AMATEUR MECHANICS

A BOOK

FOR OLD AND YOUNG WHO LIKE TO MAKE THINGS

"Written So You Can Understand It"

Reprinted from POPULAR MECHANICS

TELLS HOW TO MAKE

Home-Made Telescope, Aquarium, Telegraph Instruments, Paddle Boat, Wireless Telegraph, Small Auto, Box Kite, Water Motor, Electric Furnace, Microscope, Book-Binding, Electroplating, China Kiln, Acetylene Gas Generator, Steam Engine, Tricks for Parlor Magic, Bobsled, Silhouettes, Jump Spark Coils, Induction Coils, Rheostats, Lathe, Foundry Work at Home, Etc., Etc.

CHICAGO
POPULAR MECHANICS

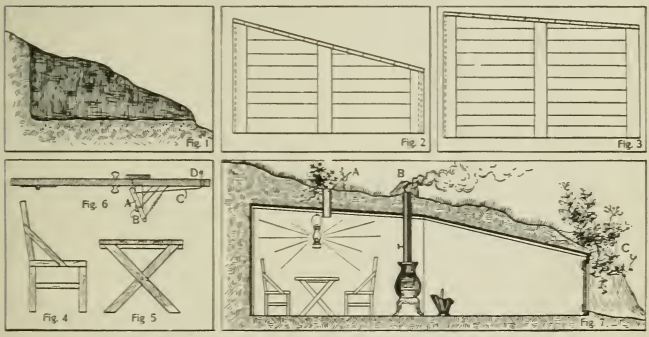
CONTENTS

AN UNDERGROUND CLUB-HOUSE

Nearly every boys' club wants a place to meet and it was for this purpose that the underground house here shown was constructed. The house is built in a hill which was first excavated, as shown in Fig. 1, the dirt being thrown on each side, to be used later for banking and covering the roof.

The house consists of two principal parts: the entry, Fig. 2, and the club room, Fig. 3. This may be made any length desired, but should not be more than 5 or 6 ft. wide, as a greater width would require cross beams of furniture that are usually required. These may be either home-made, as shown, or may be obtained from the old furniture discarded from the home. The door, Fig. 6, is provided with a secret lock which consists of a latch, A, supported on a strong frame, B, and swinging on a pivot near the center.

A string, C, is fastened to the latch and terminates in a ring, D, which is placed in a location known only to the members of the club. A light spring or rubber band may be used to make the latch spring over



Details of Construction and Equipment of Underground Club-House

to support the roof and would thereby make the construction much more complicated.

The lumber used should be about 1 in. thick and should be fastened together in a good workmanlike manner. This is especially true of the roof, which is required to support the weight of the earth above in addition to the weight of any possible intruder and which, if too weak, will endanger the occupants of the house. The boards should be nailed across the short way to give greater strength and it is well to nail a long board along the middle the entire length of the roof.

In Figs. 4 and 5 are shown the articles in front of the door, and when the door is closed it will lock itself.

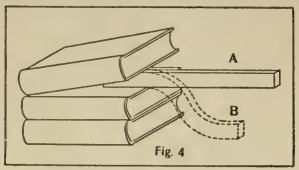
The longitudinal section of the complete house is shown in Fig. 7. The ventilator, A, can be made of either wood or stove pipe and if desired can have a small cover over the top to prevent rain coming in. If a stove is used, a pile of burnt wood can be placed around the stack, as shown at B, so that the suspicions of passers-by will not be aroused in any way. Also a bush, C, transplanted at the entrance, will hide the door.

An underground club-house of this kind will prove a source of mystery to those

uninformed of the secret entrance.—Contributed by Charles Edwards, Jr., 2623 E. Preston St., Baltimore, Md.

SEALING WAX BENT WHILE COLD

If a piece of sealing wax is supported in a horizontal position by one end, as shown at A in the sketch, it will gradually bend to the shape indicated by the dotted lines, B.



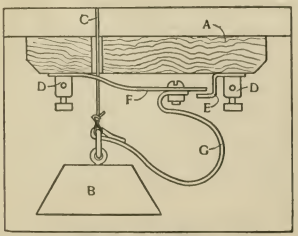
Bending Cold Sealing Wax

To attempt bending it with the hands would result in breaking it unless a steady pressure were applied for a long time. This peculiar property is also found in ice.

A CHEAP FIRE ALARM

An electrical device for the barn that will give an alarm in case of fire is shown in the accompanying diagram. A is a wooden block, which is fastened under the loft at a gable end of the barn; B is an iron weight attached to the string, C, and this string passes up through the barn to the roof, then over a hook or pulley and across the barn, under the gable, and is fastened to the opposite end of the barn.

D D are binding posts for electric wires. They have screw ends, as shown, by which means they are fastened to the wooden block, A. They also hold the brass piece, E, and the strip of spring brass, F, in place against the wooden block. G is a leather strap, fastened to the weight, B, and the spring, F, connected to the latter by a small sink bolt.



Automatic Circuit-Closing Device

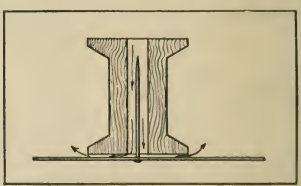
At the house an electric bell is placed wherever convenient. Several battery cells, of course, are also needed. Dry batteries are most convenient. The battery cells and bell are connected in the usual manner, and one wire from the bell and one from the battery are strung to the barn and connected to the binding posts, D D.

If a fire occurs in the hay mow the blaze will generally shoot toward the gable soon after it starts, and will then burn the string, C, which allows the weight, B, to fall and pull the brass spring against the iron piece, E, which closes the circuit and rings the bell that is in the house.

If desired, the string can be stretched back and forth under the roof several times or drawn through any place that is in danger of fire.—Contributed by Geo. B. Wrenn, Ashland, Ohio.

A CURIOUS COMPRESSED AIR PHENOMENON

Push a pin through an ordinary business card and place the card against one end of a spool with the pin inside the bore, as



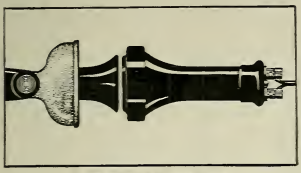
Experiment with Spool and Card

shown in the sketch. Then blow through the spool and it will be found that the card will not be blown away but will remain suspended without any visible support. This is explained by the fact that the air radiates from the center at a velocity which is nearly constant, thereby producing a partial vacuum between the spool and the card. Can any of the readers of Mechanics for Young America devise a practical application of this contrivance?

Amateur Mechanics

A SINGING TELEPHONE

Those who have not already tried the experiment may be interested to know that a telephone can be made to sing by holding the receiver about $\frac{1}{16}$ in. from the transmitter, as shown in the illustration. The experiment will work well on most telephones, but not on every one.

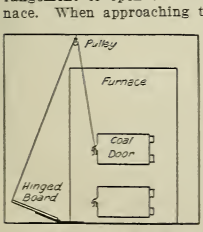


To Make a Telephone Sing

When the receiver is placed in the position shown it acts like an ordinary buzzer, and the function of the transmitter will then be that of an interrupter. The slightest movement of the transmitter diaphragm will cause an increased movement of the receiver diaphragm. This in turn will act on the transmitter, thus setting up sympathetic vibrations between the two, which accounts for the sound.

DOOR OPENER FOR FURNACE

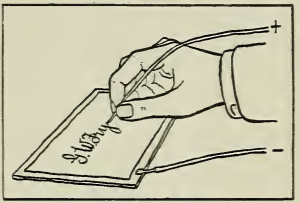
The accompanying diagram shows an arrangement to open the coal door of a furnace. When approaching the furnace with a shovelful of coal it is usually necessary to rest the shovel on the top of the ash door, while the coal door is opened. With my device it is only necessary to press the foot pedal, which opens the door. After putting in the coal, pressing the pedal closes the door. The pulley in the ceiling must be placed a little in front of the door, in order to throw the door open after lifting it from the catch.



A large gate hinge is used to hold the pedal to the floor.—Contributed by Edward Whitney, 18 E. Gorham St., Madison, Wis.

WRITING WITH ELECTRICITY

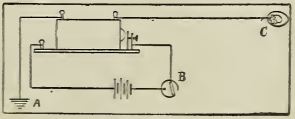
Soak a piece of white paper in a solution of potassium iodide and water for about a minute and then lay on a piece of sheet metal. Connect the sheet metal with the negative or zinc side of a battery and then, using the positive wire as a pen, write your name or other inscription on the wet paper. The result will be brown lines on a white background.—Contributed by Geo. W. Fry, 1250 Locust St., San Jose, Cal.



Electrolytic Writing

TO DRIVE AWAY DOGS

The dogs in my neighborhood used to come around picking up scraps. After I connected up my induction coil, as shown in the sketch, we were not bothered with them. A indicates the ground; B, switch; and C, a bait of meat, or a tempting bone.—Contributed by Geo. W. Fry, 903 Vine St., San Jose, Cal.



Shocking Machine

HOW TO BUILD A TOBOGGAN SLED

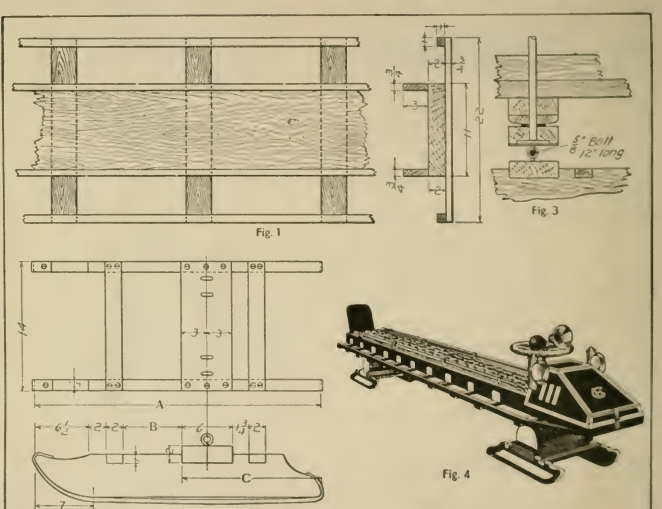
By A. Boette

The first object of the builder of a sled should be to have a "winner," both in speed and appearance. The accompanying instructions for building a sled are designed to produce these results.

The sled completed should be 15 ft. 2 in. long by 22 in. wide, with the cushion about 15 in. above the ground. For the baseboard select a pine board 15 ft. long, 11 in. wide and 2 in. thick, and plane it on all edges.

length of the sled from the back to the auto front. These are to keep the cushion from falling out. See Fig. 1. For the back of the sled use the upper part of a child's high chair, taking out the spindles and resetting them in the rear end of the baseboard. Cover up the outside of the spindles with a piece of galvanized iron.

The construction of the runners is shown at Figs. 2 and 3. The stock required for



Constructing a "Winner" Toboggan Sled

Fit up the baseboard with ten oak foot rests, 22 in. long, 3 in. wide and ¾ in. thick. Fasten them on the underside of the baseboard at right angles to its length and 16 in. apart, beginning at the rear. At the front 24 or 26 in. will be left without crossbars for fitting on the auto front. On the upper side of the cross bars at their ends on each side screw a piece of oak 1 in. x 1 in. by 14 ft. long. On the upper side of the baseboard at its edge on each side screw an oak strip 3 in. wide by ¾ in. thick and the

them is oak, two pieces 30 in. x 5 in. x 1¼ in., two pieces 34 in. x 5 in. x 1¼ in., two pieces 14 in. x 6 in. x 2 in., and four pieces 14 in. x 2 in. x 1 in. They should be put together with large screws about 3 in. long. Use no nails, as they are not substantial enough. In proportioning them the points A, B and C, Fig. 2, are important. For the front runners these measurements are: A, 30 in.; B, 4 in.; C, 15½ in., and for the rear runners: A, 34 in.; B, 7 in.; C, 16½ in. The screw eyes indicated must be placed in a

straight line and the holes for them carefully centered. A variation of $\frac{1}{16}$ in. one way or another would cause a great deal of trouble. For the steel runners use $\frac{3}{8}$-in. C. R. steel flattened at the ends for screw holes. Use no screws on the running surface, however, as they "snatch" the ice.

The mechanism of the front steering gear is shown at Fig. 3. A $\frac{3}{4}$-in. steel rod makes a good steering rod. Flatten the steering rod at one end and sink it into the wood. Hold it in place by means of an iron plate drilled to receive the rod and screwed to block X. An iron washer, Z, is used to reduce friction; bevel block K to give a rocker motion. Equip block X with screw eyes, making them clear those in the front runner, and bolt through. For the rear runner put a block with screw eyes on the baseboard and run a bolt through.

Construct the auto front (Fig. 4) of $\frac{3}{4}$-in. oak boards. The illustration shows how to shape it. Bevel it toward all the sides and keep the edges sharp, as sharp edges are best suited for the brass trimmings which are to be added. When the auto front is in place enamel the sled either a dark maroon or a creamy white. First sandpaper all the wood, then apply a coat of thin enamel. Let stand for three days and apply another coat. Three coats of enamel and one of thin varnish will make a fine-looking sled. For the brass trimmings use No. 27 B and S sheet brass 1 in. wide on all the front edges and pieces 3 in. square on the cross bars to rest the feet against. On the door of the auto front put the monogram of the owner or owners of the sled, cutting it out of sheet brass.

For the steering wheel procure an old freight car "brake" wheel, brass plated. Fasten a horn, such as used on automobiles, to the wheel.

Make the cushion of leather and stuff it with hair. The best way is to get some strong, cheap material, such as burlap, sew up one end and make in the form of an oblong bag. Stuff this as tightly as possible with hair. Then get some upholstery buttons, fasten a cord through the loop and bring the cord through to the underside of the cushion, and fasten the button by slipping a nail through the knot. Then put a leather covering over the burlap, sewing it to the burlap on the under side. Make the cushion for the back in the same way. On top of the cushion supports run a brass tube which will serve the double purpose of holding the cushion down and affording something to hold on to.

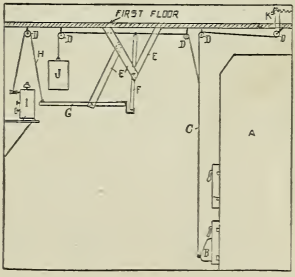
If desired bicycle lamps may be fastened to the front end, to improve the appearance, and it is well to have a light of some kind at the back to avoid the danger of rear-end collisions.

The door of the auto front should be hinged and provided with a lock so that skates, parcels, overshoes, lunch, etc., may be stowed within. A silk pennant with the monogram on adds to the appearance.

If desired, a brake may be added to the sled. This can be a wrought iron lever $1\frac{1}{2}$ in. by $\frac{1}{2}$ in. by 30 in. long, so pivoted that moving the handle will cause the end to scrape the ice. This sled can be made without lamps and horn at a cost of about $15, or with these for $25 and the pleasure derived from it well repays the builder. If the expense is greater than one can afford, several boys can share in the ownership.

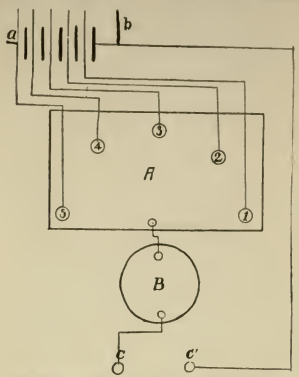
AUTOMATIC DRAFT OPENER

A simple apparatus that will open the draft of the furnace at any hour desired is illustrated. The parts are: A, furnace; B, draft; C, draft chain; D, pulleys; E, wooden supports; F, vertical lever; G, horizontal lever; H, cord; I, alarm clock; J, weight. K shows where and how the draft is regulated during the day, the automatic device being used to open it early in the morning. The spool on the alarm clock is fastened to the alarm key by sawing a slit across the top of the spool and gluing it on. When the alarm goes off a cord is wound up on the spool and pulls the horizontal lever up, which releases the vertical lever and allows the weight to pull the draft open.—Contributed by Gordon Davis, 518 W. Dutton St., Kalamazoo, Mich.



CONNECTING UP BATTERIES TO GIVE ANY VOLTAGE

Referring to the illustration: A is a five-point switch (can be home-made); B is a one-point switch and C and C¹ are binding



Batteries Connected to Give Any Voltage

posts. When switch B is closed and A is on No. 1, you have the current of one battery; when A is on No. 2 you receive the current from two batteries; when on No. 3 from three batteries; when on No. 4 from four batteries, and when on No. 5 from five batteries. More batteries may be connected to each point of switch B.

I have been using the same method for my water rheostat (home-made). I have the jars of water where the batteries are and the current coming in at a and b.—Contributed by Eugene F. Tuttle, Jr., Newark, Ohio.

TO BUILD A SMALL BRASS FURNACE

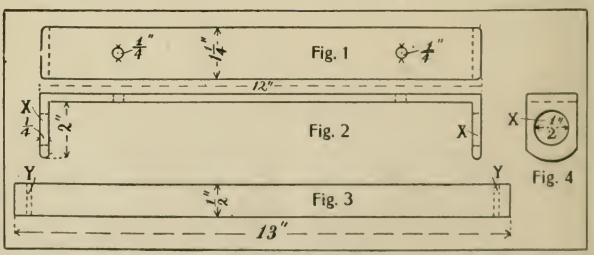
Bend a piece of stout sheet iron 23 in. by 12 in. round so that the inside diameter is 7 in. and then rivet the seam. Fit in a round piece of sheet iron for the bottom. Make a hole about the size of a shilling in the side 2 in. from the bottom. This is for the purpose of blowing.

Brass Furnace

Line the furnace, bottom and sides, with fireclay to a depth of ½ in. Use charcoal to burn and an ordinary bellows for blowing, says the Model Engineer, London. The best blast is obtained by holding the nozzle of the bellows about an inch from the hole, instead of close to it.

BOB-SLED HINGE

The illustrations show how to make a good bob-sled hinge which will hold the sled very firmly, but allow it to move up and down. The hinge should be made of iron and of the dimensions indicated in the sketches. Fig. 3 passes through the hole, X.



Hinge for a Bob-Sled

X is a hole to bend a nail through. This hinge can be made for 30 or 40 cents.—Contributed by Harold R. Bullock, 983 Richmond street, Appleton, Wis.

Amateur Mechanics

PARLOR MAGIC FOR WINTER EVENINGS

By C. H. Claudy

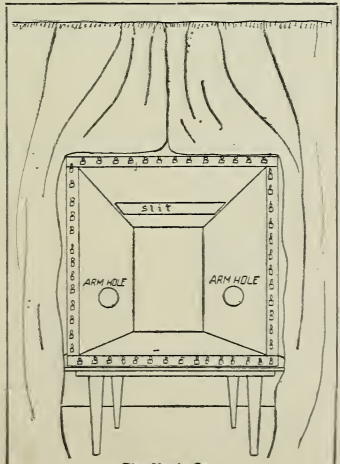
You are seated in a parlor at night, with the lights turned low. In front of you, between the parlor and the room back of it, is an upright square of brightly burning lights, surrounding a perfectly black space. The magician stands in front of this, in his shirt sleeves, and after a few words of introduction proceeds to show the wonders of his magic cave. Showing you plainly that both hands are empty, he points with one finger to the box, where immediately appears a small white china bowl. Holding his empty hand over this bowl, some oranges and apples drop from his empty hand into the bowl. He removes the bowl from the black box, or cave, and hands its contents round to the audience. Receiving the bowl again, he tosses it into the cave, but it never reaches the floor—it disappears in mid-air.

The illusions he shows you are too many to retail at length. Objects appear and disappear. Heavy metal objects, such as forks, spoons and jack-knives, which have been shown to the audience and which can have no strings attached to them, fly about in the box at the will of the operator. One thing changes to another and back again and black art reigns supreme.

Now all this "magic" is very simple and requires no more skill to prepare or execute than any clever boy or girl of fourteen may possess. It is based on the "Black Art" performance of the famous Hermann, and relies on a principle of optics for its success. To prepare such a magic cave, the requisites are a large soap box, a few simple tools, some black paint, some black cloth, and plenty of candles.

The box must be altered first. One end is removed and a slit, one-third of the length from the remaining end, cut in one side. This slit should be the width of the box and about five inches wide. On either side of the box, half way from open end to closed end, should be cut a hole, just large enough to comfortably admit a hand and arm.

Next, the box should be painted black both inside and out, and finally lined inside with black cloth. This lining must be done neatly—no folds must show and no heads of tacks. The interior must be a dead black. The box is painted black first so that the cloth used need not be very heavy and consequently, inexpensive; but if the cloth be sufficiently thick, no painting inside is required. The whole inside is to be cloth-lined, floor, top, sides and end.



The Magic Cave

Next, the illumination in front must be arranged. If you can have a plumber make you a square frame of gas piping, with tiny holes all along it for the gas to escape and be lit, and connect this by means of a rubber tube to the gas in the house, so much the better;

but a plentiful supply of short candles will do just as well, although a little more trouble. The candles must be close together and arranged on little brackets around the whole front of the "cave" (see diagram), and should have little pieces of bright tin behind them, to throw the light towards the audience. The whole function of these candles is to dazzle the eyes of the spectators and prevent them seeing very far into the black box.

Finally, you must have an assistant, who must be provided with either black gloves or black bags to go over his hands and arms, and several black drop curtains, attached to sticks greater in length than the width of the box, which are let down through the slit in the top.

The audience room should have only low lights; the room where the cave is should be dark, and if you can drape portieres between two rooms around the box (which, of course, is on a table) so much the better.

The whole secret of the trick lies in the fact that if light be turned away from anything black, into the eyes of him who looks, the much fainter light reflected from the black surface will not affect the observer's eye. Consequently, if when the exhibitor puts his hand in the cave, his confederate behind inserts his hand, covered with a black glove and holding a small bag of black cloth, in which are oranges and apples, and pours them from the bag into a dish, the audience sees the oranges and apples appear, and does not see the black arm and bag against the black background at all.

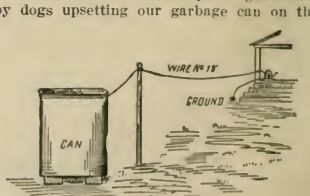
The dish appears by having been placed in position behind a black curtain, which is snatched swiftly away at the proper moment by the assistant. Any article thrown into the cave and caught by the black hand and concealed by a black cloth appears to disappear. Any object not too large can be made to "levitate" by the same means. A picture of any one present may be made to change into a grinning skeleton by suddenly screening it with a dropped curtain, while another curtain is swiftly removed from over a pasteboard skeleton, which can be made to dance either by strings, or by the black veiled hand holding on to it from behind, and the skeleton can change to a white cat.

But illusions suggest themselves. There is no end to the effects which can be had from this simple apparatus, and if the operators are sufficiently well drilled the result is truly remarkable to the uninitiated. The illusion, as presented by Hermann, was identical with this, only he, of course, had a big stage, and people clothed in black to creep about and do his bidding, while here the power behind the throne is but a black veiled hand and arm. It can be made even more complicated by having two assistants, one on each side of the box, which was why it was advised that two holes be cut. This enables an absolutely instantaneous change as one uncovers the object at the moment the second assistant covers and removes the other.

It is important that the assistants remain invisible throughout, and if portieres are impossible, a screen must be used. But any boy ingenious enough to follow these simple instructions, will not need to be told that the whole success of the exhibition depends upon the absolute failure of the audience to understand that there is more than one concerned in bringing about the curious effects which are seen. The exhibitor should be a boy who can talk; a good "patter"—as the magicians call it—is often of more value than a whole host of mechanical effects and helpers. It is essential that the exhibitor and his confederate be well drilled, so that the latter can produce the proper effects at the proper cue from the former. Finally, never give an exhibiton with the "cave" until you have watched the illusions from the front yourself; so that you can determine whether everything connected with the draping is right, or whether some stray bit of light reveals what you wish to conceal.

TO KEEP DOGS AND CATS AWAY FROM THE GARBAGE CAN

Last summer I was annoyed a great deal by dogs upsetting our garbage can on the



lawn, but finally executed a plan that rid the yard of them in one afternoon.

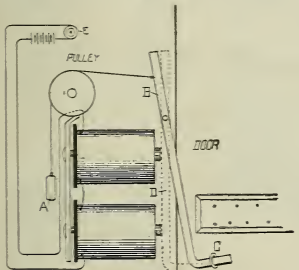
I first secured a magneto out of an old telephone, then drove a spike in a damp

place under the porch, attached a wire to the spike and run the wire to one of the poles of the magneto. Then I set the garbage can on some blocks of wood, being careful not to have it touch the ground at any point. I next ran a wire from the other pole of the magneto to the can, wrapping the wire around the can several times. Then I sat down on the porch to wait.

It was not long before a big greyhound came along, putting his forepaws on the top of the can to upset it. At the same instant I gave the magneto a quick turn, which sent the dog away a very surprised animal. This was repeated several times during the afternoon with other dogs with the same result.—Contributed by Gordon T. Lane, Crafton, Pa.

AN AUTOMATIC LOCK

The illustration shows an automatic lock operated by electricity, one cell being sufficient. When the circuit is broken a weight, A, attached to the end of the armature, B, tends to push the other end of the armature into the screw eye or hook, C,



Automatic Electric Lock for Doors

which is in the door, thus locking the door

To unlock the door, merely push the button, E. The magnet then draws the armature out of the screw eye and the door is unlocked. The dotted line at D shows the position of the armature when the circuit is complete and the door unlocked. The weight must be in proportion to the size of the magnet. If it is not, the door will not lock, or would remain locked. The button can be hidden, as it is the key to the lock.—Contributed by Claude B. Melchoir, Hutchison, Minn.

NEW METHOD OF LIFTING A TABLE

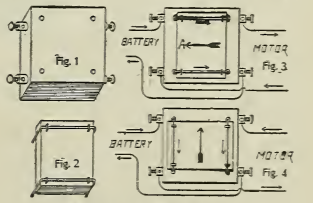
To perform this feat effectively the little device illustrated will be required. To make it take a sheet-iron band, a, ¾ in. wide and attach a strap to fasten on the forearm between the wrist and elbow. Put a sharp needle point, B, through the sheet-iron so that it extends ¾ in. outward. Make one of these pieces for each arm.

In lifting the table first show the hands unprepared to the audience and also a light table, removing the cover to show that the surface of the table is not prepared in any way. Then replace the table, rest the hands upon it and at the same time press the needle points in the arm pieces into the wood of the table, which will be sufficient to hold it, says a correspondent of the Sphinx. Then walk down among the audience.

SIMPLE CURRENT REVERSER

On a block of hardwood draw a square (Fig. 1) and drill a hole in each corner of the square. Fill these holes with mercury and connect them to four binding posts (A A A A, Fig. 1).

On another block of wood fasten two wires, as shown in Fig. 2, so that their ends can be placed in the holes in the first block. Then connect up with the motor and battery as in Fig. 3. When the block

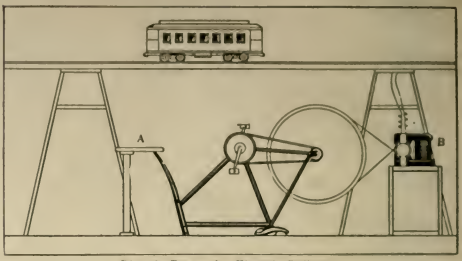


For Reversing a Current

is placed on with the big arrow, A, pointing as in the direction indicated in Fig. 3, the current flows with the small arrows. To reverse turn through an angle of 90 degrees (Fig. 4).—Contributed by F. Crawford Curry, Brockville, Ontario, Canada.

BICYCLE POWER FOR RUNNING MINIATURE TRAINS

Remove the front wheel from the bicycle and in its place fix a seat as at A in the sketch. Take the tire off the back wheel and run a small leather belt around the wheel to transmit power to the dynamo, B, which is connected up, as shown, and causes the little electric car to run when the wheel is operated. — Contributed by Clifford B. Brainerd, Chevy Chase, Md.



Bicycle Power for Electric Railway

RUSTIC WINDOW BOXES

Instead of using an ordinary green painted window box why not make an artistic one in which the color does not clash with the plants contained in it but rather harmonizes with them and brings out the beauty of the foliage to the most advantage.

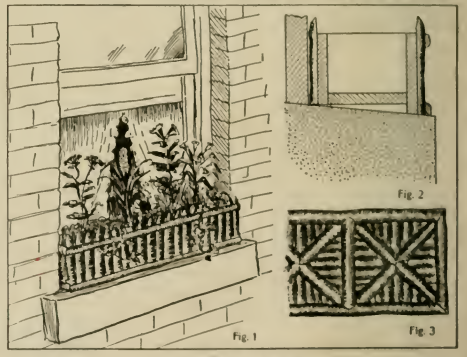
Such a window box can be made by anyone having usual mechanical ability and will furnish more opportunities for artistic and original design than many other articles of more complicated construction.

