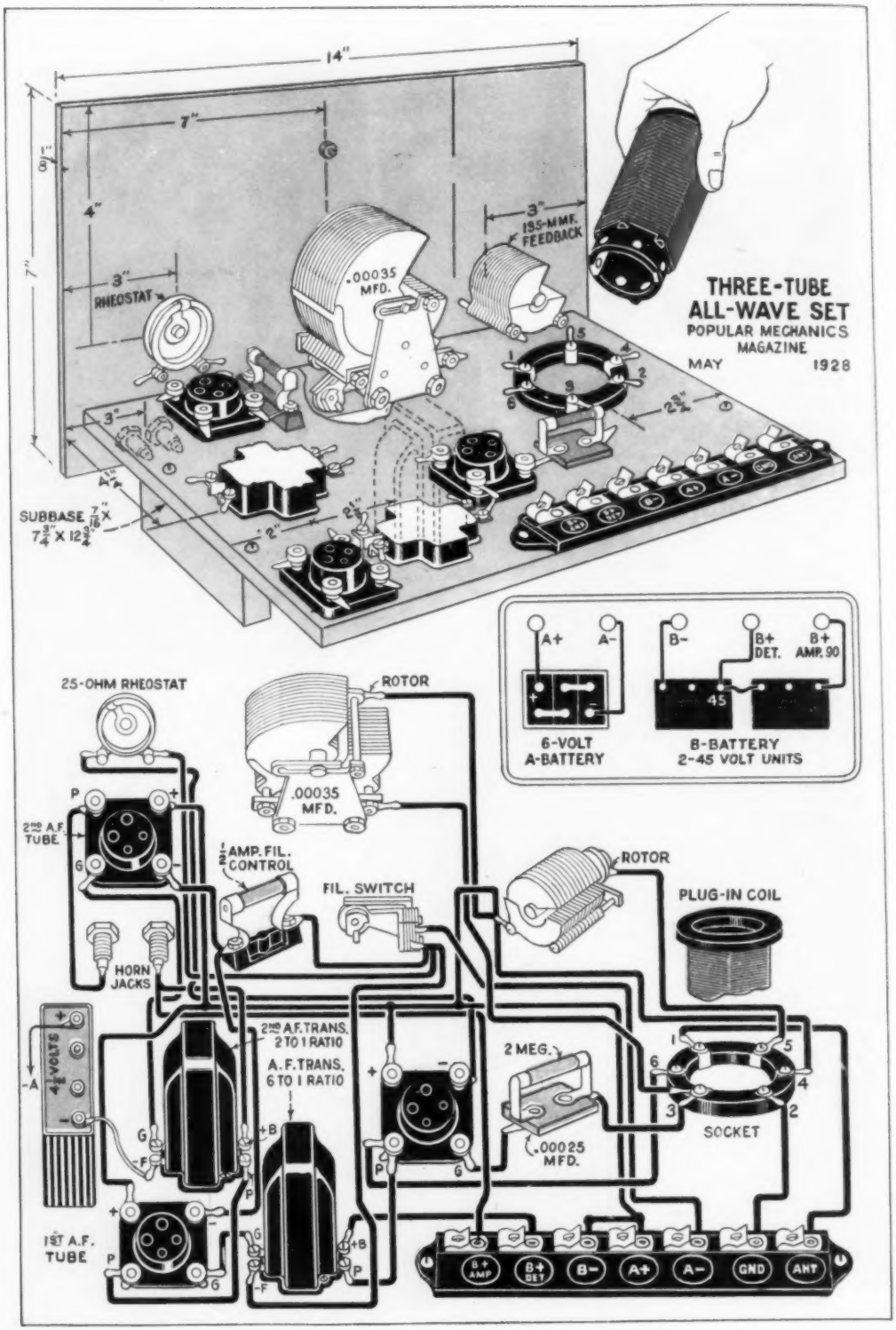
An automatic valve on the tip of the hydrometer illustrated herewith prevents acid from dripping on rugs and floors, so that those who have had such accidents occur will appreciate this new device. Another interesting feature will be noted in the sketch at left, which shows how the float is raised by the acid to the narrow part of the barrel, and held in the center, making reading easy. The valve is shown at right. As the tip is withdrawn from the battery, a rubber cap automatically slides over the opening in the lower end, preventing dripping while the reading is taken and spraying when drawn into or forced out of the tip.

Facts and Fads for Radio Fans

Joe Sullivan, of Toledo, with His Home-Grown Loud Speaker; He Collects Gourds, Removes the Seeds and Then Thoroughly Dries the Gourd, after Which a Loud-Speaker Unit Is Fastened to the Small End

Above, Recording Edison's Late Radio Interview on a Dictaphone of His Invention, 3,000 Miles Away from the Point Where He Delivered the Address; Miss Eva Buerg, of San Francisco, Is Shown Recording It for Posterity; Left, Miss Gail Walker of Honolulu, aboard the "City of Los Angeles," en Route to Hawaii, Is Listening In on Programs from Distant Stations; the Ship Carried a Number of These Receivers

Right, This Motorcycle Outht for Radio Reception and Transmission Was Demonstrated Recently at the French Army Camp at Satory; Numerous Other Applications of the Motorcycle and Sidecar for Military Use Were Also Shown


14"
7"
8½"
7"
4"
3"
RHEOSTAT
.00035 MFD.
3"
135-MMF. FEEDBACK
THREE-TUBE ALL-WAVE SET
POPULAR MECHANICS MAGAZINE
MAY 1928
SUBBASE 7" X 7¾" X 12¾"
A+
A-
B-
B+ DET.
B+ AMP. 90
45
6-VOLT A-BATTERY
B-BATTERY 2-45 VOLT UNITS
25-OHM RHEOSTAT
ROTOR
.00035 MFD.
2ND A.F. TUBE
½ AMP. FIL. CONTROL
FIL. SWITCH
ROTOR
PLUG-IN COIL
HORN JACKS
2ND A.F. TRANS. 2 TO 1 RATIO
A.F. TRANS. 6 TO 1 RATIO
2 MEG.
.00025 MFD.
SOCKET
4 VOLTS
1ST A.F. TUBE
B+ AMP
B+ DET
B-
A+
A-
GND
ANT

Simple Three-Tube All-Wave Receiver

By FRANK L. BRITTIN

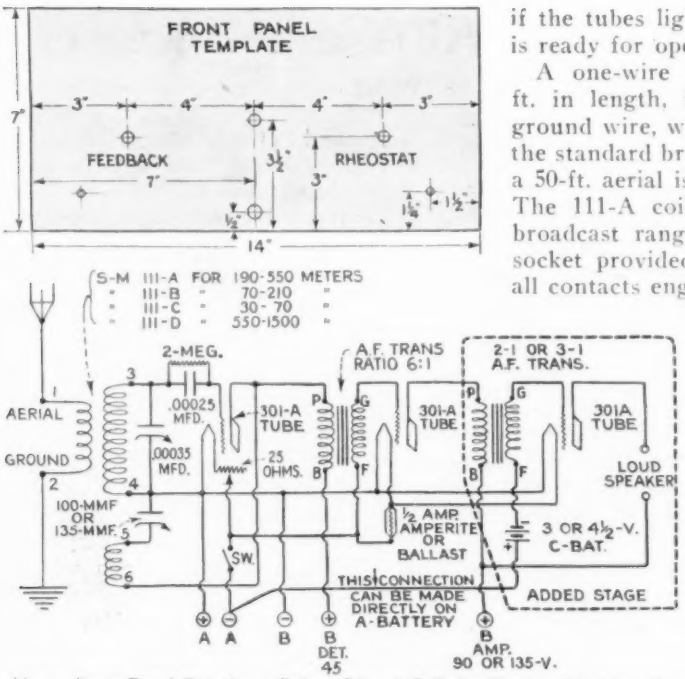
THIS simple receiver, which is ideal for the beginner, appeared in the October, 1927, issue and met with the enthusiastic approval of our readers. It was first described as a "Two-Tube All-Wave" set that would operate a loud speaker. A second a.f. amplifier stage has been added in answer to numerous requests for greater volume on the speakers now in common use with the larger sets. With the addition of the second stage, the set is now capable of good DX-range at loud-speaker volume, and can be used with any of the late types of speakers. The low cost, simple construction, wide range of wavelengths available, and the fact that the set can be operated with either the large or small tubes make it an ideal receiver for the beginner.

The layout given is intended for use with the large tubes, but if dry-cell tubes are employed, substitute a No. 120 amperite for the ½-amp. filament control and a 4-volt storage battery or three No. 6 dry cells in series, for the A-battery. The parts cost about $27.75, the price varying slightly in different localities. The a.f. transformers are $6 each and the coils, with the exception of the type tuning from 550 to 1,500 meters, cost $2.50 each; the last-named coil is $5. The coil socket specified will take any of these coils, which may be plugged in and out as desired. The X-type spring-suspended tube sockets are a standard type which is suitable for either kind of tube without changing the wiring.

The front panel and baseboard layout are shown on page 830; the wood baseboard is supported by two ¾ by 1 by 3½-in. blocks, also of wood. The front panel is screwed to the baseboard at front, with two 1-in. round-head nickelplated wood screws, the filament switch and horn jacks being located below the baseboard. Those who built the former two-tube set will notice that very few alterations are necessary to add the third tube and transformer. The choke coil has been dropped from the assembly, and the first a.f. transformer moved to the right to make room for the first a.f. tube. The socket at front, formerly for the first a.f. tube, now becomes the second a.f. socket, and the filament leads are not changed on this socket. The simplified wiring diagram is given on page 830 and also a separate diagram, showing the battery connections which are the same as before, with the exception that the positive lead from the 4½-volt C-battery is to be connected to the negative terminal of the A-battery. Flexible rubber-covered hookup wire is used for the circuit and all diagrams are complete in every way for the entire construction of the set. The position of the added stage is pointed out in the photo on this page; note that as much of the wiring as possible is run down through holes drilled in the baseboard. The rear-view photo on page 832 shows the neat appearance which is due to the lack of exposed wiring. The schematic diagram of the circuit, with the front panel drilling template is given on page 832, as well as a list of the various coils suitable for the set.

This View Indicates the Position of the Added Transformer and Tube

When wiring the circuit, use soldering lugs under each terminal, and solder all connections securely, taking care that a good, tight connection is made and that the solder flows smoothly into the joint. The writer has examined several sets lately



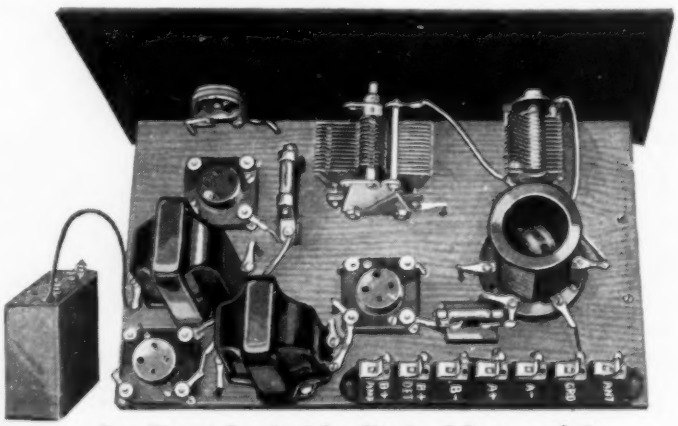
Above, Front-Panel Template; Below, List of Coils for Various Wavelengths, and Schematic Circuit Diagram

that were built by beginners, and in each case the soldering had been done with an insufficiently heated iron. A slight pull on such a connection suffices to break it off and these "chewing gum" joints will never do in a radio set. Note carefully the rotor connections of both variable condensers. The small condenser may be either 100 or 135 mmf. Do not judge the capacity by the number of plates, as this varies in different makes; the capacity will be found marked on the box in which the condenser is packed.

Make all grid and plate leads as short as possible, being careful not to run them parallel at any point. The rheostat controls the detector tube only, while the filaments of the two amplifier tubes are controlled by the automatic control unit. After the wiring has been completed, connect the batteries, turn on the filament switch and place one tube successively in each socket to test the circuit; if the tubes light as they should, the set is ready for operation.

A one-wire aerial, not exceeding 100 ft. in length, including the lead-in and ground wire, will give the best results on the standard broadcast wavelengths, while a 50-ft. aerial is best for the short waves. The 111-A coil will cover the common broadcast range. Plug the coil into the socket provided for it, making sure that all contacts engage with the bosses in the base of the coil form. Turn on the filament switch and rotate the dial of the large variable condenser, keeping the plates of the small condenser about half out, then slowly turn up the detector-tube rheostat until a slight hissing sound is heard in the loud speaker or headphones. Continue to rotate the large condenser dial until a station is heard, then readjust the small condenser to the best setting for volume and clarity. It need not be reset for every station; rotating the large condenser dial will bring in one station after another. Keep the detector rheostat at the lowest point consistent with good results.

Stations, once logged, can be found again at the same dialing; if the small condenser is set at too critical a point, the set will easily become unbalanced with a resulting loss of the station. Therefore, keep it set at a point where this does not



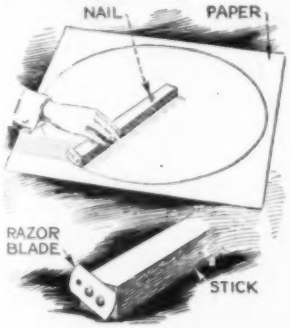
Rear View of Completed Set, Showing C-Battery at Left

happen. The a.f. transformers used in this set are capable of producing excellent results if you have a good loud speaker. While such an instrument will cost as much as the set, the results will be worth the expense.

A complete material list with the name and price of each part used in the original model will be sent free of charge to any address; a postal card will bring you this list. If you wish a large detailed blueprint of the wiring diagram and layout, this is available for 25 cents to cover cost and mailing; address Popular Mechanics radio department, 200 E. Ontario st., Chicago, Ill. Specify blueprint No. 132.

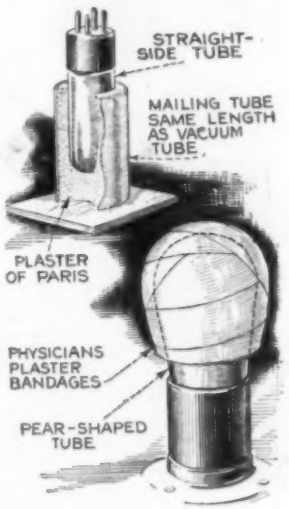
Disk Cutter for Cone Speakers

A useful tool for cutting paper for homemade cone speakers can be made by fastening a safety-razor blade to the end of a stick in the manner shown in the illustration. A hole is drilled near the other end of the stick for the nail used as a pivot. The heavy paper is fastened to a flat surface with thumbtacks, and the nail is driven through the hole in the stick into the center of the paper. When the stick is swung in a circle the razor blade cuts a neat and perfect disk.—R. J. Williams, Chicago, Ill.



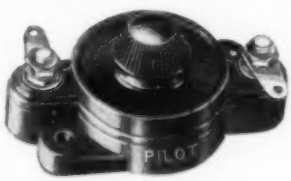
Homemade Howl Preventers

Simple and effective howl preventers may be made of plaster of paris in the manner shown in the sketch. Detector tubes not mounted on spring-suspended sockets are the worst offenders, as they are especially affected by microphonic disturbances. The preventer merely changes the vibration period of the tube to a point that does not interfere with the elements within the tube. The small straight-sided tubes of the dry-cell type are treated as shown in the upper sketch, a mailing tube of suitable diameter providing the outside case for the mold. The inside diameter of the cardboard tube should be ⅜ in. larger than the diameter of the vacuum tube. The writer has found that this device works best if about ½ in. of the glass tube is left exposed, wherefore the paper tube should be cut about the same length as the vacuum tube to be treated. Pour a small quantity of plaster into the mold, grease the glass tube with a thin layer of vaseline and set the tube centrally in the mold; the latter is then completely filled with the plaster. Keep turning the tube after the plaster has started to set, so that it can be removed from the cast when completed. Any rough places in the casting can be scraped smooth after the tube has been removed. For the larger pear-shaped tubes a different process must be used; physicians' plaster bandages are employed, or a similar bandage may be made by impregnating ordinary gauze bandage with plaster. These are wound on the tube after being soaked in water.



Dust-Proof Midget Condenser

The midget variable condenser shown in the photo is dust-proof, well insulated and easily mounted. It may be used as a balancing condenser, variable grid condenser where fine adjustment is required to match dial readings, and also in any of the usual wavetraps. It is of the mica type, with plates shaped to provide a capacity range said to be twice that of ordinary mica condensers.



RADIO TESTING and TROUBLE SHOOTING

by E. R. Haan

PART I

MANY radio-set owners know enough about their receivers to correct minor troubles without outside help, but a far larger number do not; and this series of articles is written especially for the man who knows scarcely any more about his set than how to tune it. The articles will also be helpful to the service man and to those who wish to extend their general knowledge of the subject, whether they anticipate trouble or not. Few of us seek trouble, but it often comes when least expected, and knowing where to look for the fault and how to correct it, frequently will save an interesting program when the set "dies" just as company comes in. More than this, however, the satisfaction of being able to "do his own fixing" and the ability to talk radio intelligently, will more than compensate any radio fan for the little time he need spend in acquiring this knowledge.

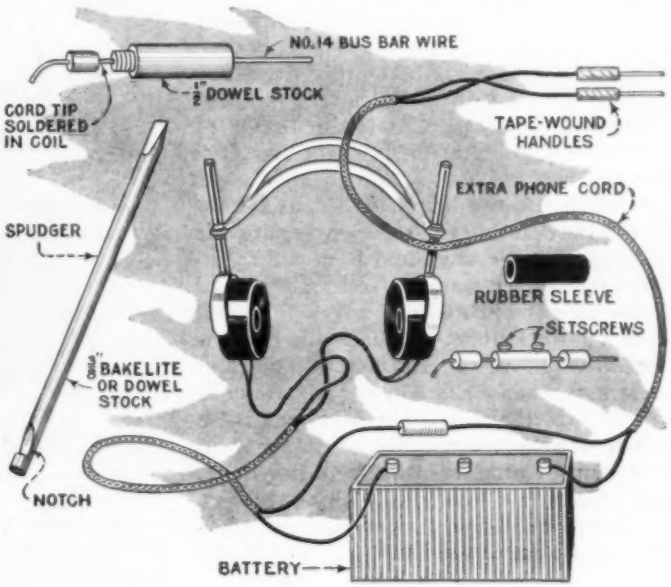
No one can expect to hang a picture without a hook or a hammer, neither can we repair or correct trouble in a set without some tools. Every radio owner should have a simple outfit of tools and instruments for testing, maintaining and repairing his receiver. It is not advisable, however, for the average fan to purchase the more expensive instruments, which he would seldom use unless he intends to go into radio-service work as a spare-time occupation. The sketch shows a headphone tester of simple construction, which is generally useful for the detection of open and short circuits, grounds, and faulty conditions in the receiver or the accessories. It consists of a battery connected in series with an ordinary pair of headphones, and two specially made testing tips. It is provided with an extra cord, as indicated, to facilitate connecting and disconnecting the battery. The use of an extra phone cord is handier than separate flexible leads. A connector of the type shown is handy for connecting cord tips, a short length of rubber tubing being slipped over it so that there will be no possibility of short circuits by accidental contact with the battery terminals. Testing tips with insulated handles should be provided. They are made as follows: Get a length of ½-in. dowel stock and cut off two pieces, each about 2 in. long. Drill a hole through the center of these pieces, just large enough to permit a length of No. 14 round copper wire to be pushed through. The end of the wire is bent to form a small coil in which the tip is soldered. Rubber tape is then wound over the wooden handles in order to provide good insulation.

Adjustments must sometimes be made while the receiver is in operation, as, for instance, in the midget balancing or neutralizing condensers. No metal tools should be used for this work, as the capacity of the operator's body and of the tool may interfere with the accuracy of the adjustment. A "spudger" (shown in sketch) will serve the purpose better. It consists of a 6 or 8-in. length of ⅜-in. wooden or bakelite rod, one end of which is cut or filed down to a screwdriver edge, and the other notched. Besides being useful for making adjustments, this tool will also be found handy for locating loose connections and for cleaning and bending up socket prongs, the notch being used for the latter operation. The spudger can be inserted between the wires without danger of short circuits, but care must be taken not to bend the wires as this may cause them to come in contact with each other and result in a short circuit.

In radio receivers, it is absolutely essential that all the connections are mechanically and electrically tight. If this is not the case, there may be considerable loss of energy from high-resistance joints, or reception may be noisy owing to loose connections. For this reason all wires attached to soldering lugs must be securely soldered. A cheap electric soldering iron, which can be obtained for about $1, will meet the needs of the average fan, who uses it only occasionally. The service man, of course, requires a better grade.

The simple tools required for radio-repair work may be picked up at any department or hardware store at little cost. A medium-size screwdriver, having a long, narrow shank; a smaller one, also narrow; a pair of 5-in. pliers with narrow nose; a pair of long-nose pliers to get in between instruments, and a pair of side cutters are the tools used most frequently. A paring knife with two notches filed in the edge, near the handle, will be useful for removing insulation from wire, and for scraping joints, etc. A hand drill is often needed for drilling and countersinking. No. 27 and No. 36 drills are the sizes most used in radio work, the latter being the proper size for tapping holes for 6-32 machine screws, and a countersink is needed for reaming out holes to permit flat-head or oval-head screws to come flush with the panel. A long tapered reamer is also handy for enlarging holes where the proper size drill is not at hand. In order to drill the holes accurately, the spot should first be centered with a small prick punch. This will prevent the drill from shifting before it seats itself. A small flat file and a round file are often useful. Occasionally there will be need for a hacksaw. A couple of screwdriver-type socket wrenches, to fit the small and large nuts of the 6-32 screws should be included in the kit. If the owner has a storage battery, a hydrometer is necessary to examine the condition of charge. The use of this instrument will be explained in a later article. A strip of emery cloth, some fine sandpaper, friction tape, some soldering lugs, a few lengths of No. 14 copper busbar wire, and a few lengths of "spaghetti" tubing will also be handy.

