THE MAGAZINE WITHOUT A RIVAL

PRACTICAL MECHANICS

DECEMBER

6D.

SPECIAL CHRISTMAS FEATURES

MECHANICAL MAGIC – ELECTRICAL ENTERTAINMENT – SCIENTIFIC AMUSEMENT AND ALL THE REGULAR FEATURES

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Practical Mechanics

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Edited by F.J.CAMM

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Notes, News and Views

The Encyclopædia of Popular Mechanics

THOSE readers who are qualifying for our Presentation ENCYCLOPÆDIA OF POPULAR MECHANICS should carefully study the announcement in the central column of this page, and also the instructions given on the subscription vouchers. The last coupon appears on p. 156 of this month's issue. When you receive the volume you will agree that it is a reasonably complete technical library conveniently contained between two covers—readily consultable and useful alike in the workshop or for the fireside hour when looking up some favoured subject.

Paired Broadcasts

A NEW system of wireless transmission is at present the subject of experiment in Holland, with the object of doubling the present ether accommodation and thus eliminating the present acutely congested state, which makes interference-free reception impossible except on expensive superheterodynes. Briefly, in the new system, which has already met with encouraging success, two different programmes are transmitted simultaneously on the same carrier wave. By means of a simple change-over switch, either of the two programmes may be received free from mutual interference, the switch altering the circuit arrangement only.

The Wavelength Change-over

IT has now been decided that the change-over in wavelengths according to the Lucerne Plan will commence at 11 p.m. G.M.T., on January 14th, 1934, at which time all European transmissions on present wavelengths will cease, and one by one, in a sequence yet to be settled, stations will recommence on their new wavelengths. What effect, if any, this change-over will have on receiver design remains to be seen.

Modern Bicycles at Last

MOST bicycles sold to-day have not progressed beyond the stage they had reached twenty years ago. Cone bearings, rim brakes, old-fashioned saddles, absurd handlebars and drop-frames are still the main features of the two-wheeler. It is usually sent out without lamp, bell or stand, and with the minimum amount of cheap tools. It is an absurdity to enamel or plate the wheel rims, when the brakes rapidly strip the finish off. One bicycle firm, at least, is now supplying its machines completely equipped with internal-expanding hub brakes, dynamo lighting, chromium plating and cellulose finish, and bell. Other manufacturers should follow this example.

The Wingless Autogiro

THE extended use of aircraft for commercial and passenger carrying services is hampered by the lack of aerodromes in this country. Fortunately municipalities all over the country have realised that they owe it to residents and industries located within their districts to have spaces cleared and landing grounds prepared in readiness for the aviation era. Two great drawbacks to civil aviation—the length of run necessary to take-off and land, and lack of aerodromes—have now been removed, the latter by the development of the wingless Autogiro which, whilst not being a helicopter, can take off with a run of only a few feet and descend almost vertically. Even with ordinary aircraft the length of run after landing has been considerably reduced by the use of efficient wheel brakes; but the length of run before take-off can never be much reduced, for high air speed means high loading in pounds per square foo of wing area, which in turn means a long run along the ground before the requisite air speed is attained. Air safety under all weather conditions means high air speed.

Binding Case and Index

IN reply to many readers, we shall issue an annual binding case, title page and index for PRACTICAL MECHANICS, and an announcement will be made in issue No. 12.

Advice to Inventors

IT is evident that many of our readers are inventors of a fairly high order, for our daily post brings scores of letters from readers, disclosing clever ideas of marketable value. But most of these readers make the mistake of presuming that fortune follows *as a matter of course!* Something more than inventive ability is necessary in order to make money, and business ability is often worth far more than the idea itself. Everyone who overcomes some little mechanical difficulty is an inventor, and we all possess inventive ability to a more or less marked degree. The clever inventor is he who produces something which is *wanted*, which can be *marketed cheaply*, which is *satisfactory*, which *improves* upon something already in existence, is of *popular appeal*, and who possesses also business energy, enthusiasm and ability. Invention does not necessarily mean the creation of something intricate, for inventors of ingenious machinery seldom make money. On the other hand, fortunes have been made out of the lever collar stud, the propelling pencil, the safety pin and the safety razor—all simple devices of universal appeal.

It is absolutely essential to patent an idea, if it is intended to exploit it, and we are quite unable to help inventors who "haven't the money to do so. If you lack business ability, you should place the matter in the hands of a competent patent agent.

We are always prepared to advise inventors regarding the novelty or validity of their ideas.

The LATEST Novelties

The address of the makers of any device described below will be sent on application to the Editor, PRACTICAL MECHANICS 8-11, Southampton St., Strand, W.C. 2. Quote number at end of paragraph.

A Pocket X-Ray

THIS ingenious little device can be used as an X-ray, glass-cutter, a reading glass and also contains a mirror which

A pocket X-ray and combination tool.

will be useful in a number of ways. The price is 2*s.* 6*d.* or 2*s.* 9*d.* postage free. [18]

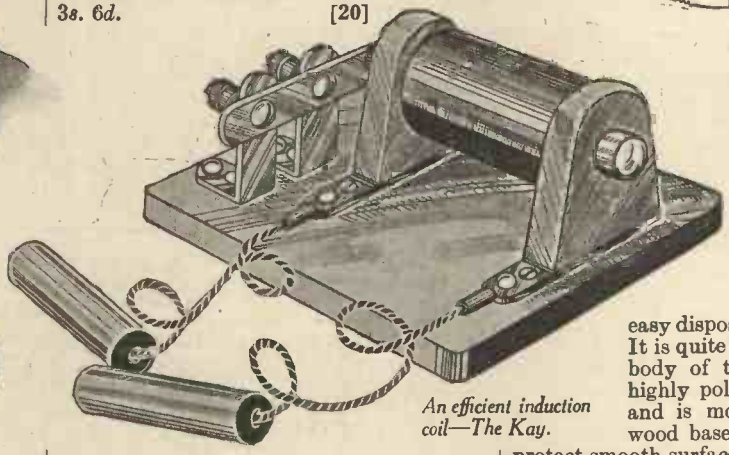
Rain Goggles for Motorists

ACCORDING to a daily paper an inventor has recently marketed the ingenious goggles shown below, the object being to keep the lenses of the goggles perfectly clear when motor cycling or motoring. A small fan actuated by the speed of the vehicle drives a small belt which in turn oscillates across each lens a small wiper blade. As soon as details of manufacture reach us we shall pass them on to our readers. [19]

Goggles that are kept clear during rain.

A Simple Induction Coil

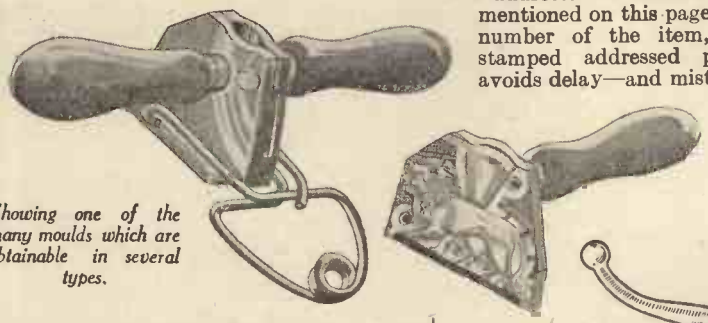
EXPERIMENTS with electricity always hold a certain amount of fascination to most of us, and the simple piece of apparatus shown on this page is capable of producing harmless shocks, and will give an endless amount of amusement. The coil costs 3*s.* 6*d.* [20]



An efficient induction coil—The Kay.

Casting Your Own Toys

METAL toys and novelties are always in the greatest demand at this time of the year, and by means of solid metal casting

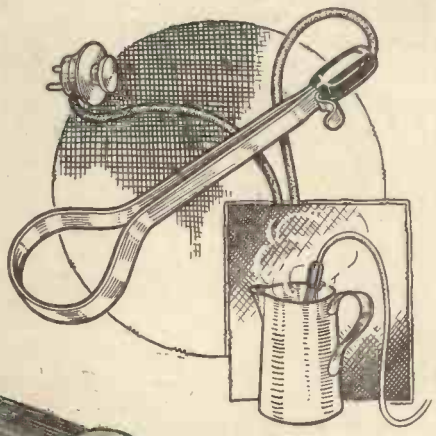


Showing one of the many moulds which are obtainable in several types.

moulds, similar to that shown in the sketch you can produce without limit a large number of cow-boys, soldiers, Indians, etc. The method of working these moulds is simplicity itself; you simply pour the molten lead, tin, or other scrap metal into the mould, and in less than two seconds complete figures are cast. The moulds are obtainable for 5*s.* 6*d.*, post free, and a pamphlet showing the various designs, which are numerous, can be obtained upon application to the makers of these moulds, whose address we shall be pleased to forward to interested readers. [21]

The "Instant" Juice Press

THE illustration at the foot of the third column shows an ingenious juice presser which makes it a pleasure instead of work to squeeze the juice out of lemons, oranges, etc. The taste of the fruit juice is much improved, and pips and pulp are eliminated. To operate it place a glass tumbler in place between the feet of the press, in which position it is not only protected from being upset or jolted off the board but centres itself immediately underneath the spout. Cut the fruit in half and lay one half inverted on the slotted tray; press down the lever and the juice, free from rind, pips and pulp, pours into the glass. The tray lifts out for easy disposal of the pulp residue. It is quite easy to clean and the body of the press is made of highly polished cast aluminium and is mounted on a polished wood base with rubber feet to protect smooth surfaces. The price is 20*s.* complete. [22]



An immersion heater, details of which were given on page 56 of last month's issue.

How the juice presser is operated.

Special Note

WILL readers requiring names and addresses of manufacturers of items mentioned on this page *please* quote the number of the item, and enclose a stamped addressed postcard? This avoids delay—and mistakes.

The VOXOMETER

The Voxometer enables one to see on a translucent screen the strange effects of sound waves and the endless variety of patterns, many of them curiously beautiful, that are produced by the incoming music and speech in a wireless receiver.

WITH the simple instrument described herewith a new field is opened for the amateur wireless experimenter. The Voxometer is made by placing a small loud speaker unit in a tin can as illustrated in the sketches. A half-pint paint tin, or round cocoa tin, will answer the purpose admirably. Two tin brackets are soldered to the can to secure it to the baseboard. Molten paraffin wax is poured into the space between the tin can and the loud speaker unit in order to produce a dead sound chamber between the loud speaker unit and the rubber diaphragm.

To obtain the best results the diaphragm must consist of very thin rubber. In the original Voxometer, rubber from a toy rubber balloon was used, strong rubber bands being used to bind it over the top of the can.

The degree of tautness of the rubber diaphragm will depend somewhat upon the power of the loud speaker and the current fed into it, but a little perseverance will produce the desired results.

Owing to the fact that a small pool of mercury is placed on the rubber diaphragm, it will be necessary to create just the slightest depression in the centre. This can be done by fixing a small iron weight in the centre.

The cabinet is constructed of plywood with a ¼-in. soft wood base. The window in the front is cut out with a fret-saw and provided with ground glass.

The images of the sound waves are created by the light reflected by a series of mirrors, the mercury itself acting in the capacity of a mirror. These mirrors have tin backs of the size and shape illustrated and are attached to the post with small angle brackets.

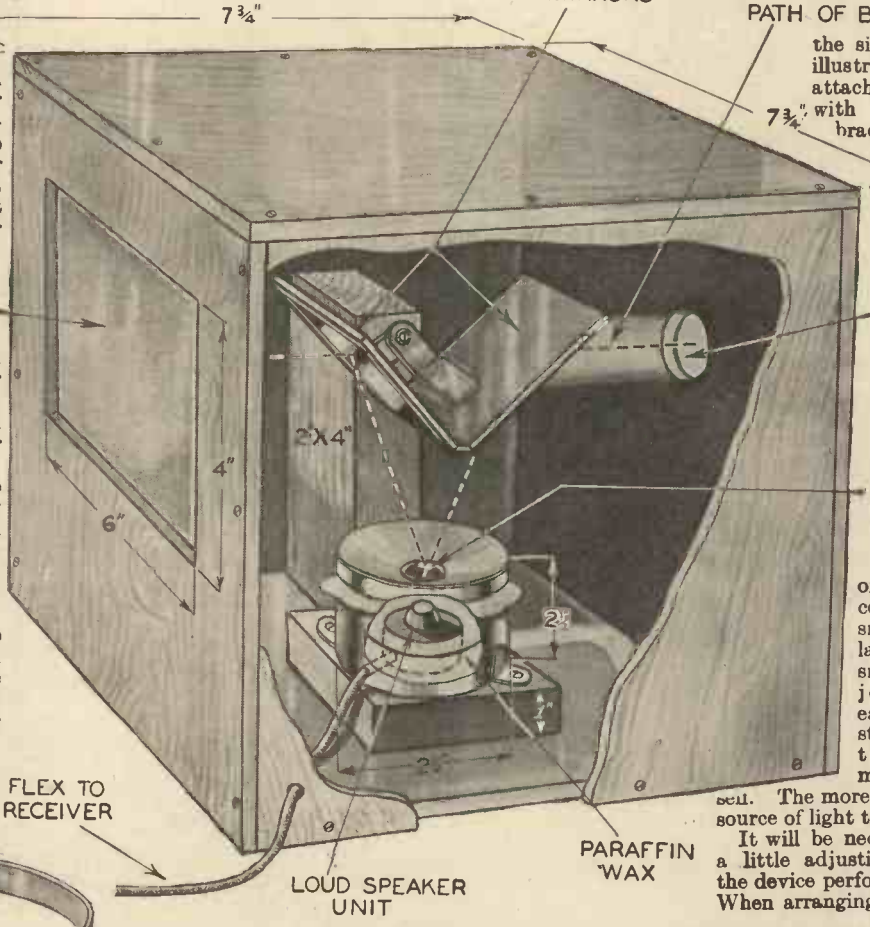


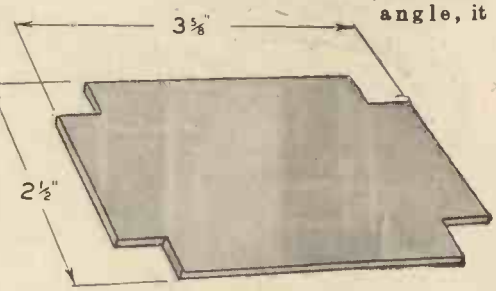
Fig. 1.—A cut away view of the complete apparatus with all the necessary dimensions.

The source of light may come from a small magic lantern, or a small light projector may easily be constructed by the experimenter himself. The more powerful the source of light the better.

It will be necessary to do a little adjusting to make the device perform perfectly. When arranging the mirrors at the correct angle, it should always be borne in mind that the angle of incidence is always equal to the angle of reflection.

Matters will be helped a little if the inside of the cabinet is painted with dull, black paint.

Fig. 2.—How the diaphragm is made.



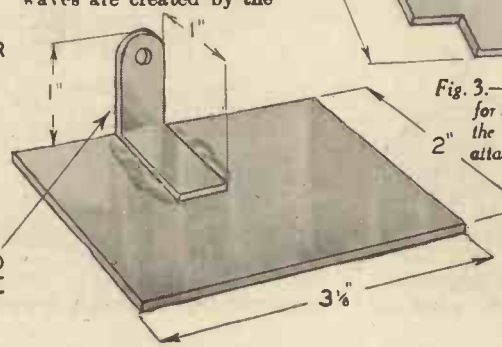


Fig. 3.—The tin backs for the mirrors with the fixing bracket attached.

A BROADCAST MICROPHONE FOR THE AMATEUR

A SIMPLE AND EFFICIENT DEVICE SUITABLE FOR HOME BROADCASTING

By "ELECTRON"

THE construction of a real high quality microphone that will compare very favourably with the more conventional broadcast type is quite within the scope of the average experimenter. No great skill and very few tools are required.

The two-carbon electrodes E may be made from the carbon pole of an old dry cell. Cut it roughly to shape with a hacksaw and finish off by rubbing it *very carefully* against a sheet of glasspaper. Then, *very slowly and very lightly*, drill a hole through it for the connecting screw.

The Case

Now to begin building the case (Fig. 1). Disc D is first. Drill two holes 1 in. from the edge to receive the connecting screws which also hold the electrodes in place. Place the electrodes in their correct positions and tighten up the screws securely.

Be careful not to make them too tight or the electrodes are apt to break. The spacing-block, G, is glued between the two electrodes.

Next glue disc B on top of D and place a weight upon it until the glue has set firmly. A ¼-in. hole is then drilled through D and G for filling the microphone with carbon granules at a later stage.

With an eighth drill very carefully honeycomb the *surface* of each electrode. The 3-in. cellophane diaphragm is then glued on top of disc B. Stretch it just tight enough to pull out the wrinkles, and no tighter (Fig. 2).

Over the cellophane secure disc C to the rest of the microphone with brads. Finally, glue a circular piece of muslin over disc C and fasten ring A on top of it with wood screws.

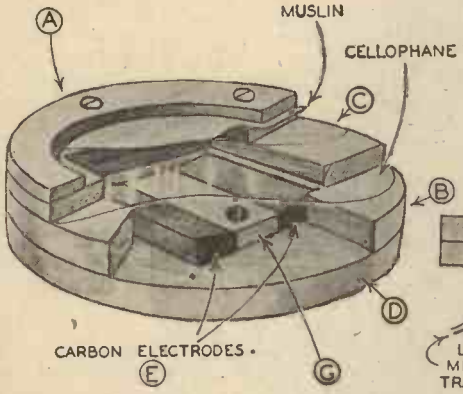


Fig. 2.—A cut-away view of the microphone, showing the position of the various parts shown in Fig. 1.

The Carbon Granules

Turn the microphone over on its face and carefully fill the filler-hole full of carbon granules. Lift it off the table or bench and gently tap it. The granules will gradually disappear into the innards of the microphone. Repeat this until no amount of tapping will make the microphone absorb more carbon granules. Seal the filler-hole with wax, and the microphone is finished!

A professional-looking mounting for the microphone is illustrated in Fig. 3.

The actual granules should preferably be obtained from a good electrical dealer, although a satisfactory form of granule may be made at home. The best carbon should be purchased, and this may be of the stick or plate type. It should first be broken into medium size pieces with the aid of a hammer lightly applied, and then the whole carefully tapped until the pieces are sufficiently small for the final process, which is best carried out by rubbing them between two sheets of *coarse* sandpaper held in the hands.

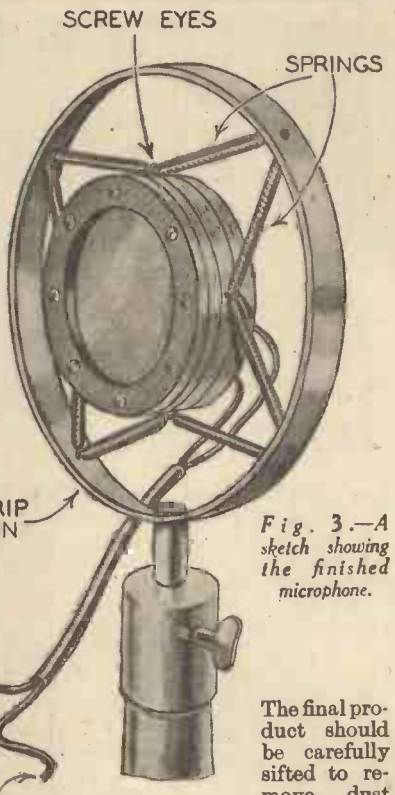


Fig. 3.—A sketch showing the finished microphone.

The final product should be carefully sifted to remove dust and large pieces.

The Transformer

The choice of the transformer will go a long way towards the efficient working of the microphone. A really high-ratio will be found most suitable, probably 100 to 1 proving as good as any. The method of using the microphone in conjunction with a broadcast wireless receiver is explained elsewhere in this issue, and the notes there given should be carefully studied. The transformer must, of course, be joined to a suitable battery, and the voltage of this should be about 4·5 to 6 volts. A modification of this may be made, of course, according to the requirements of the particular transformer which is employed. The connections for the transformer are . Secondary winding to the grid circuit of the input valve on the amplifier; Primary winding in series with a battery and the microphone, and in order to avoid the use of a large voltage battery it is obvious that the primary winding resistance must be kept low, say, of the order of 5 to 10 ohms.

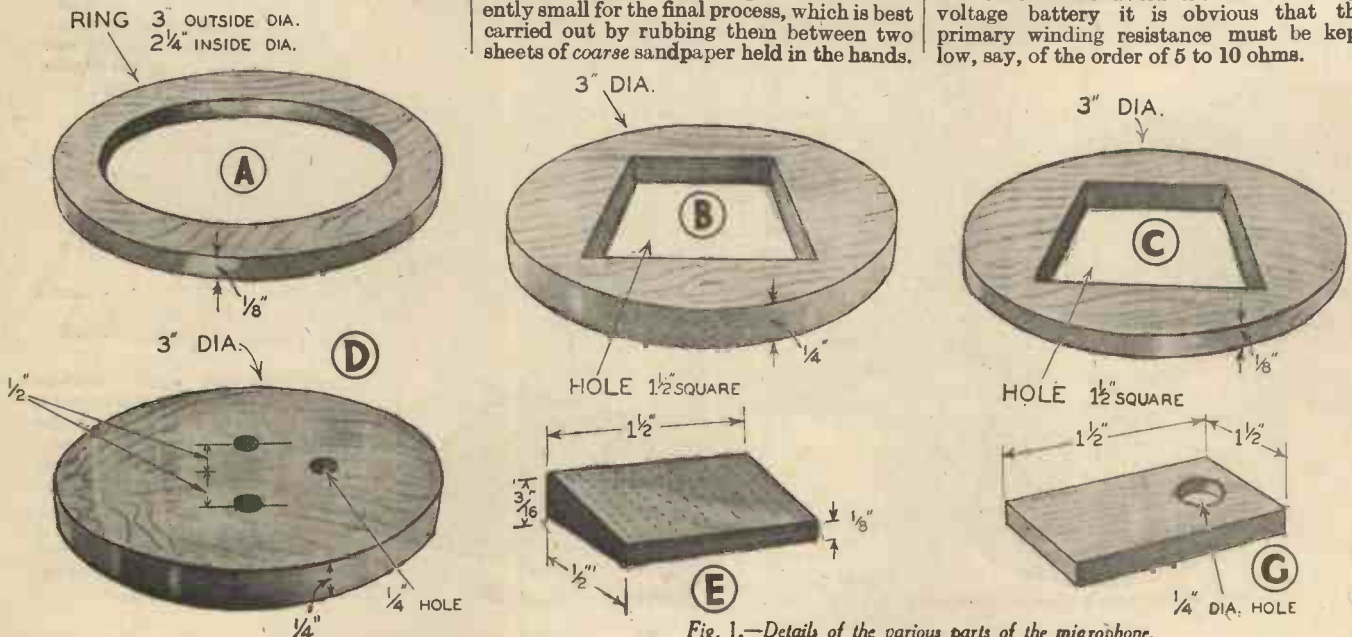


Fig. 1.—Details of the various parts of the microphone.

PARTY RADIO FUN

HOW THE RADIO MAY BE INTRODUCED AS AN ADDITIONAL AID TO THE ENJOYMENT OF A XMAS GATHERING

By W. J. DELANEY

WHEN the usual run of well-known parlour games has been exhausted there is a danger of the enjoyment being marred owing to a sudden attack of "What shall we do next?" If you have a wireless set there are any amount of ingenious ideas which may be carried out by its aid, and which will lend not only an air of novelty to the customary party, but will also be of educational interest to young and old alike.

The Microphone

With the aid of a microphone many "Home Broadcasting" ideas may be carried out. The microphone may be purchased as a ready-made affair in various forms. Undoubtedly the best type to obtain is one similar to that shown in No. 1. This is actually a highly sensitive microphone which has been especially developed for the purpose of the amateur broadcaster and is a splendid piece of apparatus. It is sensitive and very free from noises, thus enabling really high-quality broadcasting to take place without any difficulty. In addition to these special microphones, there are a number of cheaper types obtainable from 1*s.* upwards, and these may generally be improved by attaching them to the centre of a flexible diaphragm of mica, celluloid, thin ebonite sheet, etc. In most cases the makers of the device will supply an instruction sheet stating how to adapt the instrument for best results, and it is unnecessary to add that these instructions should be adhered to.

Whatever type of microphone is obtained, it must be joined to the wireless set in the same way, and that in the grid circuit of one of the valves. Where the receiver is fitted with a gramophone pick-up device, or connections for such an arrangement, the microphone takes its place. If no such modification has been made to the receiver, a Bulgin pick-up adaptor should be obtained (price 1*s.* 6*d.*), and this should be plugged into a valveholder in place of one of the valves, and the valve inserted into the sockets on top of the adaptor. The leads from the microphone are then joined to the two terminals on the adaptor. Now to use this device for novelty arrangements—as distinct from the more obvious ideas of singing or playing musical instruments so as to form small concert programmes—there are one or two ingenious games which are possible. For this the loud speaker should be joined to the receiver by means of extension leads so that it may be stood in one room whilst the microphone and receiver are in another room. Charades will be the first obvious arrangement, and this will prove much more entertaining than the usual way of playing it, owing to the air of "mystery" which is lent by the distant actors.