The box proper should be made a little shorter than the length of the window to allow for the extra space taken up in trimming and should be nearly equal in width to the sill, as shown in Fig. 1. If the sill is inclined, as is usually the case, the box will require a greater height in front, to make it set level, as shown in Fig. 2.

The box should be well nailed or screwed together and should then be painted all over to make it more durable. A number of ½-in. holes should be drilled in the bottom, thus allowing the excess water to run out and prevent rotting the plants and box.

Having completed the bare box it may be trimmed to suit the fancy of the maker. The design shown in Fig. 1 is very simple and easy to construct but may be replaced with a panel or other design. One form of panel design is shown in Fig. 3.

Trimming having too rough a surface will be found unsuitable for this work as it is difficult to fasten and cannot be split as well as smooth trimming. It should be cut the proper length before being split and should be fastened on with brads. The half-round hoops of barrels will be found very useful in trimming, especially for filling-in purposes, and by using them the operation of splitting is avoided. After the box is trimmed, the rustic work should be varnished, in order to thoroughly preserve it, as well as improve its appearance.



Artistic Window Boxes

Farmer's Boy Builds a Telescope and Discovers a Comet

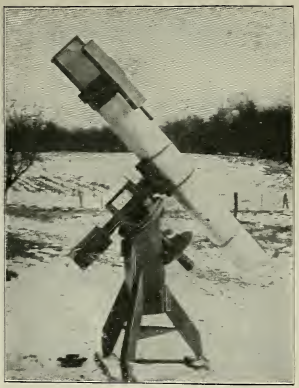
[A young farmer boy living near Cottage Grove, Wis., with his own hands and such tools as are usually found on a farm, built a telescope, and with it recently discovered a comet which had escaped the watchful eyes of the big observatories. He describes how he made the instrument.—Editor.]

First, get two pieces of plate glass, 6 in. square and 1 in. thick, and break the corners off to make them round, grinding the rough edges on a grindstone. Use a barrel to work on, and fasten one glass on the top of it in the center by driving three small nails at the sides to hold it in place. Fasten, with pitch, a round 4-in. block of wood in the center on one side of the other glass to serve as a handle.

Use wet grain emery for coarse grinding. Take a pinch and spread it evenly on the glass which is on the barrel, then take the glass with the handle and move it back and forth across the lower glass, while walking around the barrel; also rotate the glass, which is necessary to make it grind evenly. The upper glass or speculum always becomes concave, and the under glass or tool works convex.

Work with straight strokes 5 or 6 in. in length; after working 5 hours hold the speculum in the sunshine and throw the rays of the sun onto a paper; where the rays come to a point gives the focal length. If the glass is not ground enough to bring the rays to a point within 5 ft. the coarse grinding must be continued, unless a longer focal length is wanted.

Have ready six large dishes, then take 2 lb. flour emery and mix in 1½ qt. of water; immediately turn the water into a clean dish and let settle 30 seconds; then turn it into another dish and let settle 2 minutes, then 8 minutes, 30 minutes and 90 minutes, being careful not to turn off the coarser emery which has settled. When dry, turn the emery from the 5 jars into 5 separate bottles and label. Then take a little of the coarsest powder, wetting it to the consistency of cream, and spread on the glass, work as before (using short straight strokes 1½ or 2 in.) until the holes in the glass left by the grain emery are ground out; next use the finer grades until the pits left by each coarser grade are ground out. When the two last grades are used shorten the strokes to less than 2 in. When done the glass should be semi-transparent, and is ready for polishing.



The Telescope

When polishing the speculum, paste a strip of paper 1⅓ in. wide around the convex glass or tool, melt 1 lb. of pitch and turn on to it and press with the wet speculum. Mould the pitch while hot into squares of 1 in., with ¼-in. spaces, as in Fig. 1. Then warm and press again with the speculum, being careful to have all the squares touch the speculum, or it will not polish evenly. Trim the paper from the edge with a sharp knife, and paint the squares separately with jeweler's rouge, wet till soft like paint. Use a binger to spread it on with. Work the speculum over the tool the same as when grinding, using straight strokes 2 in. or less.

When the glass is polished enough to reflect some light, it should be tested with the knife edge test. In a dark room, set the speculum against the

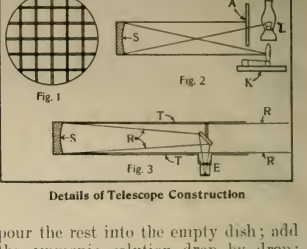
wall, and a large lamp, L, Fig. 2, twice the focal length away. Place a large sheet of pasteboard, A, Fig. 2, with a small needle hole opposite the blaze, by the side of the lamp, so the light from the blaze will shine onto the glass. Place the speculum, S, Fig. 2, so the rays from the needle hole will be thrown to the left side of the lamp (facing the speculum), with the knife mounted in a block of wood and edgeways to the lamp, as in K, Fig. 2. The knife should not be more than 6 in. from the lamp. Now move the knife across the rays from left to right, and look at the speculum with the eye on the right side of the blade. When the focus is found, if the speculum is ground and polished evenly it will darken evenly over the surface as the knife shuts off the light from the needle hole. If not, the speculum will show some dark rings, or hills. If the glass seems to have a deep hollow in the center, shorter strokes should be used in polishing; if a hill in the center, longer strokes. The polishing and testing done, the speculum is ready to be silvered. Two glass or earthenware dishes, large enough to hold the speculum and 2 in. deep, must be procured. With pitch, cement a strip of board 8 in. long to the back of the speculum, and lay the speculum face down in one of the dishes; fill the dish with distilled water, and clean the face of the speculum with nitric acid, until the water will stick to it in an unbroken film.

The recipe for silvering the speculum is:

Solution A:	
Distilled water	4 oz.
Silver nitrate	100 gr.
Solution B:	
Distilled water	4 oz.
Caustic stick potash (pure by alcohol)	100 gr.
Solution C:	
Aqua ammonia.	
Solution D:	
Sugar loaf	840 gr.
Nitric acid	39 gr.
Alcohol (pure)	25 dr.

Mix solution D and make up to 25 oz. fluid with distilled water, pour into a bottle and keep for future use, as it works better when old.

Now take solution A and set aside in a small bottle one-tenth of it, and



Details of Telescope Construction

pour the rest into the empty dish; add the ammonia solution drop by drop; a dark brown precipitate will form and subside; stop adding ammonia solution as soon as the bath clears. Then add solution B, then ammonia until bath is clear. Now add enough of the solution A, that was set aside, to bring the bath to a warm saffron color without destroying its transparency. Then add 1 oz. of solution D and stir until bath grows dark. Place the speculum face down in the bath and leave until the silver rises, then raise the speculum and rinse with distilled water. The small flat mirror may be silvered the same way. When dry, the silver film may be polished with a piece of chamois skin, touched with rouge, polishing with a light spiral stroke.

Fig. 3 shows the position of the glasses in the tube, also how the rays, R, from a star are thrown to the eyepiece, E, in the side of the tube. Make the tube, I, of sheet iron, cover with paper and cloth, then paint to make a non-conductor of heat or cold. Make the mounting of good seasoned lumber.

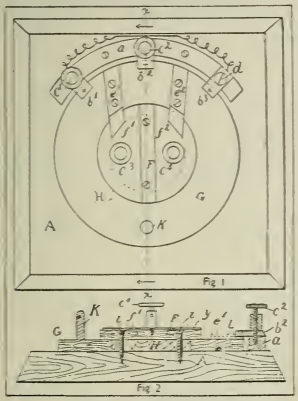
Thus an excellent 6-in. telescope can be made at home, with an outlay of only a few dollars. My telescope is 64 in. long and cost me just $15, but I used all my spare time in one winter in making it. I first began studying the heavens through a spy glass, but an instrument such as I desired would cost $200—more than I could afford. Then I made the one described, with which I discovered a new comet not before observed by astronomers.—John E. Mellish.

Amateur Mechanics

REVERSING SWITCH FOR ELECTRICAL EXPERIMENTS

A home-made reversing switch, suitable for use by students of electrical and engineering courses in performing experiments, is shown in the diagram.

Referring to Fig. 1, A represents a pine board 4 in. by 4 in. and a is a circular piece of wood about ¼ in. square, with three brass strips, b^1, b^2, b^3, held down on it by two



Suitable for Students' Use

terminals, or binding posts, c^1, c^2, and a common screw, d. Post c^1 is connected to d by means of an insulated wire, making them carry the same kind of current (+ in the sketch).

About the center piece, H, moves a disk, held down by another disk, F (Fig. 2), which is fastened through the center piece to the wooden base, A, by means of two wood screws. On the disk, G, are two brass strips, e^1 and e^2, so arranged that, when handle K is turned to one side, their one end just slips under the strips b^1, b^2, or b^3, b^2, respectively, making contact with them, as shown in Fig. 2 at L, while their other ends slide in two half circular brass plates f^1 f^2, held down on disk F by two other terminals, c^3, c^4, making contact with them as shown at y, Fig. 2.

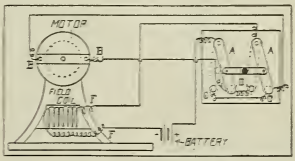
The action of the switch is shown in Fig. 1. Connect terminal c^1 to the carbon of a battery, and c^2 to the zinc. Then, if you turn handle K to the right, so that the strips, e^1 and e^2 touch b^1 and b^2, respectively, terminal c^3 will show + and c^4 — electricity; vice versa, if you turn the handle to the left so that e^1 and e^2 touch b^2 and b^3, respectively, terminal c^3 will show — and c^4, + electricity.

The switch is easy to make and of very neat appearance. The wooden parts could be made of any insulating material, as fiber, for instance.—Contributed by Arthur Schulz, 1111 Rutledge St., Madison, Wis.

REVERSING A SMALL MOTOR

All that is necessary for reversing the motor is a pole-changing switch. Connect the two middle posts of the switch with each other and the two outside posts with each other. Then connect one of the outside posts of the switch to one brush of the motor and one middle post to the other brush.

Connect one bar of the switch to one end of the field coil and the other bar to one pole of the battery and connect the other pole of the battery to the other field coil. To re-



Reverse for a Small Motor

verse the motor, simply change the switch.

Referring to the illustration, the letters indicate as follows: FF, field of motor; BB, brushes of motor; AA, bars of pole-changing switch; DD, center points of switch; CC, outside points of switch.—Contributed by Leonard E. Parker, Plymouth, Ind.

AN INGENIOUS ELECTRIC LOCK FOR A SLIDING DOOR

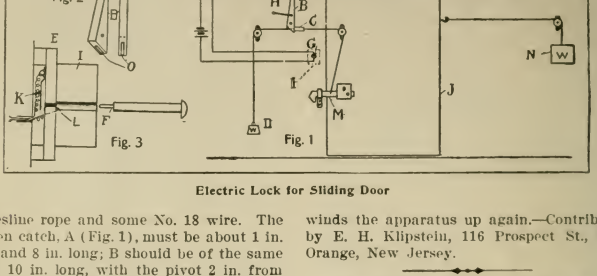
The apparatus shown in Fig. 1 not only unlocks, but opens the door, also, by simply pressing the key in the keyhole.

In rigging it to a sliding door, the materials required are: Three flat pulleys, an old electric bell or buzzer, about 25 ft. of clothesline rope and some No. 18 wire. The wooden catch, A (Fig. 1), must be about 1 in. thick and 8 in. long; B should be of the same wood, 10 in. long, with the pivot 2 in. from the lower end. The wooden block, C, which is held by catch B, can be made of a 2-in. piece of broomstick. Drill a hole through the center of this block for the rope to pass through, and fasten it to the rope with a little tire tape.

When all this is set up, as shown in Fig. 1, make a key and keyhole. A ¼-in. bolt or a large nail sharpened to a point, as at F, Fig. 3, will serve for the key. To provide the keyhole, saw a piece of wood, I, 1 in. thick by 3 in. square, and bore a hole to fit the key in the center. Make a somewhat larger block (E, Fig. 3) of thin wood with a ⅛-in. hole in its center. On one side of this block tack a piece of tin (K, Fig. 3) directly over the hole. Screw the two blocks together, being careful to bring the holes opposite each other. Then, when the point of the key touches the tin, and the larger part (F, Fig. 3) strikes the bent wire, L, a circuit is completed; the buzzer knocks catch A (Fig. 1), which rises at the opposite end and allows catch B to fly forward and release the piece of broomstick, C. The weight, D, then falls and jerks up the hook-lock, M, which unlocks the door, and the heavier weight, N, immediately opens it.

Thus, with a switch as in Fig. 3, the door can only be opened by the person who has the key, for the circuit cannot be closed with an ordinary nail or wire. B, Fig. 2, shows catch B, Fig. 1, enlarged; O, Fig. 2, is the cut through which the rope runs; H, Fig. 1, is an elastic that snaps the catch back into place, and at G the wires run outside to the keyhole.

This arrangement is very convenient when one is carrying something in one hand and can only use the other. Closing the door winds the apparatus up again.—Contributed by E. H. Klipstein, 116 Prospect St., East Orange, New Jersey.



Electric Lock for Sliding Door

ANOTHER ELECTRIC LOCK

The details of the construction of an electrically operated lock are shown in the illustration. When the door is closed and the bolt, A, pushed into position it automatically

Simple Electric Lock

locks. To unlock, push the button, D, which act will cause the electro-magnet to raise the latch, C, when the bolt may be drawn and the door opened.—Contributed by A. D. Zimmerman, Boody, Ill.

Amateur Mechanics

YOUNGEST RAILROAD PRESIDENT IN THE WORLD

The youngest railroad president in the world is Carleton Kinney, nine years old, official head of the Venice Railroad Co., which operates in Venice, Calif., twelve miles from Los Angeles. Carleton has charge of the general management and operation of the line, and his brother Innes Kinney, 13 years of age, is chief engineer. The road is two miles long, laid with light T-rail to 18-in. gage. There are two locomotives built at Los Angeles, after the model of the big standards They are oil burners, carrying 160 pounds of steam; weight, 6 tons each; diameter of cylinders, 5 in.; stroke, 7 in.; 6 drivers, 20 in. diameter; height to top of stack, 57½ in.; maximum speed, 25 miles per hour. Each engine will draw 5 cars, which, loaded, weigh a total of 16 tons. Fuel consumption ¼ gal. of oil per mile.

The cars are 20 ft. long, steel frames, open type, reversible seats, accommodate 12 passengers. A round trip is made in 3 minutes; fare 5 cents. The father of the boys built the line and turned it over to them.

Pres. Carleton Kinney (at right); Chief Engineer Innes Kinney (left)

HOW TO MAKE A GALVANOSCOPE

A galvanoscope for detecting small currents of electricity can be made from a coil of wire. A; a glass tube, B, full of water; a core, C; and a base. D, with binding posts as shown. The core C, which is made of iron and cork is a trifle lighter than the water it displaces and will therefore remain in the top of the tube normally; but as soon as a current of electricity passes through the coil, the core is drawn down out of sight. The current required is very small as the core is so nearly balanced that the least attraction will cause it to sink.

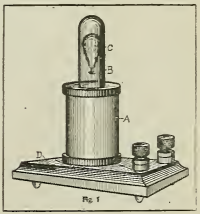


Fig. 1

The glass tube may be a test tube as

shown in Fig. 2, or an empty developer tube. If one has neither a test tube nor developer tube, an empty pill bottle may be used. The washers at the ends of the coil can be made of fibre, hard rubber, or wood; or can be taken from an old magnet. The base may be made of wood or any other insulating material and should have four short legs on the bottom. Make the coil of single covered wire about No. 18 and connect ends to binding posts as shown in Fig 2.

The core is made by pushing a small nail through a piece of cork. It should be made so that it will rise slowly when placed under water. Some filing may be necessary to get the weight just right, but it should be remembered that the buoyancy of the core can be adjusted, after the parts are assembled, by pressing the cork in the bottom of the test tube. This causes compression in the water space and specially of the upper cork, reducing its displacement and causing it to sink. The lower cork is then slowly withdrawn, by twisting, until the core slowly rises. The instrument will then be adjusted ready for use.

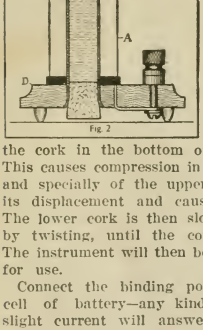


Fig. 2

Connect the binding posts to a single cell of battery—any kind will do as a slight current will answer. On completing the circuit the core will descend; or put in a switch or push button on one of the battery wires. If the button be concealed where the operator can reach it, the core will obey his command to rise or fall, according to his control of the current. This is a mysterious looking instrument the core being moved without visible connection to any other part.

HOW TO MAKE A NEW LANGUAGE

Any one possessing a phonograph can try a very interesting and amusing experiment without going to any expense. Remove the belt and replace with a longer one, which can be made of narrow braid or a number of strands of yarn. The new belt should be long enough to allow crossing it, thus reversing the machine. This reverses every sound on the record and changes it to such an extent that very few words can be recognized.

MINIATURE ELECTRIC LIGHTING

Producing electric light by means of small bulbs that give from one-half to six candle power, and a suitable source of power, is something that will interest the average American boy.

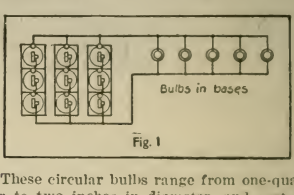


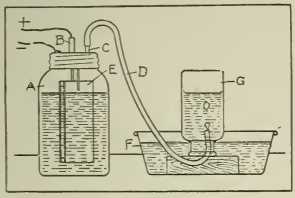
Fig. 1

These circular bulbs range from one-quarter to two inches in diameter, and cost 27 cents each complete with base. They are commonly known as miniature battery bulbs, since a battery is the most popular source of power. The one-half candle power bulbs are usually 2½ volts and take one-quarter ampere of current. It requires about three medium dry cells to operate it. However, there is now upon the market a battery consisting of three small dry cells connected in series, put up in a neat case with two binding posts, which sells for 25 cents. This is more economical than dry cells, as it gives about 4 volts and 3 amperes. It will run as large a lamp as 3½ volts, one candle power, for some time very satisfactorily. More than one lamp can be run by connecting the bulbs in parallel, as indicated by Fig. 1, which shows the special battery with 3 dry cells in the case, and the two binding posts for connection with the bulbs. In this case it is also advisable to connect several batteries in parallel also, so as to increase the current, but maintain the constant voltage. Thus, the individual cells are in multiple series, i. e., multiples of series of three. By keeping in mind the ampere output of the battery and rating of the lamp, one can regulate the batteries as required. It must be remembered, in this connection, that any battery which is drawn upon for half of its output will last approximately three times as long, as if drawn upon for its total output. Thus, in any system of lamps it is economical to

powder can, or a syrup can with a tube soldered to it, and is connected to the engine by a piece of rubber tubing. The heat from a small gas stove will furnish steam fast enough to run the engine very fast. This engine was built by W. G. Schuh and A. J. Eustice, of Cuba, Wis.

SMALL ELECTRICAL HYDROGEN GENERATOR

A small hydrogen generator may be made from a fruit jar, A (see sketch), with two tubes, B C, soldered in the top. The plates, E, can be made of tin or galvanized iron,



Hydrogen Generator

and should be separated about ⅛ in. by small pieces of wood. One of these plates is connected to metal top, and the wire from the other passes through the tube, B, which is filled with melted rosin or wax, to make it airtight. This wire connects to one side of a battery of two cells, the other wire being soldered to the metal top of the jar, as shown. The jar is partly filled with a very dilute solution of sulphuric acid, about 20 parts of water to 1 of acid.

When the current of electricity passes between the plates, E, hydrogen gas is generated, which rises and passes through the rubber hose, D, into the receiver, G. This is a wide-mouth bottle, which is filled with water and inverted over a pan of water, F. The gas bubbling up displaces the water and fills the bottle.

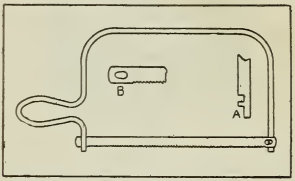
If the receiver is removed when half full of gas, the remaining space will be filled with air, which will mix with the gas and form an explosive mixture. If a lighted match is then held near the mouth of the bottle a sharp report will be heard.

If the bottle is fitted with a cork containing two wires nearly touching, and the apparatus connected with an induction coil, in such a manner that a spark will be produced inside the bottle, the explosion will blow out the cork or possibly break the bottle. Caution should be used to avoid being struck by pieces of flying glass if this experiment is tried, and under no condition should a lighted match or spark be brought near the end of the rubber hose, D, as the presence of a little air in the generator will make an explosive mixture which would probably break the jar.

HOW TO MAKE A CHEAP BRACKET SAW

For the frame use ⅜-in. round iron, bending it as shown in the diagram and filing a knob on each end, at opposite sides to each other, on which to hook the blade.

For the blade an old talking machine spring or a clock spring will do nicely. Heat the spring enough to take some of the temper out of it, in order to drill the holes in the ends, as



Hack Saw Frame and Blade

shown, and file in the teeth. Make the blade 12 in. long, with ten teeth to the inch. A and B show how the blade fits on the frame.—Contributed by Willard J. Hays, Summitville, Ohio.

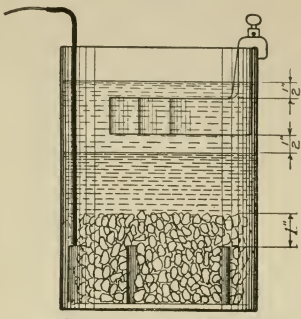
WHY GRAVITY BATTERIES FAIL TO WORK

Many amateur electricians and some professionals have had considerable trouble with gravity batteries. They follow directions carefully and then fail to get good results. The usual trouble is not with the battery itself, but with the circuit. A gravity battery is suitable only for a circuit which is normally closed. It is therefore undesirable for electric bells, induction coils and all other open circuit apparatus. The circuit should also have a high resistance. This makes it impractical for running fan motors, as the motor would have to be wound with fine wire and it would

then require a large number of batteries to give a sufficiently high voltage.

The directions for setting up a gravity battery are as follows: Use about 3½ lbs. of blue stone or enough to cover the copper element one inch. Pour in water sufficient to cover the zinc one-half inch. Short-circuit for three hours and the battery is ready for use. If desired for use immediately do not short-circuit, but add 5 or 6 oz. of zinc sulphate.

Keep the dividing line between the blue



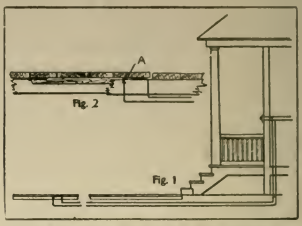
Setting up a Gravity Battery

and white liquids about one-half inch below the bottom of the zinc. If too low syphon off some of the white liquid and add the same amount of water, but do not agitate or mix the two solutions. This type of battery will give about .9 of a volt and should be used on a circuit of about 100 milliamperes.

CALLERS' APPROACH ALARM

This alarm rings so that callers approaching the door may be seen before they ring the bell and one can exercise his pleasure about admitting them—as in the case of agents or beggars; it may not be desirable to see them.

If one has a wooden walk the alarm is easy to fix up. Take up about 5 ft. of the walk and nail it together so as to make a trap door that will work easily. Place a small spring under one end to hold it up about ¼ in. (A, Fig. 2). Nail a strip of tin along the under side of the trap near the spring and fasten another strip on the baseboard, so that they will not touch, save when a weight is on the trap. Connect up an electric bell, putting the batteries and bell anywhere desired, and using rubber-covered wire outside the house, and the alarm is complete.

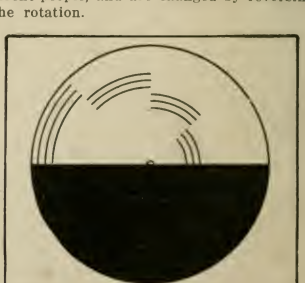


Alarm Rings When Caller Approaches

When any person approaching the house steps on the trap the bell will ring and those in the house can see who it is before the door bell rings.—Contributed by R. S. Jackson, Minneapolis, Minn.

AN OPTICAL TOP

One of the latest optical delusions, and one not easy to explain, is Benham's color top. Cut out the black and white disc shown in the figure, and paste on a piece of stiff cardboard. Trim the edges of the cardboard to match the shape of the disc, and make a pin hole in the center. Cut the pin in half and push through from the under side until the head of the pin touches the cardboard. Spin slowly in a strong light and some of the lines will appear colored. The colors appear different to different people, and are changed by reversing the rotation.

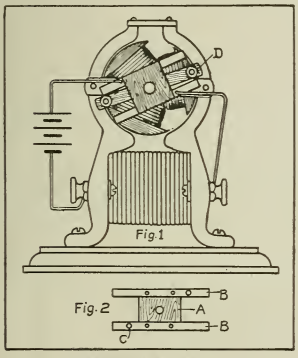


An Optical Top

Amateur Mechanics

DIRECT-CONNECTED REVERSE FOR SMALL MOTORS.

A simple reverse for small motors can be attached directly to the motor as shown in Fig. 1. Fig. 2 shows the construction of the reverse block: A is a strip of walnut ⅝ in. square and ⅜ in. thick with strip of brass or copper (BB) attached as shown. Holes (CC) are drilled for the wire connections and they must be flush with the surface of the block. A hole for a ⅛-in. screw is bored in the block. In Fig. 1, D is a thin strip of walnut or other dense hard wood fitted



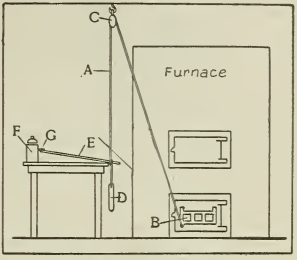
Direct-Connected Reverse.

to the binding-posts of the brush holders, to receive the screw in the center.

Before putting the reverse block on the motor, remove all the connections between the lower binding posts and the brush holders and connect both ends of the field coil to the lower posts. Bend the strips, BB (Fig. 2), to the proper position to make a wiping contact with the nuts holding the strip of wood D, Fig. 1. Put the screw in tight enough to make the block turn a little hard. Connect as shown in the illustration. To reverse, turn the block so the strips change connections and the motor will do the rest. —Contributed by Joseph B. Keil, Marion, Ohio..

ALARM CLOCK TO PULL UP FURNACE DRAFT

A stout cord, A, is attached to the draft, B, of the furnace, run through a pulley, C, in the ceiling and has a window weight, D, attached at the other end. A small stick

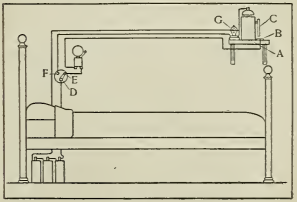


Automatic Time Draft-Opener.

is put through a loop in the cord at about the level of the table top on which the alarm clock, F, stands. The other end of stick, E, is placed under the key, G, of the alarm clock. When the alarm rings in the early morning, the key turns, the stick falls away, releasing the weight, which pulls the draft open.—Contributed by Edward Whitney, 18 Gorham St., Madison, Wis.

HANDY ELECTRIC ALARM

An electric alarm which may be turned off from the bed without one's arising and also having a light which may be turned



Handy Electric Alarm.

on and off from the bed, so one can see the time, is the device of H. E. Redmond, of Burlington, Wis.

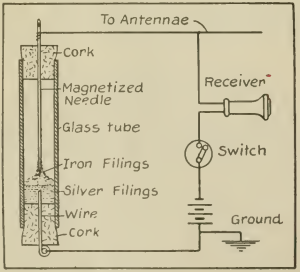
The alarm clock rests on a shelf, A, which has a piece of metal, B, fastened in such a position that the metal rod, C, soldered to the alarm winder, will complete the circuit and ring the bell. The two-point switch, D, is closed normally at E, but may be closed at F any time desired, thus turning on the small incandescent light, G, which illuminates the face of the clock. When the alarm goes off, the bell will continue to ring until the switch is opened.

EASILY MADE WIRELESS COHERER

A good wireless coherer may be made with very little expense, the only materials necessary being a glass tube, two corks, a magnetized needle and a quantity of iron and silver filings. Push a piece of wire through one cork and place in the bottom of the tube, as shown in the sketch.

Pour in the filings and insert the top cork with the needle pushed through from above. The point of the needle should barely touch the filings and by slightly agitating the tube the iron filings will separate from the silver and cling to the magnetized needle, as shown.