Some of the most useful meters for radio purposes are shown in one illustration. The condition of B-batteries and the voltages applied to the plate circuit of



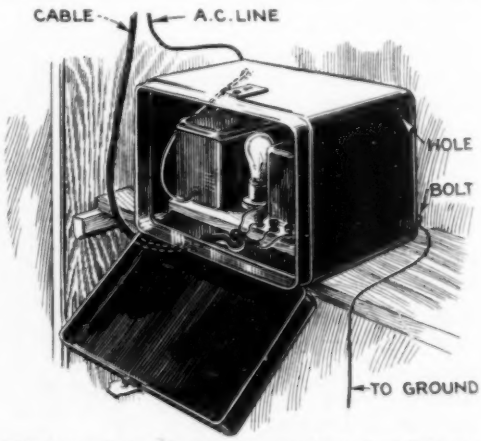
a receiver can be determined accurately only by means of a voltmeter. When a B-eliminator is used to supply the plate current, a high-resistance voltmeter is necessary to determine the exact output. A low-resistance voltmeter will not do for this purpose because it consumes so much current that it gives an erratic reading during the test. It should cover a range of from zero to the highest voltage obtainable from the B-batteries or the B-eliminator.

A small pocket-type ammeter, having a range of from 0 to 35 amp., is generally used for "flashing" dry cells. However, a more accurate method of testing such cells is the use of a voltmeter, reading from 0 to 3 volts, graduated in tenths of a volt. A milliammeter is not essential for the average-set owner, although the service man often may need it. If it is to be used for testing the plate current of the individual tubes, it should have a 0 to 10-milliamp. range, and for testing the total plate-current draw of a receiver, it should have a 0 to 50 range. It should be remembered, when using voltmeters and ammeters, that, as a rule, the former are connected directly across the terminals of a device of which the voltage reading is to be taken. Ammeters, on the other hand, are hooked up in series with the device or devices of which the current consumption is to be ascertained.

(To Be Continued)

Shielding for the Homemade B-Eliminator

Homemade B-eliminators are seldom shielded to prevent induction hum, but the hum can be eliminated and the instrument protected from dust and injury by installing it in a metal container as shown in the sketch. If specially made, these metal boxes are rather expensive. Therefore, in casting about for a convenient and cheap substitute, the writer called at an automobile-supply house and explained his need to the salesman. A steel step box of the type used for tools or auto battery was suggested, and proved ideal for the purpose. These sturdy black-lacquered boxes are of standard make and may be obtained in various sizes. The one shown in the illustration is 7¾ by 9 by 11¾ in. inside measurements and housed the eliminator nicely. The box is laid upon its side with the catch up, the set cable being brought in through a hole drilled below. The bolt holes in the bottom, now at rear, serve for the ventilation and outlet for the ground lead. The holes should be enlarged to provide sufficient ventilation to prevent the case from heating. The lid



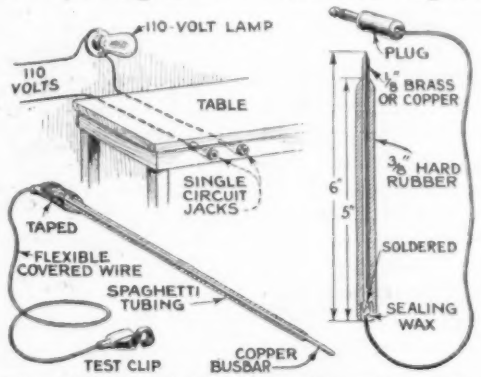
Eliminator Installed, Showing the Method of Bringing Out the Various Leads

may be dropped down when it is desired to examine the eliminator. Being dust and fireproof, the case also protects the instrument.—L. Harrison, Redondo Beach, Calif.

THESE valuable kinks have been written especially for Popular Mechanics Magazine by prominent radio experts. They represent not merely ideas, but practical advice from the best technicians in the profession on methods that will help make your set more efficient in operation, more convenient to handle or easier to build.

Insulated Points for Set Testing

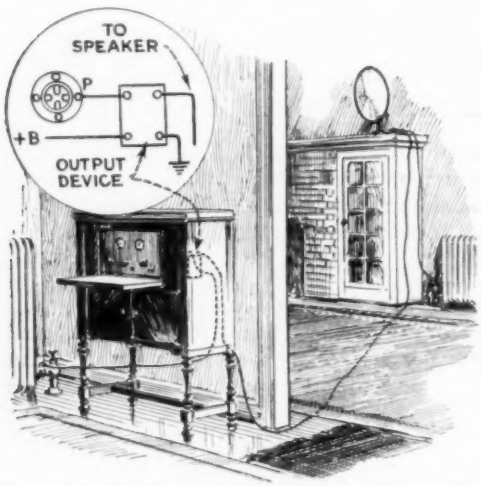
When testing and trouble shooting, the average amateur usually employs two lengths of wire with the insulation bared, and, while this serves the purpose, it is, at best, only a makeshift. The simple and efficient device shown in the sketch will enable one to do his own testing under safer conditions, as there is much less danger of short circuits. The two test rods required are made from lengths of ⅜-in. hard-rubber rod, 5 in. long, each rod having a ⅛-in. hole drilled lengthwise through it. One end of each rod is rounded as shown, and at the other end the hole is slightly enlarged. Two pieces of ⅛-in. copper or brass rod, 6 in. long, are pushed through the hard-rubber handles; the rods should fit tightly (a little glue on the rod before inserting will assure a solid fit) and the projecting ends of the rods are then filed or ground to points. Two flexible covered wires, about 3 or 4 ft. long, are soldered to the other ends of the brass or copper rods. The enlarged holes in the handles provide room for soldering, after which the holes are closed with sealing wax. The ends of the flexible leads terminate in standard horn plugs; these are inserted into single-circuit jacks, mounted in the side of the table. Either on the wall or on the test table, mount a socket for a 110-volt lamp. The lamp is wired in series with one side of the 110-volt line, and its glow will make a simple checking signal for continuity tests. For precision work, a meter may be used instead of the lamp, and in



Circuit Diagram Showing Lamp Connected in Series with 110-Volt Line; Details of Rubber-Insulated Test Rod; Left, Simpler Test Rod

this case it would be better to use a battery, instead of the 110-volt line. A simpler form of test rod is shown in the lower left-hand corner, spaghetti being used instead of the hard-rubber rod and two pieces of round busbar instead of the ⅛-in. rods. The flexible leads are then soldered to the upper ends of the rods and taped. These test rods may be used in the same manner as the other type, or may terminate in clips in the case of a 6-volt storage battery.—Herman R. Wallin, radio operator, Brooklyn, N. Y.

Simplified Connections for Portable Loud Speakers



Upper Left, Connections to and from the Output Device; Below, Sketch Showing External Connections

The common practice of moving loud speakers from room to room usually necessitates the use of long, expensive horn cords, which are also difficult to conceal. The diagram shows a simple and effective way to connect the speaker in a remote position, provided the set is of the modern type in which the speaker is coupled to the plate of the last tube through a condenser and choke-coil combination or an output transformer. It is only necessary to have one wire leading to the speaker, while the other connection may be made to a near-by water pipe, as close to the set as possible. The single lead to the speaker may be of small rubber-insulated wire, which is easy to conceal.—Bert E. Smith, engineer, Allen D. Cardwell Mfg. Corp., Brooklyn, N. Y.

Homemade Relay for Trickle Charger

During some recent experiments, I hit upon a simple relay for automatically operating a trickle charger that can be made at very small cost, and may also be arranged to control the 110-volt a.c. supply to the B-eliminator if desired. The diagram practically tells the whole story. A 6-ohm doorbell buzzer is used for the relay to control the trickle charger as shown at the top, one magnet being shorted so as to make the total resistance of the buzzer 3 ohms. It is important that the leads from the magnet be insulated away from the frame, as in most cases the frame will be found grounded. When the contact is adjusted properly, the battery will be placed on charge when the switch on the radio set is off, and will stop charging when the set is on. In Fig. 1 the buzzer connections are changed so that the lower magnet is shorted out, and leads are shown from the buzzer contacts at front. In Fig. 2 the relay is connected to the charger and battery ready for operation. Any standard battery charger of the trickle or low-rate type may be used, but do not attempt to use the device on a charger of the mechanical type. If a B-eliminator is used, a few simple changes in the relay will provide an automatic cut-off for the eliminator as well as for the charger control. The diagram in Fig. 3 shows the relay controlling both the eliminator and charger. A spring from a jack is soldered to the underside of the copper contact on the armature, and is arranged so that a connection is made when the armature is drawn toward the magnet. The armature is held when the set switch is turned on as shown in the diagram; by

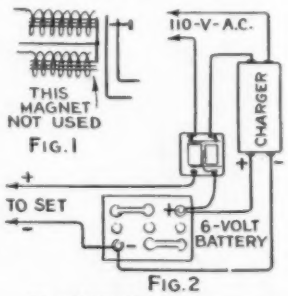


FIG. 1

FIG. 2

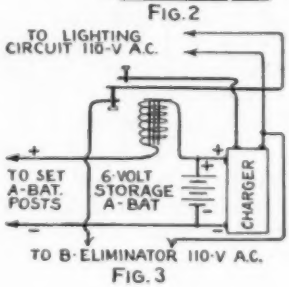
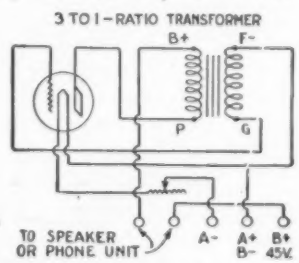


FIG. 3

tracing the leads it will be seen that the 110-volt a.c. supply is turned on the B-eliminator and cut off from the charger.—H. Lawrence Mills, chief engineer, Station WAMP, St. Paul, Minn.

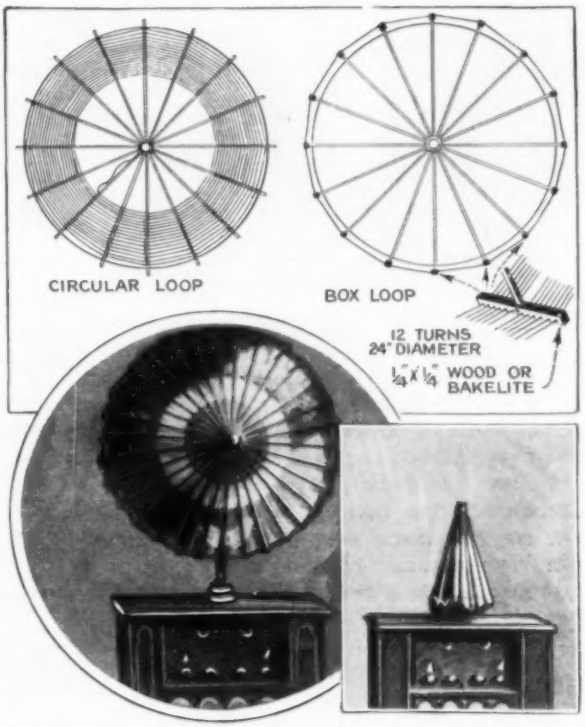
A Simple Tube Tester for Experimenters

The diagram of the tube tester shown in the accompanying sketch is self-explanatory and the tester costs but little to make, as most experimenters have the parts lying around. The parts required are: a standard tube socket, a 30-ohm rheostat, five binding posts and a 0 to 6 d.c. voltmeter, the latter being optional. The writer made up one of these testers in a cigar box, with a phone unit inclosed for portable use. To make a test, connect the batteries and place the tube in the socket. Adjust the rheostat to the normal operating brilliance of the tube. The voltmeter, of course, is the best means of checking this voltage. If no sound is heard in the phones, the tube is dead for all practical purposes. If a low clear note is heard, the tube will make a good oscillator. If a shrill, high note comes through, the tube needs rejuvenating. The lower the note heard in the headphones the better the tube; the higher the note the poorer the tube. To obtain matched tubes, select all tubes of the same note, and as low pitch as possible. This takes a little practice and a good ear but is not hard to do. If the tester does not respond as outlined above, it may be necessary to reverse the primary connections on the transformer. Service men and owners of sets requiring matched tubes will find this tester a great help and a real saving where work of this type is to be done.—Frank Nickel, Jr., second operator, Station WIP, Philadelphia.



Loop Built on Japanese Umbrella

A Japanese umbrella may be utilized for mounting a loop and makes an attractive ornament for the home. The one shown in the photos is equipped with a socket and lamp at the rear, which, when lighted by the house current, gives an unusually pleasant effect. The sketch at the right shows how crossarms are fastened to the ends of the ribs when a box-type loop is required. If a circular type is desired, the insulated loop wire is stitched on the inside of the frame, as shown at the left. Eighty-six feet of stranded loop wire should be used for sets employing a .0005-mfd. tuning condenser; the turns should be spaced about ¼ in. apart.—A. C. Schmidt, engineer, Weehawken Electric and Mfg. Co., Weehawken, N. J.

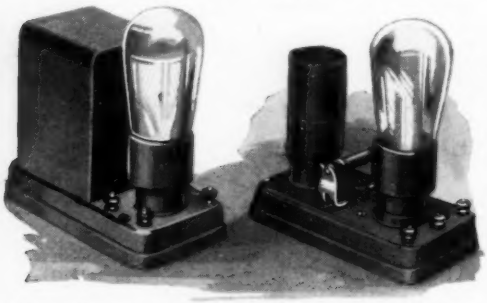


Wiring Details for Either Box or Circular Loop; Below, Completed Loop Open and Closed

¶Popular Mechanics radio department offers its information service free to all readers of our magazine. We will be glad to help you with your radio problems, and will promptly answer all inquiries.

Wired Radio Units

The manufacturer of the units shown in the photo describes them as "the sectional-bookcase idea applied to radio."



Left, Complete Audio-Amplifier Unit; Right, Complete Detector, Including the Gridleak

The radio builder simply hooks up various units to form the circuit desired, and the set is ready for operation. For example, if a five-tube tuned r.f. set is decided upon, the parts required will be two of the r.f. stages, detector stage and two a.f. amplifier stages. Each unit is made with two binding posts, and hooking them up is no more work than connecting a similar number of dry cells.

Rubber Feet for Loud Speakers

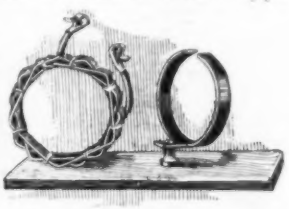
Many owners of receivers place their speakers on top of the radio cabinet, if space is scarce. This is not usually a good place for it, as the vibration from the speaker may be transmitted to the tubes, causing howls. If the horn or cone is cushioned at the base, however, this objection is overcome. Feet for the loud speaker, to minimize vibration, can be made from the halves of two hollow rubber balls as shown. The balls are cut in two with a sharp knife and three or four of the halves are fastened to the speaker base by means of small brass machine screws, as shown in the insert. The metal base is drilled to receive the screws.—Harry G. Schultz, Astoria, N. Y.

How to Prevent Tube Blowouts

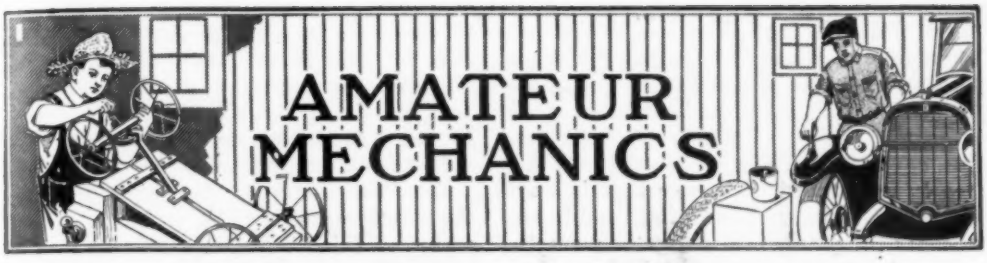
The most common cause of accidental burning out of tubes is letting the B-battery voltage get across the tube-filament terminals. When testing a new set it is an excellent idea to connect the 6-volt A-battery to the B-terminal plug in all the tubes and make sure that no filament lights. If a filament does light, it is an indication that the B-lines are crossed with the A-wiring somewhere in the set, and this fault must be located and remedied. If no filament lights, it is quite safe to connect the B-battery to its terminals.

Handy Mounting for Homemade Coils

A handy mounting for homemade coils of the honeycomb or basket-weave type is shown in the illustration. The supporting form is cut from a 3-in. fiber or bakelite tube as shown at the right; the ring is ½ in. wide and a mounting lug about 1½ in. long is left on one side. A section is cut out of the top, sufficiently wide so that, when the coil is pushed over the mounting, it will be held firmly. A hole is now drilled in the mounting lug, and a long wood screw run through this and into the baseboard, a half spool being used as a spacer. Two or more of these mountings may be used, and the coils turned in any desired relation to each other. The writer has found them very handy in experimental work, especially if the coil leads are provided with clips for quick changes.—Lloyd R. Dickens, Windsor, Ont., Canada.



¶C-batteries do not run down rapidly as they are not subject to drain; however, any dry cell has a limited shelf-life due to cell corrosion, and when the battery falls below its rated voltage it should be replaced with a new one.



How to Recanvas a Canoe

By HENRY E. C. DITZEN

RECANVASING an old canoe is not as hard a task as is usually imagined. Having bought an old wreck of a canoe, I was told on all sides that it would be most difficult to recanvas it, and that the job would, as likely as not, be a failure. No literature could be found on the matter, consequently a method had to be "invented." The success of my procedure was so pronounced and the job so perfect, that it is described here for the benefit of others who may want to try their hand at it. There may be better ways but I have not learned of them. The canoe is an eighteen-footer, and the make is unknown, since the nameplate was gone. Different makes have somewhat different shapes and this must be borne in mind when these instructions are followed.

Place the canoe, bottom side up, on a pair of carpenters' horses. Take a sharp knife and cut the canvas along the keel and gunwale. Then remove the bang plate. The canvas is usually tacked to the bow and stern stems. Pull out these tacks; then remove the entire canvas. This, of course, leaves the planking bare. If the planking, which consists of very thin boards, has holes in it, use a sharp knife to cut the planking in the

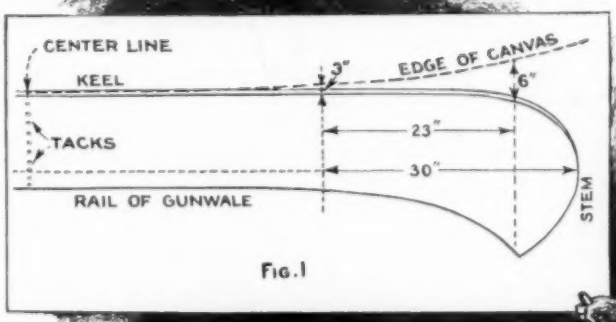
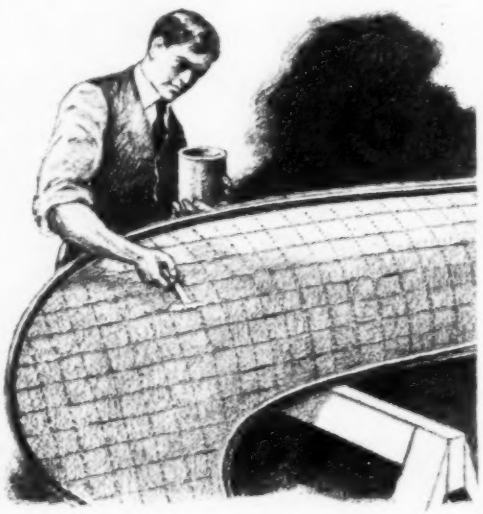


FIG. 1

center of each of the ribs adjacent to the holes, and lift the piece or pieces out. Then take a piece of wood of the same thickness and cut a piece to fit the opening exactly. Nail this into place with tacks that do not quite go through the ribs, copper tacks being preferable. When you have patched each hole in this way, look the hull over carefully and see whether the planking fits together snugly.

The chances are that you will find many a crack. These should be filled carefully both from the outside and inside of the canoe. The joints of the patches should also be filled. For this purpose, make a sort of putty of whiting and the waterproof glue that you will use for attaching the canvas later on. This putty gets very hard in a short time. After it has set, use a file or sandpaper to cut down the rough surface of the filler. Get the surface quite smooth. When this is done, the canoe is ready for recanvasing.



It is generally neither necessary nor advisable to take the keel off. In fact, it would be more difficult, it would seem, to recanvas the whole canoe at once, while it is an easy matter to canvas one side of a canoe at a time. An 8-oz. canvas is about the best; this is not too heavy and it will withstand jabs from sharp rocks satisfactorily. If in a country where the waters have a sandy and not a rocky bottom, a lighter canvas will be better, for it will keep the weight of the canoe down. This is a matter of personal choice and does not, of course, affect the manner of putting it on.

It might be supposed that one edge of the canvas should be fastened in a straight line along the keel and the canvas then stretched over the gunwale. The writer has not found this to be the case, although it may work in some canoes. In the writer's case, it was found that the edge of the canvas extended beyond the keel at the ends in a large arc, as shown in Fig. 1. This is not stated as a guide for all cases, but merely as a warning not to try to make it run along the keel, unless by doing so the canvas will cover the hull with perfect smoothness.