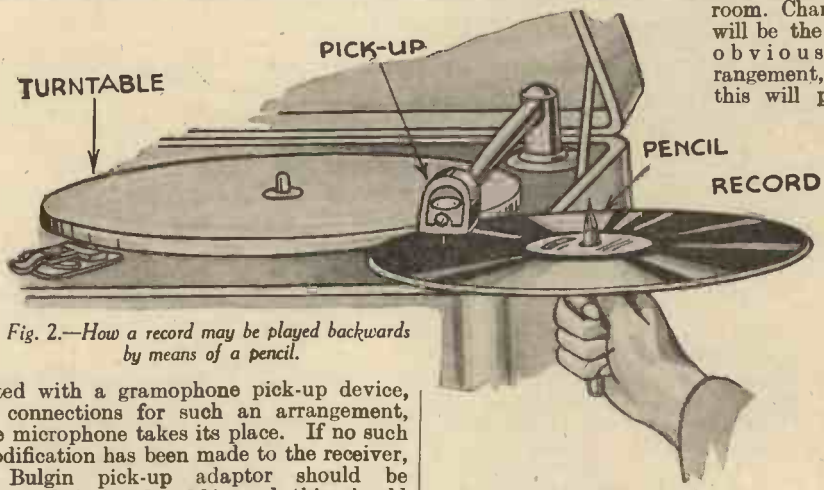


Fig. 2.—How a record may be played backwards by means of a pencil.

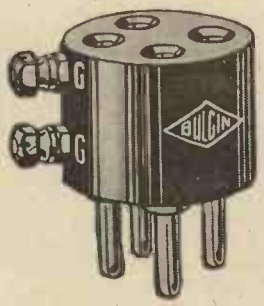


Fig. 1.—The Bulgin pick-up adaptor.

What is it?

A good scope for individuality will be obtained if you endeavour to disguise various well-known sounds. Thus, one person goes into the "studio" and the remainder stay by the loud speaker. The absent member then takes some object, such, for instance, as a bunch of keys, and either jingles them or taps them with a wooden object, etc., in front of the mike. By arranging one member as judge, and informing him on leaving the room what object is going to be used, the winner may be declared as the first person to shout out the name of the object. Many similar devices may be carried out by the aid of the mike.

The Gramophone

One idea which may be turned to interesting speculation with the radio

Fig. 3.—How the party make a human connection to the loud speaker.

gramophone or wireless receiver which is adapted for use with records is to play a record backwards and see who is first to guess the tune. Obviously well-known dance tunes will prove most suitable, and the method of rotating them backwards is illustrated in Fig. 2. As an additional idea for causing laughter, and not by any means one which is in the form of a game, is to take one of your older records (preferably one which is of no further use) and to make another hole about ¼ in. from the existing spindle hole. A good way of doing this is to burn it through with a cigarette. Place the record on the turntable and put the needle on the first groove *without starting the motor*. Turn the volume control "off" and then start the motor. When it has obtained maximum speed turn up the volume control, and I will guarantee that everyone will join in the laughter that greets the terrible noise which the record gives off. This idea, incidentally, works best with a soprano!

Fig. 4.—Music can be heard by placing a sheet of brown paper between the heads of two people, whilst each holds one of the loud speaker leads from the set.

Electrical Games

Providing the receiver is battery-operated, there are a number of interesting party games which may be carried out without any danger of shocks, and thus may be participated in by even the youngest child. The simplest, and one which causes wonder even in these days of enlightenment, is the "Human Chain." For this purpose obtain a length of ordinary twin lighting flex and attach the two ends to the loud speaker terminals. Divide the party into two sections, and let the end of one wire be grasped by one member whilst the other wire is grasped by another member. Now everyone else joins hands and the two ends of the chain each take hold of the loud speaker leads or terminals. Fig. 3 should make the arrangement quite clear. If the receiver is tuned to a station, or a gramophone record is played through the pick-up, the music will be heard from the speaker in almost undiminished volume, having passed through the bodies of the human chain. Another interesting idea is for two members each to hold one of the extension wires, and for them to place their heads together with a sheet of stiff, *dry* brown paper between their two adjacent ears. Again the music will be heard, but this time without the aid of any electrical reproducing apparatus, such as telephones or loud speaker. Where does the music come from? (Fig. 4). If the local station is not situated too far away, an interesting arrangement is for the members of the party to join hands and see if the programme can be picked up by using the "party" as an aerial. The end member takes hold of the aerial terminal for this purpose, the normal aerial being disconnected. It will probably be found that quite good signals can be obtained, although if the receiver is not very powerful, or the station is some distance away, it will be necessary for the other end of the chain to take hold of the aerial lead as well.

A novel game, on the "Hunt the Slipper" principle, may be carried out with the aid of extension lines from the loud speaker terminals. For this arrangement the wireless receiver must be fitted with an output filter, and if this has not already been fixed, it may be joined outside the receiver. Fig. 5 shows the connections, from which it will be seen that only a good L.F. choke and a 2-mfd. fixed condenser are required. The lead marked A is carried into the centre of the room, and is of such a length that it may be taken to any part of the room without being disconnected from the receiver. Now to complete the circuit so that the speaker will give out signals it is necessary for lead B to be joined to earth. Therefore by connecting various metal objects in the room to a common earth lead it is possible to carry out the idea of giving each person in turn the lead A (which, of course, is bared at the end) and allowing a certain time for them to "find the music." To do this they must, of course, touch some earthed object, and the fun may be increased by arranging a large number of metal objects in the room and standing these on wooden surfaces, such as the table, etc., and running the earth wire to only a few. By suitably disguising those which are "earthed," the chances of a quick solution are greatly reduced. The old idea of calling out "hot" or "cold" may, of course, be included, but the game will be found much more entertaining than the older form.

A Table Game

Lastly, a table game may be made up by the handyman suitable for participation by four or more players. A sheet of three-ply wood is cut roughly to shape, and upon it is marked a railway route obtainable from any good map of England. The map may be coloured to add detail, or it may simply be drawn on in ink. At the principal towns a small hole is drilled and a brass paper fastener fitted with the head uppermost, and so forming the dot which usually takes the place of a town on a railway map. At one end of the board a larger fastener is fitted with the head underneath, and at two opposite corners small square plates of brass are fixed on the upper surface to which are attached a number of flexible wires. Instead of the plate, of course, a large terminal may be used. From the large fastener wires are run below the board to the bottoms of the fasteners which are spread over the board, and two extension leads are taken to the loud speaker terminals. Disconnect the aerial and earth from the set and turn up the reaction control so that the receiver is oscillating. Now the participants in the game sit round the table and those on one side take hold of the wires from one corner, whilst those on the opposite side take the wires from the other corner. The master of ceremonies gives each member the name of one of the towns, and when all is ready he calls out, for instance, London to York. Instantly the person who has been given the name London places the end of his wire on the dot which is fixed on the town of that name on the map, whilst the person who represents York does the same with his wire. By allowing a time limit much fun may be caused by the delay in some members searching for a town, especially if some of the lesser-known places are included in the scheme. No doubt many variations of this arrangement will occur to the mechanically-minded, but sufficient has been given to enable quite an enjoyable evening to be spent entirely different from the customary games and pastimes.

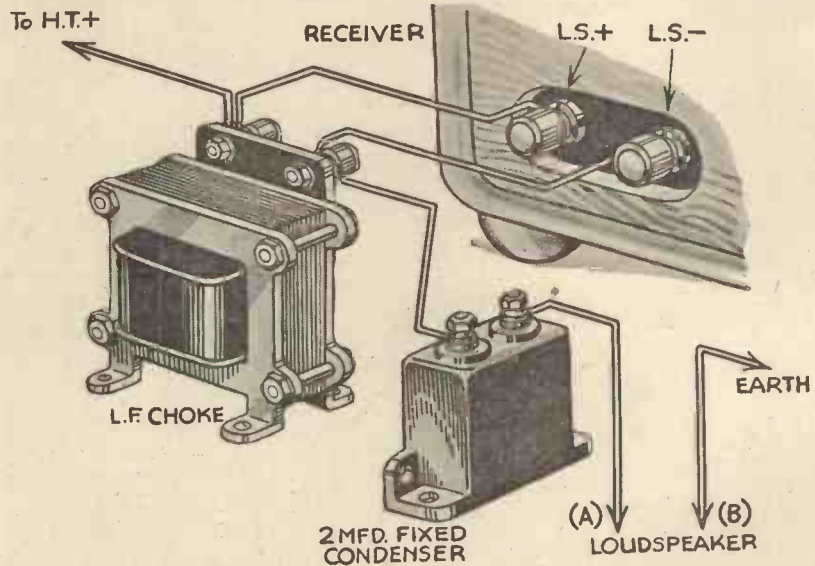
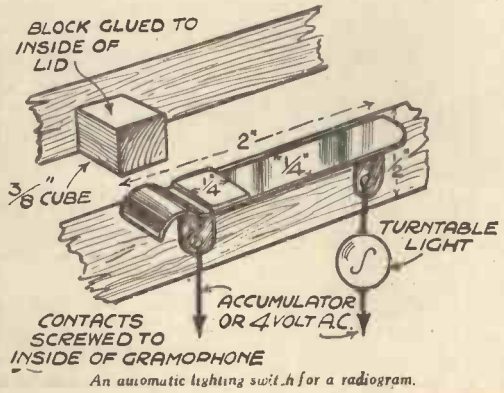


Fig. 5.—The arrangement of the apparatus for "hunt the slipper."

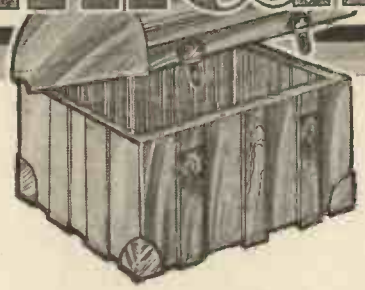
An Automatic Radiogram Switch

THE sketch shows the constructional details of an automatic radiogram switch that is worked by simply lifting the lid of the cabinet. When the lid is lifted the turntable is automatically lighted up. It is composed of a piece of springy brass 2 inches long and ¾ inch wide, four wood screws, and a small block of wood ⅜ inch cube.



An automatic lighting switch for a radiogram.

Mechanical Magic



Some Mystifying Conjuring Apparatus Described by Louis Nikola

A TOP SPINNING TRICK

LATHE workers may like to make this little device. It offers no special difficulty either in construction or performance, and in many cases can probably be made from workshop scrap.

Spinning a top upon the edge of a sword-blade presents to the uninitiated an appearance of supernatural skill, as, indeed, it would be if it were exactly as the unthinking accept it. As a matter of fact, the prodigy is made possible by the design of the top, and the secret is ludicrously simple.

Custom leads one to think of a top as spinning upon a fixed peg. It seldom occurs to anybody that the body of a top may just as well revolve round a loose peg!

There is little more to offer in the way of necessary explanation beyond the information that the toe of the peg is slotted to accommodate it to the sword blade, as shown in Fig. 1. The body of the top is turned out of brass or other metal and its precise design is very much a matter of personal fancy. An approximate diameter of 3 or 3½ in. is convenient, and the general form as illustrated. The body of the top revolves upon a central spindle which forms both handle and peg. The driving cord is wound round the leg portion below the disc; the spindle is grasped firmly at the handle end and the cord smartly drawn away to effect rotation. The hand that operated the cord now seizes the sword and the top is carefully placed upon it so that the slot of the toe engages with the edge of the blade. With a little practice the top may be made to run up and down the sword by gently tilting it see-saw fashion. As a finish, as its energy begins to abate, it should be tossed off the sword and caught in the hand.

The top itself may be polished and lacquered or painted in bright colours with cellulose paints.

As an alternative to the use of brass for the body, a rough casting may be made from an alloy of lead and zinc, or even from tinsmith's solder, and finished on the lathe.

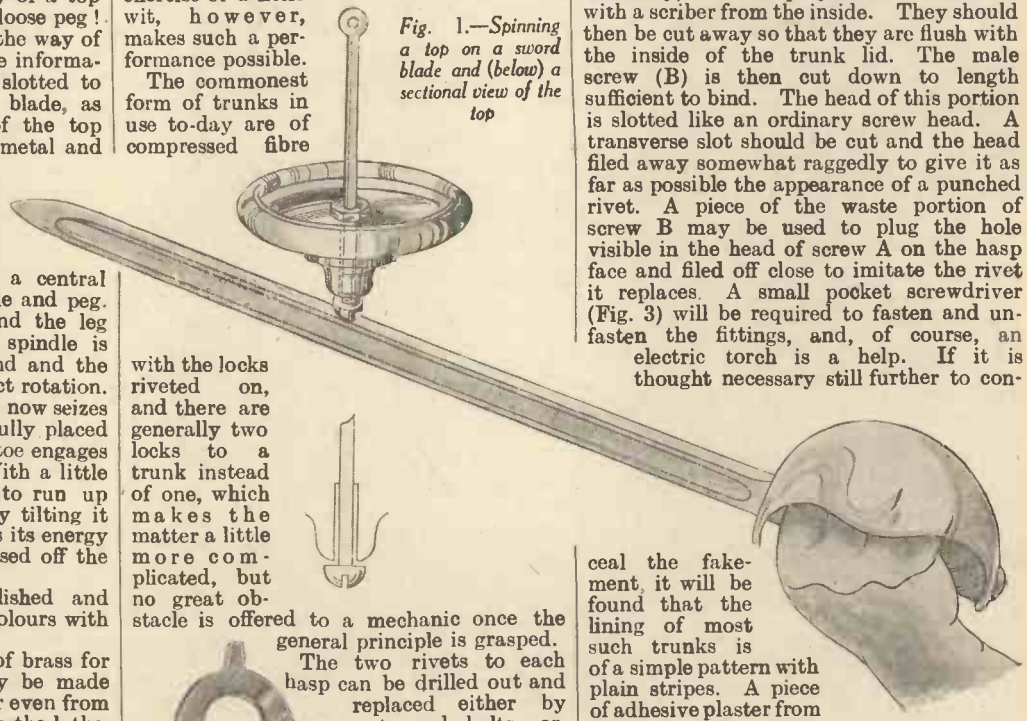


Fig. 1.—Spinning a top on a sword blade and (below) a sectional view of the top

ESCAPING FROM A TRUNK

An escape from a locked trunk has long been regarded as a *pièce de résistance* of the professional magician. A mere amateur may reasonably be expected to do a few card tricks, or, in an advanced stage, even to produce a rabbit from a hat, but one who could effect his escape from a trunk, would be looked upon as one of a superior order of beings. The exercise of a little wit, however, makes such a performance possible.

The commonest form of trunks in use to-day are of compressed fibre with the locks riveted on, and there are generally two locks to a trunk instead of one, which makes the matter a little more complicated, but no great obstacle is offered to a mechanic once the general principle is grasped.

The two rivets to each hasp can be drilled out and replaced either by nuts and bolts, or, better, by specially made fasteners that will stand a more strict examination. There is a screw paper fastener procurable at some stationers that can be effectively adapted to the purpose, or a similar fitting could be made by those having the necessary tools. To make it clear, the shortest fastener (they are made in various lengths, and any length will do, as they have to be cut down anyway) is illustrated approximately full size in Fig. 2. The device is in two sections, each with a stud head, one, B (with an external thread), screwing within the other (having an internal thread) A. As many of these will be required as there are rivets to be replaced. The section with the internal screw (A) is drawn through the rivet hole from the front and soldered. The hasp is then placed in position (the holes in the trunk being enlarged as may be necessary) and the projections marked off with a scriber from the inside. They should then be cut away so that they are flush with the inside of the trunk lid. The male screw (B) is then cut down to length sufficient to bind. The head of this portion is slotted like an ordinary screw head. A transverse slot should be cut and the head filed away somewhat raggedly to give it as far as possible the appearance of a punched rivet. A piece of the waste portion of screw B may be used to plug the hole visible in the head of screw A on the hasp face and filed off close to imitate the rivet it replaces. A small pocket screwdriver (Fig. 3) will be required to fasten and unfasten the fittings, and, of course, an electric torch is a help. If it is thought necessary still further to conceal the fakement, it will be found that the lining of most such trunks is of a simple pattern with plain stripes. A piece of adhesive plaster from the chemists can be pressed down over the rivet heads, rolled aside when necessary, and replaced by simple pressure. A little colour from a water colour box will easily match up the pattern. Gum should be mixed with it to prevent running.

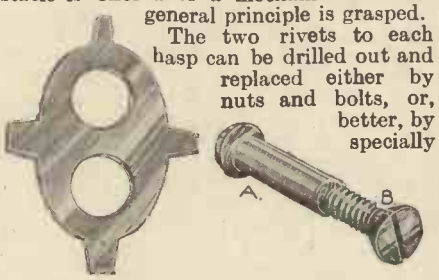


Fig. 3.—A useful form of pocket screwdriver. *Fig. 2.—A paper fastener that replaces a rivet.*

As the amateur is not likely to want to go to the trouble of erecting a cabinet after the manner of stage performers (although a very good substitute can be had in the form of a portable bathing tent if he wants to do the thing in style), some sort of temporary cover must be provided for operation, such as a folding screen or hanging curtain, and a little music to fill in the wait, and divert attention from any clue that sounds might give, is desirable.

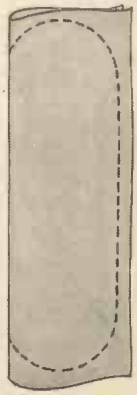


Fig. 4.—The pattern for cutting the sausage skin.

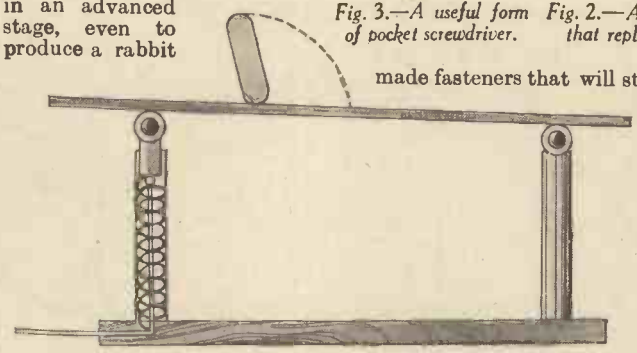


Fig. 5.—Showing how the sausage is made to perform antics.

THE EDUCATED SAUSAGE

This is more of a joke than a trick, though I have indicated a form of elaboration that may add something of mystery to it if the constructor considers it worth while to carry it so far.

The " sausage " is a tube of thin felt or

Fig. 7.—The fire screen opened out.

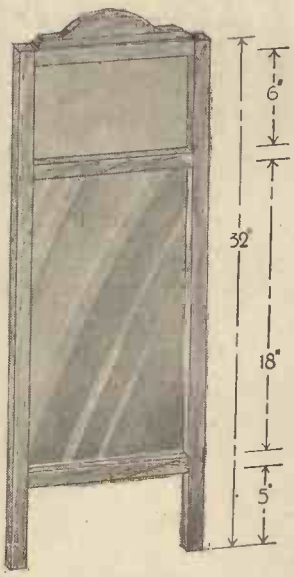


Fig. 6.—The framework of the screen.

stiff cloth of the nearest colour to a sausage obtainable, with closed, rounded ends. Fold the material double and cut to the pattern of the dotted line (Fig. 4). Have it sewn together along the cut edge, all but one end. Then turn inside out and introduce a steel ball of about 1 in. diameter and sew the remainder of the seam from the outside. A grooved batten or channel (the former cut in 1¼ in. square section material, the latter consisting of a piece of 1¼ in. metal tubing cut into two longitudinally, or a similar piece of strawboard postal tubing covered with fabric) is used for a track. Either of these may be between 2 and 3 ft. long.

If the sausage be placed in the track and the latter tilted, the ball will roll down the incline, causing the sausage to tumble end over end in a comic way that is as surprising as it is amusing if seen for the first time. As, however, toys working on this principle (in different forms) appear periodically, it may be lacking in mystery but can furnish material for a little fun and effectively contrast tricks of a more sober character. With a little practice it may be kept under complete control, running backwards and forwards on the track by an almost imperceptible movement of the latter, and made to stop, stand up on end or lie down, "at command."

To make it appear independent of direct personal control, a stand might be constructed on the lines of Fig. 5. The track in this case is supported on two slender pillars and the exhibitor stands apart. The design of the stand is that one of the supports (tubular) is a little shorter than the other and contains a light spiral spring adjusted to raise this end of the track above the height of the other, to which it is pivoted. By pulling upon a cord passing down within the spring, this end can be alternately lowered and released, producing the necessary see-saw action. The cord passes out through the bottom of the pillar and along a groove cut in the underside of the baseboard, and at this stage is joined to a piece of strong black thread, which passes out at the end of the base and terminates at a convenient length in a small button, to be controlled either by the exhibitor himself or a hidden assistant.

A MAGICAL FIRE SCREEN

This is a threefold fire screen of normal appearance. If properly made and finished, it may stand in a room and pass for a piece of household furniture—indeed, it may be used in summer for the purpose its title indicates.

It is not itself a trick. It is an accessory for a trick, an appliance of general utility. With a little imagination it may be used to produce a variety of effects. For instance, a bowl of plaster or modelling clay standing upon a milking stool and surrounded by the screen may develop into a statuette. A seed planted in a pot of earth and placed within its folds may grow into a tomato plant, an orange tree or a rose bush, bearing real fruit or flowers. A tray placed beneath may become piled up with parcelled toys or other presents for a party. Used as an incubator it will hatch out young chickens from china eggs. It could even supplement this wonder by producing a live hen (falsely accused of laying the eggs). It will produce a traditional conjurer's rabbit or a miniature menagerie if need be. It is a useful thing to have.

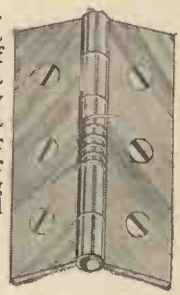


Fig. 9.—How a spring hinge is made.

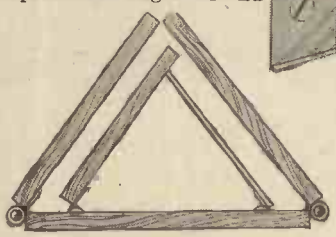


Fig. 8.—The screen folded as seen rom above, showing the secret chamber.

Some 1 × 1 in. scantlings will be required for the framework, two pairs of three-way screen hinges and some knobs, feet, pediments, beading and inlay transfers *ad lib.*

Fig. 6 shows the framework of the screen. The dimensions may be modified as desired. Three of these are required and are to be hinged together as shown in Fig. 7. The panels of the outside section are filled in with plywood. A ¼-in. fillet is first nailed inside the frame and a piece of plywood, cut to size, fixed with panel pins and glue to each side. Finish with a ¼-in. quarter round beading in the angles.

The main centre panel is not quite so straightforward. It is, in fact, a three-sided box minus a bottom. The two panel faces are set at an angle of 45 degrees, fixed together at one edge and distended at the other by a third panel, the structure made rigid by fillets in the inside angles. This is hinged on the narrow edge to the inside of the frame so that it will swing and bring either face at will flush with one side of the frame. Small stops are provided to prevent it swinging too far in either direction.

To give an improved finish to the apparatus and for convenience in storage or use as a piece of household furniture, the box-panel, instead of being made rigid as first described, can be made to fold. To this and the front and back panel faces should be spring-hinged together, and the distending piece should be spring-hinged to one of them and provided with double pins on its free edge, filling into corresponding holes where it adjoins the other panel when opened out. The hinges should be spring-closing. The double pins will keep the folds open when required, and the springs will automatically close them flat when released.

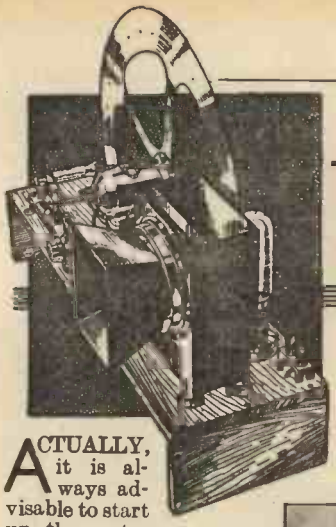
Spring hinges are made by removing the pin from a butt hinge and cutting out the centre knuckle. Screw up the pin of the hinge in the chuck of a wheel brace and fix the latter in a vice. Get some steel piano wire, about 20 gauge, and fix one end in the chuck. Turn the handle, keeping the wire pressed against the hinge pin, and wind till of the required length, and cut off. Replace the pin in the hinge with the spring in the gap, the ends of the spring (left about ¼ in. long) *outside* the hinge if for spring closing and inside if for spring opening (Fig. 9).

Now with the box loaded with the required production it stands folded in triangular form till required (Fig. 8). By opening out the sections flat, the whole may be shown on one side. Then, closing them up again it is turned round, the box swung to the other way, and the screen opened out and shown upon its opposite side. It is now folded round a small stove and the required production made. If made with the folding box, as is in every way preferable, the whole thing may now be folded flat and put aside.

It only remains to explain how the concealed articles are contained. They are suspended to the upper edge of one of the moving panels. If a plant or statuette as first suggested, this is upon a circular wooden base and provided with a central wire support terminating at the upper end in a hook.

For livestock, a special bag is constructed. This is of triangular form with a folding flap the size and shape of the bag itself, fitted with a double-ended hook at the apex and a small ring at the point of the flap (Fig. 10). When the ring is placed over the lower hook, the weight of the contents will keep it in position, but by tilting the hook, the ring can be dislodged and the contents of the bag released.

Fig. 10.—Details of the quick opening bag.



"PRACTICAL MECHANICS" TELE-DISCOVISOR

OPERATING NOTES

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc., A.M.I.E.E.

ACTUALLY, it is always advisable to start up the motor at least a quarter of an hour before the transmission is due to start, and the synchronous speed can be maintained by correct resistance adjustment. If the disc passes through this speed, the sectors will appear to revolve in an anti-clockwise direction, and by this means we have a very simple but effective visual speed indicator and one which will enable the user to become accustomed to making the resistance, and, in consequence, the speed adjustment slowly.