In operation the device must stand on end and should be connected in the circuit,



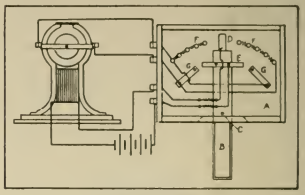
Details of Coherer

as shown in the sketch. When the electrical waves strike the needle the conductivity of the filings is established and a click is heard in the receiver.—Contributed by Carl Formhals, Garfield, Ill.

CONTROLLER FOR A SMALL MOTOR

An easy way of making a controlling and reversing device for small motors is as follows:

Cut a piece of wood (A) about 6 in. by 4½ and ¼ in. thick, and another piece (B) 6 in. by 1 in. and ¼ in. thick. Drive a nail through this near the center for a pivot (C). To the under side of one end nail



Reverse for Motor

a copper brush (D) to extend out about an inch. On the upper side at the same end, nail another brush (E) so that it projects at both sides and is bent down to the level of the end brush. Then on the board put a semi-circle of brass-headed tacks as shown at F, leaving a small space at the middle and placing five tacks on either side, so that the end brush will come in contact with each one. Connect these tacks on the under side of the board with coils of German silver wire, using about 8 in. of wire to each coil. Fix these by soldering or bending over the ends of the tacks. Then nail two strips of copper (G) in such position that the side brush will remain on the one as long as the end brush remains on the tacks on that side.

Put sides about 1½ in. high around this apparatus, raising the board a little from the bottom to allow room for the coil. A lid may be added if desired. Connect up as shown.—Contributed by Chas. H. Boyd, Phila., Pa.

When filling nail holes in yellow pine use beeswax instead of putty, as it matches the color well.

The Boston & Maine Railway is trying peat fuel in one of its locomotives and, it is said, with good results. Maine has vast peat bogs.

Amateur Mechanics

HOW TO MAKE AN AQUARIUM

In making an aquarium, the first thing to decide on is the size. It is well not to attempt building a very large one, as the difficulties increase with the size. An aquarium about 12 in. by 12 in. by 20 in. is a very good size and is inexpensive to build.

First buy one length of ¾-in. by ⅛-in. angle iron for the frame, F, Fig. 1. This can be obtained at any steel shop and should cost about 20 cents. All the horizontal pieces, B, should be beveled 45° at the ends and drilled for ⅜-in. stove bolts. The beveling may be done by roughing out with a hacksaw and finishing with a file. After all the pieces are cut and beveled they should be drilled at the ends for the ⅜-in. stove bolts, C. Drill all the horizontal pieces, B, first and then mark the holes on the upright pieces, A, through the holes already drilled, thus making all the holes coincide. Mark the ends of each piece with a figure or letter, so that when they are assembled, the same ends will come together again. The upright pieces, A, should be countersunk as shown in the detail, and then the frame is ready to assemble.

After the frame has been assembled take

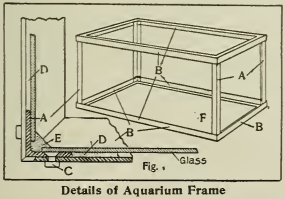


Fig. 1

Details of Aquarium Frame

it to a glazier and have a bottom made of sky-light glass, and sides and ends of double thick window glass. The bottom glass should be a good fit, but the sides and ends should be made slightly shorter to allow the cement, E, to form a dovetail joint as shown. When the glass is put in the frame a space, D, will be found between the glass and the horizontal pieces, B, of the frame. If this were allowed to remain the pressure of the water would spring the glass and cause a leak at E, so it is filled up with plaster of paris.

The cement, E, is made as follows: Take 1 gill of plaster of paris, 1 gill of litharge, 1 gill of fine white sand, and 1-3 of a gill of finely powdered rosin. Mix well and add

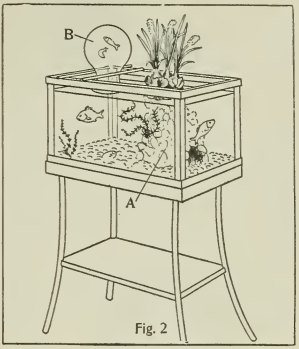


Fig. 2

Aquarium Finished

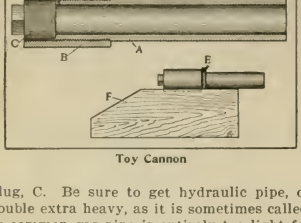
boiled linseed oil and turpentine until as thick as putty. Let the cement dry three or four days before putting any water in the aquarium.

In choosing stock for the aquarium it should be remembered that a sufficient quantity of vegetable life is required to furnish oxygen for the fish. In a well balanced aquarium the water requires renewal only two or three times a year. It is well to have an excess of plants and a number of snails as the snails will devour all the decaying vegetable matter which would otherwise poison the water and kill the fish.

If desired, a centerpiece (A, Fig. 2) can be made of colored stones held together by cement, and an inverted jar can be supported in the position shown at B. If the mouth of the jar is below the surface of the water it will stay filled and allow the fish to swim up inside as shown. Some washed pebbles or gravel should be placed on the bottom, and if desired, a few Chinese lilies or other plants may be placed on the centerpiece.

HOW TO MAKE A CANNON

A cannon, like the one in the cut, can be made from a piece of 1-in. hydraulic pipe, A, with a steel sleeve, B, and a long thread



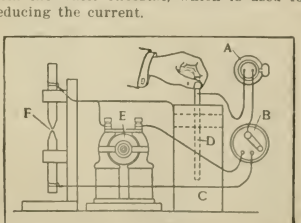
Toy Cannon

plug, C. Be sure to get hydraulic pipe, or double extra heavy, as it is sometimes called, as common gas pipe is entirely too light for this purpose. Don't have the pipe too long, or the cannon will not make as much noise. Seven or eight inches is about the right length for a 1-in. bore. Screw the plug and pipe up tightly and then drill a $\frac{1}{16}$-in. fuse hole at D.

If desired the cannon may be mounted on a block of wood, F, by means of a U-bolt or large staple, E.—Contributed by Carson Birkhead, Moorhead, Miss.

EASY EXPERIMENTS WITH ELECTRIC LIGHT CIRCUIT

An electric light circuit will be found much less expensive than batteries for performing electrical experiments. The sketch shows how a small arc light and motor can be connected to the light socket, A. The light is removed and a plug with wire connections is put in its place. One wire runs to the switch, B, and the other connects with the water rheostat, which is used for reducing the current.



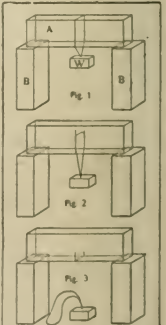
Arc Light Motor and Water Rheostat

A tin can, C, is filled nearly to the top with salt water and a metal rod, D, is passed through a piece of wood fastened at the top of the can. When the metal rod is lowered the current increases and as it is withdrawn the current grows weaker. In this way the desired amount of current can be obtained.

By connecting the motor, E, and the arc light, F, as shown, either one may be operated by turning switch B to the corresponding point. The arc light can be easily made by fastening two electric-light carbons in a wooden frame like that shown. To start the light, turn the current on strong and bring the points of the carbons together; then separate slightly by twisting the upper carbon and at the same time drawing it through the hole.

PECULIAR PROPERTIES OF ICE

Of all the boys who make snowballs probably few know what occurs during the process. Under ordinary conditions water turns to ice when the temperature falls to 32°, but when in motion, or under pressure, much lower temperatures are required to make it a solid. In the same way, ice which is somewhat below the freezing point can be made liquid by applying pressure, and will remain liquid until the pressure is removed, when it will again return to its original state. Snow being simply finely divided ice, becomes liquid in places when compressed by the hands, and when the pressure is removed the liquid portions solidify and unite all the particles in one mass. In extremely cold weather it is almost impossible to make a snowball, because a greater amount of pressure is then required to make the snow liquid.



Experiment with a Block of Ice

This process of melting and freezing under different pressures and a constant temperature can be better illustrated by the experiment shown in Figs. 1, 2 and 3. A block of ice, A, Fig. 1, is supported at each

end by boxes BB, and a weight, W, is hung on a wire loop which passes around the ice as shown. The pressure of the wire will then melt the ice and allow the wire to sink down through the ice as shown in Fig. 2. The wire will continue to cut its way through the ice until it passes all the way through the piece, as shown in Fig. 3. This experiment not only illustrates how ice melts under pressure, but also how it solidifies when the pressure is removed, for the block will still be left in one piece after the wire has passed through.

Another peculiar property of ice is its tendency to flow. It may seem strange that ice should flow like water, but the glaciers of Switzerland and other countries are literally rivers of ice. The snow which accumulates on the mountains in vast quantities is turned to ice as a result of the enormous pressure caused by its own weight, and flows through the natural channels it has made in the rock until it reaches the valley below. In flowing through these channels it frequently passes around bends, and when two branches come together the bodies of ice unite the same as water would under the same conditions. The rate of flow is often very slow; sometimes only one or two feet a day, but no matter how slow the motion may be the large body of ice has to bend in moving.

This property of ice is hard to illustrate with the substance itself, but may be clearly shown by sealing-wax, which resembles ice in this respect. Any attempt to bend a piece of cold sealing-wax with the hands results in breaking it, but by placing it between books as shown on page 8, or supporting it in some similar way it will gradually change from the original shape A, and assume the shape shown at B.

SPIT TURNED BY WATER POWER

Many of the Bulgarian peasants do their cooking in the open air over bonfires. The American Artisan describes a labor-saving machine in use which enables the cook to

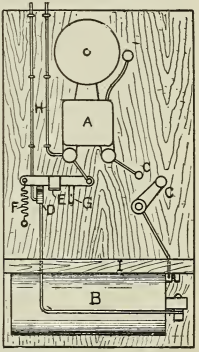
For a Summer Camp

go away and leave meat roasting for an hour at a time. The illustration shows how the spit to which the meat is fastened is constantly turned by means of a slowly moving water wheel. Some of our readers may wish to try the scheme when camping out. The success depends upon a slow current, for a fast turning wheel will burn the meat.

COMBINED DOOR BELL AND ELECTRIC ALARM

This device consists of a battery and bell connection to an alarm clock and also acts as a door bell, the whole being mounted on a board 18 in. long and 12 in. wide.

Referring to the sketch, the letters indicate as follows: A, bell; B, battery; C, switch; D, V-shaped copper strip; E, copper lever with 1-in. flange turned on one side; whole length, 4 in.; F, spring to throw lever, E, down in V-shaped piece to make connection; G, lever to hold out E when device is used as a door bell; dotted lines, H, go, one from bell, A, and one from battery, B, to the door; I, shelf for clock.



Door Bell and Alarm Combined

See that the ring in the alarm key of the clock works easily, so that when it is square across the clock it will drop down. Fasten a piece of copper about 1 in. long to key, then wind the alarm just enough so that the key stands straight up and down. Place the clock on the shelf and the key under the flange of lever, E. Pull lever, G, down out of the way and close the lever on the switch. The alarm key will turn and drop down, letting lever, E, drop into the V-shaped piece, D, and make connection.

For the door bell connection close lever on switch, C, and put G up so that D and E do not come in contact. If any one is ill and you do not want the bell to ring, open switch, C.

The wiring for this device may all be on

the back of the board. The switch and levers are fastened with small screw bolts, which allows wiring at the back. Saw two spools in half and fasten the halves to the four corners of the board at the back and the apparatus can be put up where one likes.

HOW TO MAKE A TELEGRAPH KEY AND SOUNDER

The sounder, Fig. 1, is made from an old electric bell magnet, D, fastened to a wooden base. The lever, A, can be made

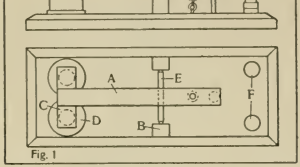


Fig. 1

SOUNDER—A, brass; B, wood; C, soft iron; DD, coils wound with No. 26 wire; E, nail soldered on A; FF, binding posts; H, spring.

of brass and the armature, C, is made of iron. The pivot, E, is made from a wire nail and is soldered to A. It should be filed to a point at each end so as to move freely in the bearings, B, which are pieces of hard wood.

The spring, H, is fastened at each end by pins, bent as shown, and should not be too strong or the magnet will be unable to move the armature. The stop, K, is a wire nail driven deep enough in the base to leave about ⅛ in. between the armature and the

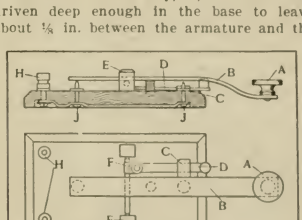


Fig. 2

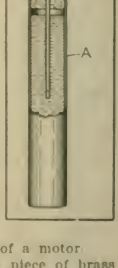
KEY—A, wood; B, brass or iron soldered to nail; C, brass; D, brass; E, wood; F, connection of D to nail; HH, binding posts.

magnet. The binding posts, F, can be taken from old dry batteries and are connected to the two wires from the magnet by wires run in grooves cut in the base.

The base of the key, Fig. 2, is also made of wood and has two wooden bearings, E, which are made to receive a pivot, similar to the one used in the sounder. The lever of the key is made of brass and has a hardwood knob, A, fastened near the end. A switch, D, connects with the pivot at F and can be either made from sheet brass, or taken from a small one-point switch. The binding posts are like those of the sounder, and are connected to the contacts, K, by wires run in grooves cut in the wood.

HOW TO MAKE A WATER RHEOSTAT

A water rheostat may be made by fitting a brass tube with a cork, through which a piece of wire is passed. The brass tube may be an old bicycle hand pump, A (see sketch), filled with water. Pushing the wire, B, down into the water increases the surface in contact, and thus decreases the resistance. An apparatus of this kind is suitable for regulating the current from an induction coil, or when the coil is not provided with a regulator, and by using a piece of pipe instead of the tube, it can be used to regulate the speed of a motor.



For Regulating Current of Induction Coil or Speed of Motor

When the pipe is used, a piece of brass or copper rod should be substituted for the wire, in order to increase the surface. Adding salt to the water will decrease the resistance, and, when used with a motor, will give a greater speed.—Contributed by John Koehler, Ridgewood, N. J.

To prevent water colors from crawling, says the Master Painter, add a few drops of ammonia or lime water, or a solution of sal soda.

Amateur Mechanics

ALARM CLOCK CHICKEN FEEDER

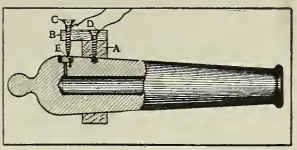
An automatic hen feeder, which will discharge the necessary amount of corn or other feed at any desired time, can be made by using an alarm clock as shown in the sketch. A small wire trigger rests on the winding key and supports the swinging bottom of the food hopper by means of a piece of string which connects the two. When the alarm goes off the trigger drops and allows the door to open, thus discharging the contents of the hopper.

After the device has been in operation for some time the hens will run to the feeder whenever the bell rings.—Contributed by Dr. H. A. Dobson, Washington, D. C.

HOW TO DISCHARGE A TOY CANNON BY ELECTRICITY

A device for discharging a toy cannon by electricity can be easily made by using three or four dry batteries, a switch and a small induction coil capable of giving an ⅛-in. spark. Fasten a piece of wood, A, to the cannon, by means of machine screws or, if there are no trunnions on the cannon, the wood can be made in the shape of a ring and slipped on over the muzzle. The fuse hole of the cannon is counterbored as shown and a small hole is drilled at one side to receive a small piece of copper wire, E. The wood screw, C, nearly touches E and is connected to one binding-post of the induction coil. The other binding-post is connected with the wood screw, D, which conducts the current into the cannon, and also holds the pieces of wood, A and B, in position.

When the cannon is loaded, a small quantity of powder is placed in the counterbore, and the spark between C and E ignites this and discharges the cannon. A cannon may be fired from a distance in this way, and as there is no danger of any spark remaining after the current is shut off, it is safer than the ordinary cannon which is fired by means of a fuse.—Contributed by Henry Peck, Big Rapids, Mich.

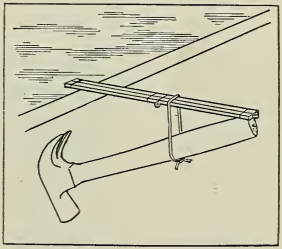


Electrical Attachment for Discharging Toy Cannon

EXPERIMENT WITH TWO-FOOT RULE AND HAMMER

An example of unstable equilibrium is shown in the accompanying sketch. All that is needed is a two-foot rule, a hammer, a piece of string, and a table or bench. The experiment works best with a hammer having a light handle and a very heavy head.

Tie the ends of the string together, forming a loop, and pass around the hammer handle and rule. Then place the apparatus on the edge of the table, where it will remain suspended as shown in the sketch.—Contributed by Geo. P. Schmidt, Culebra, Porto Rico, W. I.

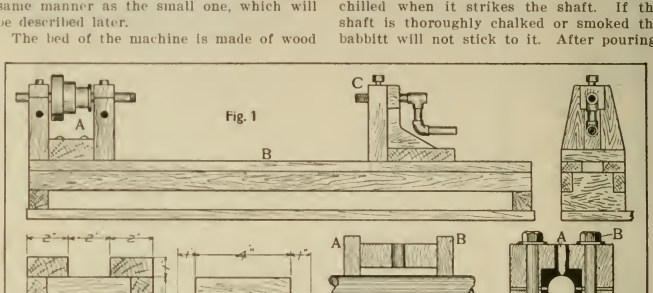


Equilibrium Experiment With Hammer and Rule

HOW TO MAKE A LATHE

A small speed-lathe, suitable for turning wood or small metal articles, can be easily made at very little expense. A lathe of this kind is shown in the cut (Fig. 1), where A is the head stock, B the bed and C the tail stock. I run my lathe by power, using an electric motor and counter shaft, but it could be run by foot power if desired. A large cone pulley would then be required, but this could be made in the same manner as the small one, which will be described later.

The bed of the machine is made of wood as shown in Figs. 2 and 3, hard wood being preferable for this purpose. Fig. 2 shows an end view of the assembled bed and Fig. 3 shows how the ends are cut out to receive the side pieces.

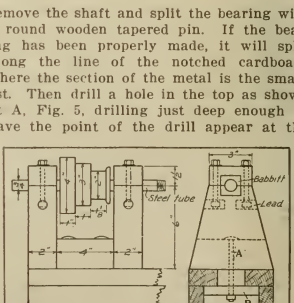


Assembled Lathe Bed and Bearing Details

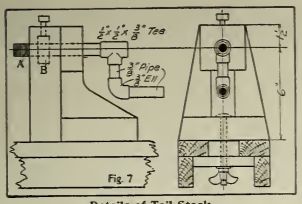
The head stock, Fig. 6, is fastened to the bed by means of carriage bolts, A, which pass through a piece of wood, B, on the under side of the bed. The shaft is made of ¾-in. steel tubing about ¼-in. thick, and runs in babbitt bearings, one of which is shown in Fig. 5.

To make these bearings, cut a square hole in the wood as shown, making half of the square in each half of the bearing. Separate the two halves of the bearing slightly by placing a piece of cardboard on each side, just touching the shaft. The edges which touch the shaft should be notched like the teeth of a saw, so as to allow the babbitt to run into the lower half of the bearing. The notches for this purpose may be about ⅛ in. pitch and ⅛ in. deep. Place pieces of wood against the ends of the bearing as shown at A and B, Fig. 4, and drill a hole in the top of the bearing as shown in Fig. 4.

The bearing is then ready to be poured. Heat the babbitt well but not hot enough to burn it and it is well to have the shaft hot, too, so that the babbitt will not be chilled when it strikes the shaft. If the shaft is thoroughly chalked or smoked the babbitt will not stick to it. After pouring, remove the shaft and split the bearing with a round wooden tapered pin. If the bearing has been properly made, it will split along the line of the notched cardboard where the section of the metal is the smallest. Then drill a hole in the top as shown at A, Fig. 5, drilling just deep enough to have the point of the drill appear at the



Head Stock Details



Details of Tail Stock

lower side. This cavity acts as an oil cup and prevents the bearing from running dry.

The bolts, B (Fig. 5), are passed through holes in the wood and screwed into nuts, C, which are let into holes, D, the holes afterwards being filled with melted lead.

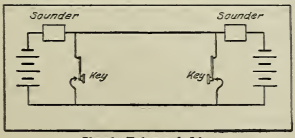
This type of bearing will be found very satisfactory and might be used to advantage on other machines. After the bearings are completed the cone pulley can be placed on the shaft. To make this pulley cut three circular pieces of wood to the dimensions given in Fig. 6 and fasten these together with nails and glue. If not perfectly true, they may be turned up after assembling, by rigging up a temporary tool rest in front of the head stock.

The tail stock (Fig. 7), is fastened to the bed in the same manner as the head stock, except that thumb nuts are used on the carriage bolts, thus allowing the tail stock to be shifted when necessary. The mechanism of the center holder is obtained by using a ½-in. pipe, A, and a ½-in. lock nut, B, embedded in the wood.

I found that a wooden tool rest was not satisfactory, so I had to buy one, but they are inexpensive and much handier than home-made tool rests.—Contributed by Donald Reeves, 6453 Iowa St., Oak Park, Ill.

SIMPLE OPEN-CIRCUIT TELEGRAPH LINE

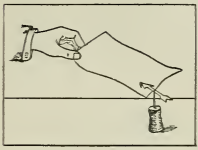
By using the circuit shown in the sketch for short-distance telegraph lines, the extra switches and wiring found in many circuits are done away with. Closing either key will operate both sounders, and as the resistance of the sounders is very high the batteries do not run down for a long time. —Contributed by A. D. Stoddard, Clay Center, Kan.



Simple Telegraph Line

HOW TO MAKE AN ELECTROSCOPE

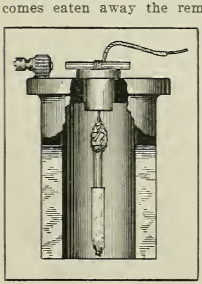
An electroscope for detecting electrified bodies can be made out of a piece of note paper, a cork, and a needle. Push the needle in the cork, and cut the paper in the shape of a small arrow. Balance the arrow on the needle as shown in the sketch, and the instrument will then be complete.



If a piece of paper is then heated over a lamp or stove and rubbed with a piece of cloth or a small broom, the arrow will turn when the paper is brought near it.—Contributed by Wm. W. Grant, 68 Kaye St., Halifax, N. S., Canada.

TO USE OLD BATTERY ZINCS

When the lower half of a battery zinc becomes eaten away the remaining part can be used again by suspending it from a wire as shown in the cut. Be sure and have a good connection at the zinc binding-post and cover same with melted paraffin. This prevents corrosion which would otherwise occur from the action of the sal ammoniac or other chemical. The wire may be held at the top by twisting around a piece of wood or by driving a peg through the hole in the porcelain insulator.—Contributed by Louis Lauderbach, 174 N. 7th St., Newark, N. J.



AN OPTICAL ILLUSION

The accompanying illustration shows a perfectly straight boxwood rule laid over a number of turned brass rings of various sizes. Although the effect in the illustration is less pronounced than it was in reality, it will be noticed that the rule appears to be bent, but sighting along the rule from one end will show that it is perfectly straight.

The brass rings also appear distorted. The portions on one side of the rule do not appear to be a continuation of those on the other, but this can be proved by sighting in the same manner as before.—Contributed by Draughtsman, Chicago.

A SIMPLE ACCELEROMETER

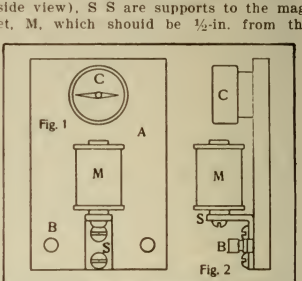
A simple accelerometer for indicating the increase in speed of a train, was described by Mr. A. F. Trotter in a paper read before the Junior Institution of Engineers of Great Britain. The device consists of an ordinary 2-ft. rule, A, with a piece of thread tied to the 22-in. mark, as shown in the sketch, and supporting the small weight, B, which can be a button or other small object.

The device thus arranged and placed on the window sill of the car, will indicate the acceleration and retardation as follows: Every ½ in. traveled by the thread, over the bent portion of the rule, indicates an increase of or decrease of velocity to the extent of 1 ft. per second for each second. Thus if the thread moved 2¼ in. in a direction opposite to the movement of the train, then the train would be increasing its speed at the rate of 4½ ft. per second.

If the thread is tied at the 17-in. mark, then each half inch will represent the miles per hour increase for each second. Thus if the thread moves one inch, it shows that the train is gaining 2 miles an hour each second.

HOW TO MAKE A GALVANOSCOPE

To make a galvanoscope for detecting small currents of electricity, a magnet, M; compass, C; two binding-posts, B B, and a base, A, of wood, all as shown in Fig. 1 (top view), will be required. In Fig. 2 (side view), S S are supports to the magnet, M, which should be ½-in. from the



For Detecting Small Currents

compass, C. This galvanoscope will detect the weakest current.—Contributed by John H. Jensen, 2537 N. Chadwick St., Philadelphia, Pa.

ANTIDOTE FOR SQUIRREL PEST

To the owner of a garden in a town where squirrels are protected by law, life in the summer time is a vexation. First the squirrels dig up the sweet corn and two or three replantings are necessary. When the corn is within two or three days of being suitable for cooking, the squirrels come in droves from far and near. They eat all they can and carry away the rest. When the corn is gone cucumbers, cabbages, etc., share the same fate, being partly eaten into. At the risk of being arrested for killing the squirrels I have used a small target rifle morning and night, but during my absence the devastation went on steadily. Last year they destroyed my entire corn crop. Traps do no good; can't use poison, too dangerous. But I have solved the difficulty; it's easy.

Shake cayenne pepper over the various vegetables which are being ruined, and observe results.

Amateur Mechanics

Foundry Work at Home

Part I--The Equipment

Many amateur mechanics, who require small metal castings in their work, would like to make their own castings. This can easily be done at home without going to any great expense and the variety and usefulness of the articles produced will make the equipment a good investment.

With the easily made devices about to be described, the young mechanic can make his own telegraph keys and sounders, battery zincs, binding-posts, engines, cannons, bearings, small machinery parts, models and miniature objects, ornaments of various kinds and duplicates of all these and many other interesting and useful articles.

The first thing to make is a molding bench, as shown in Fig. 1. It is possible to make molds without a bench, but it is a mistake to try to do this as the sand is sure to get on the floor, whence it is soon tracked into the house. The bench will also make the operation of molding much easier and will prove to be a great convenience.

The bench should be made of lumber about 1 in. thick and should be constructed in the form of a trough, as shown. Two cleats, AA, should be nailed to the front and back to support the cross-boards, BB, which in turn support the mold while it is being made. The object of using the cleats and removable cross-boards instead of a stationary shelf is to give access to the sand, C, when it is being prepared.

About one or two cubic feet of fine molding sand will be required, which may be purchased at the nearest foundry for a small sum. Yellow sand will be found a little better for the amateur's work than the black sand generally used in most foundries, but

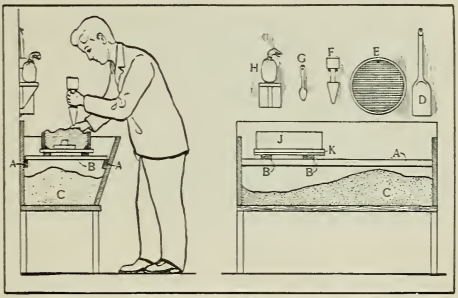


Fig. 1--Convenient Arrangement of Bench and Tools

if no yellow sand can be obtained the black kind will do. If there is no foundry near at hand, try using sand from other sources, giving preference to the finest sand and that which clings together in a cake, when compressed between the hands. Common lake or river sand is not suitable for the purpose, as it is too coarse and will not make a good mold.

For mixing and preparing the sand a small shovel, D, and a sieve, E, will be required. If desired the sieve can be home-made. Ordinary wire netting, such as is used in screen doors, is about the right mesh and this, nailed to replace the bottom of a box, makes a very good sieve.

The rammer, F, is made of wood and is wedge-shaped at one end and

flat at the other, as shown. In foundries each molder generally uses two rammers, but for the small work which will be described, one will be sufficient. An old teaspoon, G, will be found useful in the molding operations and may be hung on the wall or other convenient place when not in use.

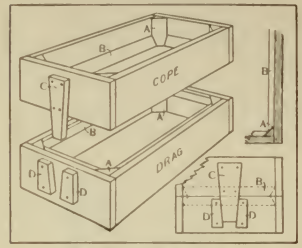


Fig. 2—Home-Made Flask

The cloth bag, H, which can be made of a knotted stocking, is filled with coal dust, which is used for a parting medium in making the molds. Take a small lump of soft coal and reduce to powder by pounding. Screen out all the coarse pieces and put the remainder in the bag. A slight shake of the bag over the mold will then cause a cloud of coal dust to fall on it, thus preventing the two layers of sand from sticking, but this operation will be described more fully in a subsequent chapter.