Find the center of the canoe, between the extreme curves of the stems. Draw a line at this point perpendicular to the keel and outer rail of the gunwale. Take a piece of canvas, somewhat wider than the distance from keel to gunwale and several inches longer than the extreme length of the canoe along its bulge; find the center of the length and make a crease across the canvas at that point. Then roll back the ends toward the center, stopping several feet from the crease. Hold these rolls in place with paper clips or something else that will serve the purpose. Then tack the central line of the canvas to the central line of the canoe. Do not drive the tacks all the way in; drive them so that they can readily be removed, yet will stand some strain. The canvas should be tacked so that it extends almost to the bottom of the keel, that is, almost to the top of the keel as the canoe lies upside down. Unroll the canvas toward one end of the canoe for a distance of several feet. If assistance can be had, the assistant should hold the canvas while it is being laid in place. From the center line of tacks work the hand forward along the bulge, keeping an even tension on all the tacks. With one hand rub upward and forward from the bulge to the keel and with the other, forward and downward toward the gunwale. When the canvas is as smooth as it can be made, tack it temporarily along the keel and gunwale. Take a short stretch of a couple of feet at a time. Fig. 2 shows how it is to be done. When the end of the canoe is reached,

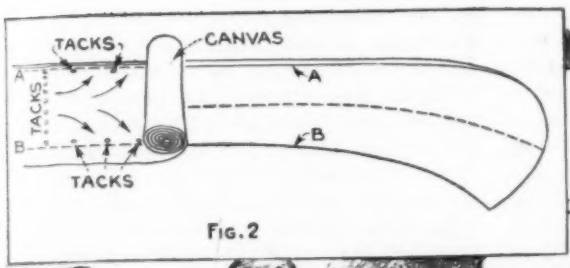


FIG. 2

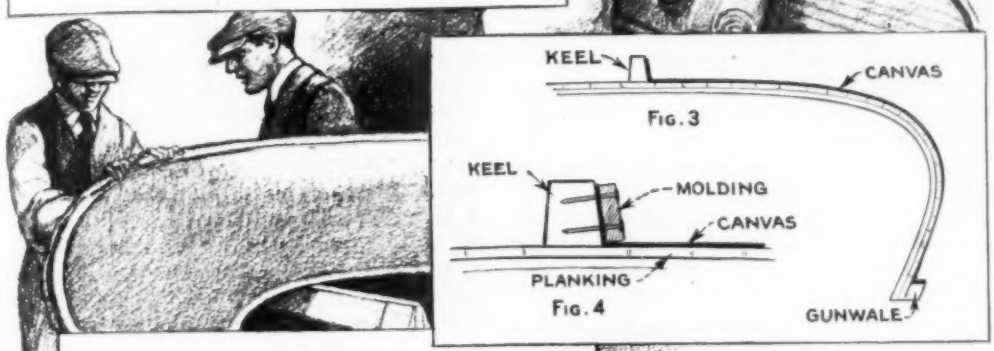


FIG. 3

FIG. 4

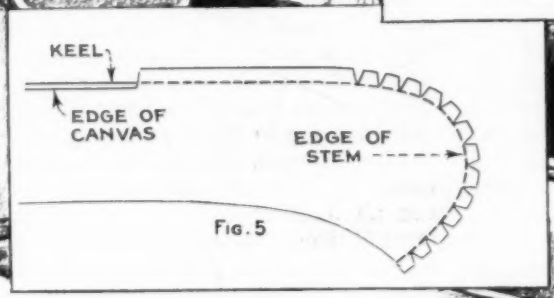


FIG. 5

look the whole over. It may not be entirely satisfactory. The canvas may bulge and pull here and there. If so, the temporary tacking may be taken out as necessary and the work gone over again until the canvas is as even as you can make it.

The canvas, when put on in this manner, in the writer's case had the shape of a large arc, and the curve was found to be as shown in Fig. 1. At the end of the bang plate, which was 30 in. back from the extreme front edge of the stem in a straight line, the canvas was found to extend 3 in. beyond the keel; 23 in. farther forward, it lapped 6 in. beyond the keel, while, in the middle of the canoe, it was slightly below the edge of the keel. These measurements must be regarded as merely illustrative. They will vary with different makes and different sizes of canoes. Even on the same canoe they are likely to vary on opposite ends and opposite sides. The fact is given, however, to show that one cannot tack the canvas straight along the keel and then stretch it over to the gunwale and expect it to be smooth. The canvas must be put on according to the curves of each canoe. You may not be able to get away from a very slight looseness along the gunwale but this will disappear when the canvas is glued on. This does not mean, however, that any folds are allowable.

When the canvas is in place, it should

be lightly tacked along the gunwale and keel and the curve of the stems. Then, with a soft lead pencil or marking crayon, run along the line of juncture between the keel and planking (A in Fig. 2), making a distinct mark; do the same along the juncture of the gunwale and the planking (B, Fig. 2) and along the edge of the stems. This is done so that, when the canvas is removed, it can be replaced exactly in its former position. All the tacks are now taken out, except those along the center line, and the canvas rolled back as it was when the work was first begun.

Before starting, the waterproof glue should have been made ready. You can buy waterproof glue or you can make it yourself. If you buy it, it will come rather expensive for a job like this, and glue that you waterproof yourself will answer the purpose perfectly well. A great many different estimates are given in regard to the quantity of glue necessary, some being very extravagant. Three pounds of glue have been found ample for an 18-ft. canoe, including the glue that was used to make the filling putty. It may be made all at once or half of it at a time. If your pot is not large enough, a pound at a time will do.

To make the glue, buy a good grade of ordinary carpenters' glue; put it into the pot (a double boiler is preferred so that the glue is not likely to burn) and cover it with just enough water to swell it without its losing shape. The exact quantity of water cannot be given since it varies with different grades of glue. A medium grade of hide glue will take about 2½ parts of water to 1 part of glue by weight. The length of time it takes to soak the glue also varies, but it is well to soak it overnight when it is to be used the next morning. When thus softened, linseed oil is added in the proportion of 1 part oil to 8 parts of glue (⅛ lb. of oil to 1 lb. of glue). Have plenty of water in the outer part of the double boiler, and then heat while stirring until the glue melts completely and is mixed with the oil thoroughly, when a gelatinous mass results. This done, it is well to add ½ oz. of nitric acid to every pound of glue. This will help to keep it liquid so that it spreads more easily and does not set too fast. This glue sticks firmly, and it is said that it neither absorbs water nor allows it to pass through. It has stood the test thus far in the writer's case.

When the canvas has been properly marked and rolled back as directed, place your glue pot in a convenient position. Apply the glue to the planking and not to the canvas, using a regular glue brush. The advice given is generally the other way, but the writer does not feel that this is better and he has certainly had wonderful results by putting the glue on the planking. The canvas having been rolled clear back to the center-line tacks, spread the glue thoroughly upon the planking for a distance of about 2 ft., rubbing it in well. Then, if an assistant can be had, it is well for him to hold the canvas a slight distance from the planking. Start at the center-line tacks and on the bulge and lightly run the hand up toward the keel, getting the pencil line back into its original position. Then run the hand lightly down to the gunwale and get that line back into its original position. In this way run first up and then down, until the lines are in place as far as the glue has been spread. The whole surface must then be gone over thoroughly so as to get out all bubbles and folds. The canvas must fit like a glove. The covering is then turned back again just a trifle from the edge of the glue, and a couple of feet more of the planking are covered with glue. The lines on the canvas are again placed into the original position and the canvas rubbed down smooth. This process is continued until the end of the canoe is reached. It is really surprising how easily the canvas will shape itself to the various curves. If the directions are followed carefully there is no reason why the finished job should not look as well as that turned out by a factory. Do not as yet attempt to glue the canvas over the edge of the stem.

After finishing this half of the side, remove the tacks on the center line and glue the canvas onto the other half out to the edge of the stem. When this is done, take a warm flatiron and run it back and forth over the canvas lightly so as to melt the glue into the canvas, being careful not to have the iron too hot or to soak the glue clear through the canvas. Then the job should be allowed to stand until

the glue has set well. A sharp knife is next taken and the canvas trimmed off close to the bottom of the keel and the outer edge of the gunwale rail. When the place is reached where the bang plate is to be attached, leave a flap, about 1 in. or so in width. V-shaped pieces are cut out of the flap, as in Fig. 5, along the curve of the stem so that it can be pasted smoothly to the front edge of the stem. Tacks are also driven in in order to hold the edge of the canvas firmly in place. When the glue has set thoroughly, the canvas is trimmed off close to the farther edge of the stem.

This completes one side of the canoe as far as gluing on the canvas is concerned. The canvas is then glued onto the other side. Tnis is to be glued around the front edge of the stem also, making a double thickness of canvas on its outer edge as shown in Fig. 5.

The next step is to nail strips over the edges of the canvas to keep them from working loose. A thin narrow strip of molding, say a ⅝ by 3/16-in. window-screen molding, properly chamfered if necessary, is covered with some of the waterproof-glue putty, as is also the side of the keel, and the molding is then nailed in place with ¾-in. flat-head wire nails, or such other nails as may be suitable. (See Fig. 4.) This will pull the molding up tight and squeeze out the superfluous putty. The surplus is wiped off and the job left to dry.

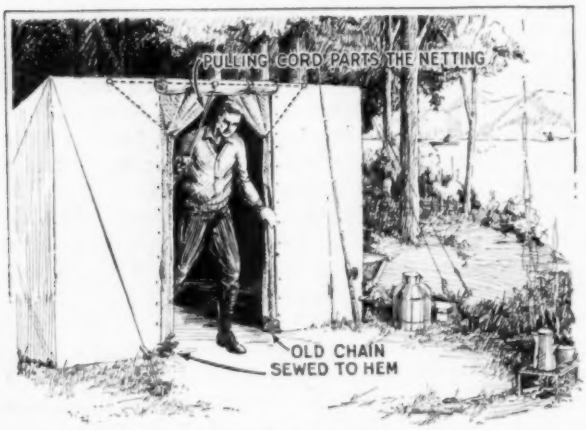
The strips tacked against the rail by the writer consisted of "kite sticks" of the proper width. These doubtless cannot be had in every community. They are the long narrow strips that are cut off cigar-box wood while making boxes of different sizes. However, some other thin narrow strips probably can be found for this purpose. They are set in glue putty in the same manner as the molding strip was fastened along the keel.

If the old bang plates are broken, new ones must be put on. The material can be bought in 10-ft. lengths. One piece is enough. It should be of ample width so that the holes drilled through it for the screws do not unduly weaken the plate. It is also advisable to put glue putty under the bang plates. The material is quite readily bent.

When the bang plates are on, the job is complete for filling and painting the canvas. This is outside the purpose of this rticle. There are different methods of treating the canvas. Some advise giving a first coat of shellac, but this is rather expensive. The writer gave a first coat of linseed oil and let that get bone-dry. This was followed with two coats of tinted white-lead paint. When thoroughly hard, this was sandpapered until smooth, and then a couple of coats of waterproof varnish were given. The author also added a swastika. The illustration below shows how the canoe looks at present.

Self-Closing Mosquito Netting for Tent Doorways

Mosquitoes, flies and other insects take much of the joy out of a camping trip. To prevent this annoyance as much as is possible, get some mosquito netting and suspend it in the entrance of the tent as shown in the drawing. If you have to brush it aside with the arm to pass through, the net is likely to cling to the clothing or catch on buttons or shoe hooks, causing it to tear. This can be overcome by sewing two pieces of old chain to the hem at the bottom of the netting. Two lengths of flexible cord, such as heavy linen fishline, are passed around the netting and through the eyelet holes in the tent wall, both cords terminating in a ring suspended from the center eyelet. Pulling the ring will part the netting so that one can enter without interference. When the ring is released, the weight of the chains in the hem will draw the netting together from top to bottom.

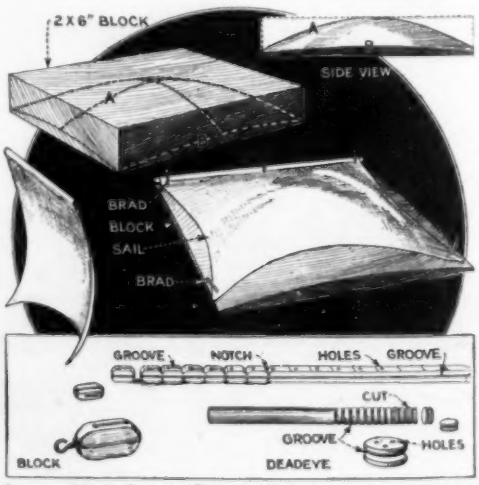


How to Use Mosquito Netting in the Door of a Tent

Making Sails, Blocks and Deadeyes for Model Ships

To make sails on model ships appear as if "bellied" by the wind, take a piece of 2-in. wood, the exact size depending on the size of the sail, and cut it down to form a pillow-shaped block, a little larger than the largest sail to be made. Cut the sail and hem it for the insertion of wire, then make up some thick starch and soak the sail thoroughly. Place it on the block and fasten with brads or pins. Lay the yard or spar on the top edge of the block and drive a brad in front of it at the center and one near each end. Catch hold of the bottom corners and pull the sail so that it is spread over the block without wrinkles. When thoroughly dry, give the sail two coats of white shellac, the second one being applied after the first has dried perfectly. Take the sail off the block and give the inside one similar coat. When dry, replace the sail on the block and leave it there for a day. The sail will then look weather-beaten. If you are building only one model, treat the largest sail first and then cut the block down to make it suitable for the smaller sails. The blocks may also be used, of course, for curving the triangular sails. If you are making several models, it is best to have a few blocks of different sizes.

To make blocks, cut a strip of suitable stock, preferably boxwood, to the width and thickness of the size desired. Mark off the length of each block on the narrow side and drill a small hole about a third of the way back from the mark. Make a little notch on each line, top and bottom, and with the point of a knife cut a small groove from the hole to the notch. Also cut one along each side. With a sharp knife also slice each block off, cut-

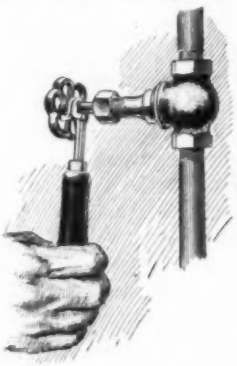


Simple Methods of "Bellying" Sails, and of Making Blocks and Deadeyes

ting a little on each side. If strapped blocks are desired, take an "E" mandolin string and bind them as indicated in the detail. If a lathe is available it is also an easy matter to make deadeyes. Turn out a piece to the right size and cut notches half the width of the deadeye. Saw each one off, sandpaper and drill it.—Carroll MacT. Elder, Bradley, Ky.

Tool for Turning Hot Valve Wheels

The wheel of a valve connected to a cleaning tank was generally too hot to be touched with the bare hands. Some of the men used waste while others preferred inserting a screwdriver between the spokes to turn it around. To avoid these makeshift methods, I made a simple lever that has proved very handy. I doubled a length of 3/16-in. wire and drove the closed part into a file handle, while the other end was formed into a hook to fit on the valve stem and the tips then bent outward at right angles so as to engage the valve wheel as shown. In the drawing, the left-hand hook is engaged with the handle to open the valve. To close it the lever is reversed on the spindle and moved in the opposite direction. Hung on a nail close to the valve, this tool is always handy when the handle is too hot to be touched by the bare hands.—Harry Moore, Hamilton, Can.



Let Nature Be Your Painting Guide

Some painters use nature to guide them in arranging the color schemes for houses. Picking, for instance, a pansy, for the purpose, he uses its dominant color as a guide for the side wall, the next most prominent color for the corner boards, cornices, etc., and the high-colored tints for the panels, brackets, shingles, carvings, etc. Nature furnishes perfect harmonies in color and such a guide is easy to find, especially in summer.—L. B. Robbins, Harwich, Mass.

Growing Long and Tender Stalks of Rhubarb

To make rhubarb stalks grow long and tender, and practically without strings, is the ambition of many amateur gardeners. This may be done easily by the use of headless kegs or half barrels, as shown in the drawing. A keg is placed over each rhubarb plant as soon as the leaves are fairly well developed, and no further attention is necessary, except to water and cultivate it in the usual way. The plant, denied the full sunlight but supplied with plenty of nourishment for its growth, pushes rapidly upward and produces long bleached stalks which are more tender.

Inner-Tube Band on Broom Protects Furniture

Using a common house broom for sweeping under dressers, buffets, and other low pieces of furniture will cause damage to the varnished surfaces unless care is taken. To avoid this trouble, cut a wide rubber band, from a discarded inner tube, to the shape indicated. The tabs are perforated so that they can be slipped over the broom handle and the band is stretched down over the broom shoulder, where it will serve as a neat and effective buffer.

Fisherman's Watch and Cigarets Kept in Rubber Balloons to Keep Them Dry

Fisherman's Watch and Cigaret Protector

Fishermen, particularly in going for trout, often slip on a slimy rock and receive a thorough ducking. The mere ducking may be taken good-naturedly, but it is rather annoying to find one's expensive watch, tobacco or cigars hopelessly water-soaked. This trouble can be avoided by the use of toy balloons as covers for these articles. Just slip your watch or tobacco inside of the rubber sack and tie up the end. The thin rubber can be stretched taut over the face of the watch and this will be sufficiently transparent to read the dial. Cigarets can be carried in the same way.

Tanning Shoes without Dye

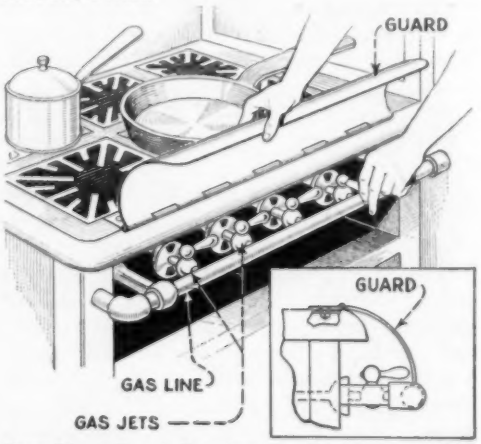
When white-kid shoes become dark and gray from much cleaning they can easily be tanned without dye. Take ten drops of tincture of saffron with three tablespoonfuls of olive oil. Rub this mixture into the leather with a piece of soft cloth, first making sure that you have cleaned the shoes as well as possible. One or two applications will do the tanning effectively. —L. H. Georger, Buffalo, N. Y.

Coloring Solder

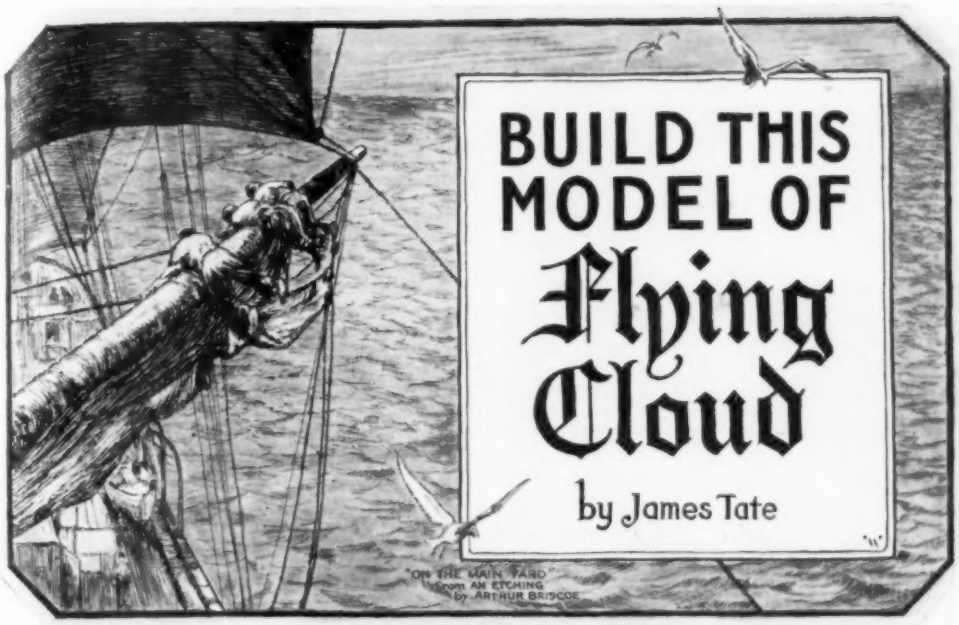
Better and more lasting jobs could be done on brass if the joints were made with solder, but the objection to its use is that it does not match in color. This can be overcome in the following way: Make a solution consisting of strong blue vitriol and water and apply this to the solder with a piece of iron wire. This will "copperize" the surface. Then mix some sulphate of zinc with strong blue vitriol and rub this over the copperized area with a piece of zinc. This mixture should be applied until the right color is obtained.

Metal Guard Keeps Children from Gas Jets

Every gas stove is a source of danger, especially where children are allowed to play in the kitchen. They may easily turn on the gas jets whether unwittingly or in mischief. This can be prevented by providing the sheet-metal guard shown in the illustration. It is made in two sections, which are hinged together, the narrow flat part being attached to the stove and the curved section arranged so that it drops over the handles of the gas jets, completely hiding them from view. The guard is raised when it is necessary to get at the jets, but the children, not seeing them, let them alone.—F. A. Inman, Grand Haven, Mich.



Sheet-Metal Guard Covering Gas Jets Prevents Children from Tampering with Them



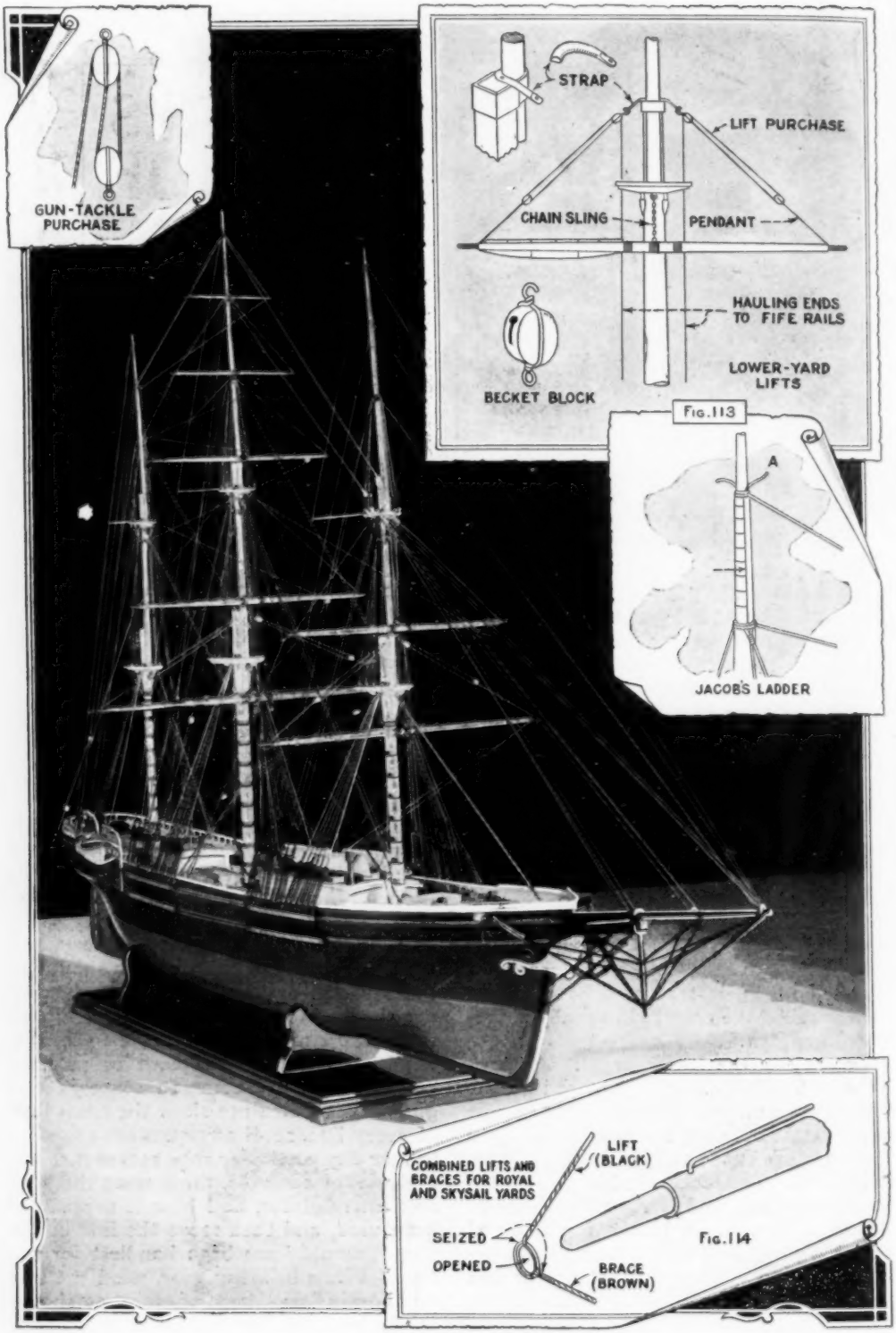
ONE more item of standing rigging should be added before tackling the running rigging—the "Jacob's ladders." These run from t'gallant masthead to royal masthead, on the after side of each royal mast. They are best made by stretching two parallel lengths of black button thread, about 3/16 in. apart, in some convenient manner, and then knotting No. 60 cotton ratlines across for the length of the individual masts. Leave long ends on the ladders, tuck these ends under the shrouds at the mastheads, as at A in Fig. 113, glue and cut off.