The normal procedure of "looking in" is as follows: First of all tune in and check the radio television signals with the aid of a loud speaker, and when the characteristic "rhythmic hum" (something like a low-pitched whistle with a varying and higher-pitched whistle superimposed upon it) is heard at full strength, change over the radio set's output leads from the speaker to the Tele-Discovisor. If the speed has been correctly predetermined by using the stroboscopic indicator, no doubt an image will be seen at once. When this is not the case, a series of black lines will appear to be sweeping upwards if the motor is running too fast, or downwards when too slow. Both the Seradex resistance R^2 and the rheostat R^3 must be adjusted to rectify this, using the coarse resistance R_1 for approximate adjustment and the finer resistance R_2 for the final regulation.

If the reader has not felt it desirable to add the synchronising equipment, this fine control resistance will have to be dexterously manipulated throughout the whole duration of the television transmission in order to keep the image exactly within the lens frame mask.

Fig. 1.—An image out of phase and frame.

Fig. 2.—An image out of phase or split vertically.

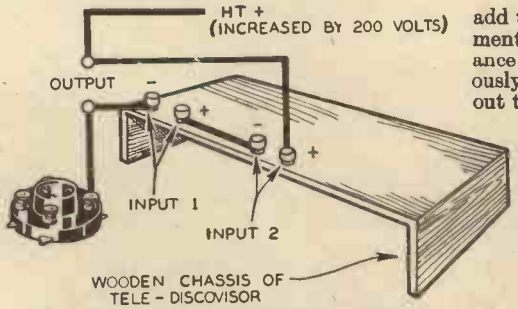


Fig. 3.—The neon and synchronising coils must be joined in series with the output valve.

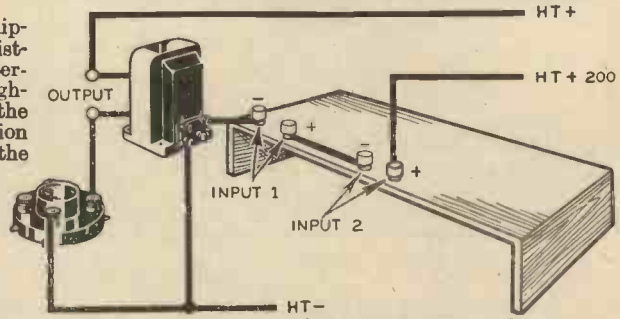


Fig. 4.—Change a negative image by reversing the leads to the output transformer.

Framing and Phasing

However, I strongly advise the reader building this apparatus to make up and incorporate the cogged wheel synchroniser described last month. The incoming television signals then pass through the coils and the synchronising pulses operating 375 times per second, and superimposed on the main television signal, function in the field coils and cogged wheel to maintain the speed constant. The action is something like an electrical brake performing its task in a manner similar to a flywheel on an engine.

With the true speed condition achieved, the image at first will nearly always be found to be out of phase and out of frame. In other words, if, say, a head and shoulder figure is seen it will quite likely look like the sketch (Fig. 1). It is split both vertically and horizontally. Two operations are necessary to rectify this.

First of all, to reframe it the image must be moved bodily up or down, and this is done by rotating slightly the synchronising coils on the motor carcase. The two framing knobs illustrated last month were included for this purpose, and they serve to adjust the relative position of the disc holes with reference to the field coils.

After this has been done, our image will appear as in Fig. 2, that is, cut into two sections by a vertical line. This state of affairs is remedied by gently altering the rheostat motor control to affect a slight speed change. The images will then start to move slowly upwards and drift to the left if the speed is increased, or slowly downwards and drift to the right if the speed is

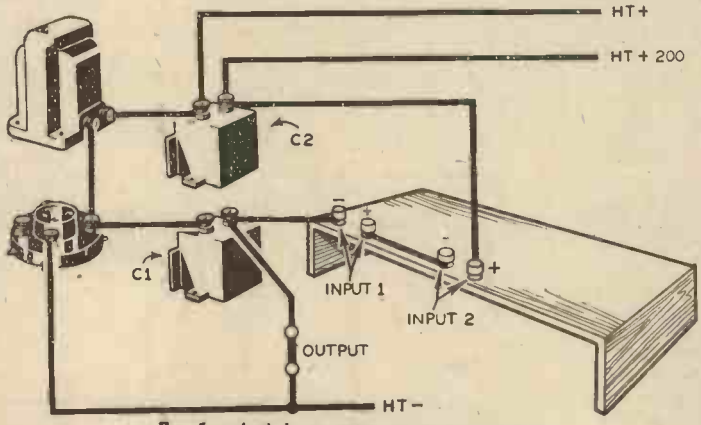


Fig. 5.—A choke capacity output arrangement.

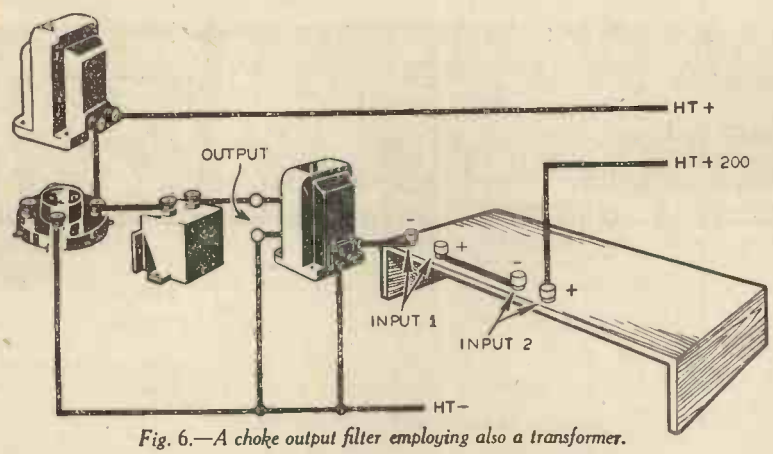


Fig. 6.—A choke output filter employing also a transformer.

decreased. Let this gentle drift go on until the double image resolves itself into a single one, and then quickly bring back the speed of the motor to normal again. The phenomenon of out of phase arises from the disc being pulled into true speed by the synchroniser when the scanning apertures at both the transmitting and receiving ends are not moving over the same relative sections of the picture.

Radio Receiver Considerations

To properly modulate the flat plate neon lamp specified and give a good synchronising signal, an undistorted output of 1½ watts is desirable. This means that the last valve in the set must be of the super-power or large pentode class.

Next, to avoid low-frequency distortion, only the best quality types of coupling components must be used, that is, really good transformers, or, better still, use low-stage gain resistance-capacity-coupling if at all possible. When low-frequency distortion is present in the image (that is, there is a considerable loss of the lower frequencies), it will evidence itself somewhat as if there is a light thrown up behind the person's head in the case of a close-up image, while the white background on either side will look almost black at the top of the picture. Then again you may notice a dark flare on the forehead and beard like shadows on the lower jaw on either side of the mouth. The whole image gives more of a silhouette effect, and when bad distortion is present the results are apt to appear very disconcerting, but, of course, can be remedied easily by overhauling and reconditioning the low-frequency side of the receiver.

H.F. and Detector Stages

As a very general guide, it may be said that if any continual streaky shadows appear to travel up the received picture, then this is an indication that the lower frequencies are not compatible with what are being broadcast. Strictly speaking, the amplifier should go down at least as low as the picture frequency, that is, 12½ per second, so if you desire the best be stringent with your L.F. standards.

Coming now to the high-frequency side, it is desirable to have a radio receiver which does not cut off the side-bands sharply. If the receiving locality will allow it, have a fairly flat-tuned set, and either avoid the use of reaction or reduce it to the barest minimum. It is fortunate to find that lack of the higher frequencies is not nearly so objectionable as that of the lower. It has the pictorial effect of a general blurring or out of focus effect. Details are absent, such as, for example, the eye appearing more as a black smudge instead of eyebrow and eye quite distinct. Also such things as teeth or beads will not be noticed clearly. As far as the detector stage is concerned, the best type for television work is undoubtedly a diode or anode bend. Next in order of merit we have power grid, and finally the normal leaky grid detector. Quite moderately efficient sets will give you recognisable images, but when better pictures are the ambition of the "looker," the notes I have just written will help him.

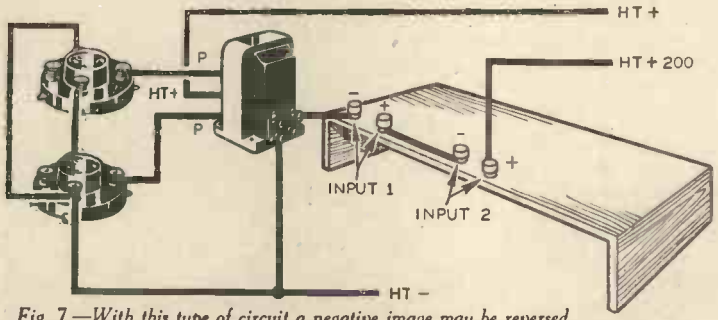


Fig. 7.—With this type of circuit a negative image may be reversed by changing over the transformer connections.

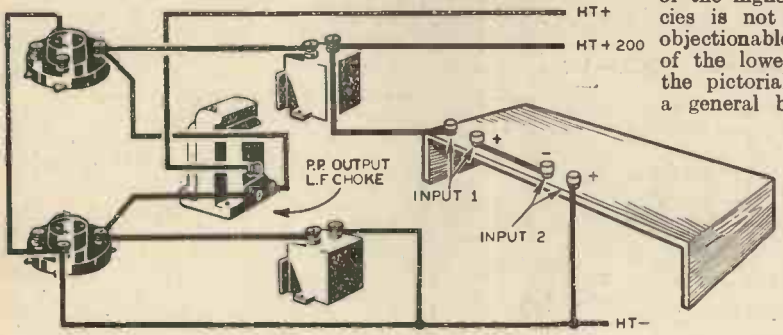


Fig. 8.—The connections for a push-pull circuit.

Negative Images

I pointed out earlier in this article how the neon lamp glows darker or brighter according to signal strength. If at any one instant more light is reflected from the televised subject, the current should increase through the neon lamp and conversely decrease when less light is reflected. This increase or decrease must perforce be a factor of the wireless set itself, and the majority of set users forget that reversals of current direction often take place stage by stage. As far as the reproduction of sound is concerned, this current reversal is immaterial, but not so with television. Take, for example, the detector stage. When signals are passing through a grid leak rectifier the mean anode current falls, but rises if an anode bend detector is employed. If the image is correctly shown with one method of detection, changing over to the other method will produce a negative image, that is, one in which shadows are high lights and *vice versâ*.

Simple methods are here given in tabular form for changing a negative image into a positive one. (*a*) Change method of rectification, *i.e.*, leaky grid to anode bend or *vice versâ*. (*b*) Add (or subtract) a stage of resistance capacity L.F. coupling. (*c*) Reverse *either* the primary or secondary windings of the L.F. transformer if one is included in the set. (*d*) Reverse either the primary or secondary connections to the output transformer (see Figs. 4 and 6). As a general rule, it may be taken that either an anode bend detector followed by an odd number of resistance-capacity-coupled low-frequency stages, or a leaky grid detector followed by an even number of resistance capacity low-frequency stages will give a positive image

(*Continued on page* 114.)

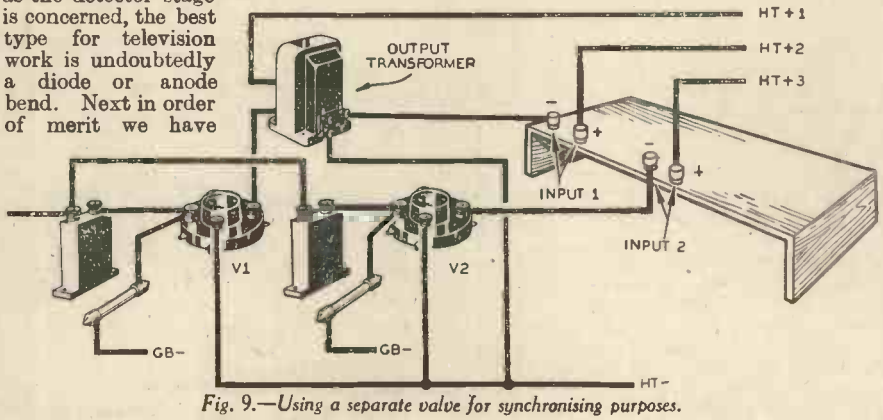


Fig. 9.—Using a separate valve for synchronising purposes.

PRODUCING ARTIFICIAL ECHOES

IN THIS ARTICLE THE AUTHOR DESCRIBES SOME SIMPLE METHODS OF OBTAINING ECHO EFFECTS BY ELECTRICAL MEANS

By FRANK PRESTON, F.R.A.

PROBABLY everyone knows that the effect we speak of as an echo is produced by the combination of "direct" and reflected sound waves. The reflected sounds reach the ear some time after the direct ones due to "time lag" which occurs between the sounds leaving their source, striking a reflecting surface and then returning to the ear. Every schoolboy knows that he can produce an echo by shouting down a long narrow passage, or even by speaking in a large room which has bare walls, but have you ever tried to make an echo by artificial means—that is, without the long passage or empty room?

As a matter of fact, echoes of an artificial character are frequently required in theatrical and broadcast work in order to produce certain "effects." They are also very often necessary for giving a natural tone to the voice on long-distance telephones, where normal methods of tone correction are either impossible or ineffective. Some of the ways of making artificial echoes are very interesting, and can be used for providing excellent fun for parties, amateur theatricals, and the like.

Echoes from Gramophone Records

I think the simplest, though by no means the least fascinating, method of producing an echo effect is by employing two gramophone pick-ups working together on the same record. Both instruments are wired in parallel and joined to the same amplifier (an ordinary wireless set can be used, of course) with loud speaker connected. The general scheme is simple in the extreme, and is illustrated in Fig. 1. By allowing one pick-up to follow closely behind the other a most realistic echo can be obtained, and the degree of echo effect can be varied as required by altering the relative positions of the pick-up needles in the record groove. In some cases it might be found even better to allow the second pick-up to "follow" the first by so much as a complete revolution of the record. A slight variation of the method just outlined is to connect each pick-up to a different amplifier and loud speaker; then by varying the distance between the speakers and between the ear and each speaker, all kinds of weird results are possible.

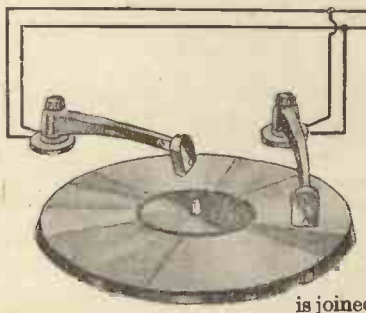


Fig. 1.—Echo effects can be produced on gramophone reproduction by using two pick-ups connected in parallel to the same amplifier.

Another very simple way of producing artificial echoes, and one which has been widely employed by the B.B.C., is to connect a microphone to the amplifier in the usual way and to place a speaker (which is joined to the output side of the amplifier) behind the person who is speaking or singing into the microphone. In this system it is necessary to employ a second speaker wired in parallel with the first and placed well away from it—preferably in another room. The sound given out by the second speaker is very "echo-y," and the exact degree of echo can properly be controlled by moving the first speaker into various positions. When a powerful echo is wanted the first speaker may be arranged some distance away from the microphone and along an empty passage, or even in a convenient empty room. The general scheme is represented in Fig. 2.

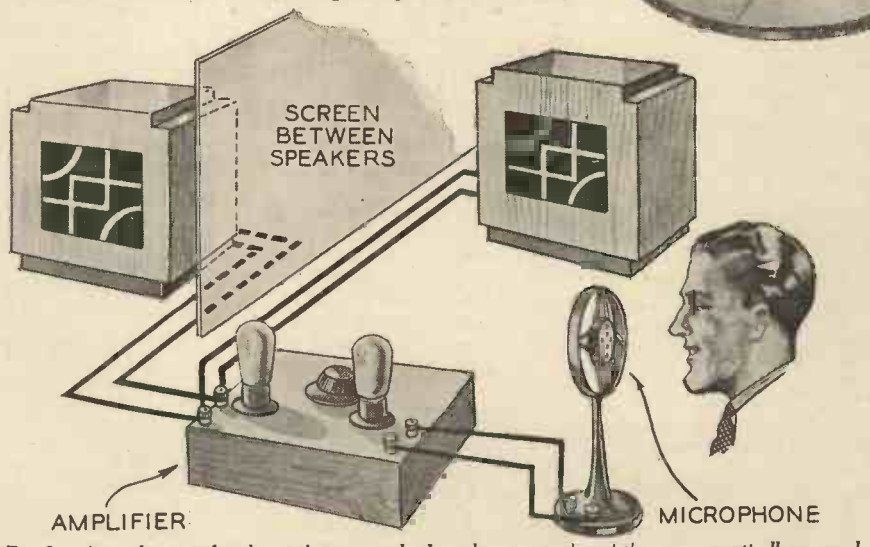


Fig. 2.—A simple way of making echoes: two loud speakers are used, and these are acoustically screened from each other.

Another Simple Method

A third method of producing echoes is diagrammatically illustrated in Fig. 3. Here two microphones are used and both are connected in parallel and to the input terminals of an amplifier. Also connected to the first microphone is a telephone earpiece, which is placed at one end of a long cardboard tube, at the other end of which is the second microphone. It will be seen that, although a portion of the output from the first microphone is immediately amplified and reproduced by the loud speaker, another portion is re-converted into sound by the earpiece. The delay which occurs by the sound from the earpiece travelling comparatively slowly down the tube to the second microphone is thus responsible for the resultant echoes heard in conjunction with the original sound from the speaker. This method is not a particularly good one, due to the fact that a very long tube is required to obtain the best results. It is, nevertheless, a very interesting one, and offers plenty of scope for experiment. If you propose to try it you might find it

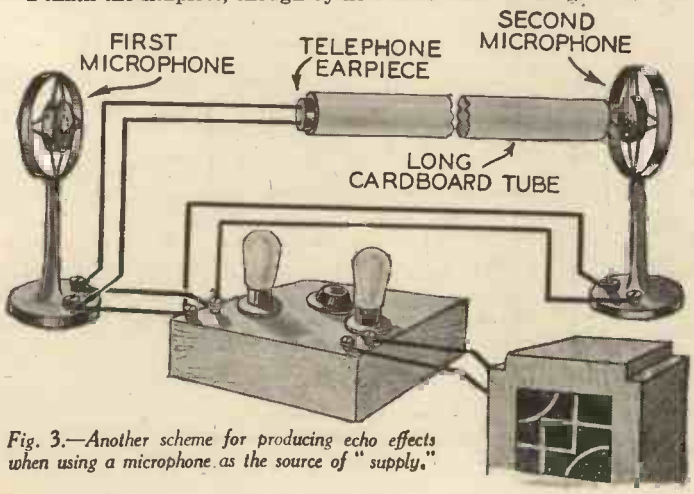


Fig. 3.—Another scheme for producing echo effects when using a microphone as the source of "supply."

desirable in some cases to insert an amplifier between the first microphone and earpiece to obtain a sufficiently powerful echo.

Fig. 4 shows the essentials of yet another method of obtaining

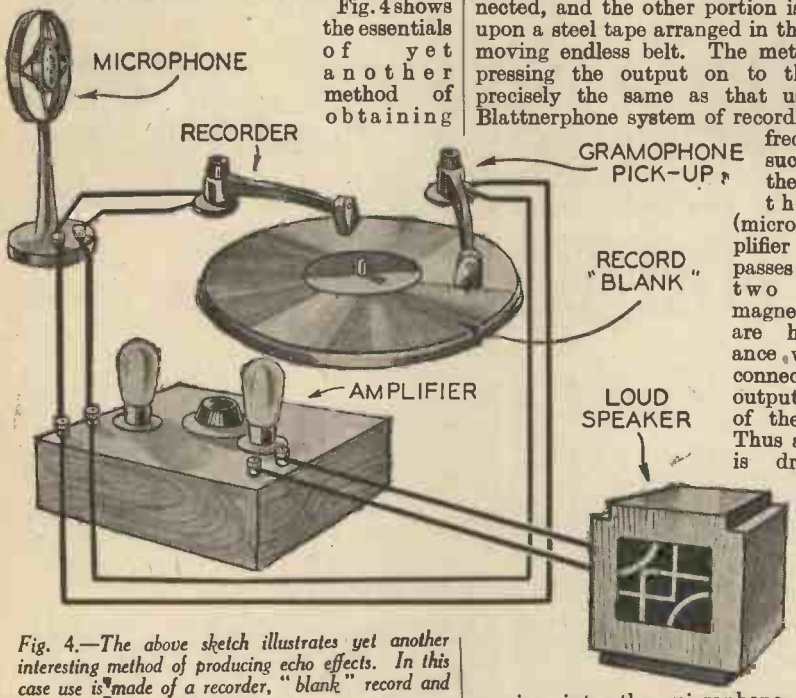


Fig. 4.—The above sketch illustrates yet another interesting method of producing echo effects. In this case use is made of a recorder, "blank" record and the pick-up.

echo effects. This is really rather similar to that shown in Fig. 1, but can be applied to "original" (as opposed to recorded) sound. A "blank" gramophone record is used in conjunction with a recorder and a pick-up. A microphone is connected to the input terminals of an amplifier as well as to the recorder, whilst a pick-up is also joined to the amplifier input. The sound picked up by the microphone is amplified and reproduced by the speaker as well as being used to "make" a gramophone record. The pick-up follows the recorder in the needle groove and reproduces the record shortly after it has been made. And since the pick-up is connected to the amplifier the sound from it is reproduced by the speaker at any desired time after the original sound; the two combine to give a most realistic effect.

A More Complicated System

The most satisfactory system of producing echoes is that represented diagrammatically in Fig. 5. Unfortunately, this idea cannot be tried out by the amateur, since it depends upon the use of a fair amount of expensive and complicated apparatus. It is, however, extremely interesting for its scientific value and because of the novel schemes involved. The microphone is again connected to an amplifier, the output from which is divided; one portion is passed on directly to a second amplifier, to which a loud speaker is connected, and the other portion is impressed upon a steel tape arranged in the form of a moving endless belt. The method of impressing the output on to the tape is precisely the same as that used in the Blattnerphone system of recording used so frequently and successfully by the B.B.C. In the first (microphone) amplifier the tape passes between two electro-magnets, on which are high-resistance windings connected to the output terminals of the amplifier. Thus as the tape is drawn past these magnets it is magnetised to a greater or lesser extent according to the sound passing into the microphone. In other words, a perfect "magnetic representation" of the sound striking the microphone is impressed upon the tape. After leaving the microphone amplifier the tape eventually passes on to the second amplifier, where it is passed between a second pair of electro-magnets, which this time re-convert the magnetic impulses into purely electrical ones. These actuate the loud speaker in precisely the same manner as do those supplied to the amplifier directly from the microphone. It can thus be seen that the magnetic tape introduces some delay into the speech applied to it, and, as a result, the reproduction given by the loud speaker has a distinct echo. On its "return journey" from the final amplifier to that taking the microphone output, the tape is passed between a pair of exceptionally powerful permanent magnets, and the magnetic impressions made upon it are thereby completely "erased," so making the tape ready to receive another "speech record" as it passes through the primary amplifier.

It will be seen that any desired echo effect or time lag can be produced by the very simple means of altering the length of the tape or by varying its speed of passage between the two amplifiers. Incidentally, it might be added that the system just described is being used experimentally in America by the Bell Telephone Laboratories and will probably be employed permanently at a later date in connection with trunk calls over long distances.

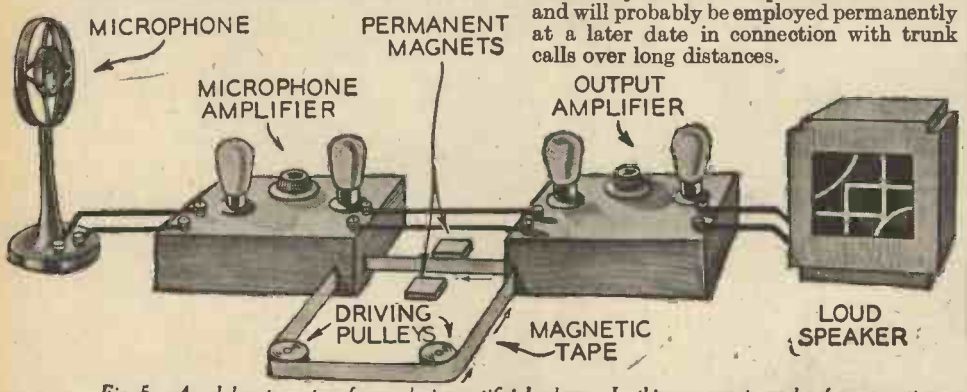


Fig. 5.—An elaborate system for producing artificial echoes. In this case use is made of a magnetic tape arranged as an endless belt and passing between the "microphone" and "output" amplifiers.

THE TELEDISCOVISOR (*Cont. from p.* 112.

with the present type of television transmissions furnished by the B.B.C.

It must be noted that the flat plate neon lamp specified requires a steady direct current of 25 milliamperes flowing through it. This causes the rectangular flat plate to glow at its normal brilliance, and it is this light intensity which is modulated or varied by the incoming television signals. Furthermore, it is necessary to allow a voltage drop of about 180 volts across the neon lamp to make this current flow, and this voltage and current condition *must be met* if the apparatus is to be made to function satisfactorily. In addition, this same polarising current of 25 milliamperes has to pass through the synchronising coils where a further drop of about 20 volts is likely to occur, this making a total of 200 volts when the two are wired in series.