The flask, J, Fig. 1, is shown more clearly in Fig. 2. It is made of wood and is in two halves, the "cope" or upper half and the "drag" or lower part. A good way to make the flask is to take a box, say 12 in. by 8 in. by 6 in. high and saw it in half longitudinally, as shown. If the box is not very strong, the corners should be braced with triangular wooden strips, AA, which should be nailed in, previous to sawing. The wooden strips, BB, are used to hold the sand, which would otherwise slide out of the flask when the two halves of the mold are separated.

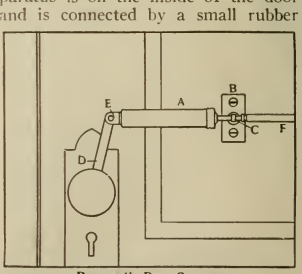
The dowels, CC, are a very important part of the flask as upon them depends the matching of the two halves of the mold. A wedge-shaped piece, CC, is nailed to each end of the cope and the lower pieces, DD, are then nailed on the drag so that they just touch C when the flask is closed. The two halves of the flask will then occupy exactly the same relative position whenever they are put together.

After the flask is done make two boards as shown at K, Fig. 1, a little larger than the outside of the flask. A couple of cleats nailed to each board will make it easier to pick up the mold when it is on the floor.

A cast-iron glue pot makes a very good crucible for melting the metal, which can be either aluminum, white metal, zinc or any other metal having a low melting point. This completes the equipment with the exception of one or two simple devices which will be described under "molding" in the next number.

Home-Made Pneumatic Lock

Mount an old bicycle hand-pump, A, on the door by means of a metal plate, B, having a swinging connection at C. Fasten the lever, D, to the door knob and make a hinge connection with the pump by means of a piece of sheet brass, E, soldered to the end of the cylinder. All this apparatus is on the inside of the door and is connected by a small rubber



Pneumatic Door Opener

tube, F, to a secret mouthpiece placed at some convenient location. A small piece of spring brass, screwed to the door frame, will open the door about ½ in. when the operator blows in the mouthpiece, or if the door is within reach of the mouthpiece, the operator can push the door at the same time that he blows, thus doing away with the spring, which is only used to keep the door from relocking.

One way of making the air connection with the outside is to bend the tube, F, around and stick it through the keyhole. Few burglars would ever think to blow in the keyhole.—Contributed by Orton E. White, 1740 Main St., Buffalo, N. Y.

HOW TO MAKE A PADDLE BOAT

A rowboat has several disadvantages. The operation of the oars is both tiresome and uninteresting and the oarsman is obliged to travel backwards. By replacing the oars with paddles, as shown in the illustration, the operator can see where he is going and enjoy the exercise much better than with oars. He can easily steer the boat with his feet, by means of a pivoted stick in the bottom of the boat, connected by cords to the rudder.

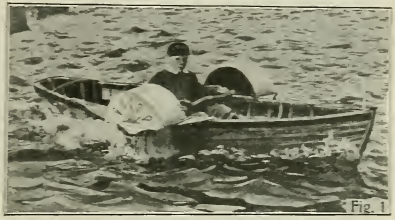


Fig. 1

Paddle Boat in Operation

At the blacksmith shop have a ⅝-in. shaft made, as shown at A, Fig. 2. It will be necessary to furnish a sketch giving all the dimensions of the shaft, which should be designed to suit the dimensions of the boat, taking care that sufficient clearance is allowed, so that the cranks in revolving will not strike the operator's knees. If desired, split-wood handles may be placed on the cranks, to prevent them from rubbing the hands.

The bearings, B, can be made of hard wood, but preferably of iron pipe filled with melted babbitt. If babbitt is used, either thoroughly smoke or chalk the shaft or wrap paper around it to prevent the babbitt sticking. The pieces of pipe may be then fastened to the boat by means of small pipe straps, such as may be obtained at any plumber's at a very small cost.

The hubs, C, should be made of wood, drilled to fit the shaft and mortised out to hold the paddles, D. The covers, E, may be constructed of thin wood or galvanized iron and should be braced by triangular boards, as shown in Fig. 1. If galvanized iron

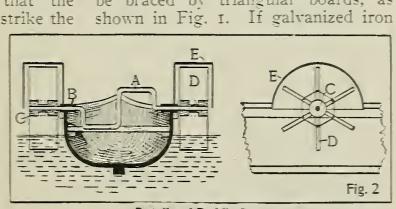


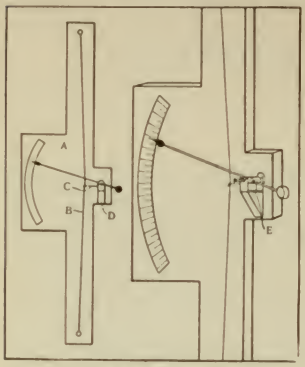
Fig. 2

Details of Paddle Boat

is used it should be exposed to the weather two or three months before painting or the paint will come off, spoiling its appearance.

How to Make a Hygrometer

A home-made hygrometer, for determining the degree of moisture in the atmosphere, is shown in the accompanying sketch and consists of a board, A, with a nail at each end to



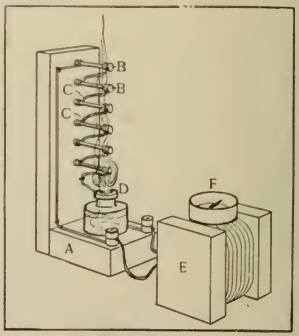
The Hygrometer

hold the silk thread, B. A second piece of silk thread, C, is tied to the center of B and connects with an indicating hand or pointer supported by the bracket, D. The axle on which the pointer revolves consists of a piece of round wood, about the size of a lead pencil, with a pin driven in each end. A piece of tin, E, is cut V-shaped at each end and bent up at the ends to form bearings for the pins. The silk thread, C, is fastened to the wooden axle and is wrapped one or two turns around it, so that when the thread is pulled the pointer will move on the scale. It will be noticed that the thread, B, is not perfectly straight but bends toward D. For this reason a very small shrinkage of B, such as occurs when the atmosphere is dry, will cause an increased movement of C, which will be further increased in the movement of the pointer. An instrument of this kind is very interesting and costs nothing to make.—Contributed by Reader, Denver.

How to Make a Thermo Battery

A thermo battery, for producing electricity direct from heat, can be made of a wooden frame, A, with a number of nails, B, driven in the vertical piece and connected in series with heavy copper wires, C. The connections should all be soldered to give good results, as the voltage is very low and the resistance of an unsoldered joint would stop the current.

The heat may be supplied by an alcohol lamp or other device and the current may then be detected by means of a simple galvanometer consisting of a square spool of No. 14 or 16 single-covered wire, E, with a pocket compass, F, placed on top. Turn the spool in a north and south direction or parallel with the compass needle. Then when the nail heads



Thermo Battery

are heated and the circuit completed the needle will swing around it at right angles to the coils of wire. Applying ice or cold water to the nail heads will reverse the current.—Contributed by A. C. A., Chicago.

Amateur Mechanics

FOUNDRY WORK AT HOME

Part II—How to Make a Mold

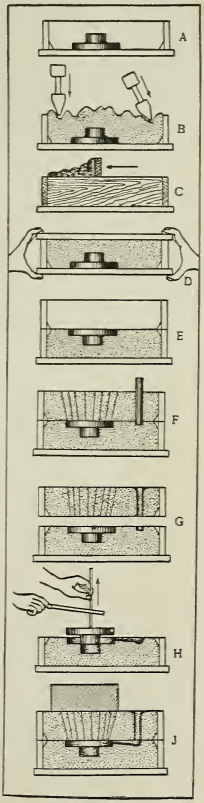
Having finished making the flask and other equipment, as described in a previous chapter, everything will be ready for the operation of molding. It would be well for those who have never had any experience in this line, to visit a small brass foundry, where they can watch the molders at work, as it is much easier to learn by observation; but they must not expect to make a good mold at the first trial. The first attempt usually results in the sand dropping out of the cope when it is being lifted from the drag, either because of insufficient ramming around the edges or because the sand is too dry.

A good way to tell when the sand is moist enough is to squeeze it in the hand. If it forms into a cake and shows all the finger marks it has a sufficient amount of moisture, but if it fails to cake and crumbles up it is too dry. An ordinary watering pot will be found useful in moistening the sand, but care should be taken not to get it too wet, or the hot metal coming in contact with it when the mold is poured will cause such rapid evaporation that the mold will "boil" and make a poor casting. A little practice in this operation will soon enable the molder to determine the correct amount of moisture.

When molding with sand for the first time it will be necessary to screen it all before using it, in order to remove the lumps, and if water is added the sand should be thoroughly shoveled until the moisture is evenly distributed. The sand is then ready for molding.

The operation of making a mold is as follows: The lower half of the flask, or "drag," and the pattern to be molded are both placed on the cover board as shown at A. A quantity of sand sufficient to completely cover the pattern is then sifted into the drag, which is then filled level with the top with unscreened sand. This is rammed down slightly with the rammer and then more sand is added until it becomes heaped up as shown at B. It is then rammed again as before.

It is impossible to describe just how hard a mold should be rammed, but by observing the results the beginner can tell when a mold is too hard or too soft and thus judge for himself. If the sand falls out of the flask when lifting the cope, or if it opens



Making a Mold

up or spreads after it is poured, it shows that the mold has been rammed too little, and if the surface of the sand next to the pattern is cracked it shows that the mold has been rammed too hard. It will be found that the edges of the mold can stand a little more ramming than the middle. In finishing the ramming, pound evenly all over the surface with the blunt end of the rammer.

After ramming, scrape off the surplus sand with a straight-edged stick, as shown at C, and scatter about ¼ in. of loose sand over the surface for a good bearing. Place another cover board on top, as shown at D, and by grasping with both hands, as shown, turn the drag other side up. Remove the upper cover board and place the upper half of the flask, or "cope," in position, as shown at E.

In order to prevent the two layers of sand sticking together, the surface of the sand at E should be covered with coal dust. This is done by shaking the coal dust bag over the flask, after which the dust on the pattern may be removed by blowing. The cope is then filled with sand and rammed in exactly the same manner as the drag.

After the ramming is done a number of vent holes are made, as shown at F, from the surface of the mold to the pattern, in order to allow the escape of air and steam when the mold is being poured. These vent holes may be made by pushing a wire about the size of a knitting needle down through the sand until it touches the pattern. The "sprue," or pouring-hole, is next cut, by means of the sprue cutter shown at the right, which consists of a piece of thin brass or steel tubing about ¾ in. in diameter.

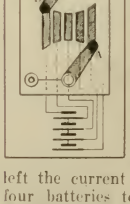
Now comes the critical part of the molding operation—that of lifting the cope from the drag. It is here that the amateur often becomes discouraged, as the sand is liable to fall out of the cope and spoil the mold, but with a little practice and patience the molder can lift the cope every time without breaking it, as shown at G.

The next operation is that of cutting the gate, which carries the molten metal from the sprue to the opening left by the pattern. This is done with a spoon, a channel being cut about ¾ in. wide and about ¼ in. deep. The pattern is then drawn from the mold, as shown at H, by driving a sharp-pointed steel rod into the pattern and lifting it from the sand. When a metal pattern is used a thread rod is used, which is screwed into a tapped hole in the pattern. Before drawing it is well to tap the drawing-rod lightly with another larger rod, striking it in all directions and thus loosening the sand slightly from the pattern. Some molders tap the pattern gently when withdrawing, as shown at H, in order to loosen any sand which has a tendency to stick.

After drawing the pattern, place the cope back on the drag, as shown at J. Place a brick or other flat, heavy object on top of the mold above the pattern, to prevent the pressure of the melted metal separating the two halves of the mold, and then pour. The operations of melting and pouring will be described in the next chapter.

Battery Switch

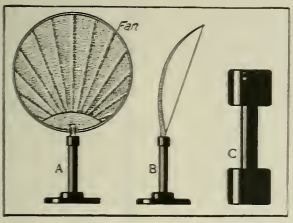
In cases where batteries are used in series and it is desirable to change the strength and direction of the current frequently, the following device will be found most convenient. In my own case I used four batteries, but any reasonable number can be used. Referring to the figure, it will be seen that by moving the switch, A, toward the left the current can be reduced from four batteries to none, and then by moving the switch, B, toward the right the current can be turned on in the opposite direction to the desired



strength. In the various positions of these two switches the current from each individual cell, or from any adjacent pair of cells, may be used in either direction.—Contributed by Harold S. Morton, 3851 Lyndale Ave. North, Minneapolis, Minn.

More Uses for Pipe Fittings

It seems that the number of useful articles that can be made from pipes



Lamp Shade and Dumb Bell Made from Pipe Fittings

and fittings is unlimited. The sketch shows two more that may be added to the list. A and B are front and side views of a lamp screen and C is a dumbbell. The lamp shade is particularly useful for shading the eyes when reading or writing and, if enameled white on the concave side, makes an excellent reflector for drawing at night, or for microscopic work.

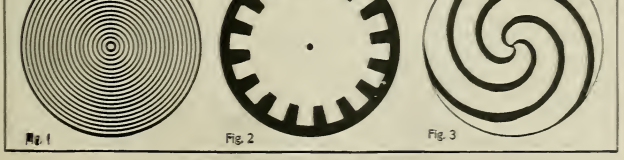
The standard and base, which consists of an ordinary pipe flange bushed down to receive the upright nipple, are enameled a jet black, and if the device is to be used on a polished table, a piece of felt should be glued to the bottom. A good way to hold the fan in the nipple consists in using a small wedge.

The dumbbells are made of short pieces of ¾-in. pipe with 1½-in. couplings fastened to each end by pouring melted lead in the space between the pipes and the couplings. The appearance is greatly improved by enameling black, and if desired the handles may be covered with leather.—Contributed by C. E. Warren, M. D., North Easton, Mass.

Optical Illusions

By giving the page a revolving or rinsing motion the figures appear to rotate. The best effect will be produced by laying the book down flat on the desk or table and revolving, first in one direction and then in the opposite direction, in such a way that any given point on the page will describe a circle of about ½ in. diameter. Fig. 1 then appears to rotate in the same direction as the revolution; Fig. 2 appears to revolve in the opposite direction, and Fig. 3 appears to revolve sometimes in the same direction and at other times in the opposite direction.

A curious effect can be produced with Fig. 1 by covering up Figs. 2 and 3 with a piece of plain paper and laying



Move Rapidly with a Rinsing Motion

a coin or other small object on the paper. If the vision is then concentrated on the coin or other object while same is being revolved, Fig. 1 will be seen to rotate.

A Home-Made Telephone Receiver

A telephone receiver that will do good work and which may be built very cheaply, can be made as follows: For the case use an ordinary ½-lb. baking powder box with a piece of heavy wire soldered on the inside, 1⅞ in. from the bottom. For the magnet use a piece of round hardened steel about ⅜ in. in diameter and 1¼ in. long. If desired, a piece of an old round file may be used for the magnet core, which should be magnetized previous to assembling, either by passing a current of electricity around it, or by direct contact with another magnet. The steel core should be wound with about 250 ft. of No. 36 insulated wire, the ends of which should be soldered to a piece of lamp cord, passed through a hole in the bottom of the can and knotted inside to prevent pulling out.

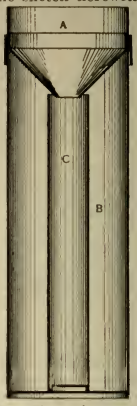
A disc of thin sheet-iron, such as is used by photographers for tintypes (Ferrotype), should be cut to the diameter of the can, taking care not to bend the iron. The magnet should then be placed in the bottom of the can in an upright position and enough of a melted mixture of beeswax and resin poured in to hold it in position.

While the wax is still in a plastic condition the magnet should be located centrally and adjusted so that the end will be ⅛ in. or less below the level of the top of the copper ring.

After the wax has hardened the disc is slipped in and fastened tightly by a ring of solder when the instrument is ready for use

How to Make a Rain Gauge

An accurate rain gauge may be easily constructed from galvanized iron, as shown in the sketch herewith. The funnel, A, overlaps and rests on the body, B, and discharges into the tube, C, the area of which is 1/10 that of the top of the funnel. The depth of the water in C is thus ten times the actual rainfall, so that by measuring it with a stick marked off in tenths of an inch, we obtain the result in hundredths of an inch.



A good size to make the rain gauge is as follows: A, 8 in. diameter; C, 2 53/100 in.; length of C, about 20 in. It should be placed in an exposed location, so that no inaccuracy will occur from wind currents. To find the fall of snow, pour a known quantity of warm water on the snow contained in the funnel and deduct the quantity poured in from the total amount in the tube.—Contributed by Thurston Hendrickson, Long Branch, N. J.

An experienced photographer uses blacklead for grooves about a camera or holder. A small quantity is rubbed well into the grooves and on the edges of shutters that refuse to slide easily with gratifying results. Care must be taken to allow no dust to settle in the holders, however.

The Colorado river broke its banks again December 9 and the Salton sea is rising once more, reminding one of Mulligan's "off again; on again; off again."

Amateur Mechanics

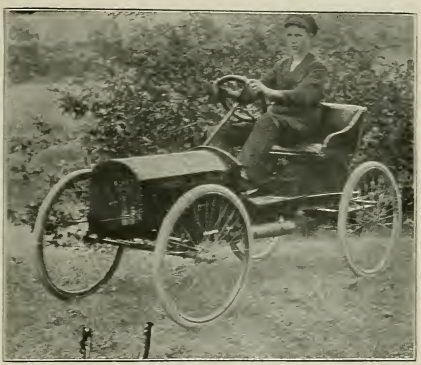
Young Mechanic Builds Successful Auto

The building of a small runabout is not such a difficult problem as would be imagined by those who have never tried it. All the machine work on mine was done on a small foot-power lathe, and the wheels, sprockets, hubs and other parts were taken from bicycle and motorcycle fittings.

The engine is of the 4-cycle type and was modeled after an ordinary motorcycle engine. The crank case is enclosed and made in two pieces with a longitudinal joint and a bearing in each half. Enclosed in the crank case are two flywheels, connected by a small pin, which is used for the crank pin. A small pulley on the engine shaft is connected to a larger pulley on a countershaft, directly under the operator's feet, by means of a slack belt, which may be tightened by means of a swinging idler pulley, operated by a hand lever. When the belt is slack the engine will run at full speed without driving the machine, but a very little pull on the lever will tighten the belt and perform the function of a clutch.

The drive from the countershaft to the rear axle is by means of a bicycle chain and sprocket. I used no differential gear on my machine, as I found that the hubs, which are of the "coaster" pattern, successfully prevent any slipping when turning a corner.

The frame of the car is built of white ash with 1 in. by 2 in. sills, and the axles are made of 1¼-in. heavy steel tubing. The seat is made of white wood with band-iron corners inside, to stiffen it, and is upholstered in imitation leather.—Contributed by Fred W. Pickles, 692 Wealthy Ave., Grand Rapids, Mich.

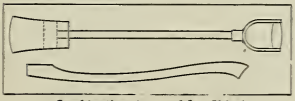


Auto Built by 15-Year-Old Boy

A Handy Ice Chisel

Fishing through the ice is great sport, but cutting the first holes preparatory to setting the lines is not always an easy task. The ice chisel described below will be found very handy, and can be made at very slight expense.

In the top of an old axe head drill



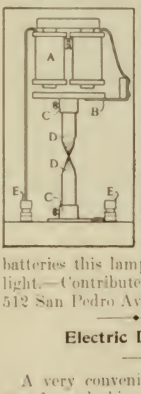
Combination Axe and Ice Chisel

a ⅝-in. hole, and then tap it for a ¾-in. gas pipe, about 18 in. long. Thread the other end of the pipe, and screw on an old snow shovel handle. When ready for use, screw the two pieces together and you have your chisel complete.

A short axe handle may be included in the outfit. When the holes are finished and your lines set, unscrew the pipe from the head of the axe, put in the handle and your axe is ready to cut the wood to keep your fire going.—Contributed by C. J. Rand, West Somerville, Mass.

Home-Made Arc Light

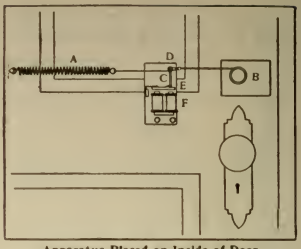
By rewinding an electric bell magnet with No. 16 wire and connecting it in series with two electric light carbons, as shown in the sketch, a small arc will be formed between the carbon points when the current is applied. In the sketch, A is the electric bell magnet; B, the armature; C C, carbon sockets; D, carbons; and E E, binding-posts. When connected with 10 or 12 dry batteries this lamp gives a fairly good light.—Contributed by Morris L. Levy, 512 San Pedro Ave., San Antonio, Tex.



Electric Door Opener

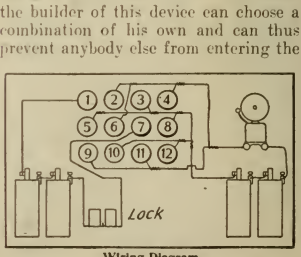
A very convenient and efficient device for unlocking any door fitted with a spring lock is shown in the accompanying sketches. A fairly stiff spring, A, is connected by a flexible wire cord to the knob B. The cord is also fastened to a lever, C, which is pivoted at D and is released by a magnetic trigger, E, made from the armature and magnet of an old electric bell.

When the circuit is completed by means of a secret contact device outside the door, the magnet, F, pulls down the armature which releases the trigger and allows the spring to open the lock. If there are metal numbers on the outside of the door they may be used for the secret contact, if desired, but if there are no numbers on the door, a small contact board may be constructed by driving about 12 brass-headed tacks into a thin piece of wood and making connections at the back as shown in the wiring diagram.



Apparatus Placed on Inside of Door

In this particular diagram the tacks numbered 1 and 7 are used for unlocking the door, the others being connected with the electric bell circuit as indicated for the purpose of giving an alarm should anybody try to experiment with the secret contacts. By means of a pocket knife or other metal article the operator can let himself in at any time by connecting the tacks numbered 1 and 7, while a person not knowing the combination would be liable to sound the alarm. Of course the builder of this device can choose a combination of his own and can thus prevent anybody else from entering the



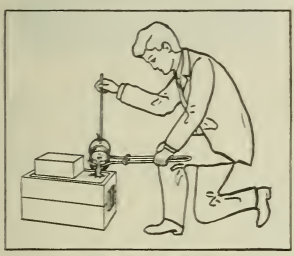
Wiring Diagram

door; even those who read this description.—Contributed by Perry A. Borden, Mt. Allison University, Gachville, N. B.

Foundry Work at Home

Part III—Melting and Pouring

Having prepared one or more molds as described in the last chapter, the next operation is that of melting and pouring. An ordinary cast-iron glue pot makes a good crucible and can be easily handled by a pair of tongs, made out of steel rod, as shown in the sketch. In order to hold the tongs together a small link can be slipped on over the



Pouring the Mold

handle, thus holding the crucible securely.

A second piece of steel rod bent in the form of a hook at the end is very useful for supporting the weight of the crucible and prevents spilling the molten metal should the tongs slip off the crucible. The hook is also useful for removing the crucible from the fire, which should be done soon after the metal is entirely melted in order to prevent overheating. The metal should be poured into the mold in a small stream to give the air a chance to escape and should not be poured directly into the center of the opening, as the metal will then strike the bottom hard enough to loosen the sand, thus making a dirty casting.

If after being poured the mold sputters and emits large volumes of steam, it shows that the sand is too wet and the castings in such cases will probably be imperfect and full of holes.

A mold made in the manner previously described may be poured with any desired metal, but a metal which is easily melted will give the least trouble. One of the easiest metals to melt and one which makes very attractive castings is pure tin. Tin melts at a temperature slightly above the melting point of solder and although somewhat expensive the permanent brightness and silverlike appearance of the castings is very desirable. A good "white metal" may be made by mixing 75% tin, 15% lead, 5% zinc, and 5% antimony. The object of adding antimony to an alloy is to prevent shrinkage when cooling.

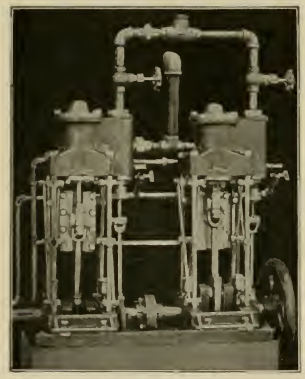
A very economical alloy is made by melting up all the old type metal, babbitt, battery zincs, white metal and other scrap available, and adding a little antimony if the metal shrinks too much in cooling. If a good furnace is available, aluminum can be melted without any difficulty, although this metal melts at a higher temperature than any of the metals previously mentioned.

In casting zincs for batteries a separate crucible, used only for zinc, is very desirable, as the presence of a very small amount of lead or other impurity will cause the batteries to polarize. A very good way to make the binding-posts is to remove the binding-posts from worn-out dry batteries and place them in the molds in such a way that the melted zinc will flow around them.

The time required for a casting to solidify varies with the size and shape of the casting, but unless the pattern is a very large one about five minutes will be ample time for it to set. The casting is then dumped out of the mold and the sand brushed off. The gate can be removed with either a cold chisel or a hacksaw and the casting is then ready for finishing.

Steam Engine Built in Amateur Shop

The amateur mechanic who has a lathe and shaper in his equipment may possibly be encouraged to build an engine along similar lines to the one here illustrated. In this engine, as in almost every engine, the cylinder and bed are of cast iron, but the frame is constructed of cold-rolled steel. The two units shown are exact duplicates, either of which may be run independently of the other by disconnecting the



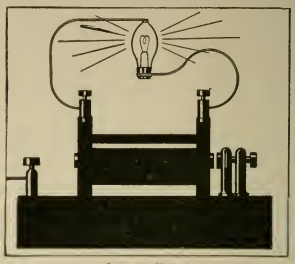
"Power is About 1 1-2 Hp."

coupling at the center and mounting on separate beds.

The complicated steam chests used in many engines are replaced in this one by simple cylinder valves with simple stuffing boxes, which may be taken from globe or angle valves, if the builder does not wish to construct them himself. The cylinders of this engine are 2½ in. diameter and the stroke is 3 in. With a steam pressure of 80 lb. acting on both cylinders and a speed of 250 r. p. m. the power is about 1½ hp.—Contributed by Dr. Mark G. McElhinney, Ottawa, Canada.

Lighting Incandescent Lamp with Induction Coil

An incandescent lamp of low candlepower may be illuminated by connecting to an induction coil in the manner shown in the sketch. One wire is con-

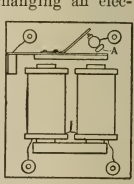


Geissler Tube

nected to the metal cap of the lamp and the other wire is fastened to the glass tip. If the apparatus is then placed in the dark and the current turned on, a peculiar phosphorescent glow will fill the whole interior of the lamp. The induction coil used for this purpose should give a spark about ½ in. long or more.—Contributed by Joseph B. Bell, 411 Herkimer St., Brooklyn, New York.

Relay Made from Electric Bell

It is not necessary to remove the adjusting screw when changing an electric bell into a relay. Simply twist it around as at A and bend the circuit-breaking contact back as shown. It may be necessary to remove the head of the screw, A, to prevent short-circuiting with the armature.—Contributed by A. L. Macey, 231 West 40th St., New York City.



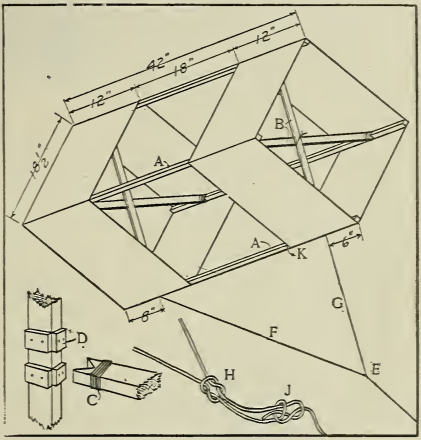
Amateur Mechanics

HOW TO MAKE A BOX KITE

As some of the readers of this magazine may desire to build a box kite, a simple method of constructing one of the modern type is given in detail as follows: The sticks should be made of straight-grained wood, which may be either spruce, basswood, or white pine. The longitudinal corner spines, A A, should be ⅜ in. square by 42 in. long, and the four diagonal struts, B, should be ¼ in. by ½ in. and about 26 in. long.