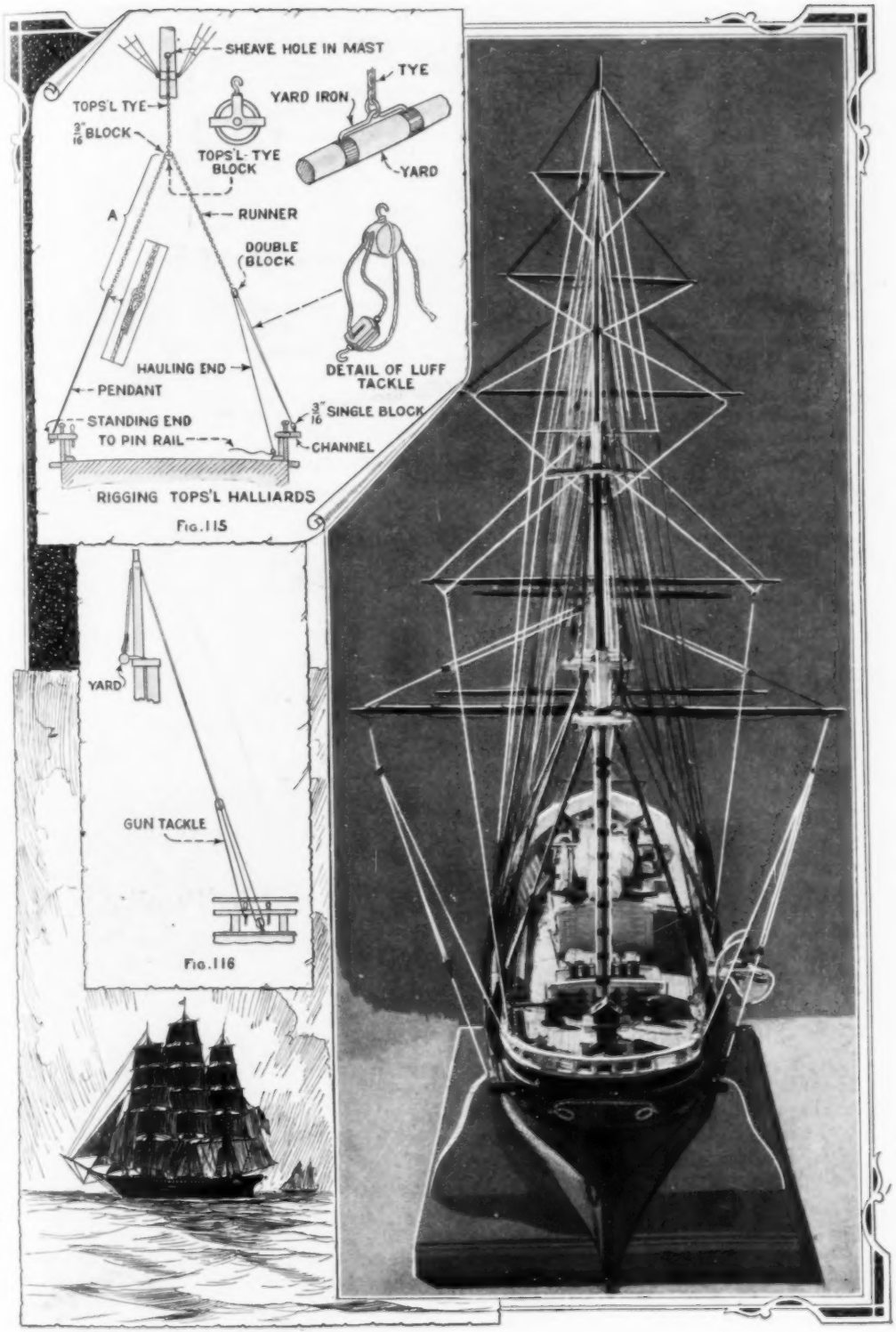
One mistake appeared in the yard dimensions given in Fig. 99, March number. The length of the mizzen lower yard should be 8 in. instead of 6 13/16 in. This yard is called the crossjack, usually abbreviated cro'jack.

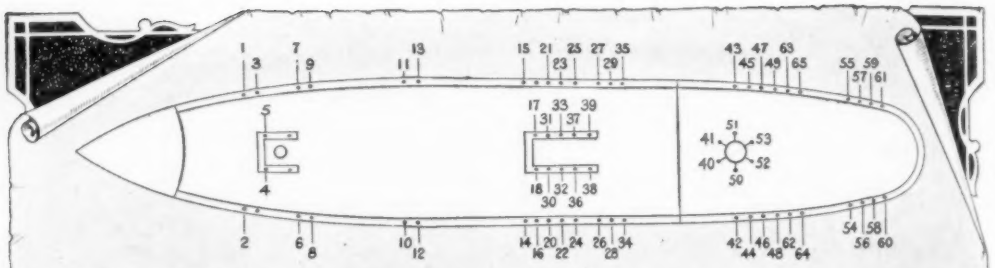
First sling the lower yards. A short piece of 22-link chain is fastened to the eye at the center of the yard and to one on the mast between the crosstrees. The yardarms are supported by the lifts shown in Fig. 113. The tackle used here is a gun-tackle purchase, and is shown in detail at the left. Use 3/16-in. blocks for lifts and braces on fore and main lower yards; 1/8-in. on mizzen. The pendants are of fine twisted wire, painted black. Note that the lift blocks at the masthead hook into a crescent-shaped strap, which is so bent as to bring the tackle well forward of the foremost topmast shrouds. This strap is half-round, filed from 1/16-in. wire.

For the entire rigging ninety-six 1/8-in. single blocks are required, ten 1/8-in. double blocks and twenty-one 3/16-in. single blocks. For the standing rigging one hundred and forty-eight 3/16-in. deadeyes are necessary and sixty 1/8-in. deadeyes.

Pay close attention to Fig. 117. This shows the points where the end of each running line is belayed, or made fast. This is one of the important points about a correctly rigged model. One authority says: "The lead of running gear aloft may, and does, vary, but the lead on deck should be the same in every ship, so that a sailor may be able to go on any strange ship on the darkest night, and be able to lay his hand at once on any piece of running gear." Also, use common sense in rigging. It is difficult to show the exact lead of every line, so, if any question arises as to how any particular rope reeves through a block, for example, think what the gear was intended for, and how it must have been used, and then reeve the line in the way it would have been handiest for the men. When belaying gear, wind the line on the pin in a figure-of-eight, as shown at the left, Fig. 118, not as in the center.


GUN-TACKLE PURCHASE
STRAP
LIFT PURCHASE
CHAIN SLING
PENDANT
HAULING ENDS TO FIFE RAILS
LOWER-YARD LIFTS
BECKET BLOCK
Fig. 113
A
JACOB'S LADDER
COMBINED LIFTS AND BRACES FOR ROYAL AND SKYSAIL YARDS
LIFT (BLACK)
SEIZED
OPENED
BRACE (BROWN)
Fig. 114


SHEAVE HOLE IN MAST
TYE
YARD IRON
TOPS'L TYE
3/16" BLOCK
TOPS'L TYE BLOCK
YARD
A
RUNNER
DOUBLE BLOCK
DETAIL OF LUFF TACKLE
HAULING END
PENDANT
3/16" SINGLE BLOCK
STANDING END TO PIN RAIL
CHANNEL
RIGGING TOPS'L HALLIARDS
Fig. 115
YARD
GUN TACKLE
Fig. 116



1-OUTER-JIB HALLIARDS
2-INNER-JIB "
3-FORETOPMAST-STAYSAIL HALLIARDS
4, 5-FOREYARD LIFTS
6-FORETOPS'L HALLIARDS
7-FORET'GALLANT HALLIARDS
8-FORE-ROYAL "
9-FORE-SKYSAIL "
10, 11-FORE BRACES
12, 13-FORETOPS'L BRACES
14-MAIN T'GALLANT STAYSAIL-HALLIARDS
15- " TOPMAST STAYSAIL-HALLIARDS
16- " ROYAL STAYSAIL-HALLIARDS
17, 18-MAIN LIFTS
20, 21-FORE-T'GALLANT BRACES
22, 23-FORE-ROYAL BRACES
24, 25-FORE-SKYSAIL "
26-MAIN T'GALLANT HALLIARDS
27- " TOPS'L "
28- " SKYSAIL "
29- " ROYAL "
30, 31-MIZZEN-TOPS'L BRACES
32, 33-CRO'JACK "
34, 35-MIZZEN-T'GALLANT "
36, 37- " ROYAL "
38, 39-MIZZEN-SKYSAIL BRACES
40, 41-CRO'JACK LIFTS
42-MIZZEN-STAYSAIL HALLIARDS
43- " TOPMAST STAYSAIL HALLIARDS
44, 45-MAIN-T'GALLANT BRACES
46, 47- " ROYAL "
48, 49- " SKYSAIL "
50-SPANKER THROAT-HALLIARDS
51-SPANKER PEAK HALLIARDS
52, 53- " TOPPING LIFTS
54, 55-VANGS
56, 57-MAIN BRACES
58, 59-MAIN-TOPS'L BRACES
60, 61-SPANKER-BOOM SHEETS
62-MIZZEN-TOPS'L HALLIARDS
63- " T'GALLANT "
64- " ROYAL "
65- " SKYS'L "

Fig. 117

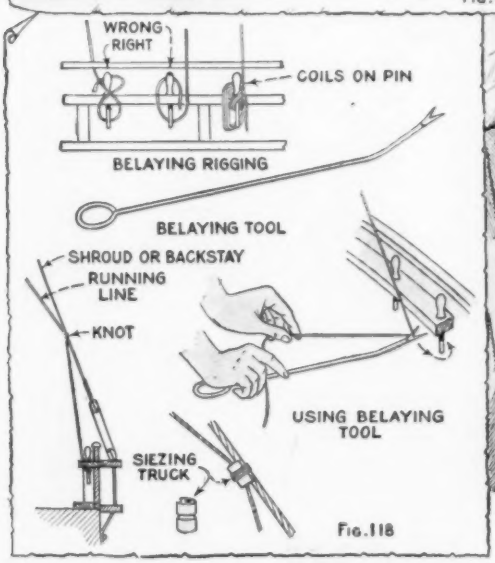
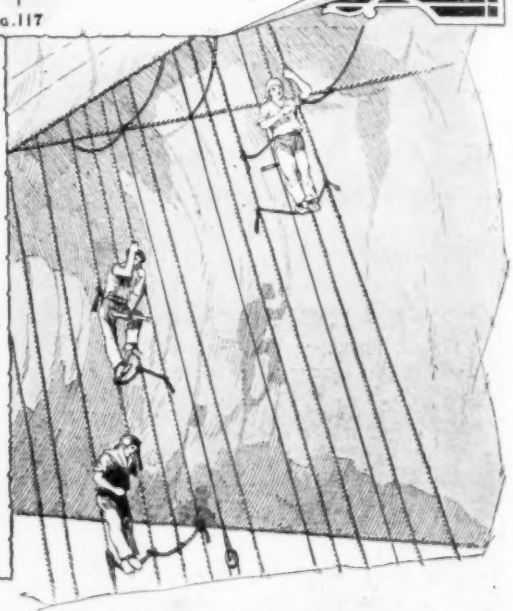


Fig. 118



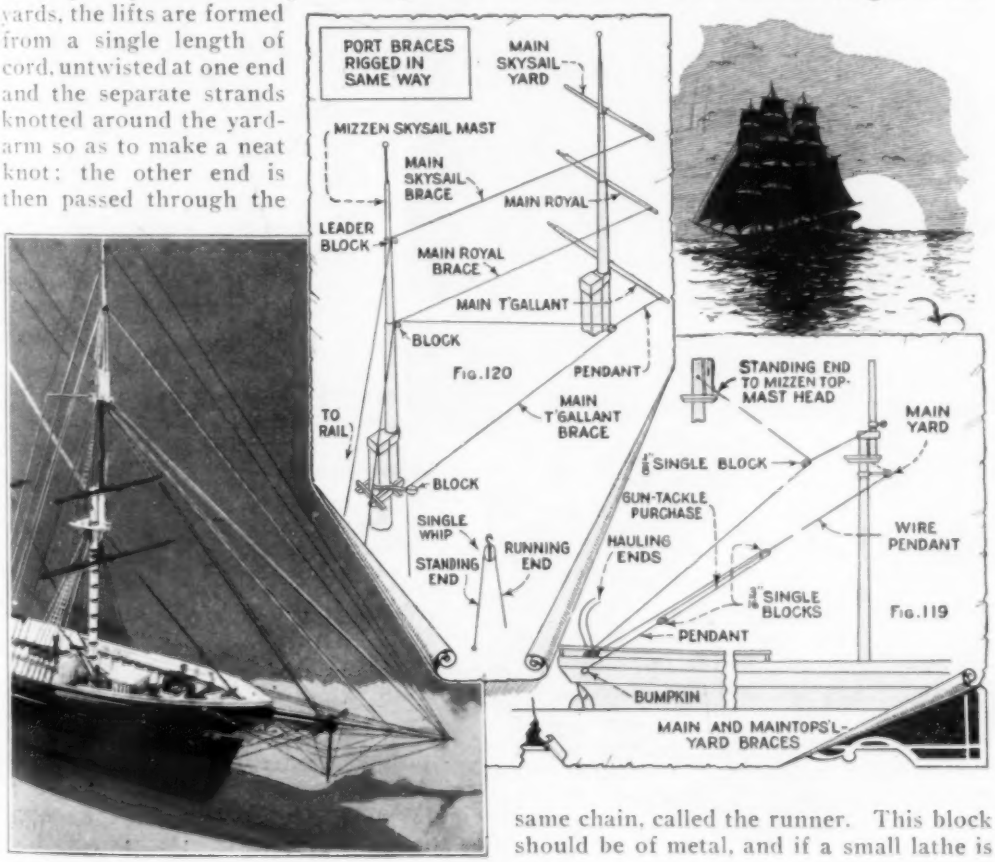
Make a simple wire belaying tool as shown in the same figure, and use it from the opposite side of the model for any particular line. Then the job of belaying will be found fairly easy. A drop of glue on the pin will keep the cord from coming off after belaying. The belaying pins can be obtained from model-supply houses for a few cents a dozen. Get sixty-four pins, ½ in. long, and cut them off to suit the monkey rail as needed. Ordinary pins, driven through holes in the rail, can be used if desired. The coils on the pins should be formed separately, by winding a few turns of line on a 3/16-in. dowel, afterward gluing the coil on the pin.

Use the lightest rigging cord for the rigging on the lower and topsail yards, and dye it light brown, as near the color of rope as you can. Don't leave the running gear white. As you go aloft, use smaller and smaller sizes of linen thread; say, No. 40 for the t'gallant rigging on fore and main, No. 70 for the royal yards and

No. 100 for the skysails. On the mizzen, where the yards are lighter, use No. 70 for t'gallant and No. 100 for royal and skysail yards. Do the same with the blocks. For the lower yards, use 3/16-in. blocks, 1/8-in. blocks for the topsail and t'gallant yards, and, where leader blocks are required for the t'gallant, royal and skysail braces, use either 1/8-in. blocks or the same blocks filed down to about 3/32 in. Keep everything in proportion to the decreasing size of masts and yards, as nothing looks worse than heavy, clumsy blocks on a light spar.

The lifts on the tops'l, t'gallant, royal and skysail yards have no purchases, but consist of single cords running from the slight shoulders on the yardarms up to the masthead, on each side. Keep these in proportion also, using the medium rigging cord for the fore and maintops'l yards, the fine cord for the t'gallants, and Nos. 70 and 100 linen thread for the royal and skysail yards. On tops'l and t'gallant yards, the lifts are formed from a single length of cord, untwisted at one end and the separate strands knotted around the yardarm so as to make a neat knot; the other end is then passed through the eyes of the shrouds at the masthead (using a needle if necessary), brought down to the other yardarm and knotted as on the other side. On skysails and royals, the neatest method is to use a thread long enough for both lifts and braces, opening the thread at the proper point, as shown in Fig. 114, seizing around the yardarm, passing the end through the shrouds at the masthead and opening and seizing to the other yardarm. Use the dyed thread for this, and, after all is in place, paint the lift portions black. All lifts are black, except, of course, the purchases on the lower yards.

The halliards are the tackles that are used to hoist the upper yards. All tops'l halliards are rigged as shown in Fig. 115, using 22-link chain, painted black, and the light rigging cord. The tye is the chain that goes through the mast sheave hole and is shackled to the yard iron. On the after end of the chain is hooked a 3/16-in. block drilled for another length of the

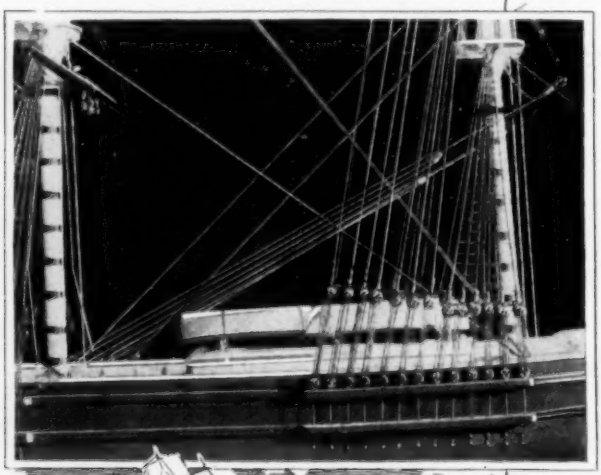


same chain, called the runner. This block should be of metal, and if a small lathe is

driven through holes in the rail, can be

and main, No. 70 for the royal yards and

available, it can be made as indicated; it must not be over 3/16 in. in diameter. In the absence of a lathe, regular 3/16-in. blocks answer very well. To the channel on one side is fastened a length of black medium cord, the upper end being fastened to the runner as indicated. On the other end of the runner a 1/8-in. double block is hooked, through which the tackle is rove to a block in the opposite channel. This is a luff tackle. The hauling end is brought down through a single 1/8-in. block in the waterways and then up to the rail. In order to get lifts and halliards set up tight, it will be found necessary to run a small pin through the mast above each yard parrel, so as to keep the yard down when setting up the gear. Note, in Fig. 117, that the hauling end of the foretops'l halliards is to port; on the maintops'l halliards, it is to starboard, and at the mizzen to port. This is done to distribute the strains on the hull, and the same thing applies to all halliards, the foret'gallant halliards being to starboard, the main to port, etc. Lead the tops'l-halliard runners, tackle, etc., down in line with the topmast backstays, the t'gallant halliards in line with the t'gallant backstays, and similarly with royal and skysail halliards. T'gallant halliards on fore and main are rigged in exactly the same way as the topsail halliards, except that a gun-tackle purchase is used instead of a luff. Fore and main royal halliards are rigged as shown in Fig. 116, with a light-cord tye and a gun tackle. As the mizzen t'gallant yard is not any heavier than the main royal, rig it in the same way. Skysail halliards consist of a No. 40 thread tye, rigged as the royals, but with a single-whip purchase on the hauling end. (See Fig. 120 for a single whip.)