In our Tele-Discovisor we have the neon lamp brought out to a pair of terminals marked input + 1 and input − 1, while the ends of the synchronising mechanism terminate in a pair of terminals marked input + 2 and input − 2.

Taking the case of a set which has a super-power or pentode output valve passing a steady direct anode current of 25 milliamperes, it is necessary merely to increase the plate voltage on the valve by 200 volts and join both the neon lamp and the synchronising coils in series with the valve, as in Fig. 3.

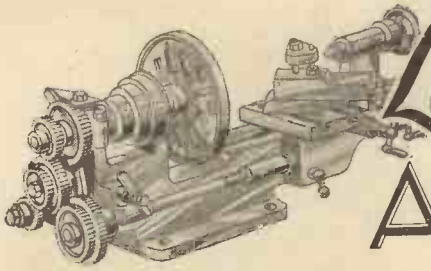
Choke and Transformer Connections

Naturally, cases may arise where it is inconvenient to furnish this additional voltage, or, alternatively, there may be present some form of choke or transformer output coupling in the set which makes it difficult to work from the output valve anode direct. Provided one has a source of voltage and current (200 volts 25 milliamperes) given by super-capacity batteries, or, better still, an auxiliary eliminator, then recourse can be made to Fig. 4. The primary winding of an output transformer (*preferably* of one to one ratio, although other ratios may be tried) is joined to the "direct" output terminals of the set. One side of the secondary winding is joined to H.T. − (this must be common for both sources of H.T., *i.e.*, the set's H.T. and the auxiliary H.T.) and the other side passes to the terminals of the Tele-Discovisor, as shown, and finally to the 200-volt H.T. +.

Next we have the case of a choke capacity coupled output. This can be joined up as in Fig. 5. Short the output terminals of the set, add an additional fixed condenser, C_2, of the same capacity as C_1, which is the one already in the set, and connect the leads as shown. A better method for this type of output is shown in Fig. 6. A one to one output transformer has its primary winding joined across the set's output terminals, the secondary being linked up in a manner identical to Fig. 4.

With push-pull or Class "B" sets, either a transformer or choke output is already incorporated in the set, and for these cases a choice of either Figs. 7 or 8 can be made.

In order to have the fullest control over the television apparatus, and also to reduce any tendency for the image to "float" (that is, move up and down) owing to insufficient synchronising signal, it is a very good plan to have an additional valve, resistance capacity coupled to the grid circuit of the set's output valve, which, of course, will feed the neon lamp. The scheme will be made clear by a reference to Fig. 9. V_1 is the set's output valve, shown transformer coupled to the neon lamp, while V_2 is the additional valve having the synchronising coils directly in the anode circuit.



Lathe Work FOR AMATEURS

By F. J. CAMM

LAST month I dealt with the various methods of centring work of a cylindrical type. Unfortunately all work operated on in the lathe is not cylindrical in form, and it is necessary to devise various means of holding irregular-shaped pieces of work such as rough castings. There are many lathe devices available, the chief of which for this style of work are face plates, angle plates, and the independent-jaw chuck.

Lathe Setting

These are purchasable in sizes to suit the centre height of the lathe, and are essential parts of lathe equipment. Additional to these chucking devices the turner is often compelled to make special fixtures for holding the work. In fact, lathe setting is really the basis of all turning, for once the work is correctly mounted, the actual operation of cutting could be undertaken by anyone. Setting work for turning calls for a considerable amount of ingenuity and care if frequent scrapping of work is to be avoided. Apart from the accuracy of the setting it is essential to see that the work is tightly locked and that there is no possibility of it moving which would have one or both of two effects—the work would be scrapped, or it might fly out and cause damage.

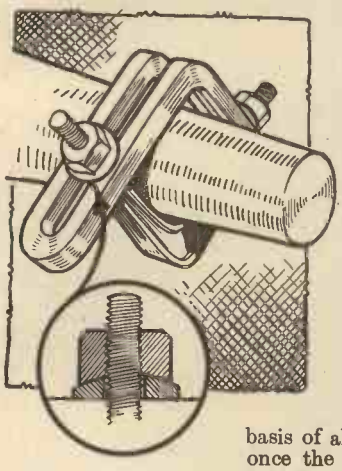


Fig. 1.—A special carrier for gripping tapered work.

The various illustrations on this and the next page will explain some of the methods adopted.

Face Plates

The face plates, for example, three types of which are illustrated, have a number of slots cut in them, and the work is held to the face plate by means of bolts and clamping plates passed through appropriate slots. Note that these slots are so arranged that it is possible to clamp a casting of any shape to it. For example, suppose it is required to bore a hole in a square casting, the hole to be out of centre, the procedure would be first to chalk over the surface of the casting, to carefully mark out the position of the hole by means of the dividers and then loosely to attach the casting to the face plate, so that its position can be adjusted until the circle scribed on the casting revolves truly when viewed in relation to the point of a scriber held in the tool-post and brought into close proximity. After finally locking the casting down, the truth of the setting should again be checked by this method.

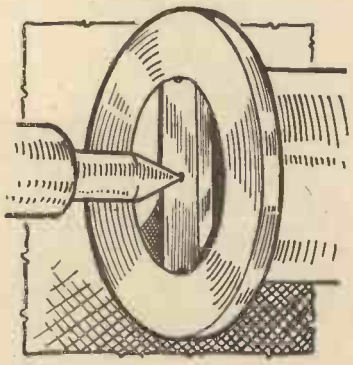
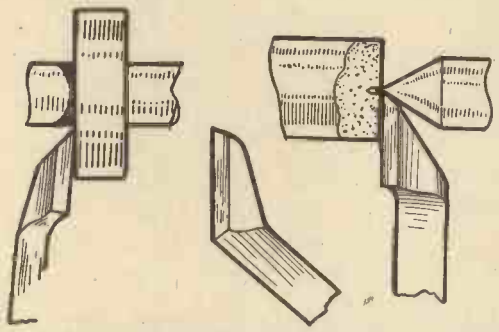


Fig. 2.—One method of turning a flanged cylinder between centres. This method is often adopted when carrying out turning operations on finished work so as to avoid chuck marks.



Figs. 3 and 4.—Various applications of the knife tool. The bent knife tool is used when the saddle can be advanced to the work.

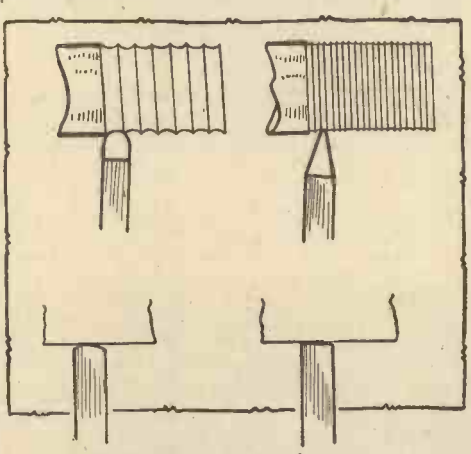


Fig. 5.—Various tool applications.

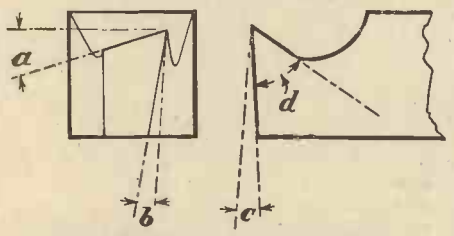


Fig. 6.—Tool angles. (See table overleaf.)

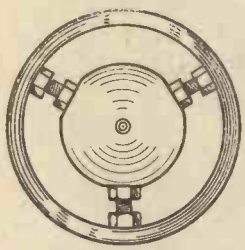


Fig. 7.—Method of turning thin tubes between centres.

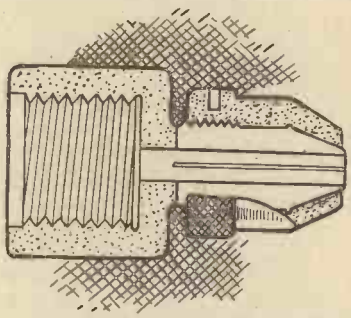


Fig. 8.—Split chuck adaptor for lathe.

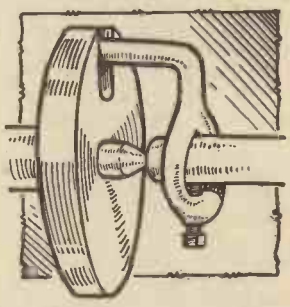


Fig. 9.—The catch pin and bent-tail carrier.

The Angle Plate

The angle plate is a right-angled casting with slots in it similar to those in the face plate, and the angle plate is attached to the face plate in a position suitable to the casting being operated on. For example, if it were required to bore the mouth of a crankcase to receive a cylinder, the crankcase would be bolted to an angle plate attached to the face plate in this way. The angle plate is also useful for boring or turning work at an angle; it is only necessary suitably to pack the work to bore a hole to any required angle of casting.

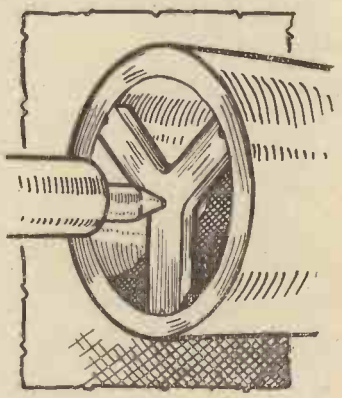


Fig. 10.—Another method of turning cylindrical work between centres.

The Independent Jaw Chuck

The independent four-jaw chuck can similarly be used to hold work of irregular shape. It has the great advantage of quick adjustment, for by means of a key each jaw can be moved independently and the work "thrown over" until the setting is correct according to the work to be done.

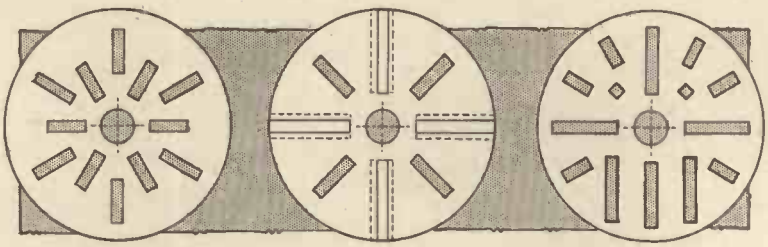


Fig. 11.—Various face plates.

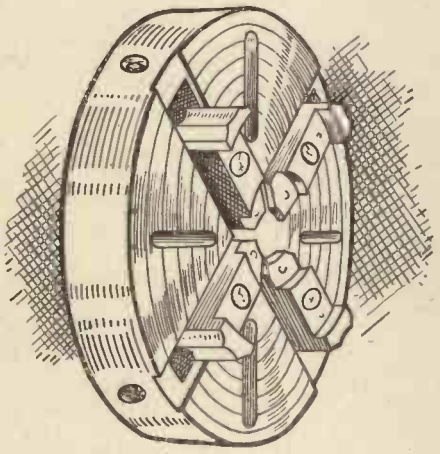


Fig. 12.—The four-jaw independent chuck. This is chiefly used for holding irregular shaped pieces and for accurate centering of work. It is not a self-centering chuck.

There are many other methods of chucking work, sometimes it may be necessary to solder the work to a round disc held in the chuck when the work itself is of such a character that it cannot be operated on in any other way, or it may be shellaced to a piece of metal or secured to a piece of wood. From this the reader will perceive that the method used to hold the work is absolutely dependent on the work itself.

Tool Angles

	Bronze.	Cast Iron.	Steel.	Wrought Iron.	Brass.
(*a*)	5°	15°	20°	25°	10°
(*b*)	3°	3°	3°	3°	3°
(*c*)	3°	3°	3°	3°	3°
(*d*)	85°	70°	60°	56°	80°

Turning Tools

The first thing the amateur will discover on attempting to turn is that the tool needs to be ground to a special angle, according to the material being turned, that it needs to be driven at a certain speed according to the diameter and the material being turned, and also that tools of various shapes are necessary to operate on particular shapes of work.

Roughing tools are used for reducing the work to its approximate diameter, and finishing tools are used to reduce the work to its finished size.

For roughing out a deep cut and a fairly coarse feed is used as shown in the top left sketch of Fig. 5, and for finishing a light cut and slow feed is used as in the right-hand sketch of the same figure. A sharp-pointed tool should never be used as, however fine the feed it tends to cut a screw-thread. For this reason, tools of the form shown in the lower sketch (Fig. 5) tend to give a smoother finish.

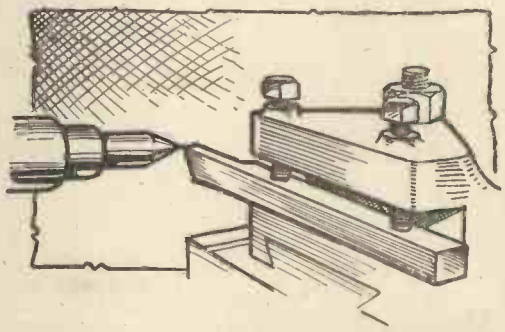


Fig. 13.—Checking tool height by means of lathe centre.

The cutting and clearance angles of tools are shown by Fig. 6, which should be used in conjunction with the small table above. The use of the knife tool is clearly indicated in Figs. 3 and 4.

I hope to illustrate the various lathe tools next month.

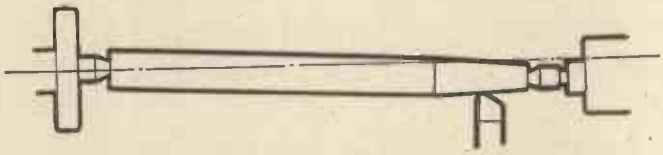


Fig. 14.—Method of setting tail stock for taper turning.

GLASS CUTTING AND BORING

MOST amateur craftsmen experience a lot of difficulty in cutting glass. Let us begin by reminding you that glass is an insulator. As there are many types of glass you will come across in your handicraft career, I will enumerate the main specimens you will deal with. Polished plate glass is manufactured in ¼-in. plates usually. Largely used for shop windows, it has the double advantage of being strong and non-distorting. Sheet glass is sold by *weight*, that is, so many ounces per square foot. For instance, we have 21-oz. sheet a standard weight; lighter and cheaper is 15 oz., largely used in picture framing. Sheet glass distorts images seen through it, is neither so strong nor so clear as plate, but is a great deal cheaper. Rough cast is the glass used for roof glazing; it is made in ¼-in. thick plates, has an uneven yet glossy surface, with a rougher bottom side. Plate glass is always cut, in the trade, with a diamond cutter, but the common American wheel cutter is perfectly satisfactory for the beginner, indeed, is to be preferred. Unlike plate glass, sheet has one side best suited for cutting; that is found by turning the glass on edge, and, closing the one eye, glance along. A pronounced bend will be noticed, the hollow or inside is the side best suited for cutting with the minimum of breakage.

Rough cast, or roof glass, is always cut with a wheel cutter, using a little more weight than for cutting sheet. A great scientific discovery a short time ago was a glass that permitted ultra-violet rays to pass through. This is known to the trade as "Vita," and is manufactured in St. Helens. Vita is cut as plate glass, that is, either side. A diamond is to be preferred on this job. The commonest roof glass now being used by all big concerns is called Wired Cast, because of the safety device of wire mesh rolled into the metal while it is being rolled to thickness. Owing to the strengthening effect of the wire, this glass may be shattered, yet it will not fall out of place on, say, workers or machinery. The wheel cutter is used in this instance. We now come to unsplinterable, safety or bullet-proof glass. This is made by solutioning two plates of glass of identical size by means of an interleaved sheet of clear celluloid. One pane may be smashed without causing the other to splinter. This is largely used in motor cars and aircraft.

Let us divide into three categories our types of glass: First, glass that is best cut with a diamond; second, glass that gives a more satisfactory job where the wheel cutter is employed; third, special types that require a treatment of their own. In the first, plate glass is cut by drawing the diamond along a straight edge in the line desired to cut, raising the plate and inserting under it on the bench the straight edge, lay down the glass with the cut running along the supporting straight edge, press smartly at the same time both sides of the plate.

The plate will then cut along the line of the diamond "tear."

Secondly, rough cast is cut by the wheel, using sufficient pressure and no more to make a deep and distinct line. A smart tap on the opposite or under side will set the cut running along the line. In the third category, wired cast is cut by the wheel as heretofore, the cut tapped on the under side and then snapped along the line. The glass is now cut, but what about the wire? By slowly bending more and more each time, while the cut edges grate and grind against each other, the wire is broken. Care must be exercised not to be hasty about this latter part of the job, as the glass might nick or split. Bullet-proof, or safety glass, requires a straight cut on each side directly in line. Using pliers, bend down gently along the cut till the top pane cuts, turn upside down and repeat the process. Now for the celluloid. A lighted candle is passed rapidly along the cut, the while gently easing the glass up and down. The celluloid will stretch and give.

Boring is carried out with a three-sided file ground to a three-sided straight-edged tip held in an ordinary hand brace. The cooling medium used on the tip of the bit is made by dissolving a small amount of camphor in a little pure turpentine. Drill half through, then turn over and commence directly opposite. When clean through, the hole may be reamered to the desired size.

ALL RADIO QUESTIONS ANSWERED FREE.

Every Question must be accompanied by the Coupon on page 156.

The PRACTICAL MECHANICS Wireless Experimenter

THE PERTUNE THREE

A new and up-to-date receiver employing a permeability tuner in place of the usual variable condenser and coils.

DURING the last few months there have been numerous interesting developments in regard to tuning systems, and the outcome of all these is the now perfected permeability tuner. A tuner of this kind does not require to be used in conjunction with a variable condenser, but it will cover the normal wavelength ranges just as well as does a coil-condenser combination of the usual type. The permeability tuner, however, is more efficient and thus gives greater selectivity, as well as improved sensitivity.

Permeability—the New Tuning System.

As the "Pertune Three" is designed around one of the new types of tuner (and, so far as we are aware, the only one available to the home constructor), it will perhaps be best in the first place to explain briefly the idea of permeability tuning. It is well known that the inductance of any coil and hence the wavelength to which it tunes, can be altered by varying the number of turns or by changing the capacity of a condenser connected across its ends. That is the principle upon which all tuners made until recently depended. It was known that the inductance could also be increased by fitting an iron core into the coil, and that was actually done with coils made for use as chokes. The iron was quite satisfactory for that purpose, since the coil had only to deal with comparatively low frequencies of alternating current, but in the case of tuning coils, which must necessarily be used with much higher frequencies, the iron had the effect of very seriously reducing their efficiency.

A rear view of the "Pertune" showing the neat layout.

Only a short time ago it was found by the German scientist, Hans Vogt, that by making the iron core of very fine particles, each of which was insulated, a considerably greater inductance could be obtained by using a fewer number of turns of wire. This was a remarkable discovery, because it meant that by making tuning coils in this way greater efficiency and selectivity could be obtained due to the fact that the reduced amount of wire required had much lower resistance losses. That explains the reason for iron-core tuning coils becoming so popular of late. But this new ferrous core material opened up newer and still more remarkable lines of development, the chief of which is permeability tuning. It is not hard to understand that, if the iron core increases the inductance of the coil, it should be possible to make a tuner whose inductance value could be varied over a wide range by arranging the core in such a way that its position in respect to the windings could be varied. When experiments were first put in hand to produce such a tuner, however, it was soon found that there were many difficulties in the way of obtaining satisfactory results. These were chiefly of a mechanical nature, and Messrs. Sovereign Products Ltd. (makers of the Permeability Tuner specified for the "Pertune Three") are to be congratulated upon being the first to evolve an efficient component that could easily and satisfactorily be employed by the home constructor.

This illustration shows the complete receiver in its handsome cabinet.

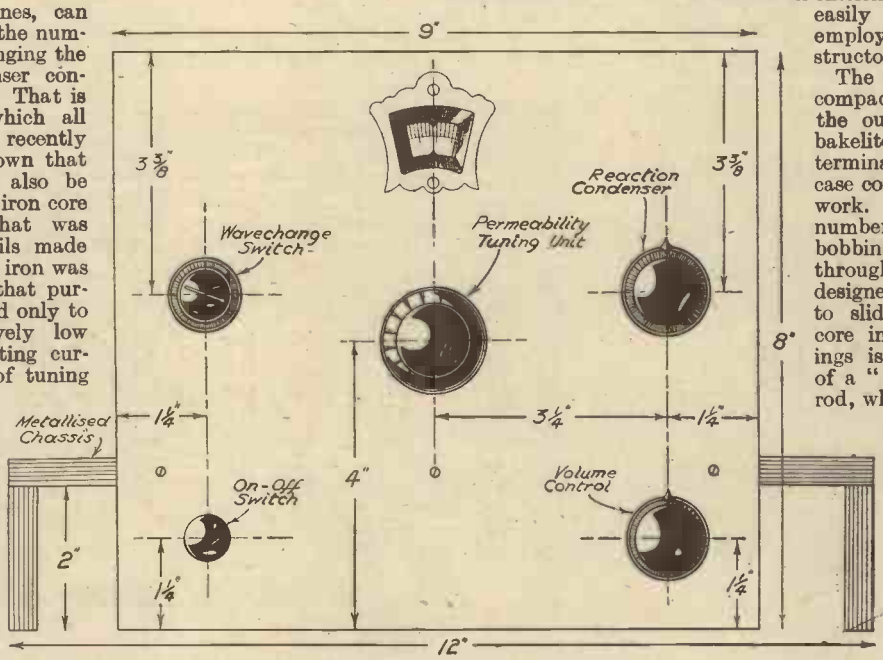
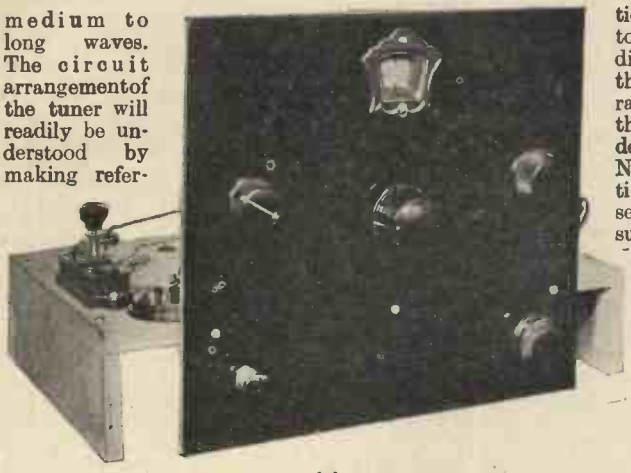


Fig. 2.—The arrangement of the panel controls will easily be followed by referring to this drawing.

The Sovereign tuner is a compact component, having the outward appearance of a bakelite cylinder fitted with terminals and a dial, but the case conceals some very clever work. Inside there are a number of windings placed on bobbins of rectangular section, through which a specially designed ferrous core is made to slide. Movement of the core in respect to the windings is controlled by means of a "quick-thread" screwed rod, which is rotated by means of the usual 0–180 degree dial operated by a vernier knob. As a result, the wavelength covered by the tuner can be varied from 250 to 550 metres and from 1,000 to 2,000 metres merely by turning the dial, a switch being used in the ordinary way to change over from

medium to long waves. The circuit arrangementof the tuner will readily be understood by making reference to the complete theoretical diagram shown at Fig. 1.



Front view of the receiver.

Circuit Arrangement

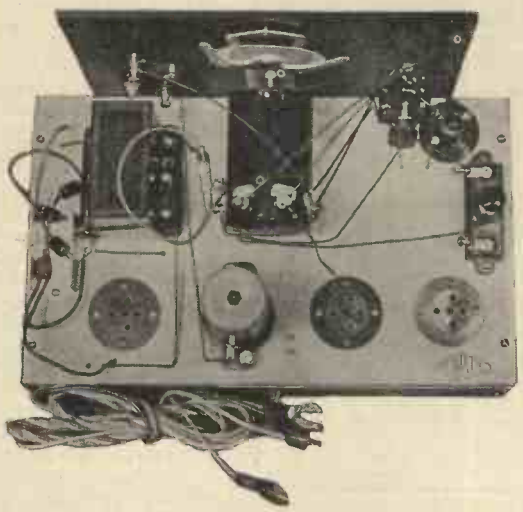
It can also be seen from the circuit diagram that the valve arrangement is that of a grid leak detector followed by two low frequency amplifying stages. The first L.F. valve is fed through a resistance capacity circuit, whilst transformer coupling is used between the second and third stages. By using a super power valve in the output stage an ample volume is obtainable in an economical manner. Provision is made for inserting a gramophone pick-up in the detector grid circuit and the output volume from gramophone records is sufficient for almost any requirements.

A particularly noteworthy feature of the circuit arrangement is the provision of a volume control which acts equally well on either "radio" or "gram" reproduction. This control consists of a 50,000-ohm potentiometer, which takes the place of the usual fixed coupling resistance in the detector anode circuit, and by moving the contact from end to end of the resistance element the volume can be varied from maximum right down to inaudibility. This form of control, though somewhat unusual, is not only effective in varying the output from the loud speaker, but it is entirely distortionless, since it functions without altering the values of any important portions of the circuit.

The "Pertune Three" is an ideal receiver for the constructor who requires selectivity, volume, quality and simplicity of construction. It is not intended to be designed for long-distance reception, although it certainly has a range which is in excess of that afforded by the usual detector-L.F. type of circuit. Not only is the receive selective, but the degree of selectivity can be varied to suit particular requirements. This is a feature we would like to stress, because it is of especial value in a comparatively small receiver, and one which we should like to see universally adopted.