Two cloth bands should be made to the exact dimensions given in the sketch and fastened to the four longitudinal sticks with 1 oz. tacks. It is well to mark the positions of the sticks on the cloth bands, either with a soft lead pencil or crayon, in order to have the four sides of each band exactly equal. The ends of the bands should be lapped over at least ½ in. and sewed double to give extra strength, and the edges should be carefully hemmed, making the width, when finished, exactly 12 in. Probably the best cloth for this purpose is nainsook, although lonsdale cambric or lightweight percaline will answer nearly as well.

The diagonal struts, B, should be cut a little too long, so that they will be slightly bowed when put in position, thus holding the cloth out taut and fla They should be tied together at the points of intersection and the ends should be wound with coarse harness maker's thread, as shown at C, to prevent splitting. The small guards, D, are nailed or glued to the longitudinal sticks to prevent the struts slipping out of position. Of course the ends of the struts could be fastened to the longitudinal strips if desired, but if made as described the kite may be readily taken apart and rolled up for convenience in carrying.



The bridle knots, E, are shown in detail at H and J. H is a square knot, which may be easily loosened and shifted to a different position on the bridle, thus adjusting the lengths of F and G. A bowline knot should be tied at J, as shown, to prevent slipping. If the kite is used in a light wind, loosen the square knot and shift nearer to G, thus shortening G and lengthening F, and if a strong wind is blowing, shift towards F, thereby lengthening G and making F shorter. In a very strong wind do not use the

bridle, but fasten a string securely to the stick at K.—Contributed by Edw. E. Harbert, kite expert, 1627 Briar Place, Chicago.

Pictures Without a Camera

If you wish to take a picture and have no camera, but would like to gain a little experience in finishing up, you can make some very nice pictures by the following method. Or, if you have a proof and have broken your plate after you took that proof, you can make another one, about as good as the original, without taking the picture over. Of course, it is not possible to take an out-door scene without a camera of some sort, as exposing the plate to the light ruins it, and no image is found, but you can take pictures of other pictures without a camera.

All you need is a dry plate, a printing frame, the size or larger than the picture you wish to take, and the usual developing outfit. Cut a picture, with nothing on the other side, out of a magazine, or take any ordinary camera picture, not mounted—this we will take our picture of.

In your printing frame place a piece of very clean glass the size of the frame; an old plate from which the gelatine has been removed by hot water is best. Place your picture in the frame on top of the glass, face up. (Better results will be had if the picture is oiled with kerosene on the back side, but don't let oil get on plate.) Then lay your plate with the sensitive side next to the face of your picture, put in the frame back, as you would in printing a picture, and fasten it tight. Of course, this is done in the dark room. Now you are all ready for the exposure. After a little practice you will have no trouble in judging the time. It depends upon the picture, the light and the plate. The best way

Made Without Camera

Experiment With Colored Electric Lamps

To many the following experiment may be much more easily performed than explained: Place the hand or other object in the light coming from two incandescent lamps, one red and one white, placed about a foot apart and allow the shadow to fall on a white screen such as a table cloth. Portions of the shadow will then appear to be a bright green. A similar experiment consists in first turning on the red light for about a minute and then turning it off at the same time that the white one is turned on. The entire screen will then appear to be a vivid green for about one second, after which it assumes its normal color.

is to open the little window of your dark room and expose the frame about a second in the subdued daylight. Remove the plate carefully and develop in the usual way. There will be a negative of the picture you had at first, if you have been successful, if not, you should try it a time or two, varying the time of exposure.

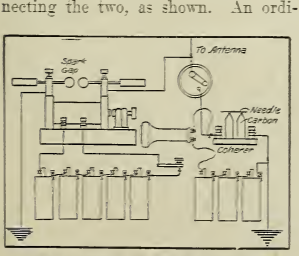
In this manner you can make many pretty blue prints for your wall, or supply yourself with postal pictures of things impossible for you to take a picture of yourself.

Should you have trouble with your high lights, print rather dark and bleach in following solution:

Water, 100 cc.
Potassium Ferricyanide (1/10 sol.), 3 cc.
Hypo (1/10 sol.), 20 cc.

Wireless Telegraph

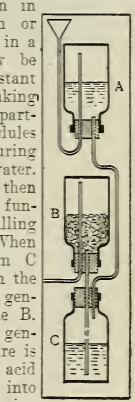
The accompanying diagrams show a wireless telegraph system that I have used successfully for signaling a distance of 3,000 ft. The transmitter consists of an induction coil, about the size used for automobiles, a key or push button for completing the circuit and five dry batteries. The small single point switch is left open as shown when sending a message, but when receiving it should be closed in order that the electric waves from the antenna may pass through the coherer. The coherer in this case is simply two electric light carbons sharpened to a wedge at one end with a needle connecting the two, as shown. An ordinary telephone receiver is connected in series with the coherer, as shown. To receive messages hold the receiver to the ear and close the switch and answer by opening the switch and operating the key.—Contributed by Coulson Glick, 816 N. Temple Ave., Indianapolis, Ind.



Wiring Diagram for Wireless Telegraph

Constant Pressure Hydrogen Generator

By fitting three bottles, A, B, C, with rubber stoppers and connecting with glass tubes as shown in the sketch, hydrogen or other gases produced in a similar manner may be generated under constant pressure. In making hydrogen, bottle B is partly filled with zinc nodules formed by slowly pouring melted zinc into water. Hydrochloric acid is then poured in the small funnel, thus partly filling bottles A and C. When the acid rising from C comes in contact with the zinc, hydrogen gas is generated and fills bottle B. The gas continues to generate until the pressure is sufficient to force the acid back down the tube into bottle C, when the action ceases. As fast as the gas is used the acid rises in the tube and generates more, thus keeping the pressure nearly constant, the pressure depending on the difference between the levels of the acid in bottle A and bottle B. As this device is easily upset, a ring stand should be used to prevent its being broken, or if it is to be a permanent apparatus it may be mounted on a substantial wooden base. This apparatus may also be used for preparing acetylene gas or almost any gas which requires a mixture of a solid and liquid in its preparation.—Contributed by C. S. J., Detroit, Mich.



MODEL LOCOMOTIVE

The illustration shows a model locomotive built by Roy C. Beaver, a student in the Greenville (Pa.) High School. This model, which is built almost entirely of wood, required 20 months' time for its construction and was made from pencil sketches, drawn from a Bessemer and Lake Erie locomotive.

All the parts were worked out in detail, including the link motions and other moving parts, and when moved along the track it runs very smoothly.

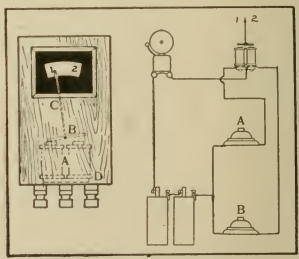
Model Locomotive Made by Roy C. Beaver

DIMENSIONS—Cylinder, 2¼ in. by 1½ in.; valve travel, ⅜ in.; fire box, 4 in. by 6 in.; diameter of boiler, smallest ring, 5½ in.; diameter driving wheels, 5 in.; height to top of stack, 13½ in.; length of engine and tender, 48 in.

HOME-MADE ANNUNCIATOR

When one electric bell is operated from two push buttons it is impossible to tell which of the two push buttons is being operated unless an annunciator or similar device is used. A very simple annunciator for indicating two numbers can be made from a small box, Fig. 1, with an electric bell magnet, A, fastened in the bottom. The armature, B, is pivoted in the center by means of a small piece of wire and has an indicator or hand, C, which moves to either right or left, depending on which half of the magnet is magnetized. If the back armature, D, of the magnet is removed the moving armature will work better, as this will prevent the magnetism from acting on both ends of the armature.

The wiring diagram, Fig. 2, shows how the connections are to be made. If the push button A is closed the bell will ring and the pointer will point at 1, while the closing of the push button B will ring the bell and move the pointer to 2.—Contributed by H. S. Bott, 109 Cooper St., Beverly, N. J.



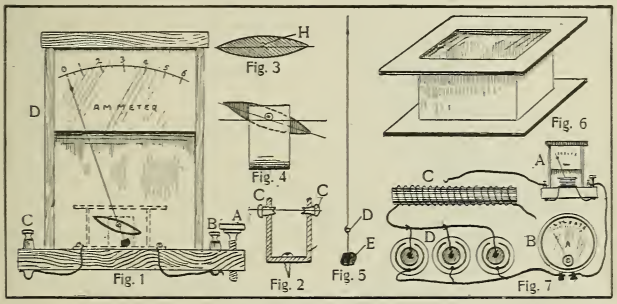
Annunciator and Wiring Diagram

Experiments are being made with brown sugar which is said to greatly increase the adhesive properties of mortar. Equal parts of sand and lime are mixed.

Amateur Mechanics

How to Make an Ammeter

Every amateur mechanic who performs electrical experiments will find use for an ammeter and for the benefit of those who wish to construct such an instrument the following description is given: The operative principle of this instrument is the same as that of a galvanometer, except that its working position is not confined to the magnetic meridian. This is accomplished by making the needle revolve in a vertical instead of a horizontal plane. The only adjustment necessary is that of leveling, which is accomplished by turning the thumb screw shown at A, Fig. 1, until the hand points to 0 on the scale.



Complete Ammeter and Details

First make a support, Fig. 2, by bending a piece of sheet brass to the shape indicated and tapping for the screws, C C. These should have hollow ends, as shown, for the purpose of receiving the pivoted axle which supports the hand. The core, Fig. 3, is made of iron. It is 1 in. long, $\frac{1}{4}$ in. wide and $\frac{1}{4}$ in. thick. At a point a little above the center, drill a hole as shown at H and through this hole drive a piece of knitting needle about $\frac{1}{2}$ in. long, or long enough to reach between the two screws shown in Fig. 2. The ends of this small axle should be ground pointed and should turn easily in the cavities, as the sensitiveness of the instrument depends on the ease with which this axle turns.

After assembling the core as shown in Fig. 4, it should be filed a little at one end until it assumes the position indicated. The pointer or hand, Fig. 5, is made of wire, aluminum being preferable for this purpose, although copper or steel will do. Make the wire $4\frac{1}{2}$ in. long and make a loop, D, $\frac{1}{2}$ in. from the lower end. Solder to the short end a piece of brass, E, of such weight that it will exactly balance the weight of the hand. This is slipped on the pivot and the whole thing is again placed in position in the support. If the pointer is correctly balanced it should take the position shown in Fig. 1, but if it is not exactly right a little filing will bring it near enough so that it may be corrected by the adjusting screw.

Next make a brass frame as shown in Fig. 6. This might be made of wood, although brass is better, as the eddy currents set up in a conductor

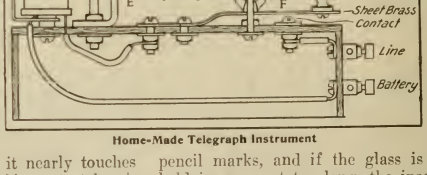
surrounding a magnet tend to stop oscillation of the magnet. (The core is magnetized when a current flows through the instrument.) The brass frame is wound with magnet wire, the size depending on the number of amperes to be measured. Mine is wound with two layers of No. 14 wire, 10 turns to each layer, and is about right for ordinary experimental purposes. The ends of the wire are fastened to the binding-posts, B, C, Fig. 1.

A wooden box, D, is then made and provided with a glass front. A piece of paper is pasted on a piece of wood, which is then fastened in the box in such a position that the hand or pointer will lie close to the paper scale. The box is 5½ in. high, 4 in. wide and 1¾ in. deep; inside measurements. After everything is assembled put a drop of solder on the loop at D, Fig. 5, to prevent it turning on the axle.

To calibrate the instrument connect as shown in Fig. 7, where A is the home-made ammeter; B, a standard ammeter; C, a variable resistance and D a battery, consisting of three or more cells connected in multiple. Throw in enough resistance to make the standard instrument read 1 ohm and then put a mark on the paper scale of the instrument to be calibrated. Continue in this way with 2 amperes, 3 amperes, 4 amperes, etc., until the scale is full. To make a voltmeter out of this instrument, wind with plenty of No. 36 magnet wire instead of No. 14, or if it is desired to make an instrument for measuring both volts and amperes, use both windings and connect to two pairs of binding-posts. — Contributed by J. E. Dussault, 228 Chs. Borromee St., Montreal, Can.

Cheap Telegraph for Learners

An inexpensive telegraph instrument can be made by fastening an electric bell magnet, A, to a small wooden box, such as a cigar box. The sheet-iron armature is provided with a tapper, B, which consists of a small bolt and nut. The anvil, C, and stop, D, are also made from bolts and are fastened to a piece of sheet brass, E, bent as shown. The key, F, is made of brass about 1/32 in. thick and so adjusted that it nearly touches the contact. If a double contact key is wanted, the adjusting screw may be used for the second contact.



Home-Made Telegraph Instrument

While the instrument as described will work only on very short distance lines, it may be rewound for use on a line 2 or 3 miles long by using about 250 ft. of No. 28 single cotton-covered wire.—Contributed by A. G. Ward, Wilkinsburg, Pa.

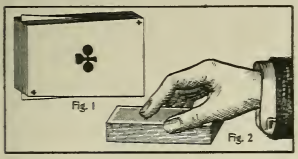
Burning Inscriptions on Trees

Scrape off the bark just enough to come to the first light under coating, which is somewhat moist. With a lead pencil make an outline of the inscription to be burnt on the tree and bring the rays of a large magnifying glass not quite to a fine focus on the same. The tree will be burnt along the pencil marks, and if the glass is not held in one spot too long, the inscription will be burnt in as evenly as if it had been written. — Contributed by Stewart H. Leland, Lexington, Ill.

To lubricate sheet metal mix 1 qt. whale oil, 1 lb. white lead, 1 pt. water and 3 oz. finest graphite. Apply with a brush before the metal enters the dies.

Mechanical Tricks with Cards

One of the simplest tricks to perform, but one not easily detected, can be executed by using a tapered deck of cards as shown in Fig. 1. A cheap deck of cards is evened up square, fastened in a vise and planed along the



edge in such a manner that all the pack will be tapered about 1-16 in. This taper is exaggerated in the illustration which shows one card that has been turned end for end.

It is evident that any card reversed in this way can be easily separated from the other cards in the pack, which makes it possible to perform the following trick: The performer spreads the cards out, fan-like, and asks an observer to withdraw a card, which is then replaced in any part of the pack. After thoroughly shuffling the cards the performer then holds the deck in both hands behind his back and pronouncing a few magic words, produces the card selected in one hand and the rest of the pack in the other. This is accomplished by simply turning the deck end for end while the observer is looking at his card, thus bringing the wide end of the selected card at the narrow end of the pack when it is replaced. The hands are placed behind the back for a double purpose, as the feat then seems more marvelous and the observers are not allowed to see how it is done.

In prize games, players having the same score are frequently called upon to cut for low to determine which shall be the winner, but a fairer way is to cut for high as a person familiar with the trick shown in Fig. 2 can cut the cards at the ace, deuce, or three spot, nearly every time, especially if the deck is a new one. This is done by simply pressing on the top of the deck as shown, before cutting, thus causing the increased ink surface of the high cards to adhere to the adjacent ones. A little practice will soon enable one to cut low nearly every time, but the cards must be grasped lightly and the experiment should be performed with a new deck to obtain successful results. —Contributed by D. B. J., Chicago.

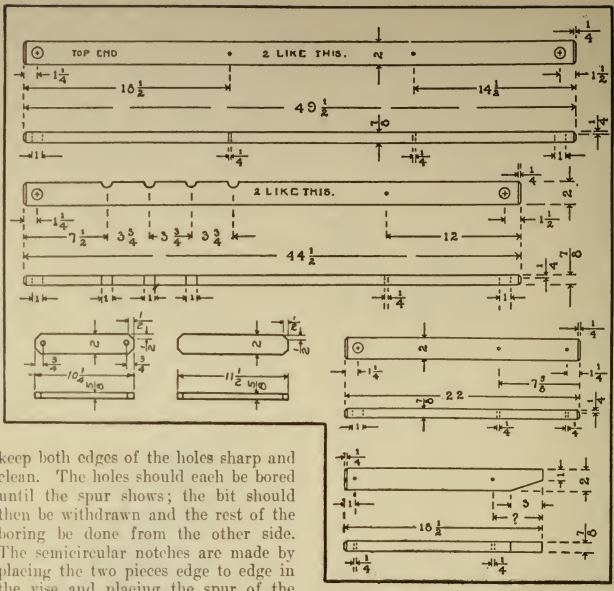
How to Make a Porch Chair

The illustration shows a very comfortable and attractive porch chair that can be made with few tools and easily procured material. Most any kind of wood will answer, says the American Carpenter and Builder, but if open grained wood, such as oak or chestnut,

Porch Chair Finished

is used the parts should be filled with a paste filler. If the natural color of the wood is not desired, the wood may first be stained, the filler being colored somewhat darker than the stain.

Procure enough lumber to make all the pieces shown in the detail drawing and finish to the dimensions shown, being careful to make the corresponding pieces exactly alike in order to preserve the perfect symmetry which is necessary in work of this kind. In boring the holes care must be taken to



Details of Home-Made Porch Seat

keep both edges of the holes sharp and clean. The holes should each be bored until the spur shows; the bit should then be withdrawn and the rest of the boring be done from the other side. The semicircular notches are made by placing the two pieces edge to edge in the vise and placing the spur of the bit in the crack. The 1-in. bit is used. As it will be difficult to finish the boring of these blocks from the second side, the parts remaining may be cut out with the knife after the pieces have been separated.

Five ½-in. dowel rods are needed. It is possible to get these in one long piece if you happen to live near a mill and then all you will have to do is to saw off the desired lengths. However, if they cannot be got easily you can make your own. Two rods each 18¼ in. long; two rods each 20¼ in. and one rod 22¼ in. give the exact lengths. It is well to cut each piece a little longer than required so that the ends which are imperfectly formed may be cut off. These rods should fit tight and may be fastened in addition with a small screw or nail from the under or back side.

The hand rests should be nailed to the arms with small nails or brads before the arms are bolted. The illustration of the assembled chair shows the relative position.

The bolts should be ¼ in. and of the following lengths: 4 bolts 2¼ in. long; 2 bolts 2 in. long; 2 bolts 3 in. long. Washers should be placed between adjacent pieces of wood fastened together with bolts and also at both ends of the bolts. This will require 26 washers in all. While the size of the chair may be varied, it will be necessary to keep the proportions if the parts are to fold properly.

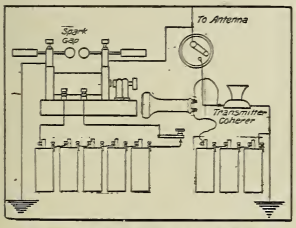
To make black ruling ink, take good black ink and add gall as for blue. Do not cork, or it will not turn black.

Amateur Mechanics

How to Receive Wireless Telegraph Messages with a Telephone

By A. E. Joerin, Wireless Telegraph Demonstrator

Any telephone having carbon in the transmitter (all ordinary telephones have carbon transmitters) can be used to receive wireless messages, by simply making a few changes in the connections and providing a suitable antenna. Connect the transmitter and receiver in series with three dry cells and run one wire from the transmitter to the antenna. Connect the other transmitter wire to a water or gas pipe in order



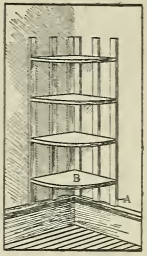
Wiring Diagram for Wireless Telegraph

to ground it, and then hold the receiver to your ear. Any wireless telegraph message within a radius of one mile will cause the transmitter to act as a coherer, thus making the message audible in the receiver.

By using an ordinary telephone transmitter and receiver and a ½-in. jump spark coil, a complete wireless telegraph station can be made, which will send or receive messages for a radius of one mile. The accompanying wiring diagram shows how to make the connections. By putting in an extra switch three of the sending batteries may be switched in when receiving, thus obviating the necessity of an extra set of batteries.

Easily Made Book Shelf

A very cheap but useful and attractive book shelf is shown in the accompanying drawing. The vertical strips, A, may be ¾ in. by 2 in. and are screwed to four shelves, B, each cut to the shape of a quarter circle. The screws are all countersunk and as the heads all come on the side next to the wall, they do not show. The design might be varied somewhat to suit the fancy of the builder, although the appearance of the shelf constructed as shown is very pleasing, especially so if the workmanship is good and the wood carefully stained and varnished. The total cost of the one I made was less than 75 cents.—Contributed by Geo. C. Murphy, 412 Critenden St., Owensboro, Ky.



Corner Shelf

Breaking in a New Pen

There are many ways of breaking in a new pen, such as moistening in the mouth, wiping on a blotter, dipping in the ink and rubbing on the edge of the ink well, etc., but the best way that I have found is to hold a lighted match under the pen for just an instant and then plunge immediately into the ink. This will effectually remove all the oil or grease on the surface and, unless the pen is overheated, will not draw the temper.—Contributed by A. C. Pearson, Duluth, Minn.

How to Make a Jump Spark Coil

By the New England Coil Winding Co.

The induction coil is probably the most popular piece of apparatus in the electrical laboratory, and particularly is it popular because of its use in experimental wireless telegraphy. Ten years ago wireless telegraphy was a dream of scientists; today it is the plaything of school-boys and thousands of grown-up boys as well.

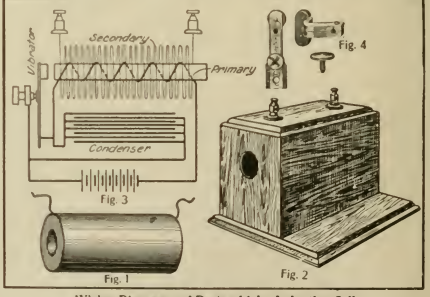
Divested of nearly all technical phrases, we may briefly describe an induction coil as a step-up transformer of small capacity. It comprises a core consisting of a cylindrical bundle of soft iron wires cut to proper length. By means of two or more layers of No. 14 or No. 16 magnet wire, wound evenly about this core, the bundle becomes magnetized when the wire terminals are connected to a source of electricity.

Should we now slip over this electro-magnet a paper tube upon which has been wound with regularity a great and continuous length of No. 36 magnet wire, it will be found that the lines of force emanating from the energized core penetrate the new coil winding almost as though it were but a part of the surrounding air itself, and when the battery current is broken rapidly a second electrical current is said to be induced into the second coil or secondary.

All or any of the parts of an induction coil may be purchased ready-made, and the first thing to do is to decide which of the parts the amateur mechanic can make and which would be better to buy ready-made. If the builder has had no experience in coil winding it would probably pay to purchase the secondary coil ready-wound, as the operation of winding a mile or more of fine wire is very difficult and tedious, and the results are often unsatisfactory. In ordering the secondary it is always necessary to specify the length of spark desired.

The following method of completing a 1-in. coil illustrates the general details of the work. The same methods and circuits apply to smaller and larger coils. The ready-made secondary is in solid cylindrical form, about 6 in. long and 2⅜ in. diameter, with a hole through the winding 1¼ in. in diameter as shown in Fig. 1. The secondary will stand considerable handling without fear of injury, and need not be set into a case until primary is completed. The primary is made of fine annealed No. 24 iron wire cut 7 in. or 8 in. in length, as the maker prefers, and bundled to a diameter of ⅞ in. The wires may be straightened by rolling two or three at a time between two pieces of hard wood. If the amateur has difficulty in procuring this wire, the entire core may be purchased ready-made.

After the core wires are bundled, the core is wrapped with one or two layers of manila paper. The straighter the wire the more iron will enter into the construction of the core, which is desirable. Beginning half an inch from one end, No. 16 cotton-covered magnet wire is wound from one end to the other evenly and then returned, making two layers, and the terminals tied



Wiring Diagram and Parts of 1-In. Induction Coil

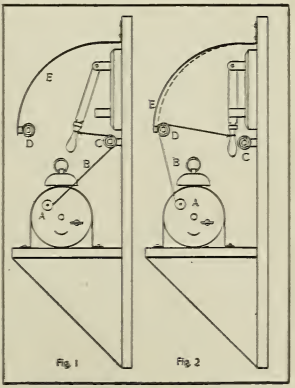
down to the core with twine. Core and primary is then immersed in boiling paraffine wax to which a small quantity of resin and bees-wax has been added. This same wax may be used later in sealing the completed coil into a box. Over this primary is now wrapped one layer of okonite tape, or same thickness of heavily shellacked muslin. This completed primary will now slip into the hole in the secondary.

Should the secondary have been purchased without a case, a wooden box of mahogany or oak is made, large enough to contain the secondary with an inch to spare all around, with room also for a small condenser, but if it is not convenient to do this work, a box like that shown in Fig. 2 may be purchased at a small cost. A ¾-in. hole is bored in the center of one end, through which the primary core projects ½ in. This core is to be used to attract magnetically the iron head of a vibrating interrupter, which is an important factor of the coil. This interrupter is shaped as in Fig. 4, and is fastened to the box in such a way that the vibrator hammer plays in front of the core and also that soldered connections may be made inside the box with the screws used in affixing the vibrator parts to the box. The condenser is made of four strips of thin paper, 2 yd. long and 5 in. wide, and a sufficient quantity of tinfoil. When cut and laid in one continuous length, each piece of tin-foil must overlap the adjoining piece a half inch, so as to form a continuous electrical circuit. In shaping the condenser, one piece of the paper is laid down, then the strip of tin-foil, then two strips of paper and another layer of foil, and finally the fourth strip of paper. This makes a condenser which may be folded, beginning at one end and bending about 6 in. at a time. The condenser is next wrapped securely with bands of paper or tape, and boiled in pure paraffine wax for one hour, after which it is pressed under considerable weight until firm and hard. One of the sheets of tin-foil is to form one pole of the condenser and the other sheet, which is insulated from the first, forms the other pole or terminal. (This condenser material is purchasable in long strips, ready for assembling.)

The wiring diagram, Fig. 3, shows how the connections are made. This method of connecting is suitable for all coils up to 1½-in. spark, but for larger coils better results will be obtained by using an independent type of interrupter, in which a separate magnet is used to interrupt the circuit. Besides the magnetic vibrators there are several other types, such as the mercury dash-pot and rotary commutator types, but these will become better known to the amateur as he becomes more experienced in coil operation.

Automatic Time Switch

This device can be used to either open or close the circuit at any desired time. An alarm clock is firmly fastened to a wooden bracket and provided with a small wood or metal drum, A, to which is fastened a cord, B. The other end of the cord is tied to the switch handle so that when the alarm goes off the switch is either opened or closed, depending on whether the cord is passed over pulley C or pulley D.



Will Open or Close Circuit as Desired

When the cord is passed over pulley C, as shown in Fig. 1, the circuit will be closed when the alarm goes off, but if it is passed over D the circuit will be opened. Pulley D is fastened to a piece of spring steel, E, which in operation is bent, as shown by the dotted lines, thus causing the switch to snap open quickly and prevent forming an arc.—Contributed by Douglas Royer, Roanoke, Va.

A Neat Model Locomotive

Noting your description of a model locomotive made out of wood, I herewith enclose a photograph of a locomotive and tender complete made of brass, 52 in. in length including tender. Gasoline is used for fuel supplied from

The Locomotive Has a Speed of 6 Miles an Hour

a small tank in the tender; the boiler is made of 5-in. seamless drawn brass tube with one 3-in. brass flue running the entire length of the boiler. It is provided with steam brakes and steam whistle, springs and equalizing lever. Cylinders 1¼ in. by 2-in. stroke. Drivers are 6 in. in diameter. The locomotive will run on circular track with a speed of about 6 miles per hour, the gauge of the track being 5¼ in. The whole locomotive and tender weighs about 87 lb. and was made by the undersigned.

The enclosed picture was taken in a store window where the locomotive was put up for exhibition. The background consists of a photograph of a lake in Dakota cleverly arranged by the artist who took the picture. The roadbed as well as the cars are made up for the occasion from magazines. The wheels on the cars are 5-cent ink bottles. The engineer at the side of the locomotive is a picture out of a magazine, and the picture of Hon. M. B. Cullum, Mayor of Duluth, appears through the cab window.—Contributed by Chas. Rigdon, Plumbing Inspector, Duluth, Minn.

Protection of Spring Lock

After shutting the front door and hearing the spring lock snap into its socket, most people go off with a child-like faith in the safety of their goods and chattels. But the cold fact is that there is scarcely any locking device which affords less protection than the ordinary spring lock. It is the simplest thing in the world for a sneak-thief to slip a thin knife between the door-casing and the strip, push back the bolt, and walk in.