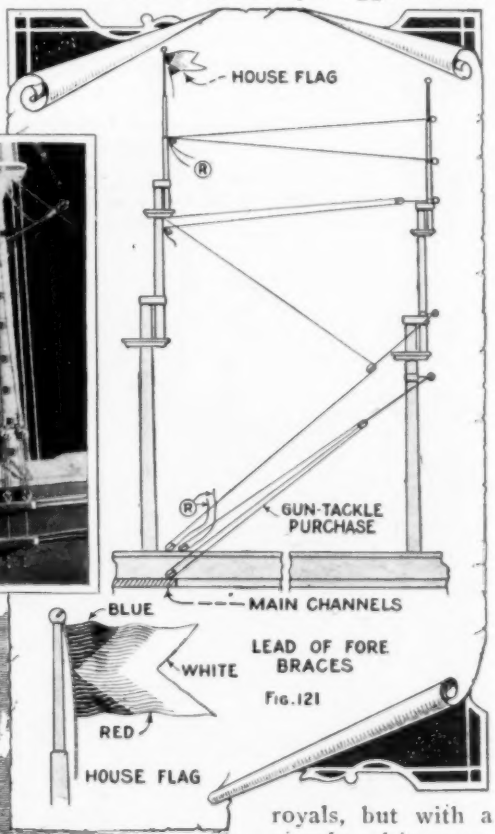
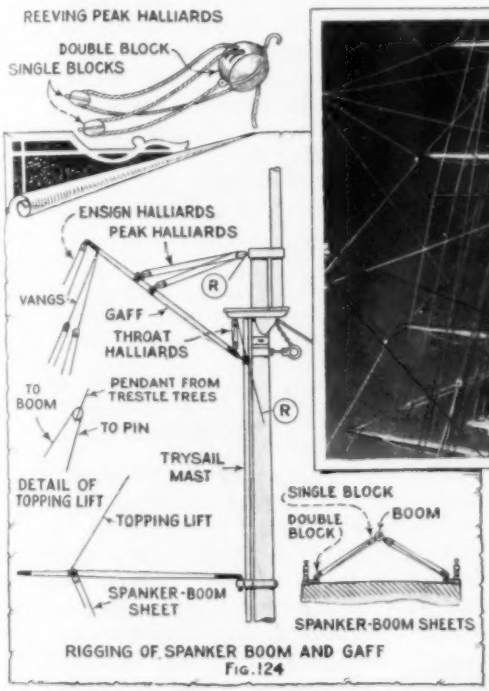
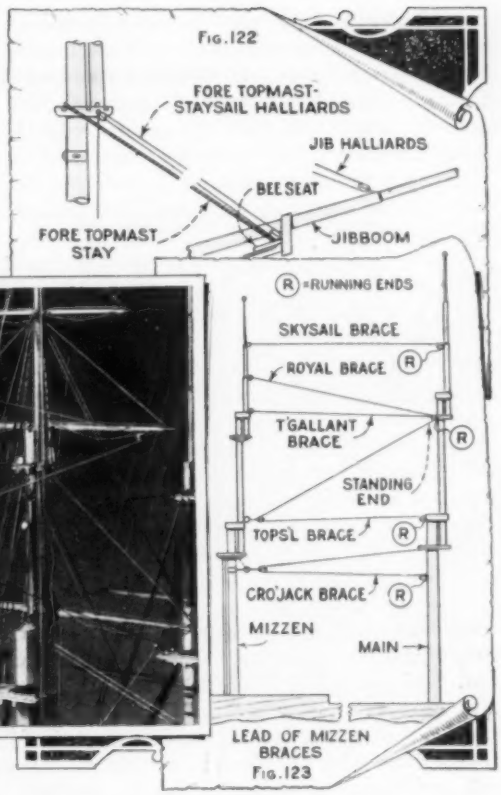


Fig. 121

The braces are the gear that control the fore-and-aft motion of the yards; Fig. 120 will make this clear. Rig the braces on the lower yards first, starting with the

main. The main braces are rigged with a twisted-wire pendant at the yardarms, with a single block at the lower end. Into each quarter, a bumpkin, consisting of a piece of 7/16-in. dowel, is driven, and projects 5/8 in. A medium-cord (black) pendant is seized to an eye at the outer end of the bumpkin, and a 7/16-in. single block turned in the upper end of the pendant.





The hauling end of the tackle runs through a block under the monkey rail and up to the rail. (See Fig. 119.) Maintops'l braces are rigged as single whips with the standing end made fast at the mizzen-topmast head. Main-t'gallant braces are rigged in the same way (see Fig. 120), with the standing ends at the mizzen-t'gallant masthead, and the hauling ends led through blocks at the mizzen futtock band. Main royal and skysail braces are single lines led through 1/8 and 3/32-in. leader blocks at the mizzen-t'gallant and royal mastheads. The leader blocks can be hooked into the eyes of the stays.

Where the ends of running gear go down to the rail on a real ship, they are led through "seizing trucks," seized to the shrouds and backstays above the rail, as in Fig. 118. These trucks cannot easily be made small enough to look well on our model, so, after the lines have been made fast, draw them in to the nearest shroud or backstay with a black cotton thread on each, and knot the thread to the stay to represent the truck. Cut the ends off close, and keep the knots all in the same line, about 2 in. above the rail.

The lead of the fore braces is shown in Fig. 121. The fore brace has a gun-tackle purchase, the lower block being fastened on the forward end of the upper main channel, and the hauling end being brought in through a 1/8-in. leader block on the rail. Fore-tops'l braces come down in the same way, without the purchase. Fore-t'gallant, royal and skysail braces are led back to the main, as shown, the hauling ends coming down through the lubber's hole in the main top, then down the main shrouds to the rail. The mizzen braces are led forward to the main, as shown in Fig 123. The "R" marks on the drawings indicate the running or hauling ends of the gear. There are no pendants on the brace blocks on mizzen yards.

In making up the purchases, the standing end of the cords are made fast to a becket block, which is strapped as shown in Fig. 113. A neater way to attach the line to the block was shown in Fig. 94, March number. Drill under the strap of the block so as to make a small groove, slip the end of the line through the groove and knot to the strap.

The rigging of the foretopmast staysail and jib halliards is shown in Fig. 122, and the outer-jib halliards are the same. All are gun tackles, the lower block of the foretopmast-staysail halliard being hooked to an eyepin in the bee seat, and the lower blocks of the jib and outer-jib halliards being hooked to eyes on the jib-boom. All the other staysail halliards are rigged in exactly the same way. The staysails were the triangular sails that were set on the stays, as the name indicates, and the stays on which the halliards are to be rigged are indicated in Fig. 117.

No very detailed instructions are necessary for the rigging of the spanker boom and gaff since Fig. 124 shows this clearly. Note carefully how the peak halliards are rigged. The throat halliards are a luff tackle, and the spanker-boom sheets are luff tackles with the double blocks hooked to eyes in the quarterdeck waterways. Topping lifts are single whips; the vangs which steady the gaff, are also single whips, the blocks hanging from light-cord pendants, and the standing ends of the whips being knotted in small holes drilled through the lower rail. The block for the ensign halliards should be made as small as possible, and hooked to a small eyepin driven into the end of the gaff.

This completes the rigging, with the exception of the ensign and house flag. The ensign is a small American flag and can be obtained at almost any store that sells favors for parties. Don't get one that is too large in proportion to the model. The house flag will have to be made, preferably of white linen, and colored with "paintex" or similar dye colors. It should not be larger than ¾ by ½ in. over all. The masts are surmounted by small gilt balls, and holes for the house-flag halliards are drilled through the ball on the main. Belay the halliards to any convenient pin. Paint the skysail poles above the skysail masts white, go over all the paintwork and touch it up where necessary, then give a final glance "alow and aloft," to see that everything is "shipshape and Bristol fashion." Cut out the name given at the end of this article and glue it on the stern, then glue around it a scroll of heavy cord, painted white, and the model is finished.

For the purpose of the prize contest, the model will be without sails. Later we will have an article describing how to rig the sails on any clipper model, but the builder of this model will realize, after he has finished the rigging, that the addition of sails is a difficult and long job.

Next month we will describe the stand for the finished model and show how the photos for the contest should be taken.

Homemade Cigar and Pipe Lighter for the Motor Car

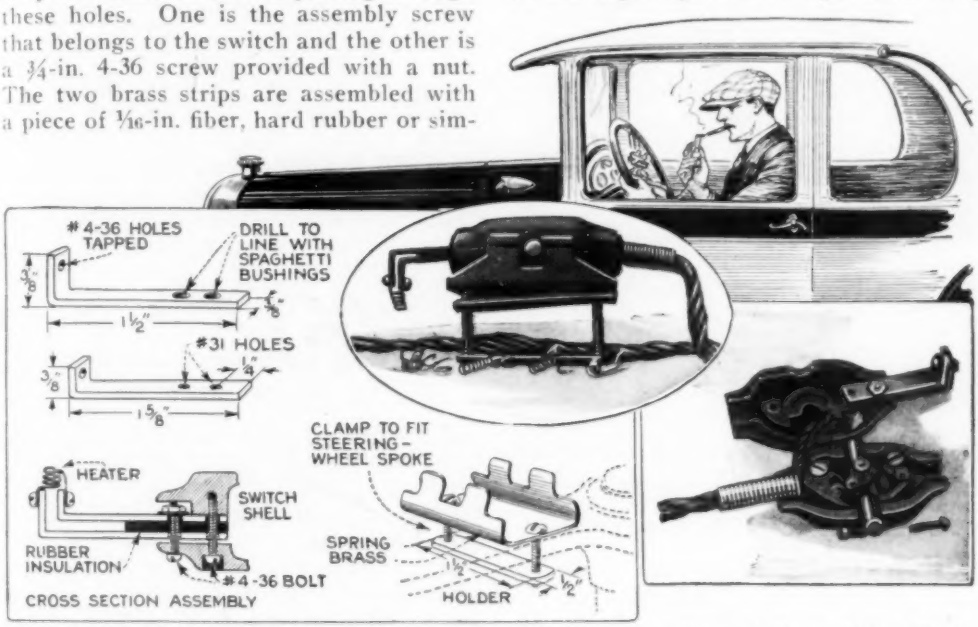
Lighting matches while driving is not only inconvenient but involves certain danger, especially at night when the light temporarily blinds the driver. There are a number of electric cigar lighters on the market, but most of these are not suitable for lighting a pipe. Auto drivers who smoke a pipe will therefore appreciate the homemade electric lighter described in this article. It can be made by any motorist and its cost should be approximately one dollar.

A pendant switch used for 110-volt appliances is obtained and taken apart. One-half of the shell serves as a cover and the other contains the switch mechanism. Get a 6-in. strip of ⅜ by 1/16-in. brass and bend the two ends at right angles as shown in the lower left-hand detail. Holes are drilled and tapped in the bent ends for ⅛-in. 4-36 machine screws which are used to fasten the heating element. Hold the empty half of the shell in the hand so that the two raised portions around the screw holes point to the right. File or cut away the material around the upper hole down to the level of the flat portion. This will make room for the brass strips. Turn the shell over and carefully drill and tap

in Fig. 118. These trucks cannot easily on the brace blocks on mizzen yards.

a hole with a No. 31 drill near the upper end, in the position indicated in the drawing. You now have two holes in line at one end of the shell. The brass strips should fit in the shell and are fastened to it by two machine screws passing through these holes. One is the assembly screw that belongs to the switch and the other is a ¾-in. 4-36 screw provided with a nut. The two brass strips are assembled with a piece of 1/16-in. fiber, hard rubber or similar insulating material between them. Shellacked cardboard may be used if nothing else is available. Place the strips in position and mark where they are to be drilled. Drill two holes with a No. 31 drill in the shorter piece, and with a No. 27 drill in the other piece, these holes being large enough to admit a little piece of spaghetti tubing. Also use an insulating washer between the nut and the upper strip. The tubing is necessary to prevent a short circuit. Connect one brass strip to the nearest terminal of the switch, by soldering a short length of insulated, stranded wire to the brass strip and fastening the other end under the screw of the switch terminal. Care must be taken to prevent a short circuit, which may occur if the insulation is scraped off too far. Next obtain a 5-ft. length of black flexible lampcord of small size, bare the ends, connect one to the other brass strip and the second to the remaining open terminal of the switch. A coil spring of the kind used on electric flatiron plugs can be used, if desired, to protect the lampcord from breaking easily where it enters the switch.

The heating element is made of No. 22 nichrome wire. A 5-in. length is wound on the tapering end of a pencil, leaving the ends straight to permit connecting the wire under the screws. The exact length of coil must be found by trial. It is convenient to hold the lighter with a spring clip on the steering wheel or it can be attached to the instrument board. This clip may be made of spring brass. The connecting wires, twisted together, are wound loosely around the steering post and are then brought down to the terminal block, if the car has one, one lead of the cord being connected to the battery terminal and the other to the ground. When in use, the lighter should glow a dull red. If it gets too hot, the resistance wire should be longer; if not hot enough the wire should be shorter.



Auto Owners Who Smoke While Driving Will Find This Homemade Pipe, Cigar and Cigaret Lighter Handy to Use; It Does Not Involve the Risk Arising from the Use of Matches

---

If veneer becomes loose at the edges, raise the section slightly with a thin knife blade and insert a flake or two of shellac under the veneer; then pass a warm iron over the spot. This will melt the shellac, holding the veneer securely.

Old Milk Can Stood, Top Down, in the End of a Hog-Feeding Trough Serves as a Funnel for Pouring Slop

"Funnel" for the Hog Slop Trough

A young farmer got tired of having his young hogs push the slop bucket out of his hands and spill the contents before he had a chance to get it into the trough, so he constructed the illustrated "funnel" from an old milk can. He first cut the bottom out and set the can, neck down, in one end of the trough next to the fence. The two handles just fitted on the edges of the trough and were bound to it with several strands of wire, holding the can securely. The slop is quickly spread from one end of the trough to the other end and all the hogs get an equal share. The amount of food saved pays well for the trouble of making the installation. —Frank Sargent, Holton, Kans.

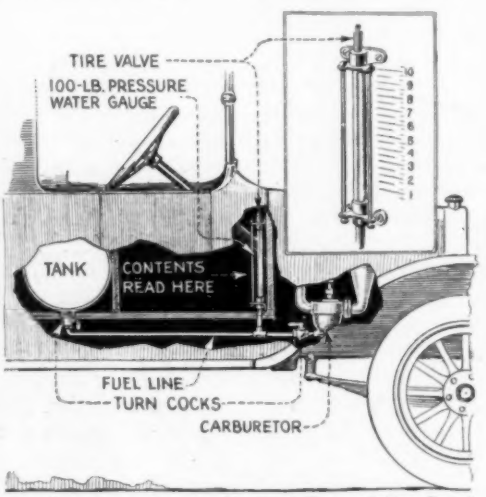
¶In nailing on light molding, first soak the material.

Hot Water from Outboard Motor

Finding innumerable uses for hot water while on outboard-motor boating trips, the writer decided to let the motor furnish it. A part of my boating equipment now consists of a towel, a washbasin and a cake of pumice soap. I also have a length of rubber tubing that fits over the end of the water-discharge pipe of the circulation system. If I get my hands soiled, I simply slip the rubber tube in place, fill the washbasin with hot water and have a comfortable wash. Under ordinary running conditions the water comes out of the motor at a temperature of about 115°, which is just right for washing one's hands.—John Edwin Hoag, Los Angeles.

Gauge and Clean-Out Pipe for Gravity Gas System

A number of automotive vehicles are fitted with gravity systems for fuel supply, particularly trucks and cars used for commercial purposes. The drawing shows an installation which provides the driver with a gas gauge on the instrument board, and a clean-out pipe to enable clearing the fuel line in case it is clogged. A T-fitting is inserted at the point indicated, and a 100-lb. pressure water gauge is attached here so that its bottom is level with that of the gasoline tank and the gas in both will reach the same height. Turn cocks are provided at the tank and at the carburetor. A tire valve is fitted to the top of the gauge, which is graduated in gallons by starting with an empty tank and adding one gallon at a time until the tank is full. A file can be used to make the marks on the gauge. To clean out the fuel line, attach the pump above the gauge and alternately open and close the turn cocks. The air pressure supplied will then force out the obstruction.



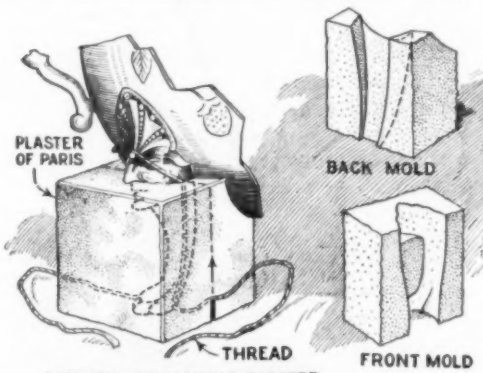
Gasoline Gauge for Gravity-Feed Type of Gas Supply Installed on Instrument Board

Repairing Broken Pewter

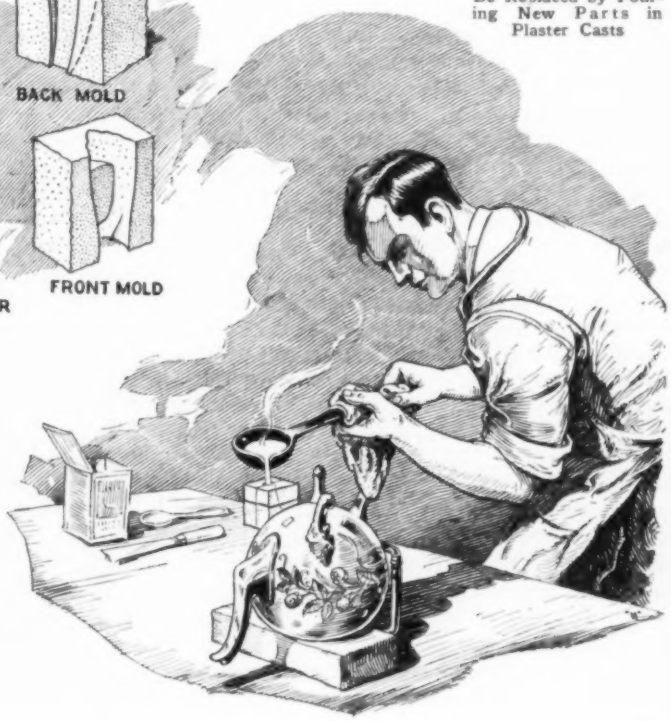
By DICK HUTCHINSON

COLLECTORS of old pewter find many pieces with a broken leg or otherwise damaged sufficiently to spoil a valued and desirable article. No matter how good a man may be at common soldering, the repair of pewter by this means is generally considered an impossible task, as pewter is one of the most fusible of metals.

A short time ago I picked up the teapot shown in the accompanying illustrations with one leg lost. After a little experimenting I made a new leg which, when finished, could not be distinguished from the others. I mixed up a small quantity of plaster of paris in cold water, and, after having drawn a linen thread over one of the good legs to divide the cast, I completely covered the leg, with the exception of a hole in the bottom, with about ½ in. of the plaster. After this had set just enough to hold together, I took hold of both ends of the linen thread and pulled it out through the plaster, cutting the cast in two. I allowed the cast to remain on the leg until it was thoroughly dry and hard, removed the two parts and then set them in place on the short piece that remained of the broken leg, fitting them snugly over this so that the new leg would be in the same position as the old one had been. I applied a thin coat of fresh plaster over the seams in the cast to hold them together, and in the proper position. When this had set thoroughly, I melted a small quantity of old pewter in a ladle and, turning the work upside down so that the hole in the bottom of the cast would come on top, I poured the molten pewter into the hole until the cast was full. The hot pewter melted a portion of the stub of the old leg, and that was just what I wanted, as the new and old pewter fused together nicely. As the whole was inclosed in the cast, the new leg was naturally set in the desired position. When the piece had cooled sufficiently, I removed the plaster cast and found that, with the exception of the seams where the cast came together, the work was entirely satisfactory. After smoothing these seams with a fine file and a piece of jewelers' emery paper, I lighted a match and held it



METHOD OF MAKING PLASTER OF PARIS CAST



Broken Parts of Pewter Teapots and Similar Pieces Can Readily Be Replaced by Pouring New Parts in Plaster Casts

under the new portion, allowing the smoke to blacken it slightly. I rubbed it up just enough to match the rest of the piece. This done, I applied a coat of transparent lacquer, and the teapot, equipped with a new leg, was as good as ever.

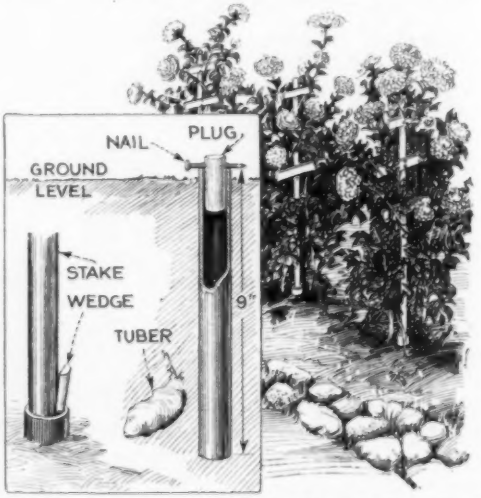
Two Samples of Broken Pewter Articles Which Were Mended by the Process Described

Other parts of pewter pieces can be renewed in a similar manner. If a portion of a cover has been broken off, use the remaining side with which to make the mold. If a section of the spout or handle is gone and there is nothing to model from, fill in the broken portion with plaster of paris, and work over the outside with a pocketknife after the plaster has set, until it conforms with the lines of the remaining section. Coat the outside of the built-up section with vaseline and proceed to make the cast as described above. Soak up the built-in plaster with hot water and dig it out with a pocketknife. In case of a broken spout, a core may be built up of dry plaster, incased in a cloth sack, and placed inside of the spout. When the work has cooled after pouring, cut a hole in the sack and sift the plaster out.

New Scheme for Dahlia Stakes

Among dahlia growers it is general practice to set the stakes, which later are to support the plants, at the time the tubers are planted. This practice prevents possible injury to them if the stakes are driven in after the plants have come up. While these bare wooden stakes, often standing 5 or 6 ft. high, do not make an inviting picture during the early weeks of growth, it does not matter so much in a garden where a special place is set aside for these flowers, and where the plot is not too conspicuous. But when, as in the case of the average home owner, the dahlias must be grown in a small yard, perhaps in front of the house, the presence of even a few bare stakes detracts from the general appearance.

One home owner overcame this objection in a novel way: Instead of driving the stakes into the ground when the tubers were planted, he buried a 10-in. length of 1-in. pipe in the ground, setting it vertically so that the top would be just above ground level. To prevent dirt and other material from getting into the pieces of pipe he stops them up with plugs made from old broom handles. A nail driven horizontally through the plug near the top prevents it from slipping down into the pipe. When the dahlia plants are tall enough to need support, the plugs are withdrawn, and the wooden stakes are inserted into the pipes. A couple of wooden wedges may be used to hold the stakes tightly. With this plan, it is not necessary to set out the stakes until the plants are 2 or 3 ft. high. It is even possible, if desired, to use short stakes at first and then longer ones as the

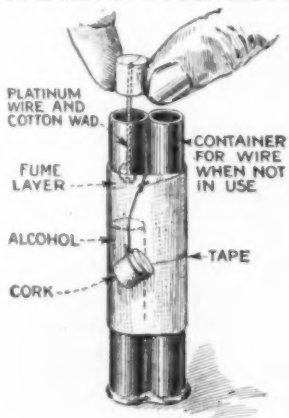


Lengths of Pipe Buried in the Ground Make Good Supports for Dahlia Props

plants grow higher. In either case the appearance of the front yard or flower bed is not marred by a group of unsightly props during the early part of the season. —Robert H. Moulton, Chicago, Ill.