Easy and Inexpensive Construction

You can see from the illustrations that this new receiver is, like the two previous and very successful PRACTICAL MECHANICS designs, built on a metallised wooden chassis and is thus easy to make and of simple design. The circuits and components have carefully been chosen so as to eliminate any unnecessary "extras" and to retain only those things which are really required. Because of this, the price has been kept down to the pleasingly low figure of £3 2*s*. 6*d*. for the set itself, or only £6 10*s*. 0*d*. when the valves, cabinet,



A plan view of the "Pertune."

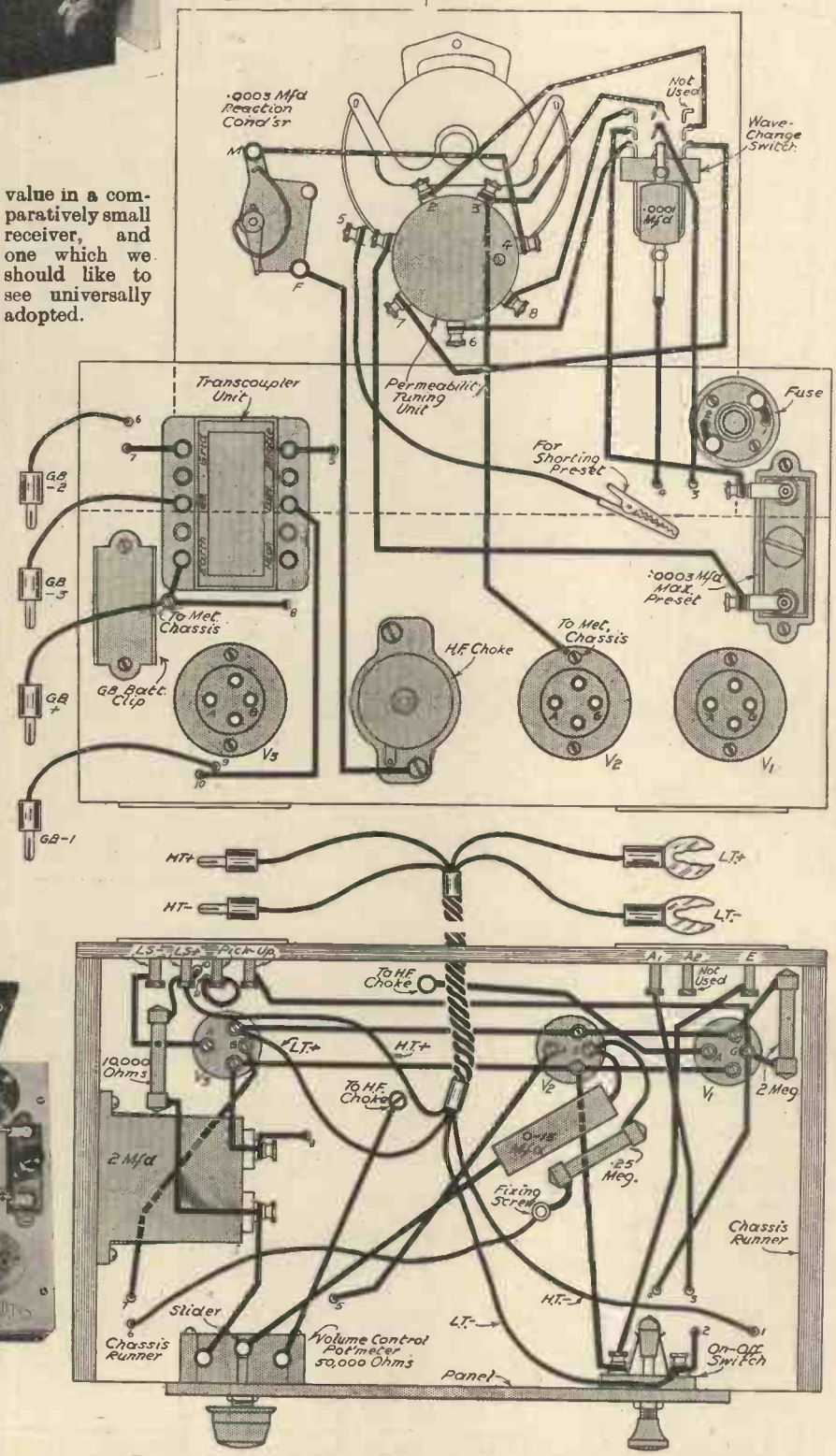


Fig. 3.—Complete wiring plans from which you can easily trace every connection.

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PILOT AUTHOR KIT — PERTUNE THREE

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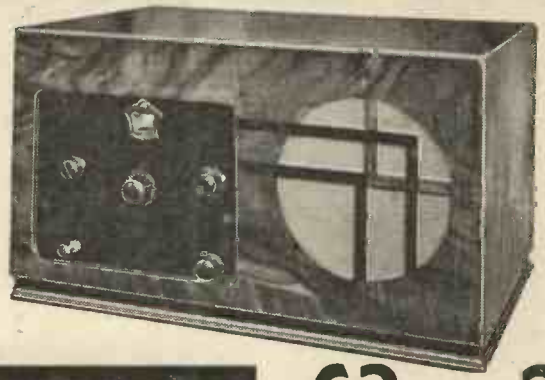

CASH — C.O.D. **£3 - 2 - 6**

Carriage Paid.

These are the Parts the Author Used

1 **PETO-SCOTT** ebonite panel, 12 × 8 in. ready drilled		4	0
1 **PETO-SCOTT "METAPLEX" CHASSIS**, 12×7×2¾ in., with back strip.		3	0
1 **SOVEREIGN**, P.T.1, Permeability Tuner.		15	0
1 **IGRANIC** 3-pole anti-capacity switch, solder-tag type		2	0
1 **MAGNUM** ·0003 mfd. reaction cond.		2	6
1 **GOLTONE** ·0003 mfd. pre-set condenser		0	9
1 **BULGIN** "Compact" 50,000 ohm Potentiometer, type V.C.36		3	6
1 **B.R.G.** On-off switch, type 49		1	0
1 **DUBILIER** ·0003 mfd. fixed cond., type 665		0	6
1 **DUBILIER** 2 mfd. B.B. fixed condenser.		3	6
1 **DUBILIER** fixed condenser, type 4404, ·15 mfd.		1	6
1 **DUBILIER** 2 megohm grid leak, wire ends		1	0
1 **DUBILIER** 10,000 ohm metallised resis., 1-watt.		1	0
1 **BULGIN** transcoupler, L.F.10		10	6
1 **GOLTONE** Screened H.F. choke, without pigtail, type S.H.F.		4	0
3 **CLIX** 4-pin chassis mtg. valve-holders		2	0
2 **CLIX** terminal socket strips		1	3
1 **BULGIN** F.7 baseboard mtg. fuse-holder and fuse		1	0
6 **CLIX** wander plugs marked		0	9
1 **BULGIN** 4-way battery cord, type B.C.2.		1	3
2 **CLIX** spade terminals		0	4
Flex, screws, 1 Bulgin G.B. battery clip, type No. 2; connecting wire		2	2
KIT "A" CASH OR C.O.D.	£3	2	6

Exact to Specification

KIT "A" Author's Kit of specified parts as detailed with ready drilled Panel and Metaplex Chassis. Cash or C.O.D. (carriage paid). £3/2/6

Or 12 monthly payments of 5/9

KIT "B." As for Kit "A," but with specified valves. Cash or C.O.D. (carriage paid). £3/19/0.
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KIT "C." As for Kit "B," but with Peto-Scott Consolette Cabinet and Peto-Scott Moving-Coil Speaker. Cash or C.O.D. (carriage paid). £5/15/0. Or 12 monthly payments of 10/6.

3 **HIVAC** valves as specified		16	6
1 **PETO-SCOTT** moving-coil speaker		15	0

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Soundly constructed of the finest materials. Hand french-polished. Selected and specified by the Author. Front ready drilled to take set. **21/-** Cash or C.O.D.
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—AIR KING—

As described in October Issue.

KIT "A." Author's Kit of FIRST SPECIFIED Parts, including Peto-Scott Ready-drilled Panel and METAPLEX Baseboard, but less Valves, Cabinet. Cash or C.O.D. Carriage paid. **£3/17/6**
Or 12 monthly payments of 7/-.

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Or 12 monthly payments of 11/-.

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KIT "A." Author's Kit of FIRST SPECIFIED Parts, including Peto-Scott Ready-drilled Panel, and Speaker. METAPLEX Baseboard, but less Valves and Cabinet. Cash or C.O.D. Carriage paid. **£3/5/0**

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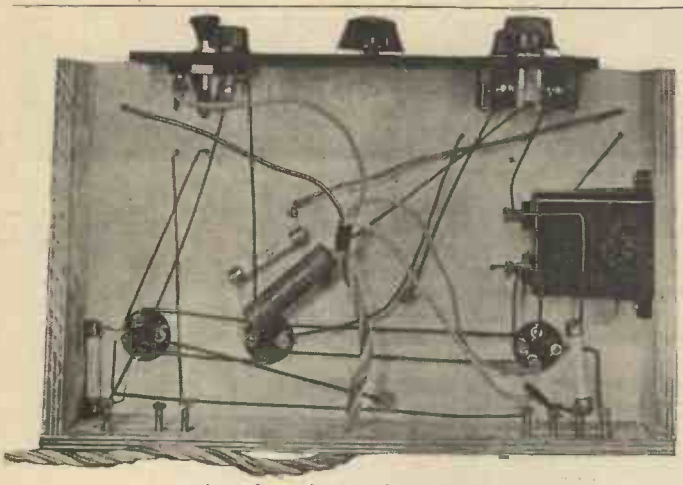


An underneath view of the chassis.

batteries and loud speaker are taken into consideration. Another point of interest is that, when desired, the set can successfully be operated from a high-tension eliminator of the simplest and least expensive type without any modification becoming necessary.

In making the "Pertune Three," the first step is to obtain all the components, a complete list of which is given elsewhere. In regard to previous PRACTICAL MECHANICS receivers, we have received a number of enquiries from readers who have asked if some alternative parts could be used. Whilst in some cases alternatives *would* prove satisfactory, we cannot recommend their adoption, because that might entail an entirely different component lay-out, or might give rise to other difficulties. In any case, our GUARANTEE—which is of real value to readers—does not apply to any receiver not built around the *exact* parts specified. These are not chosen haphazardly, but with careful consideration and regard to the circuit in which they are to be employed.

Having collected the required components together, you should make a start by drilling the ebonite panel in the positions indicated in Fig. 2. The tuner, reaction condenser, wavechange switch, volume control, and on-off switch can then be mounted in their places. Before fitting the panel you should make the slots in the rear side member of the chassis to receive the terminal socket strips. The slots are 1¼ in. long by ¼ in. wide and can be made either with a chisel or by boring a number of ¼-in. holes side by side and cutting between them, afterwards cleaning off the rough edges with a file. Next, the 1-in. diameter holes for the valve holders can be made, after which all the components can be mounted in their correct positions. In this respect there is one point which might require a little explanation; the H.F. choke is mounted on top of the chassis, but the terminals are underneath. The choke is supplied with ordinary terminals and also with two "extension" ones for through-chassis fitting. It is therefore necessary to make two ⅜-in. holes through the chassis, mount the choke on top and then screw in the terminals from the underside. Care must be taken to ensure that the terminals cannot possibly make contact with the metallised surface of the chassis, and for that reason it is well to scrape away the metal coating for a distance around the terminal holes. The rest of the assembly process is straightforward and calls for no comment.

Straightforward Wiring

After all the parts have been fixed in position the wiring can be commenced. B.R.G. insulated connecting wire is used for this purpose, and the insulation can easily be removed from the ends by means of the edge of a blunt knife blade. It will be found most convenient to start by fitting the wires on the underside of the chassis, connecting up the filament terminals of the valve holders first of all. Follow this by connecting the other valve holder terminals, since these are least accessible and might be difficult to get at later. The remainder of the wiring can be carried out in any order, but to avoid mistakes it is a good idea to work from one end of the chassis towards the other, crossing through the wires on the wiring plan as they have been dealt with. Most of the connections are made by looping the bared end of the wire to fit over the terminal shank, but a fair number of soldered joints are made; these are to the three-point change-over switch and to the fixed resistance and tubular condensers. For the benefit of new readers it might be explained that those wires which pass through the chassis baseboard can easily be traced by referring to the numbers of the holes shown in the wiring plans. These holes are, incidentally, about ⅛ in. diameter and should be made one at once as the wiring is proceeded with. Some flexible leads are fitted for battery connections, but these can easily be recognised in the drawings.

LIST OF COMPONENTS FOR THE "PERTUNE THREE"

One Peto-Scott "Metaplex" Chassis, 12 × 7 in. with 2 in. runners.
One Becol Ebonite Panel, 9 × 8 in.
One Sovereign Permeability Tuner, Type PT1.
One Igranic Three-point Change-over Switch.
One "Magnum" ·0003 mfd. Bakelite Dielectric Reaction Condenser.
One Bulgin Two-point On-Off Switch.
One Bulgin 50,000 ohm "Compact" Potentiometer.
One Bulgin Chassis Mounting Fuseholder with 100 m.a. Fuse.
One Bulgin "Transcoupler."
One Bulgin Grid Bias Battery Clip, Type No. 2.
Three Clix 4-pin Chassis Mounting Valve Holders.
Two Clix Terminal Socket Strips; one with sockets marked "A" and "E," the other marked "L.S." and "Pick-Up."
One "Goltone" ·0003 mfd. Pre-Set Condenser.
One "Goltone" Screened H.F. Choke.
One Dubilier ·0001 mfd. Fixed Condenser, Type 665.
One Dubilier ·15 mfd. Tubular Condenser, Type 4404.
One Dubilier 2 mfd. Fixed Condenser, Type BB.
Three Dubilier Metallised Resistances: one 10,000 ohms, one 250,000 ohms, and one 2 megohms.
One Bulgin 4-way Battery Cord.
Six Clix Master Plugs; marked "H.T.+," "H.T.—," "G.B.—," "G.B.—1," "G.B.—2," and "G.B.—3."
One Bulgin Crocodile Clip.
One Coil Bulgin "Quickwyre."
Short length Flex, Screws, etc.
Three "Hivac" Valves; one D.210, one L.210 and one PP.220.
One Lion 9 volt Grid Bias Battery.
One Lion 120 volt High Tension Battery.
One Ediswan 2 volt 30 a.h. Accumulator.
One Peto-Scott Cabinet.
One Peto-Scott Loud Speaker Unit.

Trying out the "Pertune"

Having completed the constructiona work, the fuse bulb and valves should be inserted, after which the batteries, aerial, earth and loud speaker can be connected. There are only two high-tension leads, and these are joined to the negative and maximum voltage sockets respectively. The positive grid bias plug should be fitted into the corresponding socket on the grid bias battery, and the plugs marked "G.B.-1" and "G.B.-2" should be placed in the "1½" and "9" tappings respectively. There are three terminals on the loud speaker (for obtaining correct matching for different types of output valves), but only those two for use with power valves will be used.

To give the set its preliminary trial, attach the crocodile clip on to terminal 5 (to which its flexible lead is attached), set the reaction condenser to zero (anti-clockwise) and slowly rotate the tuning knob. Once a signal is received it can be brought up to full strength by carefully advancing the reaction condenser; take care not to turn the knob too far or oscillation will be produced and interference with neighbouring sets might be caused. The point to remember in this respect is that reaction should be slacked off immediately there is any sign of distortion commencing. You should also try the effect of the potentiometer volume control, and after an initial setting of reaction it will probably be found that the potentiometer gives all the variation required. To change from one waveband to another you simply rotate the knob of the three-point switch.

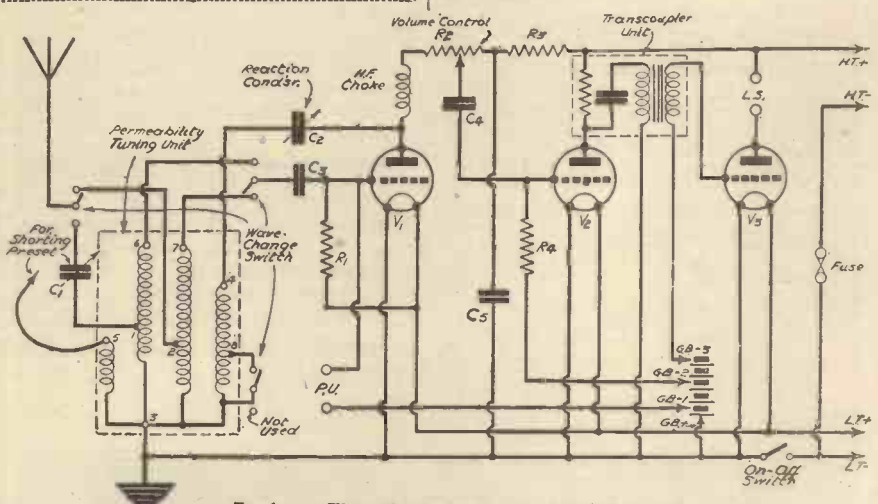


Fig. 1. —This is the circuit diagram of the "Pertune."

Fig. 1.—A new "cine" camera, the 9½ mm. Nizo, which has several novel features.

Movie Making for the Beginner

THE CINE LENS AND HOW IT WORKS

By PERCY W. HARRIS, F.A.C.I.

Editor of "Home Movies and Home Talkies."

IF readers are new to cinematography they may be bewildered by the number of cameras that are on the market. Some are large and some are small; some bristle with knobs and adjustments, while others have a sleek simplicity which makes one wonder how on earth they can work. Some are inexpensive and some cost a small fortune, but all of them have one important feature in common—the lens.

It is surprising how little attention the average cine-camera user gives to the proper understanding of the lens and its work.

The lens in a cine camera performs just the same function as in a still camera—it produces a miniature image of the scene in front of it upon the film. But there is a very important difference between still and cine cameras. In a still camera the lens forms a picture which is rarely enlarged to any great extent. Even when a 3¼ × 2¼ in. print is enlarged up to whole-plate size (8½ × 6½ in.), the enlargement is less than three diameters, and therefore the degree of sharpness of the image need only be sufficient to satisfy the eye in relatively small sizes. In the case of a cinematograph film, however, it is *always* enlarged, and to such a degree that unless the picture starts off by being exquisitely sharp it will look blurry on the screen. If you throw a 9½ mm. film on to a screen 2 ft. wide, the actual magnification is no less than sixty diameters.

Thus, while in still photography there are all kinds of lenses from the simple little lenses in the cheap box cameras up to the expensive anastigmat lenses in the more luxurious types, there is no possibility of using the simple lenses in cinematograph cameras, for the optical requirements are so high. It thus comes about that all cinematograph cameras of any consequence—even those selling for as little as 65*s*.—have "anastigmat" lenses or lenses of very high and uniform definition.

The Shutter

Most still cameras have a shutter marked with variable speeds. The simplest cameras generally have a "Time" and "Instantaneous" marking, the "Instantaneous" giving an exposure of about a fourteenth or fifteenth of a second, "Time" merely meaning that on the first pressure of the button the lens opens and on the second pressure it shuts, so that you can give long exposures on a stand for interiors. The more elaborate cameras have speeds which may include one second, a half, fifth, tenth, twenty-fifth, fiftieth, a hundredth and a three-hundredth, or perhaps even more. If the light is good, you give a high shutter speed, particularly when you want to catch animation such as a horse or a man jumping or someone running. If you have chosen your speed correctly and your lens is properly focussed, you will get a sharp image with no sign of movement. Furthermore, as high speeds require a larger lens opening in order that the right amount of

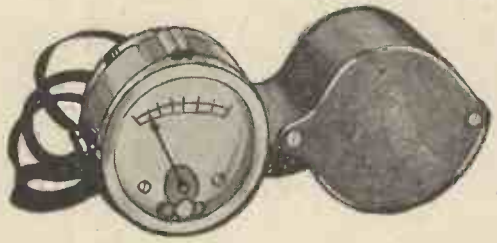


Fig. 2.—An ingenious exposure meter—the Western—which reads directly in stop numbers.

light may reach the film, you vary your stop opening. The "stops" are marked on all lenses whether still or cine, and they are generally arranged that each figure represents a doubling or a halving of the previous figure. Thus, *f*/8 is twice as large an opening as *f*/11, and *f*/11 twice as large as *f*/16, and so forth. If you give an exposure of a twenty-fifth of a second at *f*/11 (quite a common snapshot speed), then to get the same amount of light on the film for proper exposure if a fiftieth is given, one must have a bigger opening. Actually the amount of light reaching the film is exactly the same using a fiftieth at *f*/8 as a twenty-fifth at *f*/11.

The Shutter Speed on a Cine Camera

This ability to adjust lens opening and shutter speed so as to give a proper exposure is a very useful one in still cameras. A cine camera, however, has a very definite limitation, for it has but one shutter speed (in most cases). Remember, the camera is taking sixteen pictures a second—sixteen successive little exposures with an interval between, during which the film is moved to a new position. When the film is moved forward the necessary distance to bring a new surface into position the lens is covered by a rotating shutter, and in most cases the time the lens is covered and the time it is open for exposure is the same, namely, one thirty-second of a second. This then (save in more expensive cameras which have adjustments for half speed and slow motion) is the sole shutter speed. The *only* means of controlling exposure, therefore, is by varying the aperture of the lens. The individual images on a cinema film of moving objects are blurred (as you will find if you examine the frames separately), but the succession of pictures merges together and gives the *impression* of sharpness. You can prove this if you stop on a single frame of a cinema film during the time it is showing something in rapid motion.

Exposing in Poor Light

When taking subjects in relatively poor light, with only one shutter speed of a thirty-second of a second to get proper exposure, larger lens apertures must be used. In practice it has been found that nothing less than *f*/3·5 is of any use for practical cinematography, and this is the smallest lens now fitted to modern cinematograph cameras. This lens is quite "fast" compared with the lenses most frequently fitted to ordinary still cameras. The relationship of stop openings to speed varies as the *square*, so to compare speeds for different stops take the two stops, square them, and compare the results. Here is an example. It has already been noted that *f*/8 is twice as fast as *f*/11, and this cannot be worked out by the squaring method. The

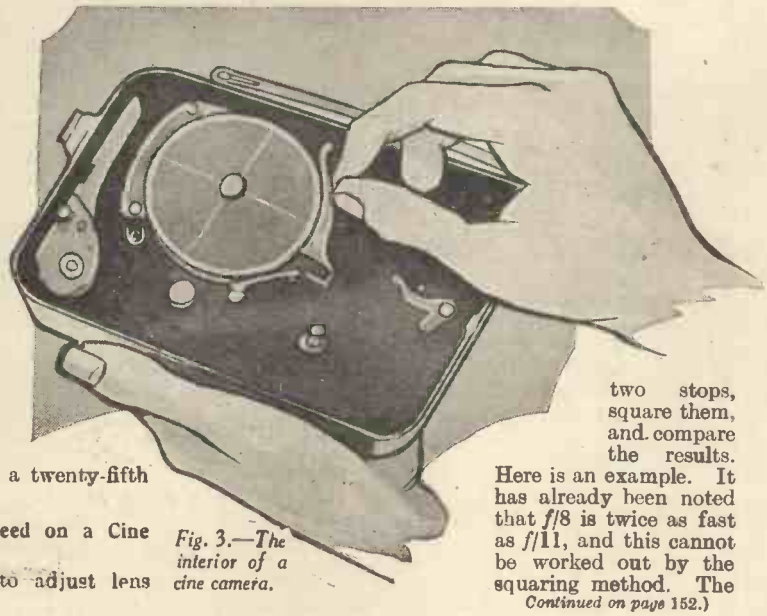
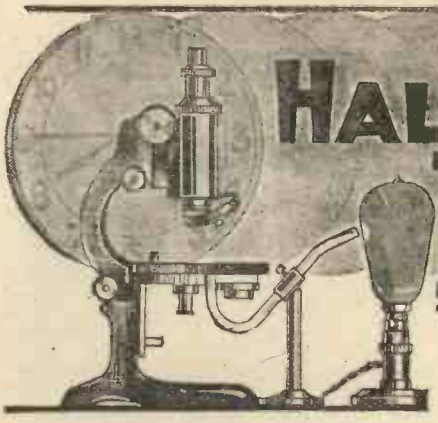


Fig. 3.—The interior of a cine camera.

(Continued on page 152.)



HALF HOURS with the Microscope

By W. J. DELANEY

The third of the Series which explains, in non-scientific language, the methods of using a simple Microscope, with everyday examples explained.

IF you have followed with interest the two previous articles on the Microscope, you will no doubt have by now become quite used to the method of manipulating this instrument, and have found for yourselves many interesting subjects to examine. I should like, however, to explain one or two simple subjects which may be found in the home or garden at this time of year which will afford interest and knowledge, whilst still further explaining the simpler forms of microscopic manipulation.

The House Fly

Even though the weather is now cold it is probable that you will be able to find an ordinary fly in the house that will answer for the experiment. By placing it under the microscope you will be able to see not only some wonderfully intricate machinery, but also observe for yourself how this insect can spread disease. No doubt many of you have wondered how the fly can walk up a vertical sheet of glass or remain suspended from the ceiling, and a brief examination of a fly's foot will reveal quite a lot. Fig. 1 is a sketch of a foot seen under fairly high power. When you remember that the fly possesses six of these feet, each provided with the double-claw arrangement, you will understand the reason for the tickling sensation when one crawls across your skin. Apart from this, however, notice the long hairs which project all round the foot. You will find that these hairs are quite stiff and bristly, with the result that soft matter clings to them. Thus, when the fly walks across such substances small particles are carried away, and although the fly is by habit quite clean—as may be witnessed when you watch one carrying out the cleaning process after eating—it is possible for the fly to pass from one substance to another and thus carry disease or filth. However, the foot will give you much to think about, as the claw will be seen to provide a suitable hold on material such as wallpaper or even porous material such as plaster, but it is undoubtedly the two large "pads" which enable it to walk on glass. These pads are studded with minute hairs, but the method by which they cling to glass, whether by suction, viscid fluid, or a combination of the two, we cannot say.