Fortunately, it is equally easy to block that trick. Take a narrow piece of tin 3 or 4 in. long, bend it at right angles throughout its length, and tack it firmly in the angle between the casing and strip, so as to make it impossible to reach the bolt without tearing off the strip.

Another way is to drive nails through the strip at intervals of half an inch, enough to protect the bolt from tampering.

A good imitation amber may be made of the following ingredients, melted carefully together: Pine rosin, 1 part; shellac, 2 parts; colophony, 15 parts.

Amateur Mechanics

How to Photograph on Apples

That the skin of an apple is sensitive to the action of sunlight is shown by the coloring, especially on the sunny side. This fact suggested a happy idea to a contributor to Camera Craft, who substituted apple skin for photographic printing paper in the following manner: Selecting green apples which grow red in sunlight, he covered them with black paper in order to increase the sensitiveness of the apple skin. Ten days later he removed the paper and pasted on each apple a film negative, using white of egg as the best adhesive. To keep the rest of the apple green, each of them was inclosed again in black paper, but with an opening cut opposite the picture. The resulting photograph was wonderfully clear and beautiful, as appears in the cut.

An autograph message may be written on thin paper and printed in the same way; also fern leaves, petals of flowers, and many other subjects.

Novel Wireless System

The illustrations will make plain a simple and inexpensive apparatus for wireless telegraphy by which I have had no difficulty in sending messages across 1½ miles of water surface. It is so simple that the cuts scarcely need explanation. In Fig. 1 is seen the sending apparatus, consisting of a 40-cell battery connected with two copper plates 36 by 36 by ¼ in. The plates are separated 6 in. by a piece of hard rubber at each end.

In Fig. 2 are seen duplicates of these insulated plates, connected with an ordinary telephone receiver. With this receiver I can hear distinctly the electric signals made by closing and opening the Morse key in Fig. 1 and I believe that in a short time I shall be able to perfect this system so as to send wireless messages over long distances. — Contributed by Dudley H. Cohen, New York.

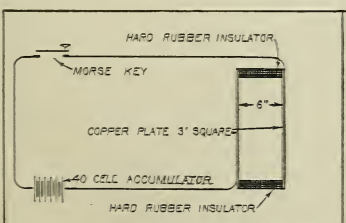


Fig 1.

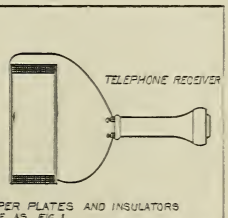


Fig 2.

A Home-Made Water Motor

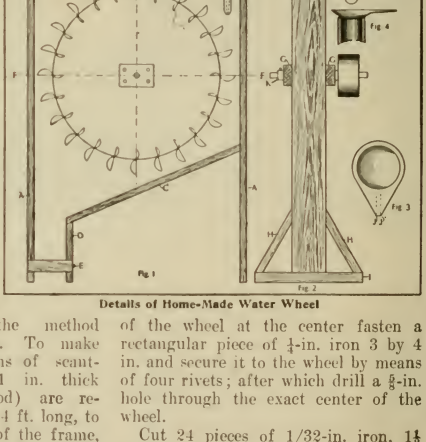
By Mrs. Paul S. Winter

In these days of modern improvements, most houses are equipped with a washing-machine, and the question that arises in the mind of the householder is how to furnish the power to run it economically. I referred this question to my husband, with the result that he built a motor which proved so very satisfactory that I prevailed upon him to give the readers of this magazine a description of it, hoping it may solve the same question for them.

A motor of this type will develop about ½ hp. with a water pressure of 70 lb. The power developed is correspondingly increased or decreased as the pressure exceeds or falls below this. In the latter case the power may be increased by using a smaller pulley. Figure 1 is the motor with one side removed, showing the paddle-wheel in position; Fig. 2 is an end view; Fig. 3 shows one of the paddles; and Fig. 4 shows the method of shaping the paddles. To make the frame, several lengths of scantling 3 in. wide by 1 in. thick (preferably of hard wood) are required. Cut two of them 4 ft. long, to form the main supports of the frame, AA, Fig. 1; another, 2 ft. 6 in. long, for the top, B, Fig. 1; another, 26 in. long, to form the slanting part, C, Fig. 1; and another, D, approximately 1 ft., according to the slant given C. After nailing these together as shown in the illustration, nail two short strips on each side of the outlet, as at E, to keep the frame from spreading.

Cut two pieces 30 in. long. Lay these on the sides of the frame with their center lines along the line FF, which is 15 in. from the outside top of the frame. They are shown in Fig. 2 as GG. Do not fasten these boards now, but mark their position on the frame. Two short boards 1 in. wide by 1 in. thick (HH, Fig. 2) and another 1 in. by 1½ in. (I, Fig. 2) form a substantial base.

Cut the wheel from sheet iron $\frac{1}{16}$ in. thick, 24 in. in diameter. This can be done roughly with hammer and chisel and then smoothed up on an emery wheel, after which cut 24 radial slots ⅞ in. deep on its circumference by means of a hacksaw. On each side



Details of Home-Made Water Wheel

of the wheel at the center fasten a rectangular piece of ¼-in. iron 3 by 4 in. and secure it to the wheel by means of four rivets; after which drill a ⅝-in. hole through the exact center of the wheel.

Cut 24 pieces of 1/32-in. iron, 1½ by 2½ in. These are the paddles. Shape them by placing one end over a section of 1-in. pipe, and hammer bowl-shaped with the peen of a hammer, as shown in Fig. 4. Then cut them into the shape shown in Fig. 3 and bend the tapered end in along the lines JJ, after which place them in the slots of the wheel and bend the sides over to clamp the wheel. Drill ¼-in. holes through the wheel and sides of the paddles and rivet paddles in place. Next secure a ⅝-in. steel shaft 12 in. long

to the wheel about 8 in. from one end by means of a key. This is done by cutting a groove in the shaft and a corresponding groove in the wheel and fitting in a piece of metal in order to secure the wheel from turning independent of the shaft. Procure two collars or round pieces of brass (KK, Fig. 2) with a $\frac{1}{2}$-in. hole through them, and fasten these to the shaft by means of set screws to prevent it from moving lengthwise.

Make the nozzle by taking a piece of $\frac{1}{4}$-in. galvanized pipe $3\frac{1}{2}$ in. long and filling it with babbitt metal; then drill a $\frac{3}{16}$-in. hole through its center. Make this hole conical, tapering from $\frac{3}{16}$ in. to a full $\frac{1}{2}$ in. This is best done by using a square taper reamer. Then place the nozzle in the position shown in Fig. 1, which allows the stream of water to strike the buckets full in the center when they reach the position farthest to the right.

Take the side pieces, GG, and drill a 1-in. hole through their sides centrally, and a $\frac{1}{4}$-in. hole from the tops to the 1-in. holes. Fasten them in their proper position, with the wheel and shaft in place, the shaft projecting through the holes just mentioned. Now block the wheel; that is, fasten it by means of wedges or blocks of wood until the shaft is exactly in the center of the inch holes in the side pieces. Cut four discs of cardboard to slip over the shaft and large enough to cover the inch holes. Two of these are to be inside and two outside of the frames (one to bear against each side of each crosspiece). Fasten these to the crosspieces by means of tacks to hold them securely. Pour melted babbitt metal into the $\frac{1}{4}$-in. hole to form the bearings. When it has cooled, remove the cardboard, take down the crosspieces, and drill a $\frac{1}{4}$-in. hole from the top of the crosspieces through the babbitt for an oil-hole.

Secure sufficient sheet zinc to cover the sides of the frame. Cut the zinc to the same shape as the frame and let it extend down to the crosspieces EE. Tack one side on. (It is well to tack strips of heavy cloth, burlap will do, along the edges under the zinc to form a water-tight joint.) Fasten the crosspiece over the zinc in its proper position. Drill a hole through the zinc, using the hole in the crosspiece as a guide. Then put the wheel in a central position in the frame, tack the other side piece of zinc in place and put the other crosspiece in place. Place the two collars mentioned before on the shaft, and fasten so as to bear against the crosspieces, in order to prevent the wheel and shaft from moving sidewise. If the bearings are now oiled, the shaft should turn easily and smoothly. Fasten a pulley 4 or 6 in. in diameter to the longest arm of the shaft.

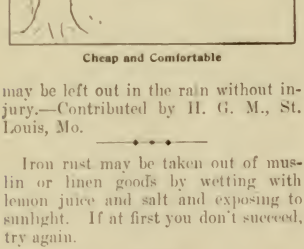
Connect the nozzle to a water faucet by means of a piece of hose; place the outlet over a drain, and belt the motor direct to the washing-machine, sewing-machine, ice-cream freezer, drill press, dynamo or any other machinery requiring not more than $\frac{1}{2}$ hp.

This motor has been in use in our house for two years in all of the above ways, and has never once failed to give perfect satisfaction. It is obvious that, had the wheel and paddles been made of brass, it would be more durable, but as it would have cost several times as much, it is a question whether it would be more economical in the end. If sheet-iron is used a coat of heavy paint would prevent rust and therefore prolong the life of the motor. The motor will soon pay for itself in the saving of laundry bills. We used to spend from 50 cents to $1 a month to have just my husband's overalls done at the laundry, but now I put them in the machine, start the motor, and leave them for an hour or so. At the end of this time they are perfectly clean, and I have noticed that they wear twice as long as when I sent them to the laundry.

A brilliant polish may be given to tarnished nickel by immersing in alcohol and 2 per cent of sulphuric acid from 5 to 15 seconds. Take out, wash in running water, rinse in alcohol, and rub dry with linen cloth.

Barrel Stave Hammock

A hammock made of barrel staves is more comfortable than one would think, considering the nature of the material employed in making it. Good smooth staves should be selected for this purpose, and if one cares to go to a little trouble a thorough sandpapering will make a great improvement. Cut half circles out of each stave, as shown at AA, and pass ropes around the ends as shown at B. When finished the weight will then be supported by four ropes at each end, which allows the use of small sized ropes, such as clothes lines. A hammock of this kind



Cheap and Comfortable

may be left out in the rain without injury.—Contributed by H. G. M., St. Louis, Mo.

Iron rust may be taken out of muslin or linen goods by wetting with lemon juice and salt and exposing to sunlight. If at first you don't succeed, try again.

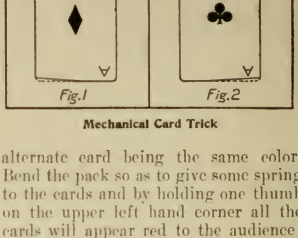
A Mechanical Card Trick

The following mechanical card trick is easy to prepare and simple to perform:

First, procure a new deck, and divide it into two piles, one containing the red cards and the other the black ones, all cards facing the same way. Take the red cards, square them up and place in a vise. Then, with a plane, plane off the upper right hand corner and lower left hand corner, as in Fig. 1, about $\frac{1}{16}$ in.

Then take the black cards, square them up, and plane off about $\frac{1}{16}$ in. on the upper left hand corner and lower right hand corner, as in Fig. 2.

Next restore all the cards to one pack, taking care to have the first card red, the next black, and so on, every

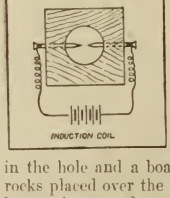


Mechanical Card Trick

alternate card being the same color. Bend the pack so as to give some spring to the cards and by holding one thumb on the upper left hand corner all the cards will appear red to the audience; place thumb in the center at top of pack and they will appear mixed, red and black; with thumb on upper right hand corner all cards appear black. You can display either color called for.—Contributed by Ralph Gingrich, Chicago.

To Explode Powder with Electricity

A 1-in. hole was bored in the center of a 2-in. square block. Two finishing nails were driven in, as shown in the sketch. These were connected to terminals of an induction coil. After everything was ready the powder was poured in the hole and a board weighted with rocks placed over the block. When the button is pressed or the circuit closed in some other way the discharge occurs. The distance between the nail points—which must be bright and clean—should be just enough to give a good, fat spark.—Contributed by Geo. W. Fry, San Jose, Cal.



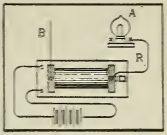
Amateur Mechanics

How to Make "Freak" Photographs

The "freak" pictures of well-known people which were used by the leading dailies recently made everybody wonder how the distorted photographs were made. A writer in Camera Craft gives the secret, which proves to be easy of execution. The distortion is accomplished by the use of prisms, as follows: Secure from an optician or leaded glass establishment, two glass prisms, slightly wider than the lens mount. The flatter they are the less they will distort; about 20° is a satisfactory angle. Secure them as shown by sectional sketch, using straw board and black paper. Then make a ring to fit over the lens mount and connect it with the prisms in such a way as to exclude all light from the camera except that which passes through the face of the prisms. The inner surface of this hood must be dull black. The paper which comes around plates answers nicely. If the ring which slips over the lens mount is lined with black velvet, it will exclude all light and hold firmly to the mount.

Place over lens, stop down well after focusing, and proceed as for any picture.

Electric Blue Light Experiment

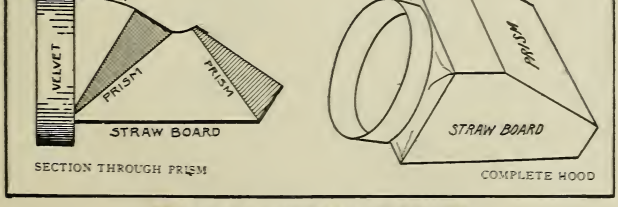


Take a jump-spark coil and connect it up with a battery and start the vibrator. Then take one outlet wire, R, and connect to one side of a 3-cp. electric lamp and the other outlet wire, B, hold in one hand and press all fingers of the other hand on globe at point A. A bright, blue light will come from the wires in the lamp to the surface of the globe where the fingers touch. No shock will be perceptible.—Contributed by J. H. Spade, 203 E. 1st Ave., Altoona, Pa.

How to Make a Music Cabinet

A neat music cabinet can be made as shown in the accompanying sketch:

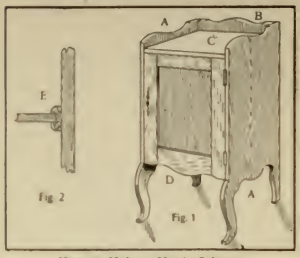
Each side, AA, Fig. 1, is cut from a board about 36 in. in length and 16 in. wide. Both are alike and can be cut from same pattern. As the front legs curve out a little the main body of the boards, AA, should be 15 in. wide. The back, B, should be about 22 in. long by 16 in. wide and set in between sides AA. Cut the top, C, 16 in. long and 14½ in.



"The Distortion Is Accomplished by the Use of Prisms"

wide. The bottom must be the same length as the top and 13½ in. wide.

The door, D, can be made panel as shown, or a single piece, 16 in. wide and



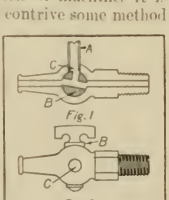
How to Make a Music Cabinet

about 20 in. long. All material used to be made from boards that will dress to ¾ in. thick.

Shelving may be put in as shown in Fig. 2 and made from ¼ in. material. Make 12 cleats, E, 13½ in. long, from a strip of wood ½ by ¾ in. with a groove ¼ by ¼ in. cut in them. Fasten 6 cleats evenly spaced on the inside of each, A and A, with ¾-in. brads. This will give seven spaces for music and as the shelves are removable two places can be made into one.

How to Make a Three-Way Cock for Small Model Work

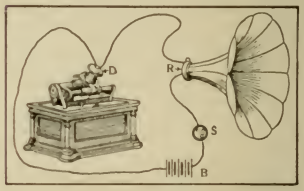
In making models of machines it is often necessary to contrive some method for a 3 or 4-way valve or cock. To make one, secure a pet cock and drill and tap hole through, as shown in the cut. If for 3-way, drill in only to the opening already through, but if for a 4-way, drill through the entire case and valve. Be sure to have valve B turned so as to drill at right angles to the opening through it. After drilling, remove the valve and remove the bur with a piece of emery paper and replace ready for work.



How to Transmit Phonograph Music to a Distance

An interesting experiment, and one calculated to mystify any one not in the secret, is to transmit the music or speech from a phonograph to another part of the house or even a greater distance. For an outdoor summer party the music can be made to come from a bush, or tree, or from a bed of flowers. The apparatus is not difficult to construct.

The cut shows the arrangement. Pro-



cure a long distance telephone transmitter, D, including the mouthpiece, and fasten it to the reproducer of the phonograph. Also a watch case receiver, R, which fasten to the horn. These parts can be purchased from any electrical supply house. Connect two wires to the transmitter, running one direct to the receiver, and the other to the battery, thence to a switch, S, and then to the receiver. The more batteries used the louder will be the sound produced by the horn, but avoid using too much battery or the receiver is apt to heat.—Contributed by Wm. J. Farley, Jr., Camden, N. J.

The Russian government is building several cars for transporting live fish which are to be planted in Western Siberia.

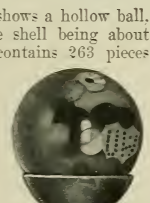
Amateur Mechanics

To Make a Negative Without Plate or Film

The accompanying illustration is a reproduction of a photograph print obtained from a negative made of developing or gas light paper which was used in the plate holder instead of a plate or film. The time given to make this exposure was one minute. The bath used in developing and fixing is the same as used on prints. When through the solutions, washed and dried, it is then printed in contact the same as a film, only it requires longer time in printing.—Contributed by Charles W. Fankboner, Grand Rapids, Mich.

How to Make a Hollow Ball

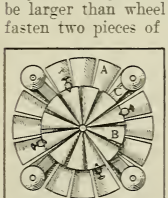
The illustration shows a hollow ball, 6 in. diameter, the shell being about 1½ in. thick. It contains 263 pieces of hardwood, fitted perfectly with glue. Twenty-five kinds of wood were used. A 6-in. ball of fir was first turned and a chuck made to hold the ball. Holes were then bored to a depth of 3 in. (to the center of the ball) and wooden plugs were inserted just 1½ in. When the entire surface of the ball had been thus bored and plugged, I had a ball 6 in. diameter with a 1½ in. shell and a 3-in. diameter hollow within. Each plug was turned out separately and the hole made to fit the plug. Some of the plugs were made up of different kinds of wood in different ways and glued together before being turned.



The stand contains 19 pieces of wood which were first cut in triangles and glued in the form of a hexagon. Two of these layers were glued and turned on a face plate to form the bowl, the other layer was turned to form the base, while the column is one piece of walnut. The task required considerable time and patience.—Contributed by C. E. Mallory, University of Washington, Seattle, Wash.

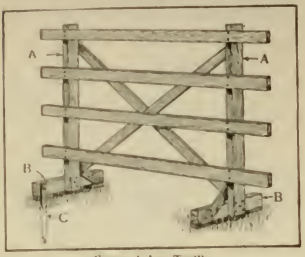
A Musical Windmill

Make two wheels out of tin, which may be of any size, but wheel A must be larger than wheel B. On wheel A fasten two pieces of wood, C, to cross in the center, and place a bell on the four ends, as shown. The smaller wheel, B, must be separated from the other with a round piece of wood or an old spool. Tie four buttons with split rings to the smaller wheel, B. The blades on the wheels should be bent opposite on one wheel from the others so as to make the wheels turn in different directions. When turning the buttons will strike the bells and make them ring constantly.



How to Build a Grape Arbor

A grape arbor made of white pine, put together as shown in the sketch, will last for several years. The 2 by 4-in. posts, A, are 7 ft. long. The feet, B, are

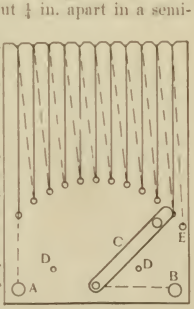


Grape Arbor Trellis

made 2 by 4 in., 4 ft. long, and rest on a brick placed under each end. The cross-pieces and braces are 1 by 2 in. A piece of strap iron, C, fastened to the foot by means of a nail through a hole in its top, is driven into the ground, which holds the arbor from blowing over.—G. A. Dale, Virginia, Ill.

A Battery Rheostat

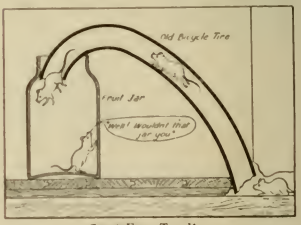
In a board 7 in. long and 5 in. wide bore holes about ¼ in. apart in a semicircle 2 in. from the bottom and cut notches in top end to correspond with the holes. From a piece of brass a switch, C, is cut with a knob soldered on at the end. Nails for stops are placed at DD.



Two binding-posts are placed in board at A and B. With about 9 ft. of fine iron wire attach one end to the bottom of post A and run through first hole and over in first notch to back of board and then through second hole and over second notch and so on until E is reached, where the other end of wire is fastened. Connect switch to post B.—Contributed by Edmund Kuhn, Jr., East Orange, N. J.

Novel Mouse Trap

A piece of an old bicycle tire and a glass fruit jar are the only materials required for making this trap. Push one end of the tire in the hole, being sure that there is a space left at the end so that the mice can get in. Then bend the other end down into a fruit jar or other glass jar. Bait may be placed in the jar if desired, although this is not



Great Fun: Try It

necessary.—Contributed by Geo. G. McVicker, North Bend, Neb.

One-Wire Telegraph Line

The accompanying wiring diagram shows a telegraph system that requires no switches and can be operated with open-circuit batteries on a one-wire

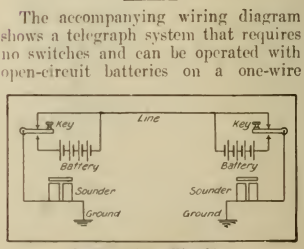


Diagram of One-Wire Line

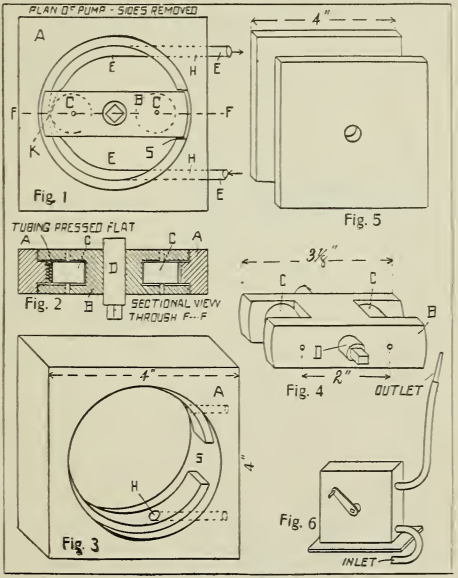
line with ground connections at each end. Any telegraph set in which the key makes double contact can be connected up in this way.—Contributed by R. A. Brown, Fairport, N. Y.

How to Make a Rotary Pump

A simple rotary pump is constructed on the principle of creating a vacuum in a rubber tube and so causing water to rise to fill the vacuum. Figs. 3, 4 and 5 show all the parts needed, excepting the crank and tubing. The dimensions and description given are for a minimum pump, but a larger one could be built in proportion.

Through the center of a block of wood 4 in. square and 7/8 in. thick (A, Figs. 1, 2 and 3) saw a circular opening 2 7/8 in. in diameter. On each side of this block cut a larger circle 3 1/4 in. in diameter, having the same center as the first circle (Fig. 3). Cut the last circles only 1/4 in. deep, leaving the first circle in the form of a ridge or track 3/8 in. wide, against which the rubber tubing, E, is compressed by wheels. Bore two 1/4-in. holes (HH, Fig. 1) from the outside of the block to the edge of the inner circle. Put the rubber tube, E, through one of these holes, pass it around the track and out through the other hole. Notice the break (S) in the track; this is necessary in order to place in position the piece holding the wheels.

Figure 4 shows the wheel-holder, B. Make it of hard wood 3 1/8 in. long, 1 in. wide and a little less than 7/8 in. thick, so that it will run free between the sides (Fig. 5) when they are placed. Cut two grooves, one in each end, 1 in. deep and 1/4 in. wide. In these grooves place wheels, CC, to turn on pins of stout wire. These wheels should be 3/4 in. in diameter. When placed in the holder their centers must be exactly 2 in. apart, or so arranged that the distance between the edge of the wheels and the track (K, Fig. 1) is equal to the thickness of the tubing when pressed flat. If the



Details of Rotary Pump

wheels fit too tight, they will bind; if too loose, they will let the air through. Bore a hole through the middle of the wheel-holder and insert the crank-

pin, D, which should be about ½ in. in diameter. The crankpin should fit tight; if necessary drive a brad through to keep it from slipping.

In the sides (Fig. 5) bore a hole in the center of the crankpin to run in loosely. Now put all these parts together, as shown in the illustration. Do not fasten the sides too securely until you have tried the device and are sure it will run smoothly. For the crank a bent piece of stout wire or a nail will serve, though a small iron wheel is better, as it gives steadiness to the motion. In this case a handle must be attached to the rim of the wheel to serve as a crank. The drive wheel from a broken-down egg-beater will do nicely. For ease in handling the pump, a platform should be added.

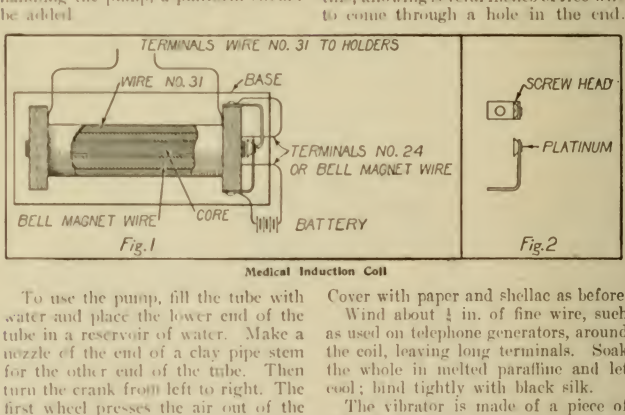
To use the pump, fill the tube with water and place the lower end of the tube in a reservoir of water. Make a nozzle of the end of a clay pipe stem for the other end of the tube. Then turn the crank from left to right. The first wheel presses the air out of the tube, creating a vacuum which is immediately filled with water. Before the first wheel releases the tube at the top, the other wheel has reached the bottom, this time pressing along the water that was brought up by the first wheel. If the motion of the wheels is regular, the pump will give a steady stream. Two feet of ¼-in. tubing, costing 10 cents, is all the expense necessary.—Contributed by Dan H. Hubbard, Idana, Kan.

How to Make a Small Medical Induction Coil

The coil to be described is 3½ in., full length of iron core, and ¾ in. in diameter.

Procure a bundle of small iron wire, say ¼ in. in diameter, and cut it 3½ in. long; bind neatly with coarse thread and file the ends smooth (Fig. 1). This done, make two wood ends, 1¼ by 1¼ in. and ⅜ in. thick, and varnish. Bore holes in the center of each so the core will fit in snugly and leave about ¼ in. projecting from each end (Fig. 1).

After finishing the core, shellac two layers of thick paper over it between the ends; let this dry thoroughly. Wind two layers of bell magnet wire over this, allowing several inches of free wire to come through a hole in the end.



Medical Induction Coil

Cover with paper and shellac as before.

Wind about ¼ in. of fine wire, such as used on telephone generators, around the coil, leaving long terminals. Soak the whole in melted paraffine and let cool; bind tightly with black silk.

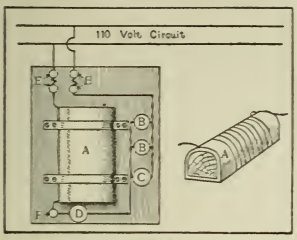
The vibrator is made of a piece of thin tin to which is soldered the head of an iron screw and on the other side a small piece of platinum, which can be taken from an old electric bell (Fig. 2).

Of course, a regulator must be had for the vibrator; this can be accomplished by bending a stout piece of copper wire as shown. The connections and the base for setting up are shown in the figures.—Contributed by J. T. R., Washington, D. C.

Amateur Mechanics

How to Make a Small Electric Furnace

Take a block of wood and shape into a core. One like a loaf of bread, and about that size, serves admirably. Wrap a layer of asbestos around it and cover



Electric Furnace

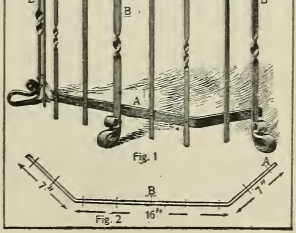
this with a thin layer of plaster-of-paris. When the plaster is nearly dry wind a coil of No. 36 wire around it, taking care that the wire does not touch itself anywhere. Put another course of plaster-of-paris on this, and again wind the wire around it. Continue the process of alternate layers of plaster and wire until 500 ft. or more of the latter has been used, leaving about 10 in. at each end for terminals. Then set the whole core away to dry.