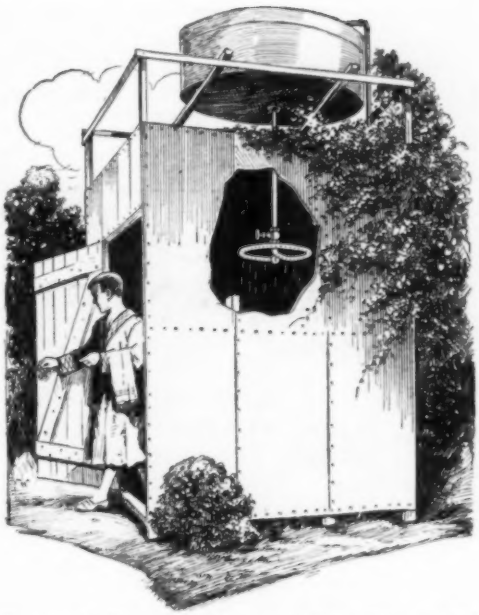
Homemade Cigaret Lighter

To make an efficient cigaret lighter like that shown in the drawing, get two brass or other metal tubes, each about 2 in. in height and ½ in. in diameter, and also a 1-in. piece of platinum wire from a chemical-supply house or jeweler. Insert the wire in the cork, that fits one of the metal tubes, and attach a small cotton wad securely to the other end of the wire. The second tube is about half filled with alcohol and is fitted with a cork to prevent evaporation. When a flame is desired, insert the cotton-wadded end of the platinum wire into this tube, not directly into the alcohol but only in the fumes above the liquid. The cotton wad will become lighted. To extinguish it return to the other tube and cork this as well as the alcohol tube. For greater convenience, the tubes should be bound together with adhesive tape, and they may be decorated if desired. The cost of this lighter will be only 25 or 50 cents —Philip C. Shera, Columbus, Ohio.



Green-Bronze Finish for Plaster Casts

Small plaster casts can be finished attractively by giving them a green-bronze finish. It is made as follows: Dissolve sal ammoniac, 1 oz., cream of tartar, 3 oz., and salt, 6 oz., in 1 pt. of water. Then dissolve copper nitrate, 2 oz., in an additional pint of hot water and mix the two solutions thoroughly. When the mixture is cool, apply it to the cast with a soft brush, putting on several coats where extra depth of color is desired.

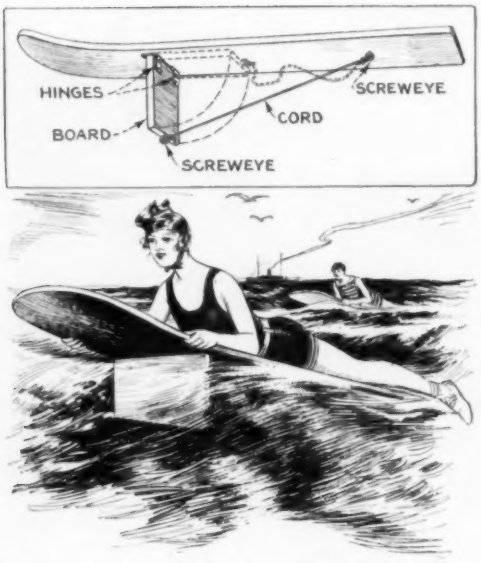


Homemade Shower Bathhouse for Farm Built of Old Lumber at Very Small Cost

Shower Bathhouse for the Farm

Shower-bath accommodations are usually missing on the farm. However, the shower house shown in the drawing is simple to make and will be appreciated by the men coming from the fields after a day's work. The water in the overhead tank is warmed by the sun's rays and much heat is also retained in the house itself as its sides and top are covered with sheet metal. In this particular case, the material for the frame was taken from an old mill tower, which had blown down. The posts are 10 ft. high and are 6 ft. apart, being set in the corners of a concrete floor. The sheet iron used for the walls can be obtained in 8-ft. lengths. Water is pumped into the tank by the windmill and a length of pipe runs down inside, terminating in a homemade sprinkler, which can be raised or lowered and has a shut-off valve. The device cost the owner only a few dollars, and he claims that it has more than paid for its cost in the convenience obtained.—Dale R. Van Horn, Lincoln, Nebr.

¶When a hot dish is set on ice to cool, place a fruit-jar rubber ring under it; then the dish will not slip.



Buoyancy of a Surfboard Can Be Increased by Extra Board Hinged to the Bottom

Improvement for the Surfboard

More pleasure can be had from a surfboard by attaching an extra board to the underside, as shown. This board is fastened on by means of hinges so that it will be forced back against the surfboard when it is being pushed out into the sea. When the user has waded out far enough to catch the crest of a wave, the board is turned around, the attachment drops down, and it will then catch part of the wave which carries the rider a long distance toward the shore. White pine should be used to make the board and two coats of shellac are applied to prevent the wood from becoming waterlogged. A strong cord connects the lower end of the attachment to the rear end of the surfboard. This provides extra support to the crossboard. A very stout person may increase the efficiency of the crossboard by making it wider than the surfboard. In use, it is, of course, necessary to observe care in order not to get one's fingers pinched between the two boards.

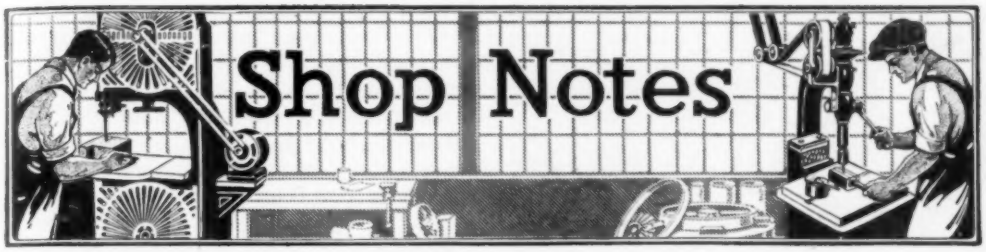
Cleaning Kerosene Range

Practically all kerosene-burning kitchen stoves feed the burners from one main pipe running the entire length of the stove. In time, the bottom of the fount holder becomes filled with dirt and water, which works its way down into the pipe and eventually clogs up the inlets to the burners. To clean the pipe and the minute outlet openings is usually a difficult task, but can be quickly and easily done with the aid of a good bicycle or auto pump. Remove the fount and the burners from the supply pipe. Also take the end plug off the same pipe. Place the nozzle of the pump over the several jet openings, one at a time, and force a stream of air through them. This will dislodge any particle in the jets and will blow it either out of the end of the main pipe or up into the fount basin, where it can be taken out. Repeating this by blowing from different jets will in a short time clean the piping of all refuse and water. Then replace the burners and the stove will operate normally

Hinged Board Protects Milk Bottles

To prevent dogs and cats from getting at the milk bottles, a simple cover can be made as shown in the drawing. It consists of a ¾-in. wooden board, hinged to the wall so that it will rest horizontally on the tops of quart-size bottles, and, when not in use, it can be swung to the position indicated by the dotted lines. The board also protects the milk bottles from being accidentally pushed over by baskets and boxes, or by persons walking past them.

Hinged Board Prevents Cats and Dogs from Licking Tops of Milk Bottles



All Shop Notes published in 1927, in book form—Fifty Cents—from our Book Department

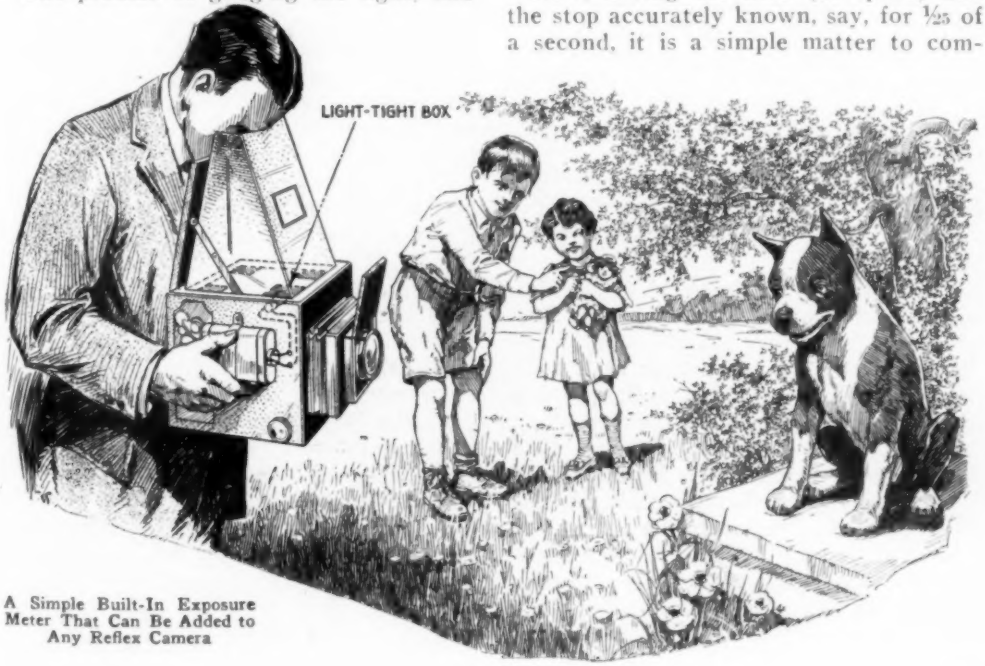
Exposure Meter for Reflex Cameras

By HERBERT J. SUMMERS

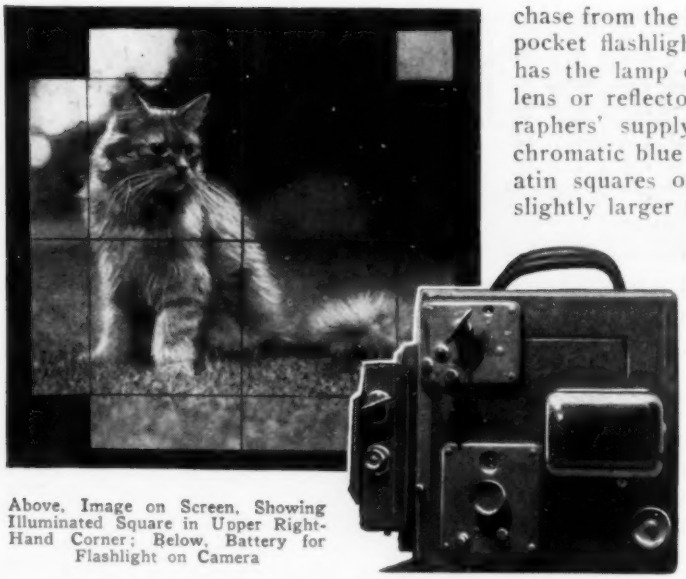
WITH small expense and a little time and ingenuity, a scientifically correct exposure meter, which is dependable, simple and almost instantaneous in operation, may be built into the ordinary reflex camera. It works on the photometer principle and depends on matching two fields of light to the same approximate intensity. One of these fields is the image on the ground-glass screen within the hood of the camera, and the other is the light from an ordinary pocket electric flashlight, the light being arranged to appear in a square in the upper right-hand corner of the ground glass.

The process of gauging the light, and hence the exposure, is this: Look in the hood at the image on the screen and press the button, illuminating a square in the upper right-hand corner of the screen. The image will be found to be either stronger or weaker than the illuminated square. Change the opening of the diaphragm until the two fields of light are approximately the same average intensity. Using, then, that particular diaphragm opening (or stop), the correct exposure will be a certain constant amount of time —say 1/25 second, which it is necessary to determine but once by experiment when your apparatus is first built.

Now, having the time (or speed) and the stop accurately known, say, for 1/25 of a second, it is a simple matter to com-



A Simple Built-In Exposure Meter That Can Be Added to Any Reflex Camera



Above, Image on Screen, Showing Illuminated Square in Upper Right-Hand Corner; Below, Battery for Flashlight on Camera

pute the speed for any other stop, or the stop for any other speed. Simply remember that an increase in the stop from one figure to the next, admitting more light, calls for one-half the speed. In short, every time the stop is changed from one figure to the next, the amount of light admitted to the film is either halved or doubled, according to whether the diaphragm is closed or opened. The speed must be halved or doubled accordingly.

In your apparatus, a correction must be made for the difference between the quality of the light as seen by the eye and the actinic light which is effective in making the picture. This is very nicely accomplished by means of monochromatic blue filters. The dark blue known as the "C4" passes a very high percentage of the actinic light of the ordinary film pack, roll film or orthochromatic plate or cut film. Viewing, then, the screen and the illuminated square through the blue filter, you are looking at the actinic light only, and the eye is prevented from being influenced by colors, and other light, such as red, which is not actinic. One of these filters may be permanently installed over the electrically illuminated square, and the other may be placed over the lens. The latter, however, must be removed from the lens before the exposure is actually being made.

For the construction of this meter, purchase from the hardware store a small, flat pocket flashlight, one of the type which has the lamp exposed and is without a lens or reflector. Then, from a photographers' supply dealer, obtain a monochromatic blue filter. These come in gelatin squares of various sizes. Get one slightly larger than is necessary to cover the lens of your camera, and mount it between two pieces of circular glass obtainable from the hardware store. This can be either fitted into the cell which holds your other filters, or some sort of holder can easily be improvised. The scraps from the corners of the blue square will suffice for the small illuminated field in the corner of the ground-glass screen. It will be noted from the photograph that the writer located the battery case on the side of his camera in such a way that the button was easily accessible to the right thumb. With some bits of fine insulated copper wire, make connections at the terminals of the flashlight where the lamp has been screwed out, and lead these wires through the case of the camera, through fine holes made with a pin, into the upper right-hand corner and on top of the ground-glass screen. There it is only necessary to construct some sort of box just large enough to house the lamp from the flashlight. A light-tight box can be built, of pasteboard and glue, around the lamp, just the same size as the black square in the corner of the finder used as an aid to framing the picture. Over the top of this box place one or two thicknesses of paper and the blue filter.

You are then ready to calibrate your meter, that is, to determine the time constant mentioned in an earlier paragraph. This can be done in two or three ways. Select a subject. Watch the blue fields of light as mentioned before and then with another (borrowed) meter, find out the time required for that particular stop. This is the quickest method. Another is to determine the stop again as above and then experiment on a few films exposing one at, say, $\frac{1}{10}$ second, one at $\frac{1}{25}$ second,

and one at 1/50 second. Then use the time constant which gives the best result. If it is found that, with an average picture, the stop comes out very small or very large, or perhaps the fields cannot be matched at all, take out some of the paper and filters (if more than one) in the illuminated square, or, if necessary, put in some more. It is best to have your time constant come out a relatively slow speed, say 1/10 to 1/20 second, so that in an average bright outdoor photograph, the stop will be small; then the meter will be fit for use in deep shadows, the limit being the dimmest picture you can take at that speed with your lens. Once this time constant is found, it will always be the same. Thus every time an exposure is calculated, you will use the stop found as told above, with this particular shutter speed. Then, if you wish to use another speed or stop opening, it may be computed as outlined.

The reason for the correct operation of this meter is fairly obvious. The square is always illuminated to the same intensity, and is constant within negligible limits. Hence, when the image on the ground-glass screen is matched with it in intensity, it, too, is always the same within the same negligible limits. With the same amount of light always admitted to the film, the shutter speed must necessarily be the same at all times. This shutter speed is the time constant determined at the outset.

It should be added here that the writer employed this meter for three months last summer making about 400 rather particular publicity photographs throughout Europe under all sorts of light conditions, and obtained excellent results. It might be thought that a battery would not be dependable, but it was found that, after the first day, it was so nearly constant that it was impossible to notice any change for nearly three months, until, by accident one day, a short circuit came somewhere in the system and the battery died. It cost 25 cents to replace. Of course, care should be taken and the current used only a short time while testing the light.

Sliding Shelves in Store Save Space

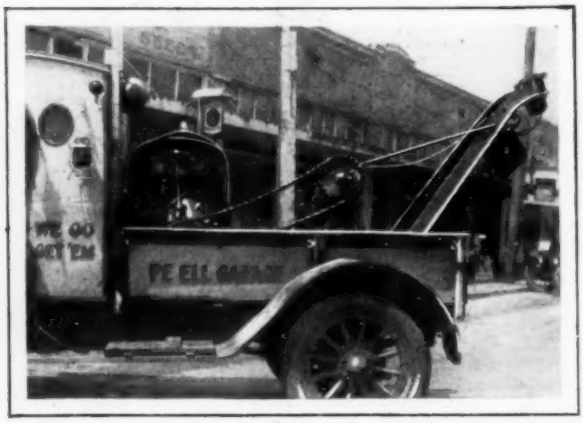
Homemade sliding shelves solve the problem of storing and displaying large stocks of small merchandise, such as kitchen utensils, enamel and china dinnerware, in a western store. Around the sides of the walls, large cases holding a great number of these sliding shelves have been built. There are from five to ten shelves in each case, and the depth of each shelf or tray varies with the type of merchandise for which it is designed. The shelves slide on steel rollers, which were taken from roller skates, four rollers being attached to each cleat on which the edges of the shelves rest. In use, a shelf can be pulled out from the wall so that the customer can inspect every piece of merchandise displayed. Additional shelves of the usual rigid type may be built above the cases if desired.—Miss Mary Gleeson, San Francisco, Calif.

Sliding Shelves Display Large Quantities of Small Merchandise in the Limited Space of a Hardware Store

¶Tin can be removed from tinplate scrap by boiling in caustic soda, and the tin in the solution deposited on a sheet-iron plate by electroplating.

Wrecking Car Has Motor-Driven Hoist

Instead of having a hand crank on this wrecking car to pull autos out of the ditch,



Old Auto Engine on Wrecking Car Is Used to Operate the Hoist

a western garage man uses an old motor to do the work. The gear shift and clutch are retained so that the hoist can be driven at different speeds. A chain and sprocket are connected to the winch drum. This arrangement saves both time and labor. —Carlton Groat, The Dalles, Oreg.

Renewing Old Water Tanks

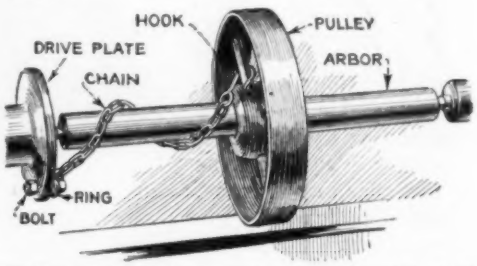
When a 15,000-gal. galvanized-iron cattle tank on a Texas ranch became old and leaky, it was repaired in a way that made it even better than a new one. The ranch was situated 80 miles from the nearest railroad station and about 3,000 ft. above sea level, so, when the tank began to rust, the manager of the ranch, if he had bought a new one, would have been faced with the problem of a long haul over a mountain road, 15 miles from the state highway, and the necessity of cutting down thousands of feet of mesquite, live-oak and cedar timber along the road to allow its passage. To avoid this and save time, the old tank was rejuvenated in this manner: It was first perforated until it looked like a huge piece of metal lath. Cement was then mixed and two layers applied to the tank, both inside and out. The result was a new and practically indestructible reinforced-cement tank, 4-in. thick. The work was repeated on other old tanks on the ranch, with the result that hundreds of dollars were saved, besides the delay and risk incidental to the transportation of new tanks by railroad, state highway and the roughest kind of mountain road.—Solon K. Stewart, San Antonio, Texas.

Mixture for Cleaning Hands

I have a cleaner for the hands, which has been found just as effective as soaps and cleaning compounds commonly used for this purpose. It does not require any rubbing and need only be applied like soap. The ingredients are obtainable in almost any drug store or paint store. Get 1 pt. of Turkish red oil, which is also called soluble oil, and ½ pt. of xylene, which is more commonly known as solvent naphtha. Mix the two thoroughly and apply to the hands. The compound is readily soluble in water.—Walter J. Stefaniak, Buffalo, N. Y.

Chain Provides Positive Arbor Drive

When turning pulleys of small bore on arbors, the work will sometimes slip under a cut. To avoid this, I tried a new device in the form of a chain with a ring at one end and a hook at the other. I clamped the ring to the driver plate and passed the hook around one of the arms of the pulley. This eliminated the slipping and made it unnecessary to drive the work very tightly on the arbor. This chain drive will be found handy also in cases where the work is too far away from the plate to allow the use of a bolt. The chain can be put on and taken off readily and is adjustable to different lengths.—Harry Moore, Hamilton, Can.



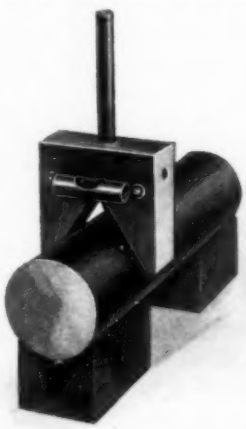
Positive Chain Drive Prevents Work, Mounted on an Arbor, from Slipping

Temperature in Developing Negatives

Many amateur photographers neglect the temperature factor when developing films or plates. This has much to do with success or failure. The best temperature is approximately 65° F. A difference of 15° usually spoils the negatives. At 50° the negatives invariably turn out weak and very flat; at 55° more strength will be evident but the image will still lack intensity, and at 60°, much longer development than normal will be required, and full intensity will still be lacking. At temperatures above 70° there is danger of the emulsion puckering away from the film base and also of too rapid development, causing "thick" negatives and chemical fog. So keep the temperature close to and slightly above 65°. Do not rely on the sensitivity of the fingers to tell the temperature of the solution, but use a thermometer, and take frequent readings, for this is the only reliable method.

Laying Out Keyways

The photo shows a tool that I have used for over ten years to lay out keyways and holes in long shafts. It consists of a V-block with a level and center punch, a small plunger, a small spring to bear against the plunger, and a headless setscrew, to increase or decrease the tension of the spring. The center punch is located in a hole drilled in the center of the block as shown. In use, the tool is set on the shaft, exactly level, and the punch is given a light blow. Without displacing the work, the tool is moved to another position to mark the shaft at a second point. After the tool has been set level, proceed as before, and you will be sure that the two punch marks are in line. —John Snitil, Cleveland, Ohio.