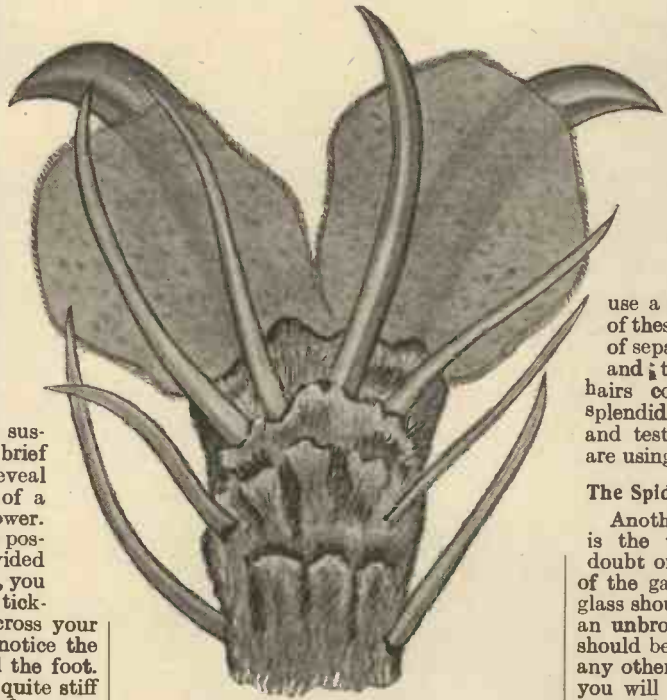


Fig. 1.—The foot of the domestic fly.

The wing will prove an interesting object to show the accuracy of focussing, as the tiny hairs which cover the silken membrane over the surface of the wing will be seen to stick up from the surface, and by carefully adjusting the focussing screw these may be traced from the wing to the tip. Again, the hairy surface will enable you to realise the possibility of dirt carrying, in spite of constant cleaning. Beneath the wing is a small structure known as a "balancer." This vibrates with the wing and appears to enable the fly to keep an even keel. I once removed the balancers from a blowfly, and found that the fly rolled over and over absolutely out of control, so that these apparently are invaluable to the insect. It is also possible, although not yet confirmed, that some organ or sense is incorporated in this small structure.

The proboscis was shown in the form of a microphotograph last month, and the small tubes (trachæ) which form the sucking medium of the fly. When you use a high power you will see that each of these tubes is in the form of a number of separate rings forming a spiral (Fig. 2), and these, together with the minute hairs covering the surface, will afford splendid practice for accurate adjustment and testing of the instrument which you are using.

The Spider's Web

Another interesting subject for practice is the web of the ordinary spider. No doubt one can be seen in some odd corner of the garden, and when found a piece of glass should be carefully pressed up against an unbroken portion of the web, and this should be carried away without touching in any other way. When placed on the stage you will be able to see, under quite a low power, how the web is made up of two separate and distinct types of thread. Perhaps you have wondered in the past how the spider can run along the web without himself getting tied up. He is not immune from the sticky substance, as you can prove by throwing a spider into the web of another. You will find that he becomes fixed and will be caught in the same way as a fly. The radial threads of the web will be

Fig. 2.—Part of the trachæ of a fly's proboscis.

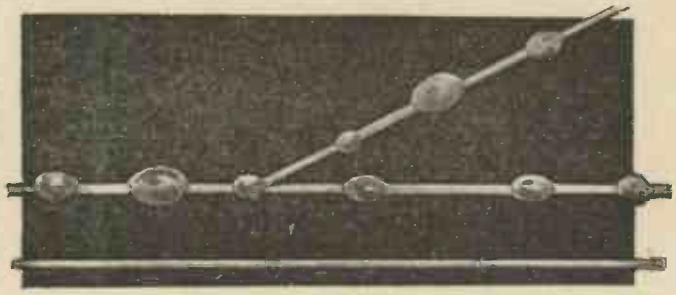


Fig. 3.—(Above) the adhesive and (below) the ordinary threads of a spider's web.

seen to resemble simple silken strands, as shown in Fig. 3, whilst the spiral threads are of both simple strands and also adhesive strands. If you can obtain a powerful glass mounted near a web you will find that the spider first of all forms the framework and the radial portions of the web, and then in some cases a large spiral, whilst in others a close spiral of ordinary non-adhesive threads. It then commences at the centre and works round in a spiral to the edge with another thread to which it attaches as it goes, a non-drying viscid fluid. If, owing to a fright or similar cause, the spider misses its footing and touches the sticky thread, you will see it break that portion away and repair the web, but generally speaking it is sufficiently sure-footed to walk across the web through the medium of the non-adhesive threads. The foot of the spider is furnished with a number of saw-like claws which rest over the threads whilst the web is under construction (Fig. 4) and when it walks across the web. Only a moderate power will be required to see these. The head of the spider will furnish amazement if you have never before studied natural history, for it possesses no fewer than eight eyes. These will be seen to be arranged slightly differently in various types of spider, but, generally speaking, they are in two rows of four each, extending round to the sides of the skull. Thus, when the spider is at rest in the centre of the web it is able instantly to see the arrival of a meal at any portion of the web, and can capture the tasty morsel before it has had time to free itself or fall away from the web. If you are able to obtain a clear view of the mouth you will, I am sure, pity any fly or insect which you may in future see in a spider's web. The mouth is truly formidable, and the poison claw-like jaws with which it is endowed will give you a nightmare if you imagine them hovering over you whilst you are trying to get to sleep. However, this is only a small investigation into the wonders of Nature, and you will, before you have spent many hours at the eyepiece of this fascinating instrument, discover that Nature is terribly cruel in her many phases, but at the same time you will appreciate many finer points of Nature which you would never realise without delving into the world of the smaller inhabitants.

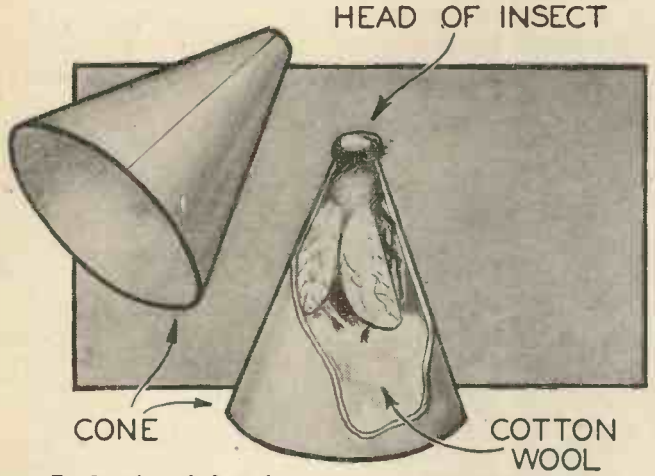
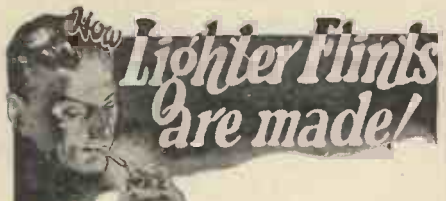


Fig. 5.—A simple device for examining an insect's head during life.

A Useful Hint

I mentioned above that the head of the spider forms an interesting subject for examination, and the house fly also will prove interesting if you watch the head during life. I would recommend the following little device which was once described to me by a member of the Queckett Club and which has proved of great value for the purpose. Obtain a piece of fairly stout notepaper and cut out small portions, wrap them round, and glue them up to form small cones, as shown in Fig. 5. It is worth while making up a number, having holes in the upper end of various sizes, and varying in length. To examine the head of the house fly, for instance, first catch your fly and then pick a cone long enough to accommodate the insect, and with a hole just large enough to permit the head to pass through. Drop the fly in at the larger end, head first, and with a piece of cotton-wool gently ease him up until his head sticks out at the top. The wool should be packed tightly enough to prevent him withdrawing, and yet not tight enough to hurt. The cone may then be stood on the stage and the head examined through all its movements.

Fig. 4.—Part of a foot of a spider showing the claws which permit it to run sure-footed across a fine web.



By H.W.

ALTHOUGH incandescent gas mantles and cigarette lighter flints bear as little resemblance to each other as cheese does to chalk, they have a common origin, and the discovery of one led to production of the other.

To a group of lesser known metals, often referred to as the "rare earth metals," belong thorium and cerium—two elements which receive very brief mention in all but the larger works on chemistry.

Thorium is extensively used in the manufacture of gas mantles (china grass or art silk frames impregnated with a solution of thorium and cerium nitrates), owing to the coherence of its oxide, which holds together after the fabric has burnt away. Welsbach was, of course, the inventor of the incandescent mantle, and in his subsequent experiments with the rare earth metals found that mixtures of cerium and iron—technically known as ferro-cerium alloys—gave off showers of sparks capable of igniting inflammable vapour when the metal was scratched or filed.

No really satisfactory explanation of this pyrophoric property of ferro-cerium has yet been put forward. It is a property possessed also by many common metals, but in a less marked degree. Copper foil ignites spontaneously in chlorine gas, while finely divided lead, iron or nickel will behave similarly in atmospheric air under certain conditions.

Pyrophoric Lead

As an illustration of this it is an easy matter to prepare a small sample of pyrophoric lead. A small quantity of lead tartrate is heated to redness in a test tube, which is then heated throughout its length to expel any residual water, securely corked and allowed to cool down. The dust it contains is metallic lead in a finely divided state. This thrown into air takes fire with a shower of sparks.

Manufacture of Ferro-cerium Alloy

Oxides of cerium, lanthanum, etc., are found in many minerals, cerite, monazite, and allanite, for instance, but as large amounts of cerium earths occur as by-products in the gas mantle industry, these are employed in the production of ferro-cerium alloys.

The oxides are first extracted and then undergo an elaborate process which reduces them to the metallic state. This metal (misch metal) is highly reactive in its molten state, combining direct with oxygen, hydrogen or nitrogen, and even with the combined oxygen in carbon dioxide or carbon monoxide. The process of reduction is, therefore, conducted in absence of air. The rare earth oxides are converted to anhydrous chlorides and then heated strongly *in vacuo* with ammonium chloride. The molten mass is then electrolysed in a graphite crucible using an iron cathode and passing a current 1,500 amperes.

There are numerous modifications of this process and various formulæ. Some manufacturers add about 5 per cent. of copper to the Misch metal. This is claimed to yield a low melting point and smooth casting alloy. Zinc and boron cerium alloys have also been produced. The popular "Auer" pyrophoric metal contains about 35 per cent. iron and 65 per cent. cerium.

"Kunheim Alloy"

A different process of French origin yields "Kunheim alloy," a mixture containing hydrides of cerium earth metals. Misch metal mixed with aluminium and magnesium is heated in an atmosphere of hydrogen to 500° C. in an electric muffle furnace. An analysis of this shows the following composition:—

Cerium	30 per cent.
Lanthanum, etc.	49 ,,
Magnesium	10 ,,
Aluminium	1 ,,
Iron	1·5 ,,
Hydrogen	1·3 ,,
Silicon	0·5 ,,

MAKING A TWIN-SOLENOID MOTOR

By A. J. BUDD

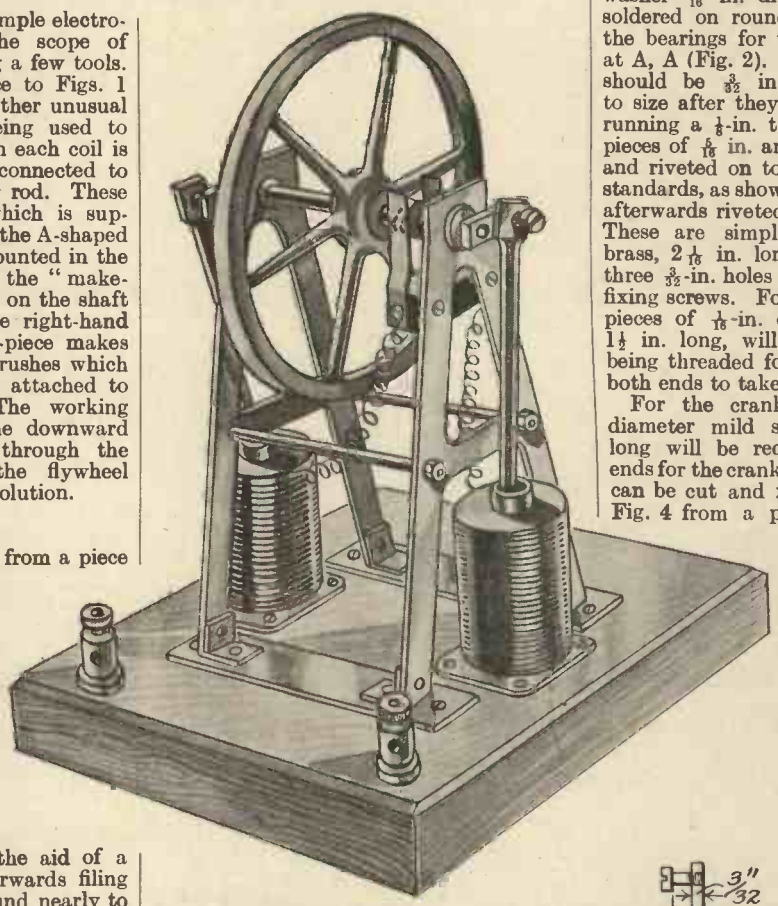
This type of motor is of a novel character. If working parts are carefully adjusted, the little motor should run at a high speed when connected up to a 4-volt accumulator.

THE construction of this simple electro-motor is well within the scope of amateurs capable of using a few tools. It will be seen, with reference to Figs. 1 and 2, that the motor is of rather unusual design, two solenoid coils being used to provide the driving power. In each coil is a soft iron plunger which is connected to the lower end of a connecting rod. These rods drive the crankshaft, which is supported in bearings at the top of the A-shaped standards. The flywheel is mounted in the middle of the crankshaft and the "make-and-break" cam-piece is fixed on the shaft between the flywheel and the right-hand bearing as shown. The cam-piece makes contact with two springs or brushes which are fixed to an ebonite block attached to the right-hand standard. The working stroke of each plunger is the downward one, a circuit being made through the solenoid coils alternately, the flywheel receiving two impulses per revolution.

Details of Construction

The baseboard can be made from a piece of mahogany or oak, planed up and made square, or, better still, a switch block of a suitable size can be used for the purpose. The A-standards can be sheet brass $\frac{1}{16}$ in. thick, and may be marked out side by side on the metal to the dimensions given next month, while the holes need only be marked and centre-punched on one standard. Cut round the outline with the aid of a hammer and cold chisel, afterwards filing down the rough edges all round nearly to the scribed line. The two standards should now be lightly soldered together in three or four places so that the edges more or less coincide. After drilling the five holes through both plates, file up the edges, leaving them as square as possible, after which the plates may be separated and cleaned up. Each standard should now have a small brass washer $\frac{1}{16}$ in. diameter and $\frac{1}{16}$ in. thick soldered on round the top hole to widen the bearings for the crankshaft, as shown at A, A (Fig. 2). The holes in the washers should be $\frac{3}{32}$ in. diameter, being drilled to size after they are soldered in place by running a $\frac{1}{8}$-in. twist drill through. Four pieces of $\frac{5}{16}$ in. angle brass can be soldered and riveted on to the bottom parts of the standards, as shown, to form feet, which are afterwards riveted to the base plates B, B. These are simply strips of $\frac{1}{16}$-in. sheet brass, $2\frac{1}{16}$ in. long by $\frac{1}{2}$ in. wide, having three $\frac{3}{32}$-in. holes drilled in each to take the fixing screws. For the two stays C, C, two pieces of $\frac{1}{16}$-in. diameter mild steel rod, $1\frac{1}{2}$ in. long, will be required, each piece being threaded for a distance of a $\frac{1}{4}$ in. at both ends to take two nuts.

For the crankshaft a piece of $\frac{1}{8}$-in. diameter mild steel rod exactly $1\frac{13}{16}$ in. long will be required, threaded at both ends for the crank webs to screw on. These can be cut and filed to the sizes given in Fig. 4 from a piece of sheet brass $\frac{3}{32}$ in. thick, and the two holes drilled and tapped in each as indicated. The two crankpins can be purchased ready made, or two ordinary set screws could be used. They should be about $\frac{3}{32}$ in. diameter under the head. The flywheel, which is $2\frac{3}{4}$ in. diameter and $\frac{3}{16}$ in. across, and other details will be dealt with next month.



A perspective sketch of the completed twin solenoid motor.

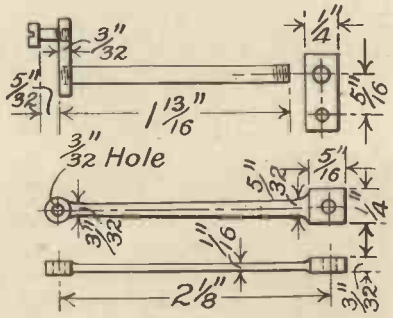


Fig. 4.—Crankshaft, and connecting rod details.

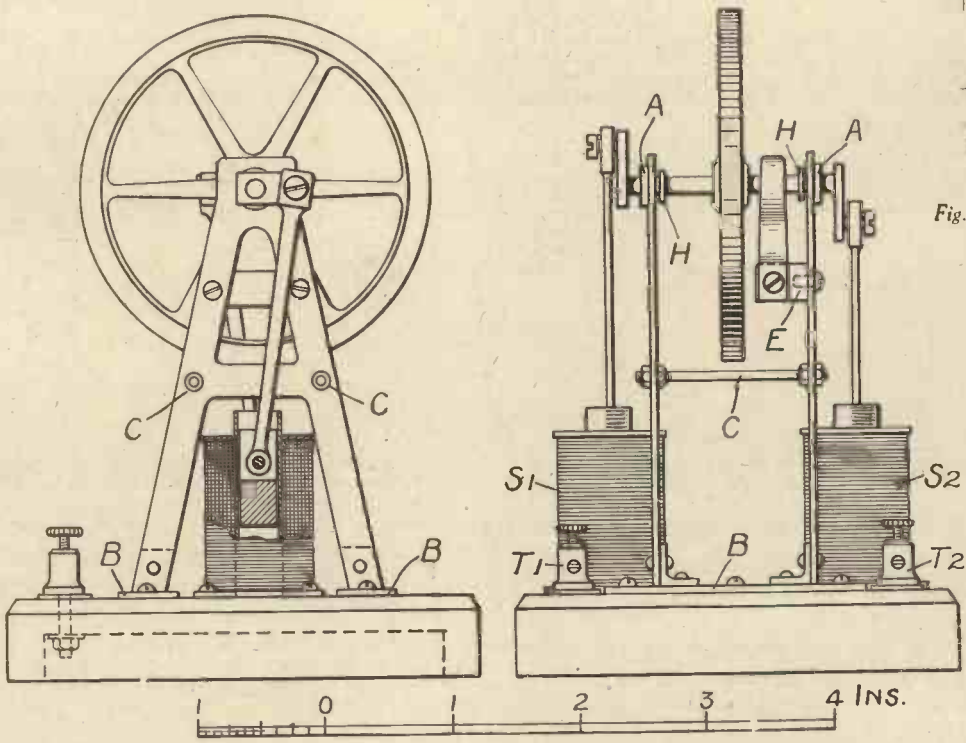


Fig. 1.—Part sectional side view of the motor.

Fig. 2.—Front view, showing the solenoid coils.

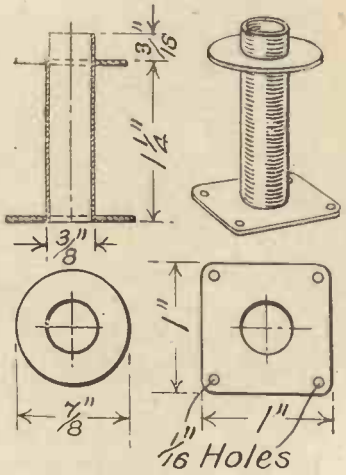
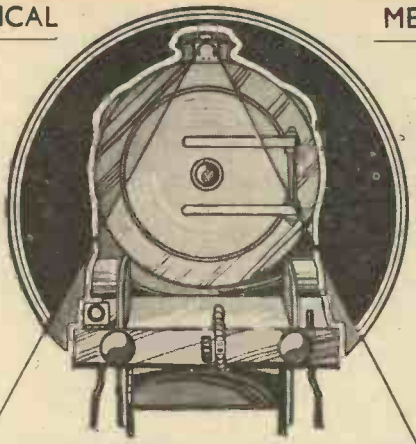


Fig. 3.—Sectional view, and details of solenoid bobbins.

A MODEL OUTRIGGER TURNTABLE

HINTS on MODEL RAILWAY PLANNING



BY THE PADRE

THE model locomotive turntable I am about to describe is somewhat novel and quite ultra-modern in its style. It is known as a Ransomes & Rapier outrigger type, and one of its kind is to be seen at the new depot at Ashford, Kent, on the Southern Railway. It differs, however, in two respects: first, in the arrangement whereby the pit is fenced for safety by a revolving set of handrails; secondly, in that the model is provided with a manual worm-gear drive. A glance at the aerial photo of the West Midland yard will at once reveal the method and idea of the table. Metal outriggers, or bars, pass across the well, being fixed to the underside of the table, and on these bars there are soldered two semi-circular tinplate strips which carry the upright posts for the handrails. When the table revolves, these outriggers move with it, and the open part of the well is therefore always enclosed for safety, only the two ends of the track-table being open. I also give another photograph, showing the new eight-coupled engine just leaving the turntable for the shed. There are also three sketches, one showing an elevation of the side of the turntable, the other a plan, and the third showing the worm drive (Figs. 1, 2 and 3).

The Base of the Well

I have followed a different method in this design of arranging the base of the well. Formerly I used a circular tin lid. But the amateur would find it a matter of greatest difficulty, I fear, to get the exact centre of this lid for the pivot. I therefore suggest a metal base for the well, the well itself consisting of a mere hole cut in the baseboard. This metal base may be of any convenient thickness, and should be quite square, with a hole in the centre found by drawing diagonals from corner to corner. Then there are four other holes, one on each corner, which must be considerably larger than the type of screw to be used. These screws are set in with large washers, and the centre of the table can thus quite easily be adjusted after the table is in place. It is therefore possible to get a perfect movement on the part of the mechanism.

The wide wall at the half-level on which the rail is laid consists, as before, of a number of layers of fairly thick picture-framing cardboard strip, glued in place to required width. There is also a wooden buttress underneath the table, between the nether girders, through which the pivot passes, and which ensures greater rigidity for the pivot. This buttress is pinned to the base plate of the well. The table itself consists of a piece of plywood 2 in. wide by no less than 9 in. long, with a pair of metal contacts at the ends to engage the top of the rail. No wheels are necessary. The pivot itself is a piece of ⅛-in. mild steel which is soldered to a tinplate cap at the top, this cap being pinned down to the table and the running rails being soldered on to it. Sleepers may then be soldered at about every inch.

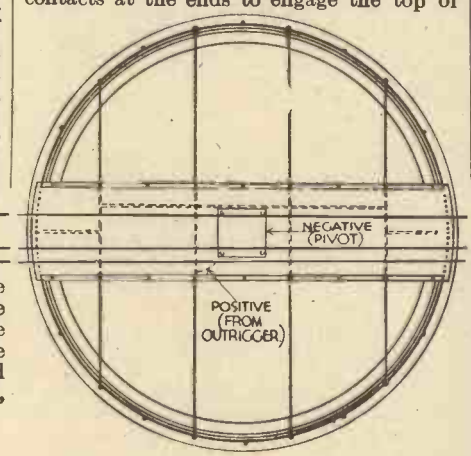
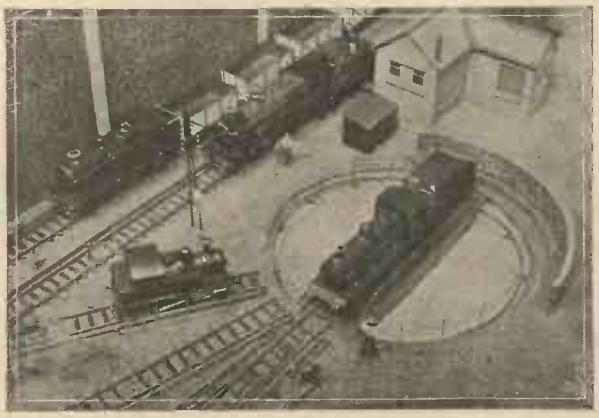


Fig. 1.—A plan view of the model locomotive turntable.



A photograph of the turntable in use, showing a model locomotive about to leave.

The Outriggers

The outriggers, fixed to the underside of the table direct, are of cage wire, and the tinplate strip, soldered to the outriggers on its edge, is a commercial product. The ends of the strip are pinned to the end edges of the table. The arrangement should be such that the outriggers will engage the rail in moving around, and they may be slightly bent down for this purpose. Handrails are also fitted to the sides of the table, common pins being stuck in for uprights, and thin wire employed for the rails, the soldering being done by inserting bits of ¼-in. strip-wood to give the spacing. In the West Midland model, these handrails are given a splay outwards near the mouth of the track at each end, so that engines will readily clear the handrails. The circular rail may be fixed down to the track bed in the pit by means of proper 00-gauge metal chairs, which may now be had from a London firm. The table having been set in place, the pivot through the holes, it is retained by means of a cuff with set-screw, which can be had with the mild steel rod.