For a base use a pine board 10 in. by 12 in. by 1 in. Bore four holes at one end for binding-posts, as indicated by E E. Connect the holes in pairs by ordinary house fuse wire. At one side secure two receptacles, B B, and one single post switch, C. Place another switch at I and another binding-post at F. The oven is now ready to be connected.

Withdraw the wooden core from the coils of wire and secure the latter by bands of tin to the board. Connect the ends of the wire to binding-posts E and F, as shown. From the other set of binding-posts, E, run a No. 12 or No. 14 wire, connecting lamp receptacles, B B, and switch, C, in parallel. Connect these three to switch, D, in series with binding-post, F, the terminal of the coil. Place 16-cp. lights in the receptacles and connect the fuses with a 110-volt lighting circuit. The apparatus is now ready for operation. Turn on switch, D, and the lamps, while C is open. The coil will commence to become warm, soon drying out the plaster-of-paris. To obtain more heat open one lamp, and to obtain still more open the other and close switch, C.—Contributed by Eugene Tuttles, Jr., Newark, Ohio.

How to Make a Fire Screen

A screen which will not interfere with the radiation of the heat from the fire, and will keep skirts and children safe can be made at little expense out of some strap iron. The screen which is shown in Fig. 1, stands 20 in. high from the base to the top crosspiece and is made of $\frac{3}{4}$ by $\frac{1}{4}$ in. and $\frac{1}{2}$ by $\frac{1}{4}$ in. iron. The top and bottom pieces marked AA, Fig. 1, are $\frac{3}{4}$ by $\frac{1}{4}$ in. and are 30 in. long, bent at an angle to fit the fireplace 7 in. from each end,



Made of Strap Iron

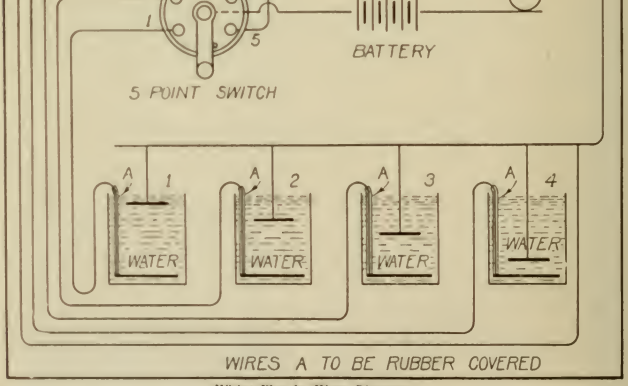
as shown in Fig. 2. The three legs marked BBB, Fig. 1, are of the same size iron and each leg will take 34 in. of material. In shaping the feet of these three pieces give them a slight tendency to lean toward the fire or inside of screen, says a correspondent in the Blacksmith and Wheelwright. In the two cross bars 1 in. from each end, A in Fig. 2, mark for hole and 3 in. from that mark the next hole. Take the center of the bar, B, 15 in. from each end, and mark for a hole, and 3½ in. on each side mark again and 3½ in. beyond each of these two, mark again.

Mark the legs 2¾ in. from the bottom and 2 in. from the top and make rivet holes and rivet them to the cross bars, AA, Fig. 1.

Cut six pieces, 17½ in. long and punch holes to fit and rivet onto the remaining holes in cross bars, AA, Fig. 1. Clean it up and give it a coat of black Japan or dead black.

How to Make a Simple Water Rheostat

The materials necessary are: One 5-point wood base switch, 4 jars, some sheet copper or brass for plates, about 5 ft. of rubber covered wire, and some No. 18 gauge wire for the wiring.



Wiring Plan for Water Rheostat

light current of 110 voltage it will be necessary to use large jars or wooden boxes made watertight, which will hold about 6 or 7 gal. Each jar to be filled with 20 parts water to 1 part sulphuric acid. Jars are set in a row in some convenient place out of the way.

The size of the jars depends on the voltage. If you are going to use a current of low tension, as from batteries, the jars need not be very large, but if you intend to use the electric

Next cut out eight copper or brass discs, two for each jar. Their size also depends on the voltage. The discs

that are placed in the lower part of the jars are connected with a rubber covered wire extending a little above the top of the jar.

To wire the apparatus, refer to the sketch and you will see that jar No. 1 is connected to point No. 1 on switch; No. 2 on No. 2, and so on until all is complete and we have one remaining point on switch. Above the jars place a wire to suspend the other or top discs in the solution. This wire is also connected to one terminal on the motor and to remaining point on switch. The arm of the switch is connected to one terminal of battery, or source of current, and the other terminal connected direct to remaining terminal of motor.

Put arm of switch on point No. 1 and lower one of the top discs in jar No. 1 and make contact with wire above jars. The current then will flow through the motor. The speed for each point can be determined by lowering top discs in jars. The top disc in jar No. 2 is lower down than in No. 1 and so on for No. 3 and No. 4. The connection between point No. 5 on switch, direct to wire across jars, gives full current and full speed. — Contributed by W. J. S., Emsworth, Pa.

Enlarging with a Hand Camera

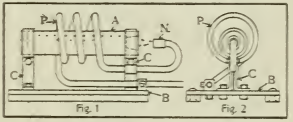
Every person that owns a hand camera has some pictures he would like enlarged. It is not necessary to have a large camera to do this, as the process is exceedingly simple to make large pictures from small negatives with the same hand camera.

A room from which all light may be excluded and a window through which the light can enter without obstruction from trees or nearby buildings with a shelf to hold the camera and a table with an upright drawing board attached, complete the arrangement. The back is taken out of the camera and fitted close against the back of the shelf, which must be provided with a hole the same size and shape as the opening in the back of the camera. The negative used to make the enlarged print is placed in the shelf at A, Fig. 1. The rays of the clear, unobstructed light strike the mirror, B, and reflect through the negative, A, through the lens of the camera and on the board, as shown in Fig. 2. The window must be darkened all around the shelf.

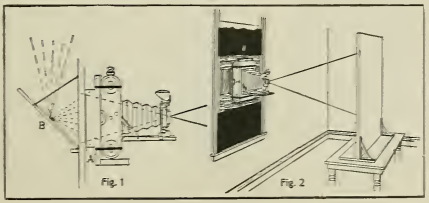
After placing the negative and focusing the lens for a clear image on the board, the shutter is set and a bromide paper is placed on the board. The paper is exposed, developed and fixed by the directions that are enclosed in the package of bromide papers.

Gasoline Burner for Model Work

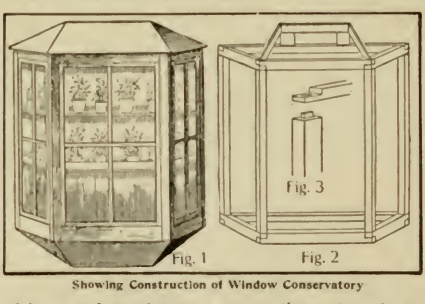
When making a small model traction engine or a locomotive the question arises, "What shall the fuel be?" If



you have decided to use gasoline, then a suitable burner is necessary. A piece of brass tubing about 3 in. in diameter and 6 in. long with caps screwed on both ends and fitted with a filling plug and a bicycle valve makes a good gasoline supply tank, says the Model Engineer, London. The bicycle valve is used to give the tank an air pressure which forces the gasoline to the burner.



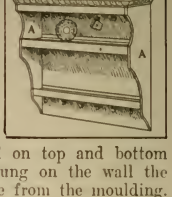
The burner is made from a piece of brass tube, A, as is shown in the illustration, $\frac{1}{2}$ in. in diameter and $2\frac{1}{2}$ in. long, which is plugged up at both ends, one end being drilled and reamed out to $\frac{1}{16}$ in. Three rows of holes $\frac{1}{16}$ in. in diameter are drilled in the brass tube. One row is drilled to come directly on top and the other two at about 45° from the vertical. It is then fitted to a sheet-steel base, B, by means of the clips, C C, Fig. 1. A piece of $\frac{1}{4}$-in. copper pipe, P, is then coiled around the brass tube, A, which forms the vaporizing coil. This coil should have a diameter of only 1 in. One end of the copper tube is bent around so it will point directly into the reamed out hole in the end of the brass tube, A. A nipple, N, is made by drilling an $\frac{1}{8}$-in. hole half-way through a piece of brass and tapping to screw on the end of the $\frac{1}{4}$-in. copper pipe. A $\frac{1}{64}$-in. hole is then drilled through the remaining part of the nipple. The other end of the copper tube is connected to the supply tank. The distance between the nipple, N, and the ends of the tube, A, should be only $\frac{5}{16}$ of an inch. Fig. 2 shows the end view.



Showing Construction of Window Conservatory

How to Make a Cup and Saucer Rack

The rack is made of any kind of wood suitable, of which sides, A, are cut just alike or from one pattern. The shelves are made in various widths to fit the sides at the places where they are wanted. The number of shelves can be varied and to suit the size of the dishes. Cup hooks are placed on top and bottom shelves. It is hung on the wall the same as a picture from the moulding. —Contributed by F. B. Emig, Santa Clara, Cal.



A Window Conservatory

During the winter months, where house plants are kept in the home, it is always a question how to arrange them so they can get the necessary light without occupying too much room.

The sketch shows how a neat window conservatory may be made at small cost that can be fastened on the house just covering a window, which will provide a fine place for the plants. The frame (Fig. 2) is made of about 2 by 2-in. material framed together as shown in Fig. 3. This frame should be made with the three openings of such a size that a four-paned sash, such as used for a storm window, will fit nicely in them. If the four vertical pieces that are shown in Fig. 2 are dressed to the right angle, then it will be easy to put on the finishing corner boards that hold the sash.

The top, as well as the bottom, is constructed with two small pieces like the rafters, on which is nailed the sheathing boards and then the shingles on top and the finishing boards on the bottom.

Deposits of copper netting $40 a ton were recently discovered in southwest Africa.

Amateur Mechanics

HOW TO MAKE SILHOUETTES

Photography in all branches is truly a most absorbing occupation. Each of us who has a camera is constantly experimenting, and every one of us is delighted when something new is suggested for such experiments.

To use a camera in making silhouettes select a window facing north if possible, or if used only at times when the sun is not on it, any window will do, says the Photographic Times. Raise the window shade half way, remove any white curtains there may be, and in the center of the lower pane of glass paste by the four corners a sheet of tissue paper that is perfectly smooth and quite thick, as shown in the sketch at B. Darken the rest of the window, shutting out all light from above and the sides.

Place a chair so that after being seated the head of the subject will come before the center of the tissue paper, and near to it as possible, and when looking straight before him his face will be in clear profile to the camera.

Draw the shades of all other windows in the room. Focus the camera carefully, getting a sharp outline of the profile on the screen. Do not stop down the lens, as this makes long exposure necessary, and the subject may move.

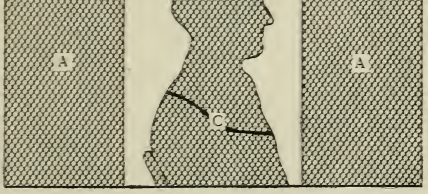
Correct exposure depends, of course, on the lens, light and the plate. But remember that a black and white negative is wanted with as little detail in the features as possible. The best plate to use is a very slow one, or what is called a process plate.

In developing get all possible density in the high lights, without detail in the face, and without fog. Printing is best done on contrasty development paper with developer not too strong.

The ideal silhouette print is a perfectly black profile on a white ground. With a piece of black paper, any shape in stopping off print may be made as shown at C in the sketch.

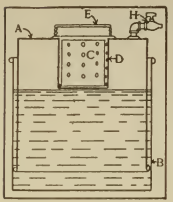
HOW TO CROSS A STREAM ON A LOG

When crossing a water course on a fence rail or small log, do not face up or down the stream and walk sideways, for a wetting is the inevitable result. Instead, fix the eye on the opposite shore and walk steadily forward. Then if a mishap comes you will fall with one leg and arm encircling the bridge.—C. C. S.



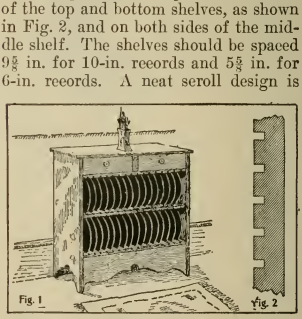
A HOME-MADE ACETYLENE GAS GENERATOR

A simple acetylene gas generator used by myself for several years when out on camping trips was made of a galvanized iron tank, without a head, 18 in. in diameter and 30 in. deep, B, as shown in the sketch. Another tank, A, is made the same depth as B, but its diameter is a little smaller, so that inverted it will just slip easily into the tank B. In the bottom, or rather the top now, of tank A is cut a hole and a little can, D, is fitted in it and soldered. On top and over can D is soldered a large tin can screw. A rubber washer is fitted on this so that when the screw top, E, is turned on it, the joint will be gas-tight. Another can, C, which will just slip inside of the little can, is perforated with a number of holes. This can C is filled about half full of broken pieces of carbide and then placed in the little can D. A gas cock, H, is soldered on to tank A, as is shown, from which the gas may be taken through a rubber tube. Fill tank B with water and set tank A into it. This will cause some air to be inclosed, which can be released by leaving the cock open until tank A settles down to the point where the water will begin to run in the perforations of the little tank. The water then comes in contact with the carbide and forms gas, which expands and stops the lowering of tank A. Then the cock must be closed and tubing attached. It is dangerous to attempt to strike a match to light a jet or the end of the cock while air is escaping and just as the first gas is being made. Wait until the tank is well raised up before doing this.—Contributed by James E. Noble, Toronto, Ont.



HOME-MADE DISC RECORD CABINET

Select some boards that have a nice grain that are about 1 in. thick and 12 in. wide. Cut the end pieces each 36 in. long and trim down the edges so as to make them 11⅜ in. wide. The top board is made 28 in. long and full 12 in. wide. The three shelves are cut 25 in. long and the edges trimmed so they will be 11⅜ in. wide. The distance between the bottom of the top board and the top of the first shelf should be 3 in. Two drawers are fitted in this space as shown in Fig. 1. A series of grooves are cut ¼ in. wide, ¼ in. deep and ¾ in. apart on one side of the top and bottom shelves, as shown in Fig. 2, and on both sides of the middle shelf. The shelves should be spaced 9⅜ in. for 10-in. records and 5⅜ in. for 6-in. records. A neat scroll design is



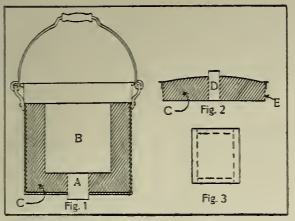
Holds 32 Records

cut from a board 25 in. long to fill up and finish the space below the bottom shelf.—Contributed by H. E. Mangold, Compton, Cal.

HOME-MADE POTTERY KILN

A small kiln for baking clay figures may be built at a cost of $1. The following shows the general plan of such a kiln which has stood the test of 200 firings, and which is good for any work requiring less than 1400° C.

Get an iron pail about 1 ft. high by 1 ft. across, with a cover. Any old pail which is thick enough will do, while a new one will cost about 80



Home-Made Pottery Kiln

cents. In the bottom of this cut a 2-in. round hole and close it with a cork or wood plug, A, Fig. 1, which shall project at least 2 in. inside the pail. Make a cylindrical core of wood, B, Fig. 1, 8 in. long and 8 in. across. Make a mixture of clay, 60%; sand, 15%; and graphite, 25%, kneading thoroughly in water to a good molding consistency. Line the pail, bottom and sides, with heavy paper and cover the core with same. Now pack the bottom of the pail thoroughly with a 2-in. layer of the clay mixture, and on it set the paper-wrapped core, carefully centering it. The 2 in. of space between the core and the sides of the pail all around is to be filled with clay, C, as is shown in the sketch, using a little at a time and packing it very tight. In like manner make the cover of the kiln, cutting the hole a little smaller, about 1 in. At the edge or rim of the cover encircle a 2-in. strip of sheet iron, E, Fig. 2, to hold the clay mixture, C. Set aside for a few days until well dried.

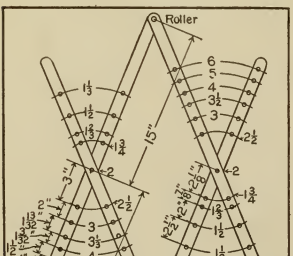
While these are drying you can be making a muffle, if there is to be any glazing done. This is a clay cylinder (Fig. 3) with false top and bottom, in which the pottery to be glazed is protected from any smoke or dust. It is placed inside the kiln, setting on any convenient blocks which will place it midway. The walls of the muffle should be about $\frac{1}{2}$ in. thick, and the dimensions should allow at least 1 in. of space all around for the passage of heat between it and the walls of the kiln. By the time the clay of the kiln is well dried, it will be found that it has all shrunk away from the iron about $\frac{3}{8}$ in. After removing all the paper, pack this space—top, bottom and sides—with moist ground asbestos. If the cover of the pail has no rim, it may be fastened to the asbestos and clay lining by punching a few holes, passing wire nails through and clinching them. Fit all the parts together snugly, take out the plugs in the top and bottom, and your kiln is ready for business. The handle of the pail will be convenient for moving it about, and it can be set on three bricks or some more elaborate support, as dictated by fancy and expense.

The temperature required for baking earthenware is 1250°-1310° C.; hotel china, 1330°; hard porcelain, 1390°-1410°. These temperatures cannot be obtained in the above kiln by means of the ordinary Bunsen burner. It will be necessary either to buy the largest size Bunsen, or make one yourself, if you have the materials. If you can get a cone which can be screwed into an inch pipe, file the opening of the cone to $\frac{1}{8}$ in. diameter, and jacket the whole with a $2\frac{1}{2}$-in. pipe. The flame end of this burner tube should be about $4\frac{1}{2}$ in. above the cone opening and should be covered with gauze to prevent flame from snapping back. When lighted, the point of the blue flame, which is the hottest part, should be just in the hole in the bottom of the kiln. Such a burner will be cheaply made and will furnish a kiln temperature of 1400°, but it will burn a great deal of gas.

A plumber's torch of medium size will cost more in the beginning, but will be cheaper in operation. Whatever burner is used, the firing should be gradual, and with especial caution the first time. By experiment you will find that a higher temperature is obtained by placing a 1-in. pipe 2 ft. long over the lid hole as a chimney. It would be still more effective to get another iron pail, 2 in. wider than the kiln, and get a down draft by inverting it over the kiln at whatever height proves most suitable.—G. L. W.

HOW TO MAKE A PANTOGRAPH

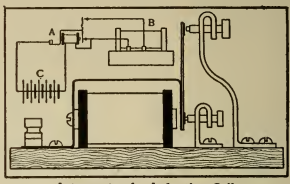
Secure four pieces of wood, from which cut and dress down to $\frac{5}{16}$ in. by $\frac{3}{4}$ in.; make two of them 31 in. long and the other two 24 in. long. These pieces of wood may be of any material, but it is best to make them of some hard wood. The "screw" in the sketch is a screw-eye long enough to pass through the arm and an old silk spool. This will keep the arms up from the board or table so as to allow a point at tracer point and pencil to be a little above the work. At tracer point a round-headed brass wood screw is used which is filed to a point and slightly rounding so it will not scratch. A lead pencil is sharpened and fitted in a hole marked "pencil." At point marked "roller" a screw-eye is put in from underneath to allow a rounding edge for this point to rest. The small holes on all arms are marked on the left from $1\frac{1}{3}$ to 6 and on the right from 6 to $1\frac{1}{3}$. When matched and clamped with a screw-eye will enlarge sketch or pattern from tracer point to the size of holes that are numbered in the semicircle. If holes marked $1\frac{1}{3}$ on left are matched and holes $1\frac{1}{3}$ on right are matched then it will increase the size of the drawing $1\frac{1}{3}$. If No. 6 on the left and No. 6 on the right are matched then the increase will be 6 times. The distance the holes are made one from the other is shown with the figures and inch marks.—Contributed by E. W. Bowen, Denver, Colo.



Home-Made Pantograph

CIRCUIT BREAKER FOR INDUCTION COILS

Amateurs building induction coils are generally bothered by the vibrator contacts blackening, thus giving a high resistance contact, whenever there is any connection made at all. This trouble may be done away with by departing from the old single contact vibrator and using one with self-cleaning contacts as shown. An old bell magnet is rewound full of No. 26 double cotton-covered wire and is mounted upon one end of a piece of thin sheet iron 1 in. by 5 in. as per sketch. To the other end of the strip of iron is soldered a piece of brass 1-64 in. by $\frac{1}{4}$ in. by 2 in., on each end of which has been soldered a patch of platinum foil $\frac{1}{4}$ in. square.



Interrupter for Induction Coil

The whole is connected up and mounted on a baseboard as per sketch, the contact posts being of $\frac{1}{16}$ in. by $\frac{1}{2}$ in. brass, bent into shape and provided with platinum tipped thumb screws. The advantage of this style of an interrupter is that at each stroke there is a wiping effect at the heavy current contact which automatically cleans off any carbon deposit.

In the wiring diagram, A is the circuit breaker; B, the induction coil, and C, the battery.—Contributed by A. G. Ward, Wilkinsburg, Pa.

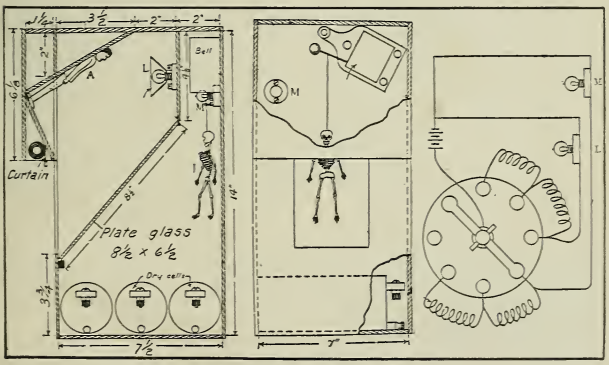
Amateur Mechanics

A Miniature Pepper's Ghost Illusion

Probably many readers have seen a "Pepper's Ghost" illusion at some amusement place. As there shown, the audience is generally seated in a dark room at the end of which there is a stage with black hangings. One of the audience is invited on to the stage, where he is placed in an upright open coffin. A white shroud is thrown over his body, and his clothes and flesh gradually fade away till nothing but his skeleton remains, which immediately begins to dance a horribly rattling jig. The skeleton then fades away and the man is restored again.

cupant are seen through the glass very plainly. The lights in front of the glass (behind the scenes) are now raised very gradually as those behind the glass are turned down, until it is dark there. The perfectly black surface behind the glass now acts like the silver backing for a mirror, and the object upon which the light is now turned—in this case the skeleton—is reflected in the glass, appearing to the audience as if really occupying the stage.

The model, which requires no special skill except that of carpentry, is



Construction of the Pepper's Ghost Illusion

The explanation is very simple, says the Model Engineer and Electrician. Between the audience and the coffin is a sheet of transparent glass, inclined at an angle so as to reflect objects located behind the scenes, but so clear as to be invisible to the audience and the man in the coffin. At the beginning the stage is lighted only from behind the glass. Hence the coffin and its occonstructed as shown in the drawings and described below.

The box containing the stage should be 14 in. by 7 in. by 7¼ in., inside dimensions. The box need not be made of particularly good wood, as the entire interior, with the exception of the glass, figures and lights, should be colored a dull black. This can well be done by painting with a solution of

lampblack in turpentine. If everything is not black, especially the joints and background near A, the illusion will be spoiled.

The glass should be the clearest possible, and must be thoroughly cleansed. Its edges should nowhere be visible, and it should be free from scratches and imperfections. The figure A should be a doll about 4 in. high, dressed in brilliant, light-colored garments. The skeleton is made of papier mâché, and can be bought at Japanese stores. It should preferably be one with arms suspended by small spiral springs, giving a limp, loose-jointed effect. The method of causing the skeleton to dance is shown in the front view. The figure is hung from the neck by a blackened stiff wire attached to the hammer wire of an electric bell, from which the gong has been removed. When the bell works he will kick against the rear wall, and wave his arms up and down, thus giving as realistic a dance as anyone could expect from a skeleton.

The lights, L and M, should be miniature electric lamps, which can be run by three dry cells. They need to give a fairly strong light, especially L, which should have a conical tin reflector to increase its brilliancy and prevent its being reflected in the glass.

Since the stage should be some distance from the audience, to aid the illusion, the angle of the glass and the inclination of the doll, A, has been so designed that if the stage is placed on a mantle or other high shelf the image of A will appear upright to an observer sitting in a chair some distance away, within the limits of an ordinary room. If it is desired to place the box lower down, other angles for the image and glass may be found necessary, but the proper tilt can be found readily by experiment.

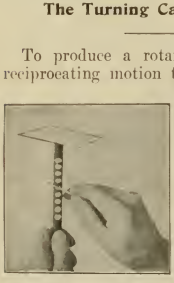
The electric connections are so simple that they are not shown in the drawings. All that is necessary is a two-point switch, by which either L or M can be placed in circuit with the battery, and a press button in circuit with the bell and its cell.

If a gradual transformation is desired, a double-pointed rheostat could be used, so that as one light dims the other increases in brilliancy, by the insertion and removal of resistance coils.

With a clear glass and a dark room this model has proved to be fully as bewildering as its prototype.

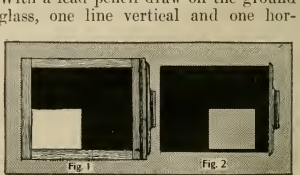
The Turning Card Puzzle

To produce a rotary motion from reciprocating motion take a lead pencil or other smooth stick and cut notches about $\frac{3}{16}$ or $\frac{1}{4}$ in. apart and about $\frac{1}{16}$ in. deep. Punch a hole exactly through the middle of a card, enlarge the hole a little and put a common pin through it, into end of pencil. Hold securely in the hand and rub a match or toothpick up and down over the notches and the card will revolve very fast. With some people to the right; with others to the left.



How to Make Four Pictures on One Plate

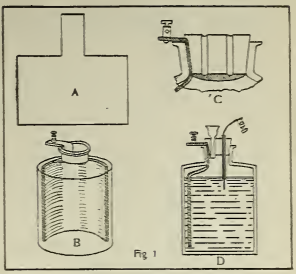
Secure two extra slides for the plate holders and cut one corner out on one of them, as shown in Fig. 1. Make a hole in the other, as shown in Fig. 2. With a lead pencil draw on the ground glass, one line vertical and one horizontal, each in the center. This will divide the ground glass in four equal parts.



Focus the camera in the usual man-

ner, but get the picture desired to fill only one of the parts on the ground glass. Place the plate holder in position and draw the regular slide; substitute one of the slides prepared and expose in the usual way.

If a small picture is to be made in the lower left-hand corner of the plate, place the prepared slide with the corner cut, as shown in Fig. 1. This slide may be turned over for the upper left-hand corner and then changed for slide shown in Fig. 2 for the upper and lower right-hand corners.—Contributed by D. L., Elizabeth, N. J.

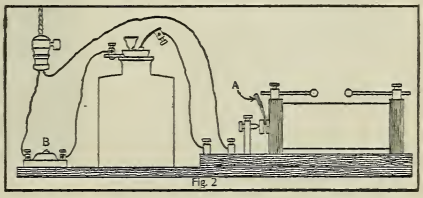


How to Make an Interrupter

The Wenult interrupter is an instrument much used on large coils and is far more efficient than the usual form of vibrators. It can also be used with success on small coils as well as large. Although it is a costly instrument to purchase, it can be made with practically no expense and the construction is very simple.

First procure a wide mouthed bottle about 4 in. high, provided with a rubber stopper. This stopper should be pierced, making two holes about ¼ in. in diameter.

From a sheet of lead $\frac{1}{16}$ in. in thickness cut a piece shaped like A, Fig. 1. Common tea lead folded several times will serve the purpose. When in the bottle this lead should be of such a size that it will only reach half way around, as shown in B. To insert the lead plate, roll it up so it will pass through the neck of the bottle, then smooth it out with a small stick until it fits against the side, leaving the small strip at the top projecting through the neck of the bottle. Bend this strip to one side and fit in the stopper, as shown in C. A small binding-post is fastened at the end of the strip.