Newsboys' Change Holder Made from Cigar Box Saves Considerable Time

Newsboys' Change Holder

While waiting for a street car on a busy corner, the writer noticed a newsboy using a novel device for holding change in readiness for his customers. During rush hours, when he was very busy, this holder enabled him to make change quickly. The holder consisted of a cigar box in which a block of wood was fitted. A series of notches or recesses were cut in the upper side of the block, deep enough to hold three cent pieces. The other part of the box was used for loose change. When not engaged with customers, the boy filled notches with pennies. Customers handing him a five-cent piece for a newspaper, would immediately receive their change. —Leslie G. Roller, Cedar Rapids, Iowa.

How to Drive Nails to Avoid Splitting

When it is necessary to drive nails in places where there is danger of splitting, and a drill of the proper size is not at hand for starting a hole, simply file or grind the point of the nail to a chisel edge instead of the regular four-sided point, and drive the nail with the sharpened edge cutting across the grain of the wood. This practice will usually prevent splitting.

Conical Sheet-Metal Container for Tar, Which Facilitates Melting and Pouring It

Practical Container for Melting and Pouring Tar

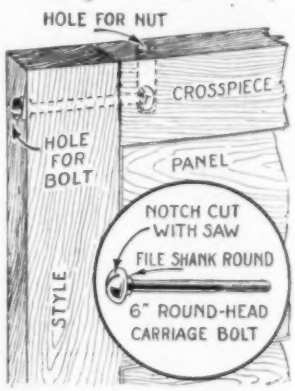
For melting and pouring tar in small quantities, the scooplike container illustrated will be found convenient. It is made of heavy tin or sheet iron, bent cone-shaped, riveted at the overlapping edges, and closed at the large end with a sheet-iron disk, riveted on. A hole is cut at the large end through which the cone is filled with pieces of tar; the small end is left open to permit the tar to flow out when melted. A wooden handle is attached to the wide end. In use, a plumbers' blowtorch is held so that the flame plays against the container, melting the tar and causing it to run out as indicated. The outfit can be moved about at will and the flow of tar can be directed with precision. The tar hardens after the flame is extinguished.

Machining Cold-Rolled Steel

It will be found that, after machining, such as planing, milling or cutting a keyway in a bar of cold-rolled steel, the bar will spring to a considerable extent when released from the vise, owing to the relieving of the "rolling strains." This trouble can be largely overcome by first heating the bar to a dull red and then allowing it to cool in the air on grates off the floor and out of a draft.—Frank N. Coakley, Buffalo, N. Y.

How to Repair a Door with Bolts

To repair a door when the stile has worked loose from the crossboards is a task within the reach of the ordinary house owner who possesses a brace with a large and a small bit, a file, a wide-bladed screwdriver, a hacksaw and a 6-in. carriage bolt. First file off the shoulder of the bolt so that the shank is smooth clear up to the head. Cut a slot in the head so that the screwdriver will fit it. Take the door down and drill a hole, large enough to let the bolt head slip in and just deep enough to let it come below the surface of the wood. Using the small bit, continue the hole through the stile and about 2 in. into the crosspiece. It is best to drill this hole about 1½ or 2 in. below the corner of the door. Drill a second hole into the end of the door. This hole must meet the first one, about 1½ in. beyond the point where the stile is joined to the crosspiece. Slip the bolt into the hole and insert the nut as shown in the drawing. A little manipulation will be necessary to get the threads started. When this is accomplished, screw up the bolt with the screwdriver, and the door will be as good as ever. The entire job can be done in about half an hour. If the hole into which the nut was inserted is at the top of the door, it should be filled with a wooden plug or cork, which is tapped in tightly and cut off flush. If this is not convenient, pour the hole full of melted paraffin or sealing wax.—F. J. Ward, Ismay, Mont.



Do not connect belt ends with a metal fastener and allow the hooks to be poorly clinched; the hands of a worker may be cut when shifting the belt.

THE interesting bird bath described and illustrated in this article was turned from concrete, on a platform or wheel made of rough boards and rotated by hand, the concrete being built up on the wheel and the contour formed by turning the mass against a sheet-metal template, supported close to the side of the wheel. The same design would also serve for a fountain or a goldfish bowl, and the method of turning the column and base would work equally well for making a sundial or gazing-globe pedestal, or similar piece of concrete garden furniture.

Build the wheel or platform of rough 1-in. stock, in two layers, with the grain of one at right angles to that of the other. (See Fig. 1.) Nail the layers together well, scribe a circle, 28 in. in diameter, on the platform, and saw it to shape with a compass saw. Now bore a hole in the center, a driving fit for a 3-ft. length of ½-in. water pipe. Over the lower end of the pipe drive a length of 2 by 6-in. pine, which is to be tacked to the underside of the platform. Light hammer blows on this block will bring the pipe at right angles to the wheel, when the block can be nailed solidly in place, with the pipe projecting through the upper surface of the platform. The pipe should also project about 3 in. below the block.

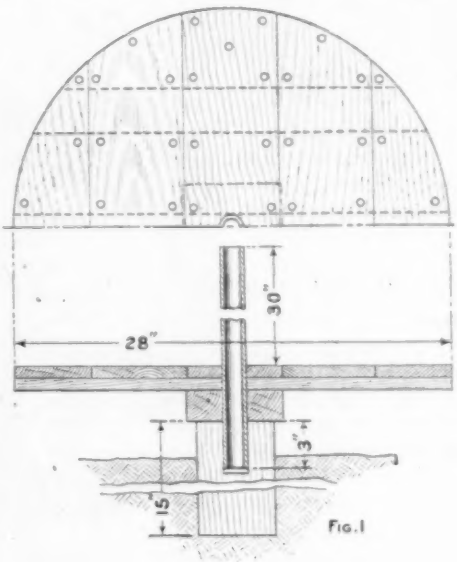


FIG. 1

Set in the ground a piece of 4 by 4-in. pine, with the end projecting 3 in. above the surface, and, centering on the end of the piece, bore a hole, ⅛ in. larger in diameter than the pipe, to serve as a socket for the projecting wheel pivot. Set the wheel in place on the 4 by 4-in. bearing, then drive a 1 by 3-in. stake into the ground close to its edge. The stake should be about 3½ ft. long and must be supported firmly. It can be braced to any convenient object near at hand, or, if this is not possible, to stakes driven into the ground behind it.

The upper end of the pipe is then secured so that the platform will be level in every direction, by means of two braces

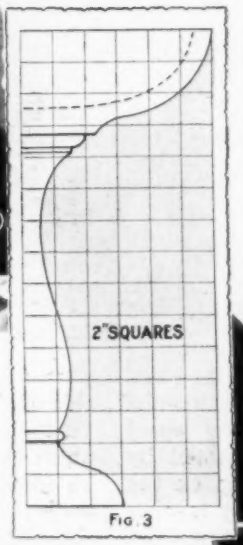


Fig. 3

bored to fit over it, and fastened to posts or stakes at the outer ends, or to the top of the long stake already in place. Rotate the platform. If the pipe does not turn with it, owing to loose fits in the wheel and block, make the necessary alterations so that the pipe will turn with the platform, for a stationary center will cause no end of trouble later, when the concrete is being shaped. At intervals of 60° around the circumference of the wheel drive short stakes as shown in Fig. 2, and nail guide cleats to them, projecting over the surface of the platform, to insure that the wheel will have a horizontal motion.

Make a paper pattern of the bird-bath profile given in Fig. 3. This is done by ruling the paper into 2-in. squares, locating a number of points on the profile in Fig. 3 with the dividers, and then marking similar points on the ruled paper, afterward drawing the profile through the points marked. Trace this on a sheet of tin or sheet iron, either with carbon paper or by cutting the paper pattern out first and then tracing along the edge. The template for the bottom may be cut separately, if desired. Cut the sheet-metal template out with tin snips and smooth with a file. Stiffen the iron with strips of wood nailed to both sides, as indicated in Fig. 2, then nail the template to the tall cleat at the side of the wheel at the proper distance from the center, allowing ¼ in. between the bottom of the template and the top of the wheel for clearance. The wheel is then ready for use.

Get some sand of the quality used for good concrete work and screen it through ⅛-in. mesh. A wheelbarrow makes a very convenient receptacle for the sand when screening, a hoe handle or similar tool being used under the screen as a roller, as in Fig. 4. On top of the platform, build a pile of moist sand and shape it to the contour

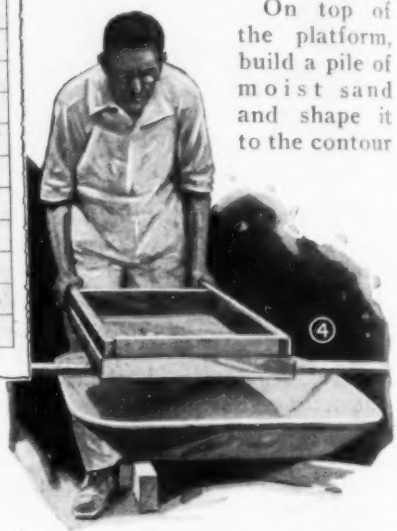


Fig. 2, Setting Up Template on Wheel; Fig. 4, Screening Sand for Concrete and Bowl Mold

of the inside of the bowl, as shown in Fig. 5 and the dotted lines in Fig. 3. Pat over the sand core a small quantity of cement, and allow this to harden.

For turning the bowl, a fair quantity of concrete, mixed in the proportion of two parts sand to one of cement, may be stirred wet in the wheelbarrow, as indicated in Fig. 6, but for the column only a small quantity at a time should be wetted. The addition of a small quantity of slaked lime to the concrete makes it more plastic and easier to work. Now cover the sand with concrete, mixed wet enough to be handled easily but not sloppy, turning the platform slowly while doing so. The concrete, of course, settles outward, and consequently it must constantly be pressed upward with the hands until it has stiffened enough to hold together. A trowel, thrust between the tem-

plate and the bowl, helps in this operation. If trouble is encountered, due to the material breaking away from the mold during this process, keep the main body of the material back from the template about ¼ in., then, when this has set, plaster with thin concrete and turn against the metal. The hands, rubbed over the surface as in Fig. 7, will smooth the work very well.

The photo, Fig. 7, shows a part of the column being turned with the base, but the writer found it advisable to cut the column away, down to the molding under the bowl. The bowl, allowed to harden, was then removed from the platform and pipe, and the base and the whole column were turned together.

In order to do this, the template, of course, was removed from the stake and reset upside down, taking care to get it in the same relative position as before.

For the column, use a mixture of one part sand to one part cement, a so-called "rich" mixture. If, as the column is built up, nails are stuck freely into its surface, much of the falling away of the material will be avoided. A small trowel, held between the surface of the work and the template, will be found useful in smoothing the concrete. When the column is finished, stand it, upside down, on the bottom of the bowl and model out the swell at the top of the column to meet the molding. As the work is upside down, this, of course, means that the swell is at the bottom of the column while the modeling is being done. A scraper made from thin wood is useful in doing this work.

Fig 5, Shaping Bowl Mold; Fig 6, Mixing Concrete; Fig. 7, Smoothing Bowl Surface

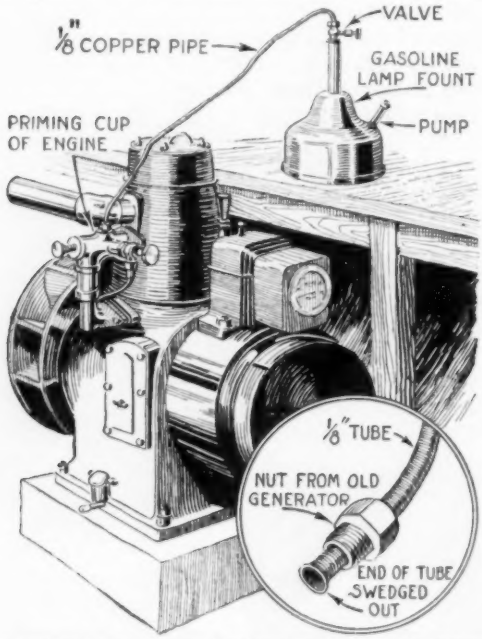
When the concrete has thoroughly hardened, the bird bath is ready to be set up. Smooth off the inside of the bowl and build up a more or less symmetrical mass of concrete around the projecting pipe, to hide it; this forms a small "island" in the center of the bowl. Lastly, round off the rough edge of the bowl with a rasp. The finished bath is shown in the headpiece of the article.

Driving Finished Work without Dogs

Some small pieces of finished work which it is not advisable to drive with a dog but on center of a lathe, can be driven to advantage by means of a length of belt lacing, passed around the work two or three times and tied securely. The free ends are passed through opposite slots in the faceplate and tied together. This will not mar the work or take up as much room as a dog driver.

Priming the Lighting-Plant Engine

The method of priming the farm-light engine shown in the drawing, while not



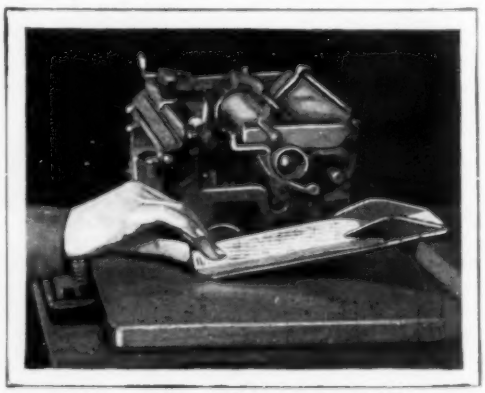
Gasoline-Lamp Fount Equipped with an Air Pump Can Be Used to Prime Gasoline Engine

automatic, keeps a large quantity of gasoline under pressure so that the engine can readily be primed by simply turning a valve, and thus avoids the trouble incident to the common method of priming.

The container consists of the fount and stem of a gasoline lamp, which is quite common in rural homes. The kind having an air pump built into the fount is the best for this purpose, but is not absolutely necessary. Remove the shade holder, air mixer and all the top parts until only the upright and valve are left. Locate the fount at any convenient point near the engine, either above or below it. Saw off the swedged end of a generator and remove the nut. Then arrange a suitable length of ⅛-in. copper pipe to reach from the lamp valve to a point just over the top of the engine priming cup. Place the generator nut on the tubing and swedge out the end of the latter with a blunt-nosed tool to resemble the generator end as much as possible. Insert the swedged end in the lamp and fasten it in place with the nut, just as though you were putting in a generator. Fill the fount with gasoline, see that the valve is closed, and pump up a good head of air pressure. See that all plugs and connections are air-tight. If this is not the case, smear the threads with soap before threading home. To prime the engine it is only necessary to turn the lamp valve. The air pressure in the fount will force gasoline through the tube to the priming cup. A few seconds only will be necessary for this and the valve can then be shut off. If the engine slows down on the first priming, the valve can just be cracked open and the gasoline allowed to drip into the cup until the engine picks up from its own fuel supply. A fount of gasoline should last for more than a month for priming purposes, and, if all connections are made air-tight, the pressure will hold for a week or ten days without pumping.—L. B. Robbins, Harwich, Mass.

Holder for Cards Aids Typist

A holder for cards that are to be picked up quickly for use in a typewriter or for other purposes can be made in a few minutes from the top or bottom and one of the sides of a cigar box. The angle for cutting the boards used as stops at the back of the holder may readily be determined by placing fifty or more cards in a pile with the ends overlapping each other. A small quantity of glue and two or three small nails will hold the stops securely.—Herbert C. Crocker, Edwardsville, Ill.



Card Holder, Made from Cigar-Box Wood, Saves Time for the Typist

¶When filing solder, a little machine oil will prevent the teeth of the file from clogging with the soft metal.

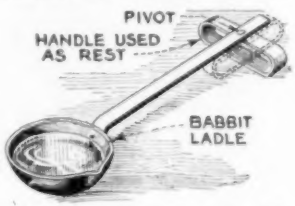
Wooden Structure, Made of Two-by-Four Framework and Ordinary Shiplap, Which Is Nailed on the Inside, Has Served as a Silo at a Fraction of the Building Expense

Cheap Homemade Silo

It was necessary to build a silo on our farm, but, as the cost was prohibitive to us, we decided to build a large bin or shed to hold the ensilage. It was made of 2 by 4-in. studs and rafters, while shiplap was used for the sides. Contrary to the usual procedure, however, we placed the studs on the outside. This method prevented the shiplap from loosening and perhaps coming off, owing to the weight and pressure of the contents, as would have been the case if it were nailed to the outside. Pegs were also driven into the ground and suitable bracing provided to prevent the bottom from spreading. In addition, a few braces were placed against the middle of the studs. In a silo of this kind it is necessary to pack the ensilage well, as the bin does not have the depth of a regular silo. The cost of this silo was only $47.50. If desired it can be dismantled and stored. —W. E. Smith, Thief River Falls, Minn.

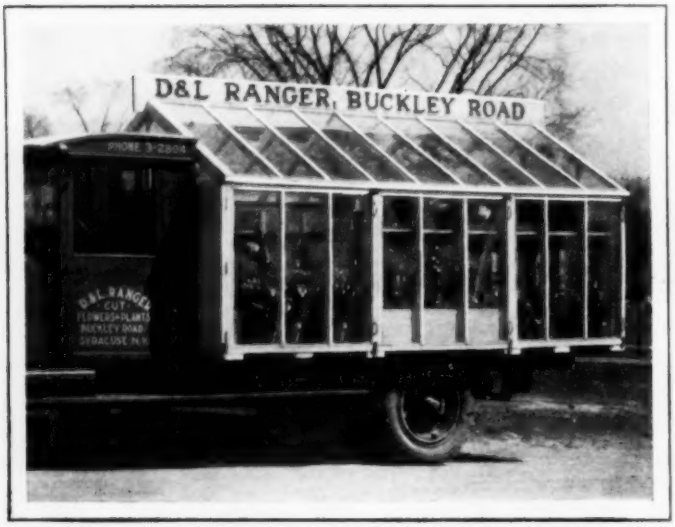
Handle Rest for Babbitt Ladle

It is often necessary to set a babbitt ladle down for a moment while resetting the work. The ordinary bowl-shaped ladle does not rest level unless it is packed up, but as babbitting always leaves little time to spare, I devised a rest to attach to the handle. I find this not only ideal for the purpose, but it also serves as an extra handle, allowing a firmer grip. The leveler consists of a piece of tubing, flattened to an oval shape and pivoted to the ladle handle with a rivet. When I am carrying the ladle or pouring the metal, the rest is in line with the handle, and if I want to set it down, I give the attachment a quarter turn to form a rest as shown in the drawing.—Harry Moore, Hamilton, Can.



Pumping Clean Water from a Cistern

Clean water may be drawn from a cistern in the following manner: Use a rubber hose instead of the lead pipe and attach a block of wood a little above the lower end to keep the end of the hose under water. The wood will float and keep the hose end just under the surface at any level of the water.



Auto Greenhouse Carries Flowers and Displays Them at the Same Time; the Outfit Did Much to Promote Sales

Flower Shop on Wheels

Considerable increase in the sale of flowers was experienced by an eastern florist, after he had made his delivery truck into a "flower shop" on wheels, as shown in the photograph. A large, sturdy truck was used for this purpose, and the framework of the shop was made of wood, especially braced to endure the jars of traveling. The top and sides were, of course, inclosed with glass. The truck facilitated moving the flowers from the greenhouse to the florist's shop.—H. L. Wheeler, Syracuse, N. Y.

Unwinding a Coil Spring

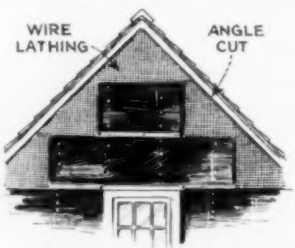
An old machinist saw one of the boys in the shop trying to straighten a coil spring with a screwdriver and a hammer on the bed of his lathe, so that he could rewind the wire to make a spring of smaller diameter than that of the original one. Telling the young fellow to "fetch the spring" over to his workbench, he took it and clamped one end in the vise, inserted an iron rod in the spring and then walked backward, unwinding the spring as he went, holding the rod at both ends. Although the wire was not made perfectly straight, it was in condition to be rewound. Besides the unhandiness of the method first employed, it was hard on the lathe. The bed of a lathe is not an anvil, and it should never be used for that purpose.

Emergency Router

On a repair job, a carpenter sometimes runs into work where he could use a router to advantage. Should he have none in his tool box, a router can easily be improvised by taking the plane bit out of a small wood plane and using a narrow chisel instead. Set the chisel edge to the right depth and tighten the wedge just as when adjusting a bit, and the router is ready. It takes only a few minutes to make the change, and this emergency tool will do better work than could be done by cutting the wood by the use of a chisel and mallet.

Cutting Wire Lath for Gables

Much labor is encountered when wire-lathing gables, owing to the fact that the lath must be cut at an angle on both sides. If the cutting is done on the scaffold and full-length pieces of the lath are used, it is slow work and rather hard to handle. To avoid this difficulty, cut the pieces short as shown in the drawing, being careful that they are cut to conform to the inspectors' requirements. The pieces left over can be saved for use on the gable at the other end of the house, so that there will be no waste. The lath can be cut on the ground and brought up, and full pieces can be lapped onto the square ends of the angle-cut parts. Any further cutting will be straight across the pieces which is much easier.—Robert Page Lincoln, Minneapolis, Minn.