Current is supplied as follows: A piece of old clock-spring is shaped to form a brush which engages the base of the pivot. To this the negative lead is attached. The current thus passes through the pivot to the top tinplate cap and to the running rails. The positive lead is taken to the circular pitrail, and the outriggers and table contacts being all linked together as shown, a connection is made from the nearest outrigger to the outer conductor rail.

Fig. 3 shows the worm-drive. The gears are the ordinary cheap loco gears, and cost only a few pence, together with a length of rodding for a spindle. This is passed through suitable bearings and is bent at the end to form a handcrank, which projects beyond the baseboard edge. The gears are very slow and the movement of the table will therefore be found correct.

The Handrails on the Outriggers

These are formed in the

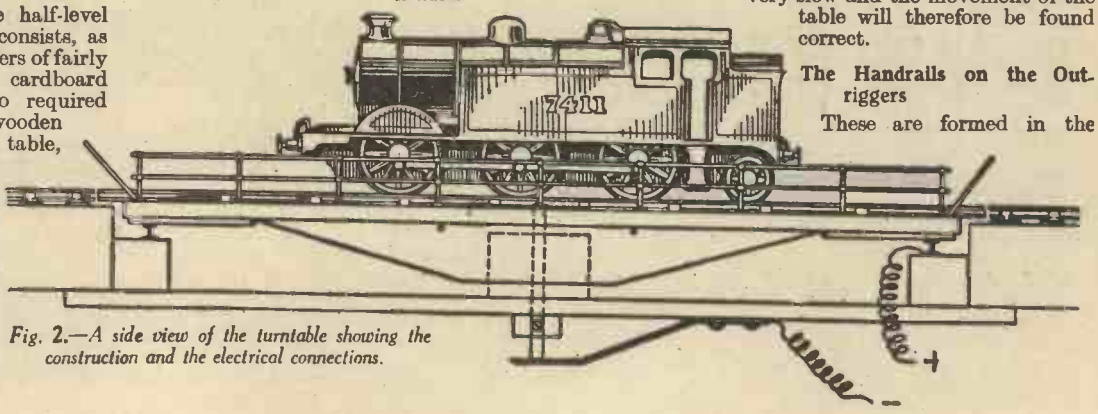


Fig. 2.—A side view of the turntable showing the construction and the electrical connections.

An aerial photograph of a model railway yard with the turntable in the background.

same manner as those on the table and the ends are soldered to the ends of the latter. But if preferred—and it would be a neater job—these rails may be in one piece, joined at the centre of the table itself and running right around the circumference.

The West Midland table to this design has been in operation for over twelve months without any hitch, so the design can be recommended. Care should be taken to cut the pit hole neatly, and to make the roof-felt on the baseboard (if this is used) fit exactly. The inside of the well may then have its walls finished in smoky brick paper and the base be painted with dove-grey paint to simulate concrete. Undergirders, handrails, outriggers, etc., are red oxide with the exception of the end sections of the table handrails, which are white. The running track should project about ¼ in. over the table ends, so as to carry the locos well over the gap. The ends of the conductor rail should be bent down, so as to lift gradually the approaching loco collecting shoes. A separate switch on the control panel of the railway will be found a great boon if placed to control the table current, as locos can then be kept stationary on the table. They can also be run on to the table with the switch cut out, and will stop themselves when they arrive. If there is only a single-track approach to the turntable, a short length of track, about 3 in., may be fitted on the opposite side and terminate in buffer-stops. But if several tracks converge on the table, a stout brick wall is more satisfactory, as this will serve the whole width of the tracks involved.

Although the 00 gauge has not been very popular with model engineers for the past few years, it is apparently now coming into its own, and many who previously pinned their faith to the 0 and 1 gauge tracks are now transferring their affections. There is no doubt that the smaller gauge offers many real advantages, one of which is that a complete track can be accommodated in a much smaller space. There are now available quite a number of 00 gauge models which are excellently and accurately produced, which fact emphasises the interest that they are evoking.

Fig. 3.—Details of the worm drive.

ENGINE DRIVEN MODEL AIRCRAFT

Concluded from page 95, November issue.

In the elevation drawing of the petrol driven model already given it will be seen that between the upper and lower tail booms there is an arrangement shown attached to the horizontal tail plane. It consists of two threaded rods, one on each side of the centre line; that is to say, one between each pair of booms. There are two lugs, also one on each side of the entering edge of the plane, which lugs encircle the threaded rods. Above and below each of these lugs there is a milled nut, which can be revolved by the fingers. The object of this whole arrangement is to alter the angle of incidence of the main planes as may be required. This is arrived at, of course, by making the horizontal tail surface act as an elevator or depressor.

The Petrol Tank

The next item is the fuel supply tank, which in both of the biplanes will be carried, as previously stated, in the top wings in much the same manner as in the full-sized DH Moth machines.

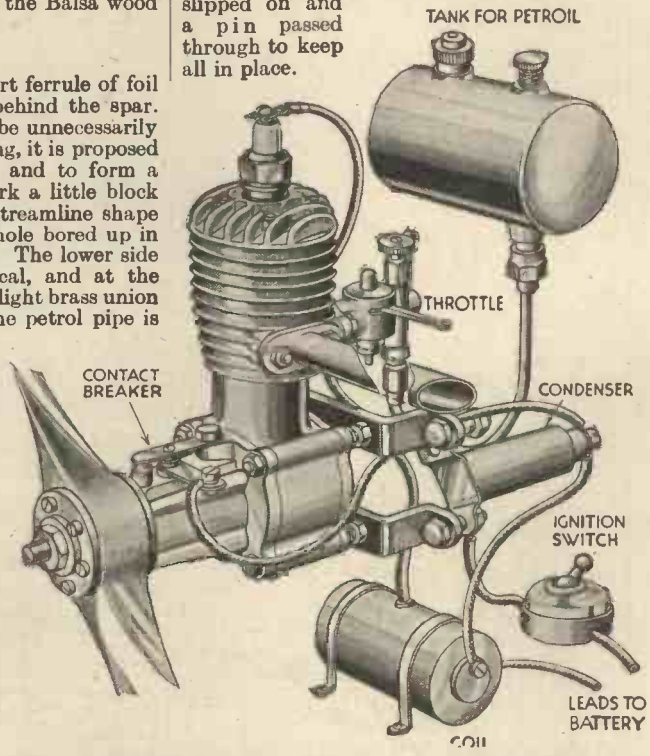
I have not previously mentioned it, but I think the reader will understand that, in the monoplane, the tank can be of any convenient shape, since it will be carried in the fuselage, but in the case of the biplanes it will need to be streamlined and, in fact, form a portion of the lifting effect of the wings. It is built of copper foil with all joints flanged and soldered. Fig. 5 shows the whole of the details of form and construction. On the left is a longitudinal section and on the right a cross-section, whilst below these the tank is sketched in perspective. The upper surface will need to be broken and an U-shaped plate inserted which will embrace the main front spar *a*. At the back a lip is formed to fit over the rear spar *b*. The front edge is made square to come close up to the entering edge spar *c*, to which it is not attached in any way. In order to provide a support for the front of the tank a long rectangular strip of Balsa wood is inserted above the front spar. The thickness of this should be just sufficient to fit between the spar and come flush with the top surface of the tank; its length, as indicated by the cross-section, should just equal that of the tank. This strip is marked *d*. On the top of the tank four tiny plates of copper foil *e*, *e* are soldered. These plates should be bent upwards until the tank is fixed in position when they are turned down to press upon the Balsa wood strip.

The Filling Plug

For filling the tank a short ferrule of foil is soldered in a hole just behind the spar. Since a screwed tap would be unnecessarily heavy for closing the opening, it is proposed that a cork shall be used, and to form a handle for gripping this cork a little block of hardwood is carved to streamline shape and the cork glued into a hole bored up in the underside of the block. The lower side of the tank is made conical, and at the extreme point of the cone a light brass union tap is soldered to which the petrol pipe is attached. As will be seen from the cross-section the tank will just fit between the ribs *h*, *h* on either side of the centre line of the machine.

The Wheels

Two holes are punched diametrically opposite to each other through a rubber ball, and a sleeve is passed through having two discs or collars upon it. These collars are pressed towards each other, so flattening the ball. Such a wheel is shown in Fig. 6. Here *a* is the ball, which should have a diameter of about 3 in., *b* are the discs. One of these should be soldered to the revolving sleeve *c*, which could be made from brass tubing. The opposite end of the sleeve should be screwed and the other disc tapped to fit. To lock this screwed disc in position, after the ball has been pressed to the requisite shape, a locking nut *d* is screwed on. For convenience this nut may well be made with two lugs, as shown. The axle of the undercarriage *g* can be of aluminium tubing and the journal *e* on which the wheel will run may be of brass with a collar *f* soldered upon it to act as a stop for the wheel. The end of the brass axle is drilled, a washer slipped on and a pin passed through to keep all in place.



The above illustration shows the new and improved "Atom Minor," 14·5 c.c. petrol engine which is being made by Messrs. A. E. Jones Ltd., 97 New Oxford Street, W.C.1. This excellent little engine weighs only 1 lb. 3 oz. without flywheel, and therefore is ideal for model aeroplane work. As illustrated, it is complete with petrol tank, coil and carburettor.

CHEMICAL REACTIONS AS A SOURCE OF PARTY ENTERTAINMENT

FROM ancient times chemical reactions have been turned to account by exponents of the art of magic in the production of their phenomena. Old tricks like the changing of water into wine and the like seem to have had great popularity in the very early days when a conjurer held considerable power and authority in the land. There is no doubt either that early religious bodies found elementary scraps of chemistry a most valuable acquisition to their stock of knowledge, mysterious fires and coloured flames being early recorded as characteristic of religious and occult rites. That this supernatural interpretation of certain chemical reactions dies hard is evidenced by the fact that the writer knows personally of an instance of so-called witchcraft being practised to-day. When the spirits are about to put in an appearance the darkened room becomes illuminated by a flickering, eerie, green light, and although by this effect no doubt the patrons get their money's worth, it is not difficult to guess the use to which the crafty old dame puts the large amount of copper salts which she often purchases. Again, many old books on chemistry treat the subject almost as a black art. This is exemplified by the sensational titles with which they endow their experiments: "To seem to make Water mix with Oil," "To produce Coruscations under Water," "To seem to make the Living Dead," and so forth.

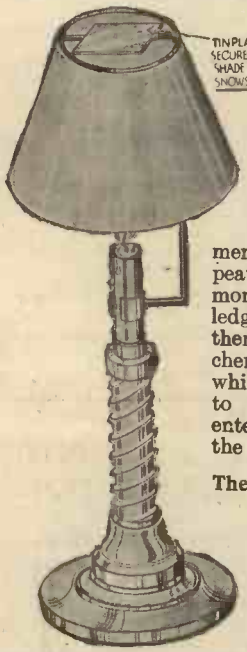


Fig. 3.—How a realistic miniature snowstorm is produced by placing a "Meta" block on top of the candle as shown.

In fact, in their vivid description of experiments the old writers certainly let their imaginations run riot, for many of their experiments we cannot repeat in spite of our more advanced knowledge! Nevertheless there are numerous chemical reactions which can be turned to account as good entertainment during the party season.

The Choice of Experiments

In devising an exhibition of chemical magic, the choice of experiments is necessarily influenced by several factors. The reacting agent should be free from odour—as apart from "giving the game away," most chemical vapours are distinctly unpleasant. The experiments should be of such a nature that the desired reaction is brought about speedily by simple means, *i.e.*, the mixing of two solutions or the application of heat, etc.

Lengthy processes are tedious and the spectators soon lose interest. Again, the final result must be self-evident and unexpected, or there can be little to hold the attention of a lay mind. In, for instance, firing sodium in chloride and handing round the product—common salt, we ourselves may be impressed with this fascinating illustration, but as an example of chemical magic it fails—a simple colour change is much more impressive.

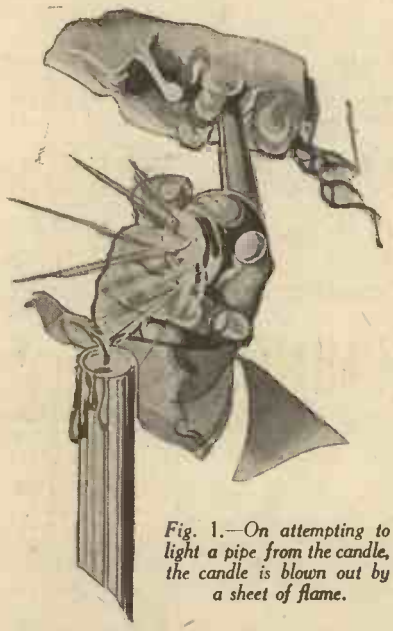


Fig. 1.—On attempting to light a pipe from the candle, the candle is blown out by a sheet of flame.

A description of the following short entertainment is offered as a suggestion, and indicates the lines upon which a successful display of chemical magic should be arranged. It should be noticed that the preceding rules have been followed, and that an attempt has been made, by means of the indicated patter, action, and the order of experiments, to impart to the whole coherence and a story-like structure. Such an entertainment would occupy a period of ten to fifteen minutes.

THE STORY

The performer stands at a small table upon which are arranged three candlesticks and an assortment of glassware. After a few preliminary remarks he comments upon lack of illumination, and carelessly picking up his wand touches one of the candle wicks with it. The candle immediately becomes ignited. More patter follows, and a tobacco pipe is produced; on attempting to light this at the candle, however, a sheet of flame flashes from it and the candle goes out. The entertainer is apparently chagrined at this and picking up his two remaining candlesticks he holds them together, whereat, with a splutter, both ignite!

Selecting a cigarette and lighting it, this time successfully, he explains that he is able by "expansion of molecules" to make the tobacco smoke penetrate even through glass and suits the action to the words by placing a stopper in a glass jar, covering it with a handkerchief, and blowing clouds of smoke upon it. On removal of the handkerchief, the jar is seen to be full of smoke which pours out when the stopper is removed. Remarking that the jar is no ordinary one, our performer stuffs his handkerchief into it and demonstrates the ease of "Dry Dyeing" for immediately the handkerchief loses its light blue colour and turns pink. Pulling up his coat collar the entertainer explains that the room temperature is fast going down, and he fears an early fall of snow. Sure enough within a few moments the air is full of snow, which falls thickly on everyone.

That the power of the chemist even places the weather within his control, however, is shown by the next trick.

A small picture depicting in black and white a country landscape in winter is passed round for inspection. On its return the entertainer waves it in the air, mutters spells, and commands the snowstorm to cease and milder weather prevail. At this the snow becomes less and less thick and finally disappears as the wintry landscape is again passed round for inspection. No longer is it wintry — the sky is blue, the foliage is green, and the fields are golden with corn!

Fig. 2.—Changing the colour of a handkerchief by placing it in a bottle.

Taking up a decanter of water, wine is called for. On pouring the water into a wineglass it miraculously

changes into a red wine! Water from the same decanter changes into milk when poured into a second glass, and in a third, black ink is similarly produced. Lights are then lowered—a few passes are made over a large glass bowl. The two candles are mysteriously extinguished by pouring over them imaginary fluid out of an empty jug. The glass bowl is now seen in the dim light to be a mass of pale blue fire with rings of fire ascending from it. This striking display concludes the entertainment.

THE EXPLANATION

1. Lighting the Candle

The candle is prepared beforehand; a very small piece of phosphorus being pressed into the wick. The wand is a hot glass rod.

2. The Explosive Tobacco Pipe

The pipe bowl contains a little lycopodium powder, and when the attempt is made to light the pipe this is blown into the candle flame.

3. Lighting the two Candles

The wicks undergo previous preparation. One is soaked in turpentine and then dusted with potassium chlorate powder. The other wick retains a globule of strong sulphuric acid.

4. The Smoke Trick

The inside of the jar is painted beforehand with a little concentrated hydrochloric acid. The stopper is similarly painted with ammonia or dusted with ammonium carbonate. In either case the two are kept well apart until the trick is actually operated.

5. The "Dry Dyeing" Trick

The handkerchief is previously dyed with a strong solution of blue litmus. Sufficient acid vapour remains in the jar to change its colour.

6. The Snow Storm

The candlesticks carry shades fitted with metal shields, as shown in sketch. A few moments before the performer complains of feeling cold he secretly places a few fragments of "Meta" solid fuel on these shields, which at this stage should be quite hot, due to the ascending heat from the candles. Sublimation of the "Meta" takes place, giving a fine imitation of falling snow, and when the chemical is almost completely dissipated, the next trick is introduced.

7. The Chemical Landscape

This is treated beforehand. A black and white picture representing a winter scene is either obtained or drawn.

It is then painted with the following :—

(*a*) The Sky and Water.	An aqueous solution of cobalt chloride.
(*b*) Foliage	A solution of cobalt oxide in acetic acid, to which is added a little common salt.
(*c*) Cornfields	An aqueous solution of copper chloride.
(*d*) Pink colour (if used).	As for (*b*), but substituting potassium nitrate for the common salt.

When dry, the picture is colourless. The colours are produced by warming it over the candle flame.

8. Wine, Milk, Ink and Water

The decanter contains water to which has been added tincture of ferric chloride and sulphuric acid in the proportions of about 1 drachm and 10 drops respectively to the pint. Three wineglasses are painted beforehand on the inner surfaces according to the following :—

Wineglass A	(Wine)	A solution of ammonium thiocyanate.
Wineglass B	(Milk)	A strong solution of bismuth carbonate in concentrated hydrochloric acid.
Wineglass C	(Ink)	A solution of tannic acid.

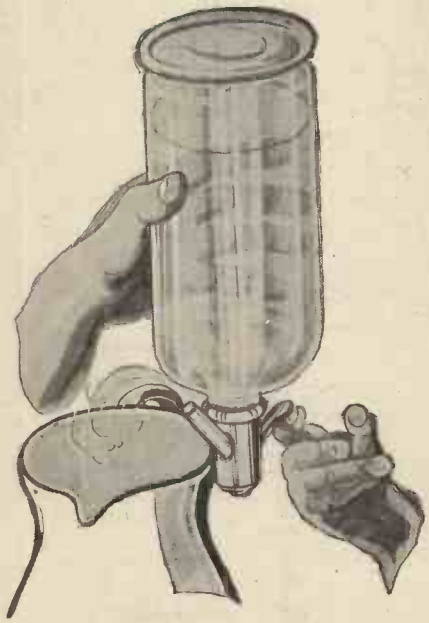


Fig. 4.—Carbon dioxide is obtained from an inverted syphon of soda water as shown in the sketch.

9. Extinguishing the Candles

The glass jug contains carbon dioxide gas, obtained most handily from an inverted syphon of soda water, as shown in sketch. The gas, being very heavy, remains in the jug during the progress of the experiment, and is simply poured on to the candle flames to extinguish them at the close of the performance.

10. The Bowl of Fire

The bowl contains water, and as the passes are made over it, small pieces of palmed calcium phosphide are dropped in.

MISCELLANEOUS TRICKS WITH CHEMICALS

These tricks are useful to have on hand for odd occasions :—

The Refractory Sugar

A cube of sugar is selected. A lighted match is applied to one corner and the sugar burns with a pale blue flame. A similar cube is handed around, and it is wagered that no one present can ignite it in the same way. Nor can they. The secret lies in first touching a corner of the cube with cigarette ash. A little of the ash clings, and the sugar can be easily ignited at this point.

Tinfoil made Inflammable

A piece of tinfoil is taken from a cigarette packet, screwed up with its paper wrapping outwards, and laid on a plate. In a few moments smoke bursts from it and the mass smoulders away. To achieve this, a little freshly powdered and damped copper nitrate is enclosed within the foil as it is folded into a wad.

Colour Changes

Fine colour changes are exhibited by red cabbage water. The cabbage is well boiled and the red liquid decanted. The colours available with this are :—

(*a*) To Purple	By adding to a solution of alum.
(*b*) To Green	By adding to a solution of potassium hydroxide.
(*c*) To Crimson	By adding to a solution of hydrochloric acid.

TO PRODUCE A BLACK LIQUID BY THE MIXTURE OF AN AMBER SOLUTION AND A BLUE SOLUTION

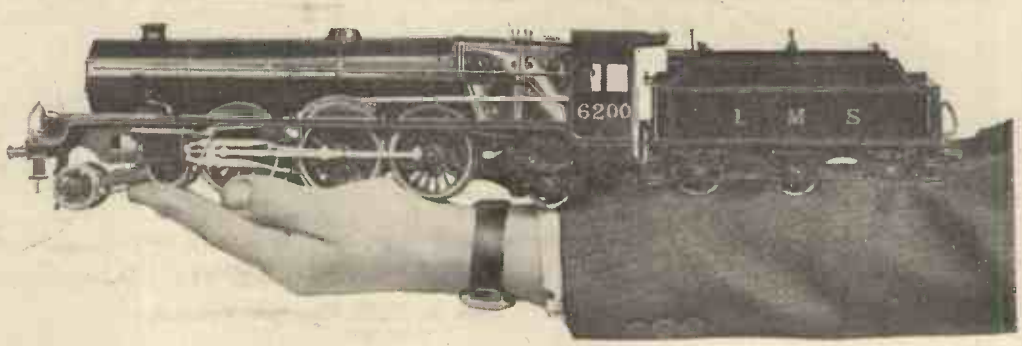
The amber solution is merely cold tea, and the blue, copper sulphate.

Water changed to Brandy, Claret, and Ink

A pinch of powdered sandalwood is dropped into water. This forms a claret-coloured solution, and, when poured into a vessel containing a little vinegar, becomes brandy coloured. On further transference to another vessel containing a trace of alum the solution turns black.

Wine changed into Milk

The "wine" consists of acidulated water coloured with tincture of iodine. This, added to photographic "hypo" solution, causes a precipitation of sulphur in such fine particles that the liquid resembles milk.



The photograph shows a fine Bassett Lowke O gauge model of the new L.M.S. locomotive, The Princess Royal, which was recently completed at Crewe and designed by the new locomotive superintendent. This model is electrically propelled by an 8-pole motor.

ABOUT MERCURY AND VENUS

By M. de NULLY

MERCURY and Venus are the only two known planets circulating within the orbit or track of the Earth. According to the formula of Bode's Law there should be another world revolving between Mercury and the Sun, but, so far, no trace of such a body has been detected. Nevertheless, it has long been named Vulcan in anticipation of discovery! Mercury and Venus, owing to their interior situations, exhibit phases similar to those of our Moon and for much the same reason. Both planets shine alternately as Evening and Morning "Stars" according to whether they are swinging round towards us from behind the Sun or, after passing between us and that luminary, are speeding back to complete their circuits. As a result of these movements they seem to oscillate to the left and right of the solar disc, but without straying far on either side. When they have reached their respective limits they are said to be at Greatest Eastern (or Western) Elongation. When between us and the Sun, they are in *Inferior* Conjunction and when on the far side, at *Superior* Conjunction. The extreme swing in the case of Mercury being comparatively restricted, it is never visible for more than about an hour, either as an "Evening Star" after sunset or as a "Morning Star" before sunrise. The corresponding maximum period for Venus may, however, extend to nearly four hours, but neither of them is ever seen very high in the heavens. Amateurs with small telescopes are practically as well equipped for the observation of Mercury and Venus as those provided with big instruments, for the markings on these planets are exceedingly faint and tend to disappear under the greater magnification of larger apertures. It has been definitely determined either. Any star gazer readers of PRACTICAL MECHANICS may, therefore, by carefully recording the shapes and times of disappearance and reappearance of even the lightest shadings, contribute valuable information to the science of astronomy.

Planet Mercury

Mercury is 3,000 miles in diameter (only half as much again as our Moon) and the nearest planet to the Sun, round which it revolves in eighty-eight days at a mean, or average, distance of 36,000,000 miles. Though its path in space is roughly circular, the planet is not situated centrally within it and the eccentricity of its orbit (0·206) is the largest among all the solar satellites except perhaps Pluto. As a result, Mercury at times approaches the Sun to within about 28,500,000 miles, and at others recedes to 43,500,000 miles. When at inferior conjunction the distance between Mercury and the Earth can be reduced to 50,000,000 miles. Although the rotation period is uncertain, it is generally assumed to be eighty-eight days, the same as that of revolution. If this be correct, one hemisphere must be exposed to perpetual scorching day and the other to everlasting frigid night. Estimates place the temperature of the illuminated half at 650° Fahrenheit—the melting point of lead—and consequently impossible to determine the periods of keen-sighted among the the averted face at far below freezing. In size, weight and surface gravity Mercury bears a strong resemblance to our Moon. The similarities of their albedos, or light reflecting properties, is particularly striking, that of Mercury indicating just such another barren, rugged and mountainous sphere. There is also a corresponding absence of any traces of surrounding air.

On certain occasions of inferior conjunction Mercury passes exactly between the Earth and the Sun. At such times the planet appears as an inky dot moving slowly over the dazzling disc of the latter. These happenings are rather infrequent, the last having taken place in 1927 and the next not being due until 1940. Mercury is sometimes visible to unaided vision for a few days near to greatest elongations, especially when a "Morning Star" in September and October, or an "Evening Star" in March and April. A less favourable opportunity will occur on the 6th of this month when Mercury will again be at Western Elongation. On that date—weather permitting—it may be found low over the south-east horizon about 7 a.m.