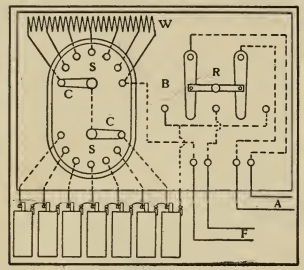
Having fixed the lead plate in position, next get a piece of glass tube having a bore of about $\frac{1}{32}$ of an inch in diameter. A piece of an old thermometer tube will serve this purpose. Insert this tube in the hole in the stopper farthest from the lead plate. Get a piece of wire that will fit the tube and about 6 in. long, and fasten a small binding-post on one end and stick the other into the tube. This wire should fit the hole in the tube so it can be easily moved. In the hole nearest the lead plate insert a small glass funnel.

The interrupter as it is when complete is shown at D, Fig. 1. Having finished the interrupter, connect it with the electric light circuit as shown in Fig. 2. Fill the bottle with water to about the line as shown in D, Fig. 1. Adjust the wire in the small glass tube so that it projects about ¼ in. Add sulphuric acid until the water level rises about $\frac{1}{16}$ in. Turn on the current and press the button, B. If all adjustments are correct there will

be a loud crackling noise from the interrupter, a violet flame will appear at the end of the wire and a hot spark will pass between the secondary terminals. If the interrupter does not work at first, add more sulphuric acid through the funnel and press the wire down a little more into the liquid. A piece of wood, A, Fig. 2, should be inserted in vibrator to prevent it from working.—Contributed by Harold L. Jones, Carthage, N. Y.

A Controller and Reverse for a Battery Motor

Secure a cigar or starch box and use to make the base, B. Two wood base switches, S S, are cut off a little past



Motor Reverse and Controller

the center and fastened to the base with a piece of wood between them. The upper switch, S, is connected to different equal points on a coil of wire, W, while the lower switch, S, is connected each point to a battery, as shown. The reverse switch, R, is made from two brass or copper strips fastened at the top to the base with screws and joined together by a piece of hard rubber or wood with a small handle attached. Connect wires A to the armature and wires F to the field of the motor. By this arrangement one, two or three and so on up until all the battery cells are used and different points of resistance secured on the coil of wire. The reverse lever when moved from right to left, or left to right, changes the direction of the armature in the motor from one way to the other. —Contributed by J. Fremont Hilscher, Jr., West St. Paul, Minn.

Athletics for Young Men

The accompanying illustration shows a group of young Americans enjoying themselves by building a human pyra-

Photo by W. Vanderslock, Paterson, N. J.

The Human Pyramid

mid on the sands of a New Jersey bathing beach between dips in the briny deep.

Don't pull a lamp hung by flexible cord to one side with a wire and then fasten to a gas pipe. I have seen a wire become red hot in this manner. If the lamp hung by a cord must be pulled over, use a string.

Don't wrap paper around a lamp for a shade. You might go home and forget it and a fire might be started from the heat. Use a glass or metal shade. That is what they are for.

Amateur Mechanics

A Microscope Without a Lens

By E. W. Davis

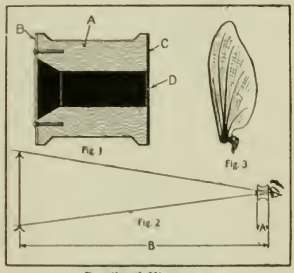
Nearly everyone has heard of the pin-hole camera, but the fact that the same principle can be used to make a microscope, having a magnifying power of 8 diameters (64 times) will perhaps be new to some readers.

To make this lensless microscope, procure a wooden spool, A (a short spool, say ½ or ¾ in. long, produces a higher magnifying power), and enlarge the bore a little at one end. Then blacken the inside with india ink and allow it to dry. From a piece of thin transparent celluloid or mica, cut out a small disc, B, and fasten to the end having the enlarged bore, by means of brads. On the other end glue a piece of thin black cardboard, C, and at the center, D, make a small hole with the point of a fine needle. It is very important that the hole D should be very small, otherwise the image will be blurred.

To use this microscope, place a small object on the transparent disc, which may be moistened to make the object adhere, and look through the hole D. It is necessary to have a strong light to get good results, and, as in all microscopes of any power, the object should be of a transparent nature.

The principle on which this instrument works is illustrated in Fig. 2. The apparent diameter of an object is inversely proportional to its distance from the eye, i. e., if the distance is reduced to one-half, the diameter will appear twice as large; if the distance is reduced to one-third, the diameter will appear three times as large, and so on. As the nearest distance at which the average person can see an object clearly is about 6 in., it follows that the diameter of an object ¾ in. from the eye would appear 8 times the normal size. The object would then be magnified 8 diameters, or 64 times. (The area would appear 64 times as large.) But an object ¾ in. from the eye appears so blurred that none of the details are discernible, and it is for this reason that the pin-hole is employed.

Viewed through this microscope, a fly's wing appears as large as a person's hand, held at arm's length, and has the general appearance shown in Fig. 3. The mother of vinegar examined in the same way is seen to be swarming



Details of Microscope

with a mass of wriggling little worms, and may possibly cause the observer to abstain from all salads forever after. An innocent looking drop of water, in which hay has been soaking for several days, reveals hundreds of little infusoria, darting across the field in every direction. These and hundreds of other interesting objects may be observed in this little instrument, which costs little or nothing to make.

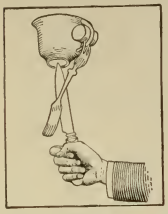
Prince Rupert's Drops

Prince Rupert's drops are made by letting drops of melted glass fall into cold water. These drops become oval in shape with a tail or neck resembling a retort. Their peculiarity is that when a small portion of the tail or neck is

broken off the whole bursts into powder with an explosion and a considerable shock is felt by the hand that grasps it.

How to Balance a Cup on a Knife

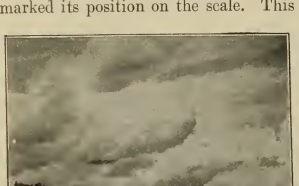
If you were told that you could balance a cup one-quarter full of coffee on the point of a carving knife you would hardly believe it. Insert a cork in the handle of a cup tightly, says the Detroit Free Press. Stick two of the prongs of a fork into the cork, in the position shown in the sketch. This arrangement lowers the center of gravity of the whole, and if you have a steady hand, you may now place the cup on the point of the knife.



Photographs Lightning Flash

This interesting letter and lightning flash photograph were received from Fred M. Roberts, Paterson, N. J., and describe how he profited from an article published in Popular Mechanics.

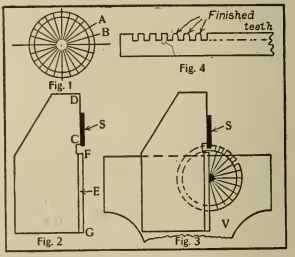
"Receiving a suggestion from an article published in Popular Mechanics on the subject of photographing lightning flashes, I took my camera out and focusing it on the setting sun marked its position on the scale. This enabled me to obtain the correct focus quickly the first night an electrical storm occurred, with a result, as you can see, to be proud of. The exposure was taken about 8:30 o'clock in the evening with the camera set due south. I had often thought of the possibilities of photographing flashes but never gave it a trial until after reading the above mentioned article."



Brilliant Cloud Effect

How to Make Small Gear Wheels Without a Lathe

To make small models sundry small gears and racks are required, either cut for the place or by using the parts from an old clock. With no other tools than a hack-saw, some files, a compass and with the exercise of a little patience and moderate skill, very good teeth may be cut on blank wheels.

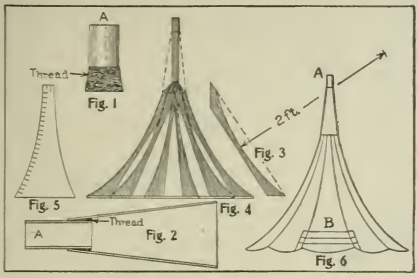


Making Model Wheels

First take the case of a small gear-wheel, say 1 in. outside diameter and $\frac{1}{16}$ in. thick, with twenty-four teeth. Draw a circle on paper, the same diameter as the wheel. Divide the circumference into the number of parts desired, by drawing diameters, Fig. 1. The distance A B will be approximately the pitch. Now describe a smaller circle for the base of the teeth and halfway between these circles may be taken as the pitch circle.

Now describe a circle the same size as the largest circle on a piece of $\frac{1}{16}$-in. sheet metal, and having cut it out and filed it up to this circle, fasten the

marked-out paper circle accurately over it with glue. Saw-cuts can now be made down the diameters to the smaller circle with the aid of a saw guide, Fig. 2, made from $\frac{1}{16}$-in. mild steel or iron. This guide should have a beveled edge, E from F to G, to lay along the line on which the saw-cut is to be made. The straight-edge, C D, should be set back one-half the thickness of the saw-blades, so that the center of the blade, when flat against it, will be over the line F G. A small clearance space, F C, must be made to allow the teeth of the saw to pass.



Details of Phonograph Horn

The guide should then be placed along one of the diameters and held in position until gripped in the vise, Fig. 3. The first tooth may now be cut, care being taken to keep the blade of the saw flat up to the guiding edge. The Model Engineer, London, says if this is done and the saw-guide well made, the cut will be central on the line, and if the marking out is correct the teeth will be quite uniform all the way round. A small ward file will be needed to finish off the teeth to their proper shape and thickness.

In making a worm wheel the cuts must be taken in a sloping direction, the slope and pitch depending on the slope and pitch of the worm thread, which, though more difficult, may also be cut with a hacksaw and file.

A bevel wheel should be cut in the same manner as the spur wheel, but the cut should be deeper on the side which has the larger diameter. To cut a rack the pitch should be marked along the side, and the guide and saw used as before (Fig. 4).

How to Make a Paper Phonograph Horn

Secure a piece of tubing about $1\frac{3}{4}$ in. long that will fit the connection to the reproducer, and wrap a quantity of heavy thread around one end as shown in the enlarged sketch A, Fig. 1. Form a cone of heavy paper, 9 in. long and 3 in. in diameter, at the larger end with the smaller end to fit the diameter of the tube A, making it three ply thick and gluing the layers together. Attach this cone on the tube A where the thread has been wrapped with glue, as shown in Fig. 2. Fig. 2 is also an enlarged sketch. Make ten pieces about 1 ft. 10 in. in length and 3 in. wide from the thin boards of a biscuit or cracker box. Cut an arc of a circle in them on a radius of 2 ft. (Fig. 3). Make a stick 10-sided, 12 in. long, that will fit loosely in the tube, A, to which nail the 10 pieces as shown in Fig. 4, connecting the bottom by cross pieces, using care to keep them at equal distances apart and in a circle whose diameter is about 2 ft.

The cone is placed over the stick as shown by the dotted lines in Fig. 4 and temporarily fastened in position. Cut out paper sections (Fig. 5) that will cover each space between the 10 pieces, allowing 1 in. on one side and the top in which to cut slits that will form pieces to overlap the next section and to attach with glue. Fasten the sections all around in like manner. The next course is put on in strips overlapping as shown at B, Fig. 6. Finish by putting on sections in the same way

as the first course, making it three-ply thick. Remove the form, trim to suit and glue a piece of paper over the edge. When the glue is thoroughly hardened, put on two coats of white and one of blue paint, shading it to suit and striping it with gold bronze. —Contributed by B. H. Haver, Houston, Tex.

How to Bind Magazines

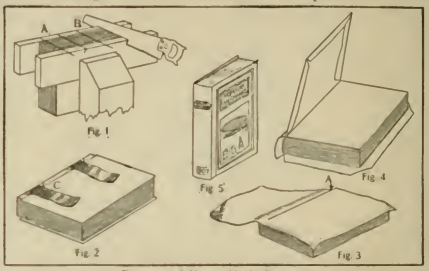
An easy way to bind Popular Mechanics in volumes of a year each is to arrange the magazines in order and tie them securely both ways with a strong cord. It is well to put two or three sheets of tough white paper, cut to the size of the pages, at the front and back for fly leaves.

Clamp the whole in a vise or clamp with two strips of wood even with the back edges of the magazines. With a sharp saw cut a slit in the magazines and wood strips about ½ in. deep and slanting as shown at A and B, Fig. 1. Take two strips of stout cloth, about 8 or 10 in. long and as wide as the distance between the bottoms of the sawed slits. Lay these over the back edge of the pack and tie securely through the slits with a string thread—wrapping and tieing several times (C, Fig. 2).

If you have access to a printer's paper knife, trim both ends and the front edge; this makes a much nicer book, but if the paper knife cannot be used, clamp the whole between two boards and saw off the edges, boards and all, smoothly, with a fine saw.

Cut four pieces of cardboard, ¼ in. longer and ¼ in. narrower than the magazines after they have been trimmed. Lay one piece of the board on the book and under the cloth strips. Use ordinary flour paste and paste the strips to the cardboard and then rub paste all over the top of the strips and the board. Rub paste over one side of another piece of board and put it on top of the first board and strips pressing down firmly so that the strips are held securely between the two boards. Turn the book over and do the same with the other two boards.

After the paste has dried a few minutes take a piece of strong cloth, duck or linen, fold and cut it 1 in. larger all around than the book, leaving the folded edge uncut. Rub paste over one of the board backs and lay one end of the cloth on it, smoothing and creasing as shown at A, Fig. 3. Turn the book over and paste the other side. The back edges should have a good coat of paste and a strip of paper the width of the thickness of the pack pasted on before pasting the cloth to the second board back.



Process of Home-Made Binding

Cut off the corners and fold over the edges of the cloth, pasting them down (Fig. 4). Rub paste on one side of a fly leaf and press the back down on it. Turn the book over and paste a fly leaf to the other back after the edges of the cloth have been folded down. The backs must not be opened until the fly leaves are thoroughly dry. Trim and tuck in the ends of the strip at the back edge.

When fixed this way your magazines make one of the most valuable volumes you can possibly add to your library of mechanical books. — Contributed by Joseph N. Parker, Bedford City, Va.

Amateur Mechanics

HOW TO MAKE A COMBINATION LOCK

A locking device which a boy can easily attach to a slide bolt on any door is made of wood or of metal as preferred.

The device consists of two discs with an

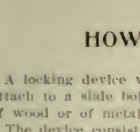


Fig. 1

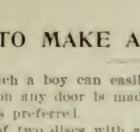


Fig. 2

indent in each, as shown in Figs. 1 and 2, which are to be held in place on the inside of the door in such position that the slide bolt cannot be opened, excepting when both discs are turned, so that the bolt may fit into the two indents, as indicated in Fig. 3.

The discs should be, say, 1½ in. in diameter; the indents in their edges ⅛ in. deep and ¼ in. wide. The indents may extend clear through the thickness of the discs, or, if the discs be made of thick wood, only deep enough to allow the slide bolt to penetrate the opening formed by the indents of both discs coming together. A ¼ in. hole should be bored in the center of each disc.

In the first disc, diametrically opposite the indent and about ½ in. from the center of the disc, a small pin ¼ in. long should be driven, driving it 3/16 in. into the disc, and allowing 1/16 in. to clear, as shown at B, Fig. 1.

On the face of the second disc, Fig. 2, at the location shown by B, a piece of leather, wood or metal, ¼ in. long, ⅛ in. wide and 1/16 in. thick, should be tacked, using very small nails. When the discs are placed in position (Fig. 4) they must be faced together with a 1 16-in. washer between them, so that the pin driven in the first disc (which disc must be allowed to turn loosely on a shaft) will be caught by the bit of leather fastened on the second disc (which disc must be keyed securely to the shaft); this will cause the second disc to be turned by the first disc after the first has revolved far enough for the piece of leather to come in contact with the pin.

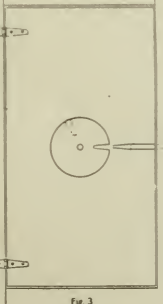


Fig. 3

The slide bolt, as well as the disc device, should be on the inside of the door; but a knob attached to the slide bolt should ex-

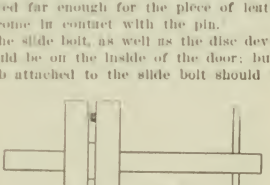


Fig. 4

tend through a slot in the door, so that the bolt may be slid back and forth from the outside of the door, when the discs are in the right position to allow it to slide. Fig. 5 shows two views of the slide bolt, with a head made to fit the indents in the disc.

Fig. 6 shows how a block may be attached to the inside of the door as a support for the pin or shaft on which the discs revolve, and leaving room between the block and the door for the discs. Fig. 7 shows the shaft, ⅛ in. in diameter, with a cross handle on the end which is to be on the outside of the door. This handle serves not only to turn the shaft, but also as an indicator on the dial face. The dial face may be painted on the door, showing figures from 1 to 12.

When you have put the device together, go on the inside of the door and then turn the shaft to the left until the piece of leather on the second disc catches the pin driven into the first disc and carries the disc around until the indent in it is in the proper position to allow the slide bolt to

open. Go to the outside of the door now, and note at what figure on the dial face the indicator rests. This figure is the first figure in your combination. The slide bolt will not open as yet, however, as the second disc is

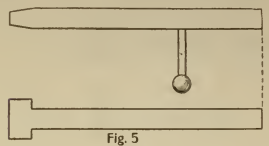


Fig. 5

not in position. To keep the first, or loose, disc in position while the second disc is being turned, a steel spring should be made to rest on its surface, acting as a "brake."

The shaft must not be turned in the opposite direction, or to the right, until the indent in the second disc comes into position alongside the first. The point at which

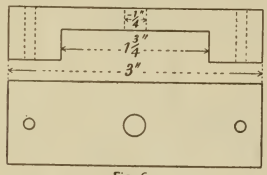


Fig. 6

the indicator rests now is the second number in your combination.

To open the lock, turn the shaft several revolutions to the left and let the indicator rest at the first number in your combination. Then turn to the right until the indicator rests at the second number of the combination; draw back the slide bolt and

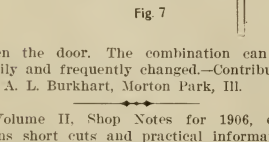


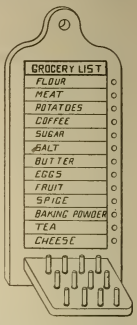
Fig. 7

open the door. The combination can be easily and frequently changed.—Contributed by A. L. Burkhart, Morton Park, Ill.

HOW TO MAKE A GROCERY MEMORANDUM

A handy device for the kitchen is a grocery memorandum by which the housewife can remind herself of what she wishes from the store when the order boy makes his morning call.

Procure a piece of white wood, 9 in. long by 3 in. wide, and plane off the edges and surface. Then, with the aid of a scroll saw, saw out the top as shown in the illustration. This done, file it even with a wood file, then sandpaper it.



With a medium pencil, not too hard, draw the lines for the names. These lines should be about ⅜ in. apart. At the right hand side of each name make a hole for a peg.

Make the peg board or shelf 2¼ in. long and 1½ in. wide and round off the corners. At the bottom of the list board chisel out a hole 3/16 in. deep for the shelf. Glue the shelf in and make the pegs of a size to fit in the holes. Finish with two coats of shellac.

When the housekeeper thinks of something she must order, she puts a peg opposite the name of that article, and thus has no trouble in remembering it. The board would be very pretty done in burnt wood. —Contributed by Walter A. Springborg, Elgin, Ill.

TRAP FOR SMALL ANIMALS

This is a box trap with glass sides and back, the panes of glass being held in place by brads placed on both sides. The animal does not fear to enter the box, because he can see through it; when he enters, however, and touches the bait the lid is released and, dropping, shuts him in. This is one of the easiest traps to build and is usually successful.

Amateur Mechanics

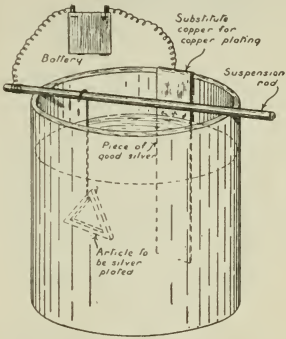
EASY METHOD OF ELECTRO-PLATING

Before proceeding to electroplate with copper, silver or other metal, clean the articles thoroughly, as the least spot of grease or dirt will prevent the deposit from adhering. Then polish the articles and rub them over with a cloth and fine pumice powder, to roughen the surface slightly. Finally, to remove all traces of grease, dip the articles to be plated in a boiling potash solution made by dissolving 4 oz. American ash in 1½ pt. of water. Do not touch the work with the hands again. To avoid touching it, hang the articles on the wires by which they are to be suspended in the plating bath, before dipping them in the potash solution; then hold them by the wires under running water for ten minutes to remove the potash.

For plating with copper prepare the following solution: 4 oz. copper sulphate dissolved in 12 oz. water; add strong ammonia solution until no more green crystals are precipitated. Then add more ammonia and stir until the green crystals are re-dissolved giving an intense blue solution. Add slowly a strong solution of potassium cyanide until the blue color disappears, leaving a clean solution; add potassium cyanide again, about one-fourth as much in bulk as used in the decolorizing process. Then make the solution up to 2 qt. with water. With an electric pressure of 3.5 to 4 volts, this will give an even deposit of copper.

A solution for silver-plating may be prepared as follows: Dissolve ¾ oz. of commercial silver nitrate in 8 oz. of water, and slowly add a strong solution of potassium cyanide until no more white precipitate is thrown down. Then pour the liquid off and wash the precipitate carefully. This is best done by filling the bottle with water, shaking, allowing precipitate to settle and then pouring off the water. Repeat six times. Having finished washing the precipitate, slowly add to it a solution of potassium cyanide until all the precipitate is dissolved. Then add an excess of potassium cyanide—about as much as was used in dissolving the precipitate—and make the solution up to 1 qt. with water. This solution, with an electric pressure of 2 to 4 volts, will give a good white coat of silver in twenty minutes to half-an-hour; use 2 volts for large articles, and 4 volts for very small ones. If more solution is required, it is only necessary to double all given quantities.

Before silver-plating, such metals as iron,



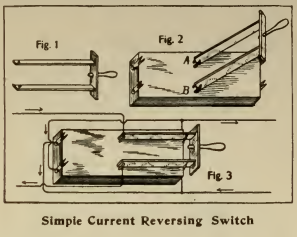
Electroplating Apparatus

lead, pewter, zinc, must be coated with copper in the alkaline copper bath described, and then treated as copper. On brass, copper, German silver, nickel and such metals, silver can be plated direct. The deposit of silver will be dull and must be polished, says the Model Engineer, London. The best method is to use a revolving scratch brush; if one does not possess a buffing machine, a hand scratch brush is good. Take quick, light strokes. Polish the articles finally with ordinary plate powder.

The sketch shows how to suspend the articles in the plating bath. If accumulators are used, which is advised, be sure to connect the positive (or red) terminal to the piece of silver hanging in the bath, and the negative (or black) terminal to the article to be plated. Where Bunsen cells are used, the carbon terminal takes the place of the positive terminal of the accumulator.

SIMPLE SWITCH FOR REVERSING A CURRENT

Take two strips of copper or brass and fasten them together by means of gutta



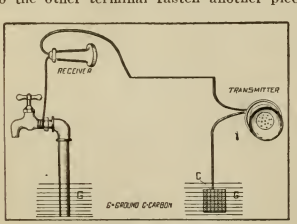
Simple Current Reversing Switch

percha (Fig. 1); also provide them with a handle. Saw out a rectangular block about one and one-half times as long as the brass strips and fasten to it at each end two forked pieces of copper or brass, as in Fig. 2. Fasten on the switch lever as at A and B, Fig. 2, so that it can rotate about these points. Connect the wires as shown in Fig. 3. To reverse, throw the lever from one end of the block to the other.—Contributed by R. L. Thomas, San Marcos, Tex.

INTERESTING ELECTRICAL EXPERIMENT

The materials necessary for performing this experiment are: Telephone receiver, transmitter, some wire and some carbons, either the pencils for arc lamps, or ones taken from old dry batteries will do.

Run a line from the inside of the house to the inside of some other building and fasten it to one terminal of the receiver. To the other terminal fasten another piece



A Unique Battery

of wire and ground it on the water faucet in the house. If there is no faucet in the house, ground it with a large piece of zinc.

Fasten the other end to one terminal of the transmitter and from the other terminal of the same run a wire into the ground. The ground here should consist either of a large piece of carbon, or several pieces bound tightly together.

If a person speak into the transmitter, one at the receiver can hear what is said, even though there are no batteries in the circuit. It is a well known fact that two telephone receivers connected up in this way will transmit words between two persons, for the voice vibrating the diaphragm causes an inductive current to flow and the other receiver copies these vibrations. But in this experiment, a transmitter which induces no current is used. Does the carbon and the zinc and the moist earth form a battery?—Contributed by Wm. J. Slattery, Emsworth, Pennsylvania.

HOME-MADE GRENET BATTERY

Procure an ordinary carbon-zinc sal ammoniac battery and remove the zinc rod. If the battery has been used before, it is better to soak the carbon cylinder for a few hours to remove any remaining crystals of sal ammoniac from its pores.

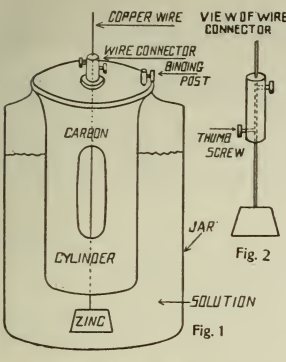
The truncated, conical zinc required is known as a fuller's zinc and can be bought at any electrical supply dealer's, or, it may be cast in a sand mould from scrap zinc or the worn-out zinc rods from sal ammoniac batteries. It should be cast on the end of a piece of No. 14 copper wire. Amalgamation is not necessary for the zinc one buys, but if one casts his own zinc, it is necessary to amalgamate it or coat it with mercury. This may be done as follows:

Dip a piece of rag in a diluted solution of sulphuric acid (acid 1 part, water 16 parts); rub the zinc well, at the same time allowing a few drops of mercury to fall on a spot attacked by the acid. The mercury will adhere, and if the rubbing is continued so as to spread the mercury, it will cover the entire surface of the zinc, giving it a bright, silvery appearance.

Next procure what is known as a wire connector. This is a piece of copper tube about 1½ in. long having two thumb screws, one on each end on opposite sides (Fig. 2). The upper screw is to connect the battery wire, the lower one to raise

and lower the zinc. The battery is now complete, and the solution (Fig. 1) must be prepared. Proceed as follows:

In 32 oz. of water dissolve 4 oz. potassium bichromate. When the bichromate has all dissolved, add slowly, stirring constantly, 4 oz. sulphuric acid. Do not add the acid too quickly or the heat generated may break the vessel containing the solution. Then pour the solution into the battery jar, until it is within 3 in. of the top. Thread the wire holding the zinc through the porcelain insulator of the carbon cylinder and also through the wire connector. Pull the zinc up as far as it will go and tighten the lower thumb screw so that it holds the wire secure. Place the carbon in the jar. If the solution touches the zinc, some of it should be poured out. To determine whether or not the zinc is touched by the solution, take out the carbon and lower the zinc. If it is wet, there is too much liquid in the jar. The battery is now ready for use.



Details of Home-Made Battery

To cause a flow of electricity, lower the zinc until it almost touches the bottom of the jar and connect an electric bell or other electrical apparatus by means of wires to the two binding posts.

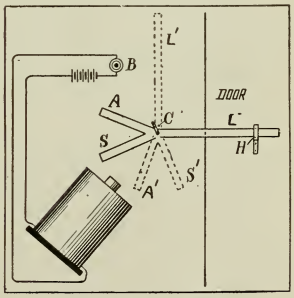
This battery when first set up gives a current of about two volts. It is useful for running induction coils, or small electric motors. When through using the battery, raise the zinc and tighten the lower thumb screw. This prevents the zinc wasting away when no current is being used.—Contributed by H. C. Meyer, 132 West Logan St., Germantown, Phila., Pa.

SIMPLE ELECTRIC LOCK

The illustration shows an automatic lock operated by electricity, requiring a strong magnet, but no weights or strings which greatly simplifies the device over many others of the kind.

The weight of the long arm, L, is just a trifle greater than the combined weights of the short arms, A and S. The fulcrum of the lever is at C, where there is a staple. The lever swings on one arm of the staple and the other arm is so placed that when the lever is in an upright position, with the long arm at L', it will not fall because of its greater weight but stays in the position shown. The purpose of this is to leave the short arm, A, when in position at A', within the reach of the magnet. Arm L rests on an L-shaped hook, H; in this position the door is locked.

To unlock the door, press the button, B. The momentum acquired from the magnet by the short arms, A and S, is sufficient to move the long arm up to the position of L'. To lock the door, press the button and the momentum acquired from the magnet by the short arms, now at A' and S' is sufficient to move the long arm down from L' to the position at L.—Contributed by Benjamin Kubelsky, 597 W. Harrison street, Chicago, Ill.



Lock Operated by a Magnet

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