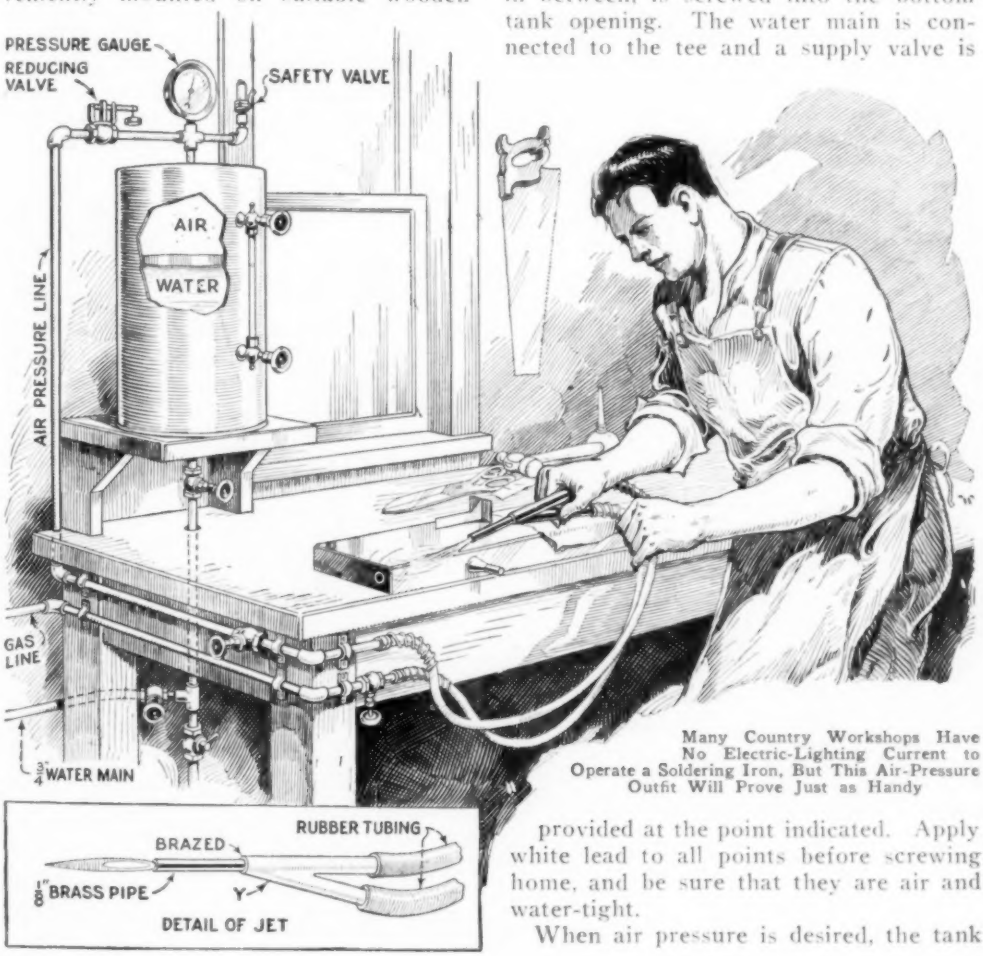
Pneumatic Soldering Plant for the Shop

By L. B. ROBBINS

MANY workshops are located in the country where electrical house-lighting current is not available and, for this reason, an electric soldering iron cannot be used. However, by utilizing the water system to compress the air, a serviceable soldering torch can be cheaply made, burning either commercial gas or gasoline. The air pressure can be regulated to suit various conditions, and a small or large flame can be produced. The torch will be suitable for large and small work, except where a flame cannot be handled safely.

The pressure tank may be an expansion tank of the kind found in hot-water systems. It should test to 75 lb., and is conveniently mounted on suitable wooden brackets or a shelf, near the workbench. The air line, consisting of pipe and a suitable length of armored-rubber hose, is provided with a safety valve, pressure gauge, pressure-reducing valve, and a shut-off valve, arranged as indicated in the drawing. The gas line is run to the same point on the bench as the air line, a shut-off valve and a length of armored-rubber hose being also provided in this line. The lengths of hose are connected to the soldering torch, which is made from a piece of ⅛-in. brass pipe brazed into the end of a brass "Y." A straight length of pipe, provided with a shut-off valve at one end, a cock at the other, and a tee cut in between, is screwed into the bottom tank opening. The water main is connected to the tee and a supply valve is provided at the point indicated. Apply white lead to all points before screwing home, and be sure that they are air and water-tight.

When air pressure is desired, the tank



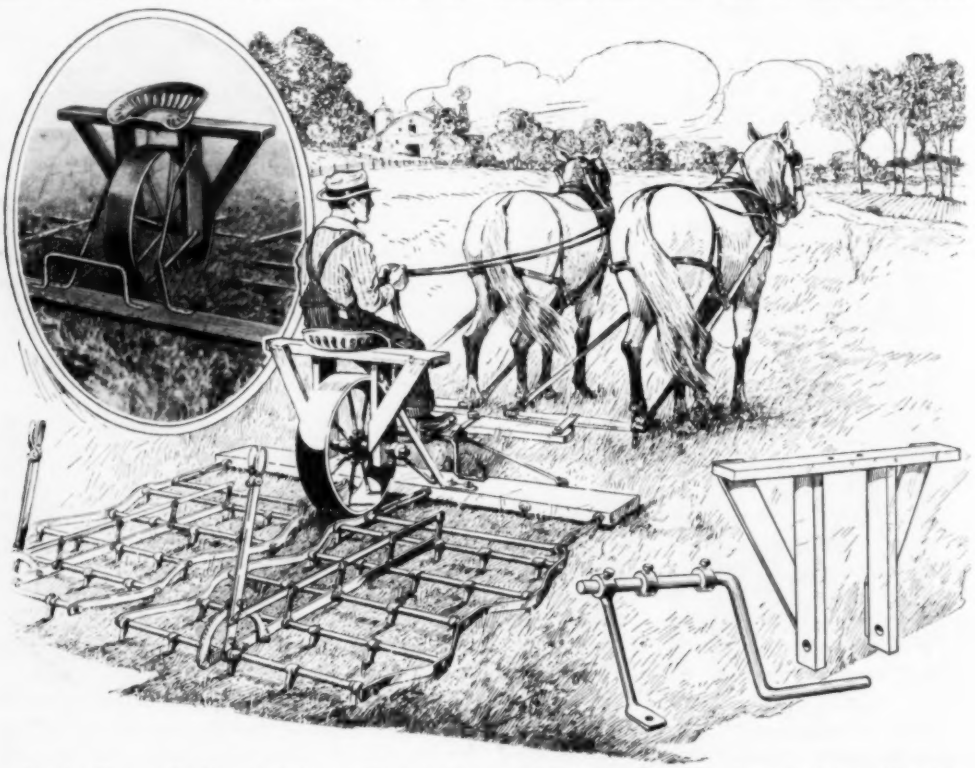
Many Country Workshops Have No Electric-Lighting Current to Operate a Soldering Iron, But This Air-Pressure Outfit Will Prove Just as Handy

must first be drained by opening both valve and cock in the drain line and closing the supply valve. Then close the cock and open the water-supply valve. As the tank fills with water, the air above the water level is compressed. If the tank is capable of safely holding 75 lb., you will have a good reserve. Do not allow the water level to rise above the water glass, as it may then get into the air line. The required air pressure can be obtained by adjusting the reducing valve on the air line. With sufficient water and pressure in the tank, the air can be drawn out as desired, by opening the air valve. When the air pressure in the tank drops too low for use, the tank must again be drained and refilled as before. One filling, however, at 60 lb., will provide air at 15 or 20-lb. working pressure for a long time. Be sure that the safety valve is set to open before dangerous pressure is reached. Suitable small soldering jets can be made from ⅛-in. brass pipe. A valve in each line will give positive pressure control at the jet and allow adjustment of the flame.

Where commercial gas cannot be obtained, gasoline will serve as fuel by utilizing an old gasoline lamp so common in thousands of homes. Simply connect the fuel opening of the jet to the lamp outlet pipe and inject the gasoline in the jet through the generator tip used in such lamps. By preheating the end of the jet and then turning on both the gasoline and a small quantity of air, a Bunsen flame will result when the jet is lighted, and the size of the flame and its intensity can be regulated by the valves.

Seat for the Harrow

A harrow having no seat can be provided with one as shown in the drawing. The seat support is made of 1 by 6-in. and 2 by 6-in. wood, securely nailed together as indicated in the lower right-hand detail. Two holes are drilled through the lower end of the 2 by 6-in. uprights to accommodate the axle of an old wheel,

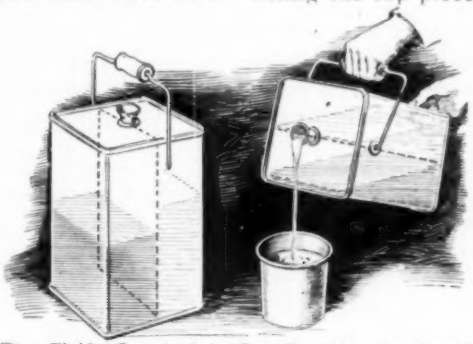


Seat for Harrow Enables the Driver to Work in Ease and Comfort; It Is Easily Improvised from Materials to Be Found on Farm Scrap Heap

which can be taken from some discarded implement. Part of an old cultivator, with collars and a brace added as shown, is used as an axle for the wheel. It is securely fastened to a 2 by 6-in. "draw plank," which is attached to the front of the cultivator. Additional flat-iron braces are provided to hold the seat support rigidly to the draw plank, and a footrest, made of ½-in. iron rod and bent to the shape indicated, is also attached to the draw plank. An iron seat from a discarded implement is fastened to the support in the most convenient position for the driver. In use, the wheel rests on the ground, and when the horses are walking, the draw plank is raised from 2 to 4 in., while, at the standstill, it rests on the ground.—Willis Mehanna, Bussey, Iowa.

Pouring Two Liquids from a Single Spout

Two liquids of different strength are held in one can at the same time by a cleaning company that finds this method quickest and best to avoid mistakes. To outward appearances the can is much the same as an ordinary square 5-gal. oilcan with a spout in the center, and to anyone not in the secret it seems mysterious to see two different-colored liquids issuing from the same spout. The secret lies in a partition that divides the can in two halves. Anyone desiring to make a similar container can do so by taking a square can and providing a piece to fit in the center, leaving it projecting above the top a little. Next, two pieces are cut out for the top, each having half a hole in one side, and lastly a funnel spout is made and all the parts are soldered together. To pour either liquid, the can is held with the part containing that liquid on top. When filling the can a funnel is used to direct the liquid into the proper half and the can is never filled quite to the top. When the can is tipped to pour, the liquid in the lower half is below the spout and does not come out.



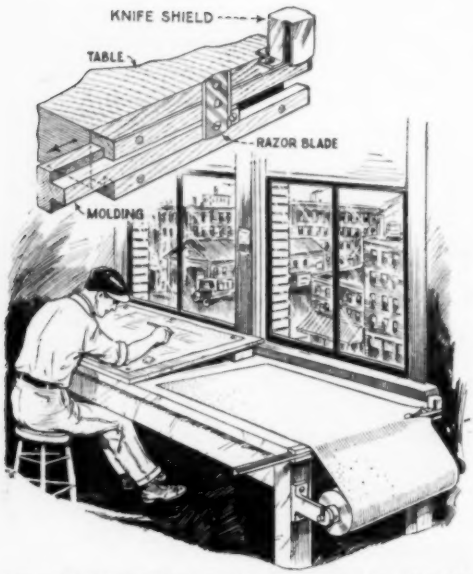
Two Fluids Contained in One Can May Be Poured Separately without Mixing

Rigid Vise Stand, Made of Pipe and Fittings, Is Bolted to Floor

Pipe Support for Heavy Vise

It is sometimes objectionable to support a heavy vise on the workbench as the vibration caused by its use may make it difficult for others to work at the bench. To overcome this trouble, a separate stand for the vise, made of pipe and fittings, was provided as shown. The stand has three legs, fitted with flanges, which are screwed or bolted to the floor. Additional strength is obtained by braces of ¼-in. iron rod. A number of elbows, couplings, nipples and a T-fitting are used to form the upper end of the stand, and the vise is bolted on top. When making the stand, start by fitting the top pieces together, then screw on the legs, brace them, and attach the flanges.

¶It is provoking to try opening a window at night for ventilation and find it frozen to the sill. This can be prevented by sprinkling a little salt on the sill every time the window is closed.



Razor Blade Attached to Simple Slide Cuts Drafting Paper Straight

Device for Cutting Drafting Paper Squarely and Quickly

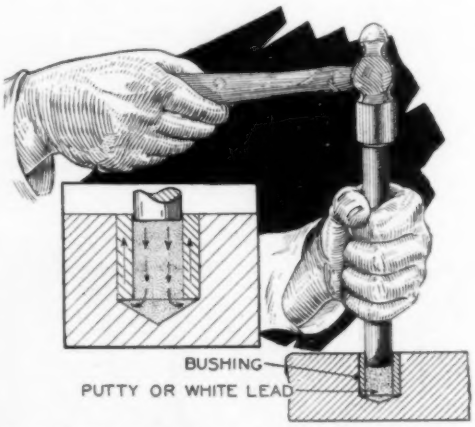
It is difficult to cut a piece of drafting paper from a roll squarely with a penknife or scissors, and many rough edges have to be removed, the total being quite considerable in a large drafting office. The trouble can be overcome by providing the cutting device shown in the drawing. Two lengths of ½ to ⅜-in. rabbeted mold are tacked to the end of the drafting table to which the roll of paper is attached. Another length of molding, rabbeted on both sides and fitting in the rabbets of the two other pieces, forms a slide. A safety-razor blade is screwed to the back end of the slide in the position indicated in the detail, so that it projects just above the surface of the table. The slide should be a little wider than the other two pieces so that it can be moved back and forth and the razor blade will not bind or cut the upper rabbeted piece. A length of drafting paper is drawn from the roll and cut squarely and rapidly by pulling out the slide which carries the blade. When not in use, the blade is pushed into a small sheet-metal guard in the shape of a box. This avoids the danger of cutting one's hands when unaware of the sharp blade. Additional precautions should be taken by setting the table on which the cutter is mounted, against the wall, as shown.—S. A. Marshall, Jr., Rome, Ga.

How to Harden Chalky Plaster Walls

Plaster walls sometimes appear soft and chalky, which is not a good condition for the application of paint. In such cases it is, of course, necessary to harden the surface. A practical method of doing this is to dampen the wall with clean water, which is applied with a brush. When the wall has dried, the plaster will be hard. Although it may cause some delay in finishing the walls, the work is well worth while as the foundation of any painting job must be right if it is to be permanent.

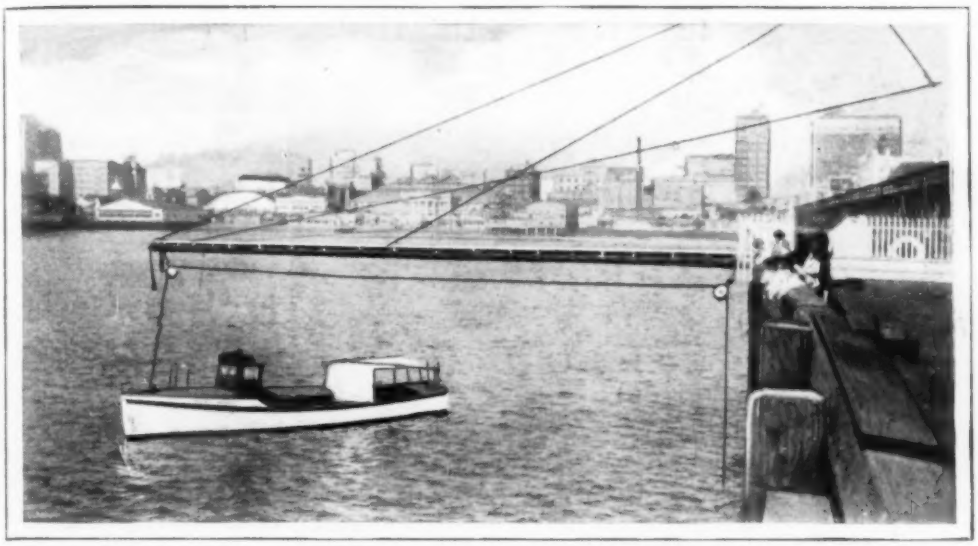
Removing a Bushing

To remove a bushing in a hole that is not drilled through, is often a difficult task. A practical and novel method is to fill the hole with some plastic medium such as white lead or thin putty. A shaft, the diameter of which is just a fraction smaller than the inside diameter of the bushing, is held in a vertical position in the hole, as shown, and a sharp blow is directed on the top of the shaft. This will cause the plastic substance, under compression, to force the bushing out as illustrated in the insert. If the shaft is a good fit in the bushing, heavy oil may be used



Easy Method of Forcing a Bushing Loose by Means of Putty or White Lead

instead of the white lead or putty.—Joseph W. Kelly, Brooklyn, N. Y.



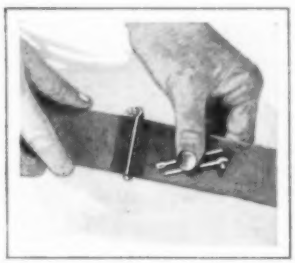
Practical Method of Mooring a Small Motorboat to a Dock in a Harbor Which Is Affected by Tide; a Walk Is Provided on the Boom, the Latter Being Securely Attached to the Dock and Braced by Guys

Mooring Motorboat to Dock

When a small boat is tied to a dock in a harbor affected by tide, the rope is tight when the tide is out, and loose when the tide is in. In the latter case the boat is free to drift around and bump against the dock, which is, of course, not desirable. This difficulty was overcome, in one instance, by using a large boom, extended horizontally from the dock as shown in the accompanying photo. Pulleys are attached, as indicated, to hold a rope, one end of which is tied to the bow of the boat and the other to a counterweight. In this way the boat is held securely and the rope is constantly under tension, no matter whether the tide is in or out. Being kept away from the dock, the boat will not be damaged by battering against it. A walk was provided on the boom by nailing crosspieces at right angles to its length and laying boards over them. The boom must, of course, be properly supported by guys.—Carlton Groat, Portland, Oreg.

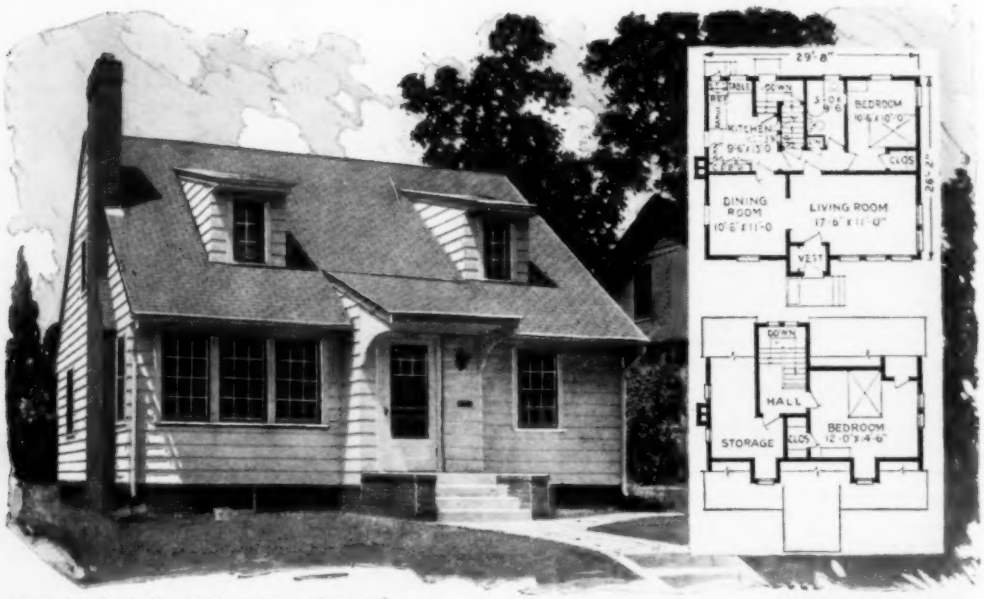
Doubling Length of Emery-Cloth Strips

When using strips of emery cloth torn from the usual 9 by 11-in. stock sheets, greater convenience can be obtained if the strips are joined together. This is particularly the case when circular pieces are being polished and the diameter of these leave but little of the cloth free for the fingers to grip. Two small cotter keys can be used, as shown in the photo, to hold two strips of emery cloth together firmly, without touching the surface over which the cloth is being passed. The legs of one key are bent back to an acute angle with the head. Between the legs of this key the two strips are forced, abrasive faces together. The short ends are then bent out, and the key ends locked with another but shorter cotter key. The latter fits in the troughlike groove formed by the faces of the short ends. The two strips of cloth can be gripped by the ends and vigorously pulled back and forth, the keys holding them securely together. The cotters can be removed from old strips of cloth and applied to new ones.—Frank W. Bentley, Jr., Missouri Valley, Iowa.



¶To refinish tops of automobiles, use brushing lacquer instead of auto-top dressing; the lacquer makes a much better dressing and will not crack or peel.

Is This Your Home?



Plan No. 4A15

QUESTIONS regarding home building addressed to this magazine will be answered by The Architects' Small House Service Bureau of the United States, Inc., controlled by the American Institute of Architects and indorsed by the United States department of commerce. Blueprints, specification forms, and material lists for the house shown here may be obtained from The Architects' Small House Service Bureau for a small fee. If further information is desired, literature describing the plan service and publications of The Architects' Small House Service Bureau will be sent you upon request. A booklet entitled "50 Ways to Lower Home Building Costs," illustrated by ten Bureau homes actually lived in and showing how as much as $1,000 can be saved on a home, may be obtained for 20c.

THE external appearance of this house suggests the restfulness of the early homes in New Netherlands. It is individual in design and provides a suitable background for American home life.

By grouping the windows in one corner of the living room, a sun-room effect is obtained. Another pleasing detail is the hooded entrance doorway with the handsome glazed door, which lights the vestibule. Besides providing space for a useful coat closet, the vestibule serves to shut off objectionable drafts from the living and dining rooms whenever desired.

French doors between the living and dining rooms permit these rooms to be thrown together to make practically one big room extending clear across the front of the house. On the other hand, by closing the doors, greater privacy can be given to the dining room.

The kitchen has been given careful thought. Observe how the designer has provided easy access from the kitchen to the dining room, front door and bedroom section of the house. Each step saved means economy in housework as well as giving the housewife time for other things. The ice box has an outside door for convenience in refilling it. There are a handy broom closet and built-in ironing board in the kitchen. The linen closet, which is also built in, is close to the bathroom. The downstairs bedroom has windows on two sides and a roomy closet.

Here is a compact plan which provides within small space a large amount of room and every comfort and convenience demanded by the average American family. The simplicity of the exterior, as well as of the layout, should insure low costs if this plan is adopted for your home.