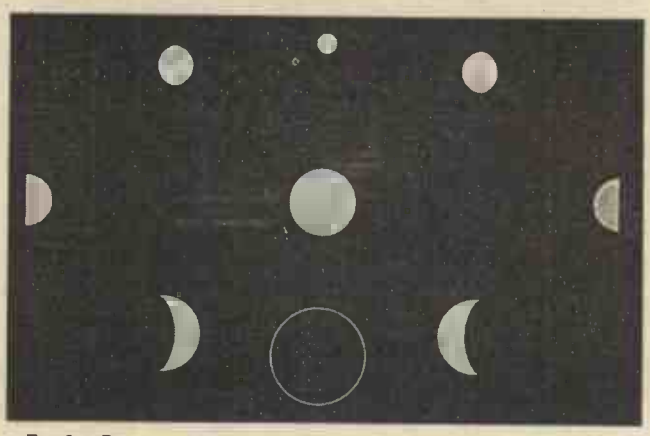


Fig. 3.—PHASES OF VENUS AND MERCURY AS SEEN FROM THE EARTH.

Diagram shows Sun in centre and planet beyond, at Superior Conjunction (small disc at top). Swinging to the left towards us, planet becomes "Evening Star" passing through Eastern Elongation (half moon). Greatest brilliancy (crescent) to Inferior Conjunction (circle). Thereafter turns to the right away from us as "Morning Star," back to the Superior Conjunction, all phases meanwhile being reversed.

Planet Venus

Venus is the brightest of all our companion worlds and comes nearest to us of any of the principal planets. It revolves round the Sun in 225 days at a mean distance of 67,200,000 miles and in an almost circular path. As with Mercury, the rotation period remains in doubt, and it is likewise assumed to coincide with that of revolution; also that the planet always turns the same face to the Sun. Under such circumstances the extremes of heat and cold must be similarly severe; but opinions in regard to the period vary down to so short a time as twenty-three hours. When at Inferior Conjunction Venus can come within 26,000,000 miles of the Earth, and it is at its greatest brilliancy about thirty-six days before and after that position. Such a phase will recur on the 31st of this month, when

Fig. 2.—The planet Venus when near Inferior Conjunction.

Fig. 1.—The planet Mercury at Elongation.

Continued on page 140.

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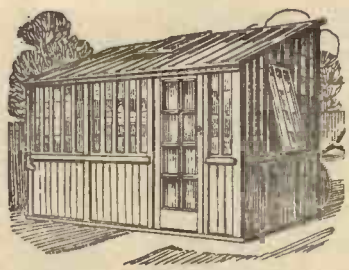

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HOW TO MAKE A BATTERY-OPERATED ELECTRIC CLOCK

THE advantage of an electric clock is well known, yet it is surprising how few are to be found in the average house. That they are too expensive cannot be the reason, for they may be obtained quite as cheaply as the ordinary spring-driven clocks.

There are essentially two different types of electric clocks obtainable. The simplest is the battery type, which is worked from a 4-volt dry battery; it will run for almost an indefinite period without renewing the battery. The second type is driven by a synchronous motor, which derives its power from the electric light mains. This type has a rather limited use, for it can only be used where the electric supply is what is known as "alternating."

Parts Required

The construction of an electric clock of the first type is a comparatively easy matter. The parts required consist of a disused pendulum clock, an electromagnet and, of course, a 4½-volt flash-lamp battery. The clock should preferably have an iron pendulum with an adjustable weight at the bottom end. If the pendulum is constructed from a material other than iron a small piece of soft iron must be attached to it in a suitable position.

The spring of the clock should be removed unless it is broken, when, in many cases, it will not be found necessary.

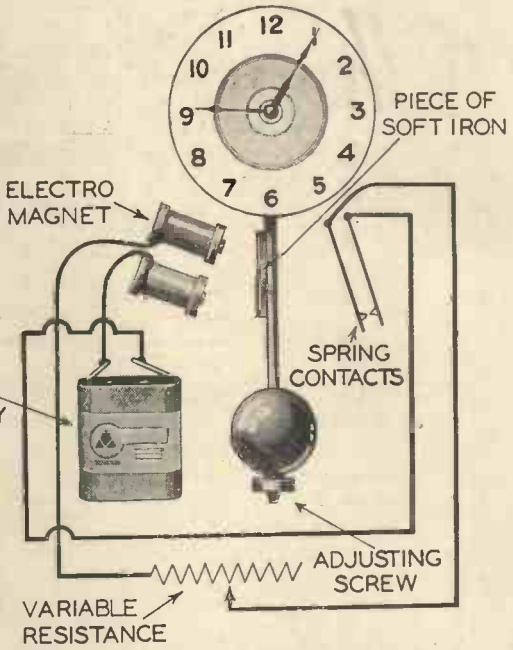


Fig. 1.—The electromagnet fitted into place so that it attracts the pendulum.

The Construction

The clock should be mounted on a baseboard which may be stained or French polished. The electromagnet is then fixed just clear of, but in such a position that it will attract the pendulum. This will be more clearly understood after a perusal of Figure 2.

On the side of the pendulum opposite to the magnet a pair of spring contacts are mounted so that at the end of each complete swing of the pendulum they are momentarily closed. These should be arranged so that they are only just in contact with the pendulum at the end of each swing. They must not, under any circumstances, retard the swing of the pendulum on that particular side.

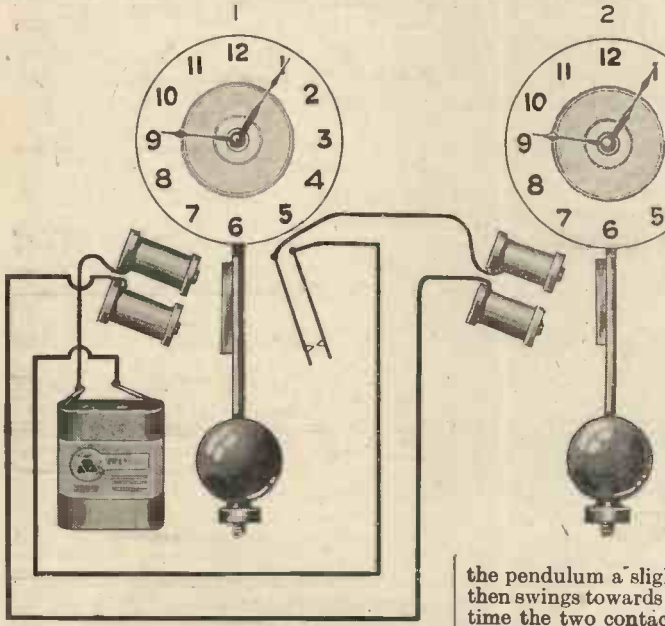


Fig. 2.—Two clocks wired in series. Clock No. 1 acts as master to clock No. 2 having no spring contacts.

The Action

The action of the clock is quite simple. It is started in the usual way by giving the pendulum a swing in the direction of the contacts. Immediately it closes the contacts an impulse of electricity is sent through the magnet which, in turn, gives the pendulum a slight pull. The pendulum then swings towards the magnet; at the same time the two contacts spring apart and the circuit is broken. After the pendulum has completed its swing in the direction of the electromagnet it will obviously swing back towards the contacts and finally close them, thus repeating the whole sequence of operations.

It may be found that the pull of the magnet is too powerful. In this case a variable resistance should be included in the circuit. The current being adjusted to a minimum.

Adjusting the Clock

It may be found that the time keeping of the clock is not correct. If the clock runs too slowly the screw at the bottom of the pendulum must be given a few turns so that the weight is raised. On the other hand, if the clock runs too quickly the weight must be lowered a little.

A clock carefully constructed will run for many months without a new battery being required. Once set, the time keeping will be perfectly accurate unless the temperature of the room in which the clock is situated varies a great deal.

Its Use as a Master Clock

If a number of clocks are arranged in a similar fashion to the above they may all be run from the same battery, and consequently only one clock need have the spring contacts. All the clocks may be neatly wired together by means of the ordinary twin bell wire. If it is desired to work the clock from the electric supply mains, the battery may be replaced by an ordinary bell transformer. This may be found desirable when a number of clocks are being worked in conjunction with each other.

Suitable bell transformers are made by several firms at quite low prices, and most of these are designed to give alternative output voltages between about 4 and 8 volts. They will also supply a current of up to at least 1 amp. which is adequate for operating three or four electric clocks of the type described above.

---

the planet, seen through a telescope, will look like a lustrous miniature Moon two days before "First Quarter." The phases of Venus are, of course, analogous to those of Mercury, but much more easily perceived. Their gradual enlargement when an "Evening Star" is very noticeable.

The Earth and Venus

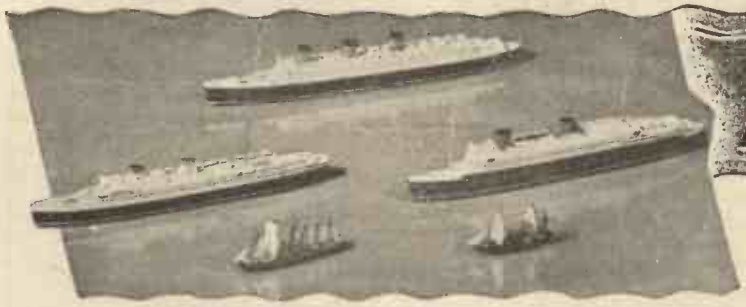
The diameter of Venus is 7,600 miles, which is almost the same as that of the Earth. Nor does the similarity end here, for its weight, density and gravitational

ASTRONOMY FOR AMATEURS

Continued from page 138

force are but 10 per cent. to 20 per cent. less. It also undoubtedly possesses an atmosphere of some kind, as, in spite of its impenetrability, twilight effects have occasionally been observed. Moreover, spectroscopic analysis indicates the existence of at least certain of the elements of moisture. Venus has no satellite, but, in view of the physical characteristics of Mercury, it has been suggested that, at a remote period, the latter fulfilled that function until the powerful attraction of the Sun drew it away and made it an independent planet. Transits of Venus are of considerable importance to astronomers, since they serve to check the accuracy of measurements of the Earth's distance from the Sun. These events are, however, exceedingly rare, the last having occurred in 1882 and the next not being expected until 2004.

The Blue Riband of the Atlantic



DETAILS OF THE VARIOUS SHIPS WHICH HAVE WORTHILY UPHELD OUR TITLE OF "MISTRESS OF THE SEAS"

By W. J. BASSETT-LOWKE

A UNIQUE GROUP OF LINERS

The new Cunarder, No. 534, as she will be when completed, the Italian super liner "Rex," the N.D.L. stream-line "Bremen," the "Great Britain," the first screw steamer to cross the Atlantic, and the "Britannia," the first Cunarder.

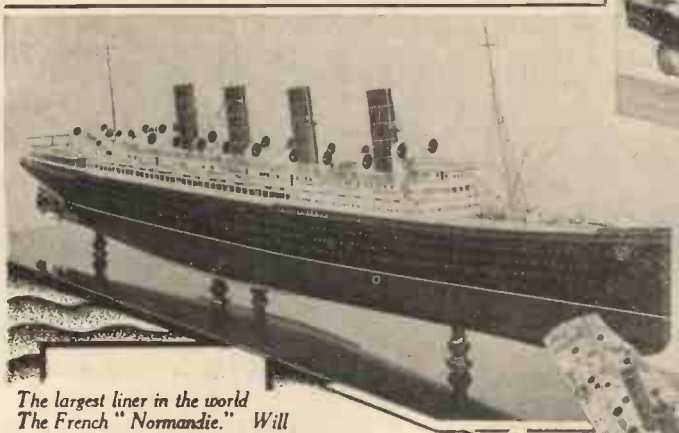
MANY of you have often noticed paragraphs in the daily Press about the new Cunarder, its progress, when it will be completed, whether or not it will beat the Atlantic record, and so forth. The unceasing contest for the Blue Riband of the Western Ocean, or what seamen called the North Atlantic, has always been an interesting and popular subject for Great Britain, the "Mistress of the Seas," and during the last hundred years many great ships have made their names in the struggle to maintain the supremacy of the Atlantic.

The first Cunarder to cross the Western Ocean was the *Britannia*. She was the first of a series of four wooden paddle-steamers built for the Cunard Company on the Clyde, and her maiden voyage was made in 1840 and occupied a period of ten days, making a speed of 8½ knots on 38 tons of coal per day. She had a registered tonnage of 1,100, was 217 feet long, and could only accommodate 115 passengers. Thus you will see she was smaller than many of our cross-Channel steamers of to-day, and would look very insignificant against our modern ocean giants.

Charles Dickens crossed to America in her in 1842, but had such an unpleasant voyage that he came home again on a sailing vessel. The illustration is of an excellent model of this ship just acquired by the Liverpool Museum.

The first *screw* steamer to cross the Atlantic was the *Great Britain*, built at Bristol, and designed by the famous Brunel, the designer of the *Great Eastern*. This ship was 3,500 tons, 322 ft. long, and actually made a speed of 12 knots on trial. It is interesting to note until quite recently her hulk was used to store coal in a harbour in the Falkland Islands. When built she had six masts, which were named after the days of the week, commencing with Monday and omitting Sunday, as this was not considered as a day at sea. It is also interesting to compare her size with that of the *Britannia* and of those ocean flyers, the *Bremen* and the *Rex*. The photographs show all these vessels and the *New Cunarder No. 534* in the background, all to the same scale, 100 ft. to the inch.

The gigantic stream-lined German vessel *Bremen* still holds the record for the North Atlantic crossing, her highest speed being on the crossing from New York to Cherbourg in June this year. Her time was four days sixteen hours fifteen minutes, at an average speed of 28·51 knots, nearly 34 miles an hour. The new Italian super-line *Rex*, which takes the Southern route from Genoa to New York, has, however, exceeded this speed by making the crossing from Gibraltar to New York in four days thirteen hours fifty-eight minutes, at an average speed of nearly 29 knots for the whole way across.



The largest liner in the world The French "Normandie." Will she beat the record when she is finished?

The first Cunarder—the "Britannia." A wooden paddle-steamer built in 1840.

Amongst Blue Riband holders I cannot leave out the *Mauretania*, the wonderful English liner built on the Tyne, which wrested the trophy from the Germans in in 1909 and held it for the unprecedented period of twenty-two years—a real triumph for British engineering skill and reliability.

The French have now launched and are busy with their monster, the *Normandie*, which is now the largest ship afloat. Instead of being driven by geared turbines like the *Bremen*, the *Europa* and the *Rex*, this vessel will be an all-electric ship.

When she starts on her voyage westward in 1935 she will have electric power equal to the combined steam powers

The wonderful Cunarder "Mauretania" whose sharp and graceful bow ploughed through the Western Ocean, and held the record for 22 years.

(Continued on page 148.)

THE RANGE-FINDER

A Precision Focusser for Photographers

By DAVID CHARLES

Fig. 1.—Barr and Stroud range-finder in use. Finding distances for artillery fire.

IT seems a natural and logical step, looking backward, from the use of a "range-" or distance-finder for artillery in warfare, to its adaptation to cameras in which accurate adjustment for distances is such a prime necessity. Yet it has taken a number of years for that step to happen. The difference between the big military range-finder (Fig. 1) and the tiny photographic one (Fig. 2) is merely that because the former is required to register accurately the distances of objects a long way off, it must necessarily have a wide "base"; in other words, it has to be big. In photography, on the contrary, the important differences of distance are those between comparatively close-up subjects, and these differences can be determined accurately by means of a range-finder of surprisingly small dimensions, as will have already been learnt from the illustrations alongside.

Size is the only essential difference. Not only is the principle of the tiny camera range-finder the same as that of the war-time one, but it is a very simple principle, and one easy to understand. In practice, its use is not only fascinating in the extreme, but it is at once the easiest and the most precise method of obtaining sharp focus on a subject to be photographed.

Why "Precision"

In cameras of the box snapshot type the lens has only a small "stop" or aperture. This results in reasonable depth of sharpness of detail at all distances beyond about 12 to 15 ft., but prohibits close-ups as well as snapshotting when the light is not at its best. On the other hand, the big-aperture, high-speed lenses fitted to more expensive cameras have but little of this "depth of focus," and the nearer the subject is to the camera, the less "depth" there is. Moreover, most small-camera owners look forward to enlarging, which inevitably shows up the slightest lack of sharp focus in the film. For these reasons it is desirable always that the principal detail of the subject should be accurately focussed, and few people are able to judge the distances of near subjects with sufficient accuracy. The novel introduction of the range-finder does this automatically with the greatest of ease and of precision.

What the Eye sees in the Finder

If a view is observed or photographed from two points, one a little to the right of the other, there is bound to be some difference between the two views. This

Fig. 3.—In a range-finder only a small central portion of the subject is viewed, as in a telescope.

fact is the basis of stereoscopic photography, but the differences appear, at first sight, to be scarcely distinguishable.

Yet immediately the top half of one of the photographs is superimposed upon the lower half of the other, some of the discrepancies immediately become visible.

That is exactly what one sees in a range-finder, at first. The subject appears split across, with everything cut in halves. The nearer the objects, the more violent is the split. Actually the range-finder does not show the whole of the subject, as the ordinary view-finder does. It shows only the middle part of it (see Fig. 3), usually on a larger scale than the image in the view-finder. When this component and the range-finder are fixed alongside one another, as they are on some cameras, the left eye sees the whole picture, and the right eye sees the middle part of it, split across as just described! After a very few tries, this becomes far more comfortable than might be supposed.

Immediately upon turning the milled knob of the range-finder the split halves of the picture begin to slide into register. But it will be quite clearly realised, on looking again at Fig. 3, that only a very light movement will bring the background detail into register. On turning the knob still further, the nearer detail comes into register, and the background slides out again on the other side. How the view looks then is seen in Fig. 4, where the mower-handle has joined up, but the distance is again split.

So all one has to do is to turn the knob until the selected detail of the principal subject slides into register, which it does quite smoothly, and to read, on the dial alongside, the precise distance between subject and camera. According to whether

Fig. 4.—Adjusting the range-finder consists in registering the principal detail. Only that in one plane or distance can be registered at a time.

the detail ranged on is near or far its precise distance is accurately indicated, and one can set the focussing scale of the camera accordingly. Fig. 5 shows one such detachable range-finder, and its distance dial.

(*Continued on page 148*).

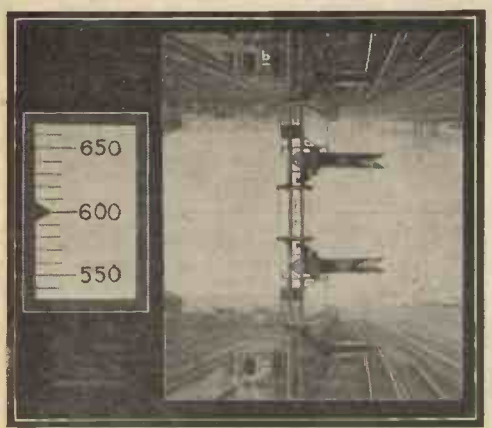


Fig. 5.—In a military range-finder, instead of splitting the detail, the same detail is inverted in the top image. This allows of exact registration of extremely distant objects.

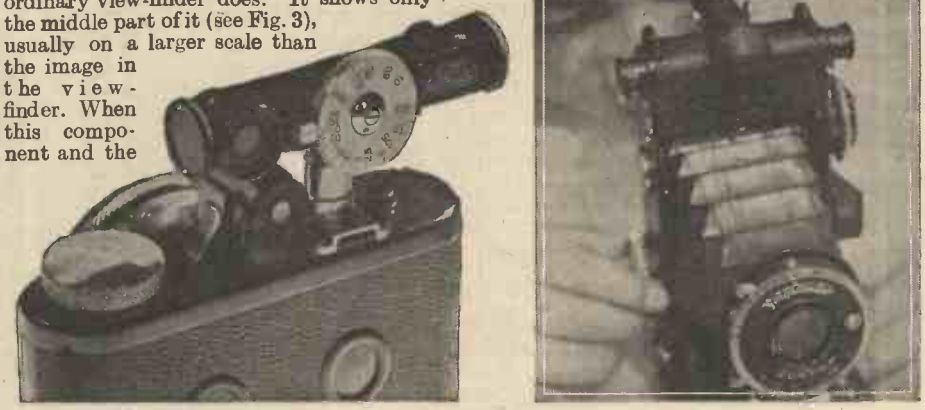


Fig. 2.—(Right) Range-finder in use for accurate distancing in hand-camera photography; and (Left) A detachable range-finder, mounted on a small high-speed camera, showing distance dial.

HOW TO REPLATE WIRELESS HIGH-TENSION ACCUMULATORS

FIXING NEW PLATES TO H.T. ACCUMULATORS

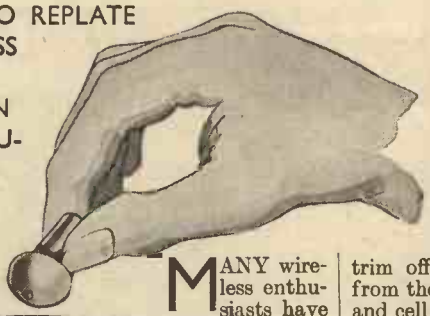


Fig. 1.—The stoppers should be soaked in water to clean the vent holes.

MANY wireless enthusiasts have found that their wireless accumulators do not last for ever, and, like the dry battery, must be "scrapped." A saving of nearly 50 per cent. may be made if the old batteries are replated at home; this is not a difficult job, and as a lead burning outfit is not required the whole operation may be done on the kitchen table.

Start the work by pouring the old acid down the sink; the old rubber stoppers must be kept and should be placed in a jar of water to remove any soluble material that may be stopping up the vents (Fig. 1). Select a large and old pan and into it pack as many of the 10-volt units as possible, cover them with cold water and place on the fire to boil. Quite a small pan will hold two units at a time (see Fig. 2), and, as only one unit can be replated at once, this will be found quite sufficient.

When the water is boiling, remove the pan from the fire and from it take one of the glass containers; this is best done by raising the container on to one end with a screwdriver and removing it with a large cloth. The sealing compound is now quite soft and the plates are removed by placing a screwdriver under the connectors and levering on the side of the cell; this should be repeated for each pair of plates. When the plates have been removed, place in cold water to harden the sealing compound, and then trim off, as much as possible, from the porcelain filling tubes and cell covers. The cell covers must not be damaged, and to remove the plates cut through the connectors with a pair of wire cutters. Remove all superfluous compound from the cells and cell covers and place it in a tin, since, to ensure the economical working of the plan, this must be used again. The end cell covers that take the terminal plates must not be confused with the others, since they have slots and not holes to take the plates.

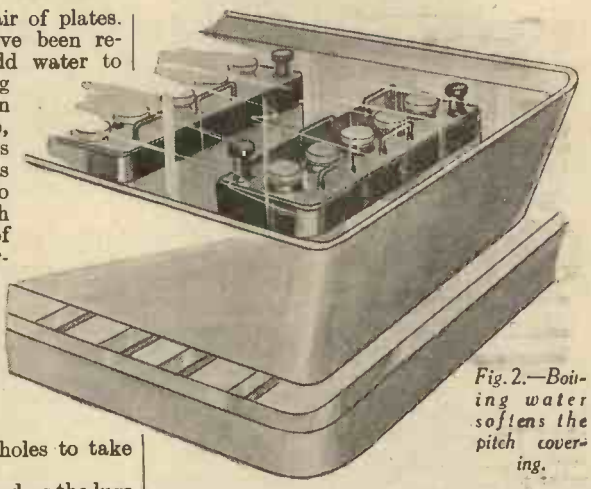


Fig. 2.—Boiling water softens the pitch covering.

Replating may now begin, and as the lugs are too long for us, they should be cut down about ⅜ in. Arrange the plates in the container, placing a negative terminal plate at one end and a positive one at the other—a negative and positive plate go in each cell; when this has been done, put the cell covers on and push them well down. The independent cells must now be connected together, and this is done by means of a roll of lead tape or wire and a hot, clean soldering iron (Fig. 3). Clean one end of the lead strip and place it on the first lug, now with the hot iron fuse the two together; a flux should not be used. This operation is extremely simple, and after one or two connectors have been burnt on the work will be found very easy. Remember the cells are connected negative to positive.

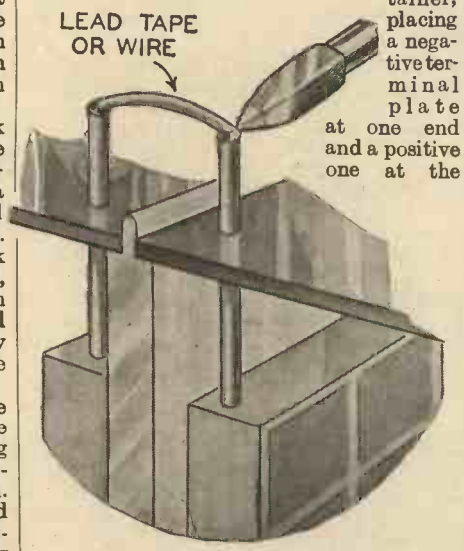


Fig. 3.—Connecting up the plates.

Take the tin with the sealing compound in it and melt it slowly over a small flame, when it is about as viscous as treacle pour a sufficient quantity into the top of each cell (Fig. 4), but before this operation replace the porcelain filling tubes. This liquid will effectively seal the top of the cell but will not run down on to the plates.

Fill the cells up to the acid level line, or ¼ in. over the tops of the plates, with acid of specific gravity 1·215; the battery will show about 9 volts on open circuit and must be given its first charge. It can be used without charging, but this is not to be recommended. If the units are charged in series, charge at ⅛ ampere; if in parallel, add up the number of cells and charge at this number divided by 8 amperes. Continue the charge until the voltage and specific gravity have been constant over five-hourly readings. Fig. 5 shows a cross-section through a typical 10-volt cell unit.

Fig. 4.—Repitching the unit.

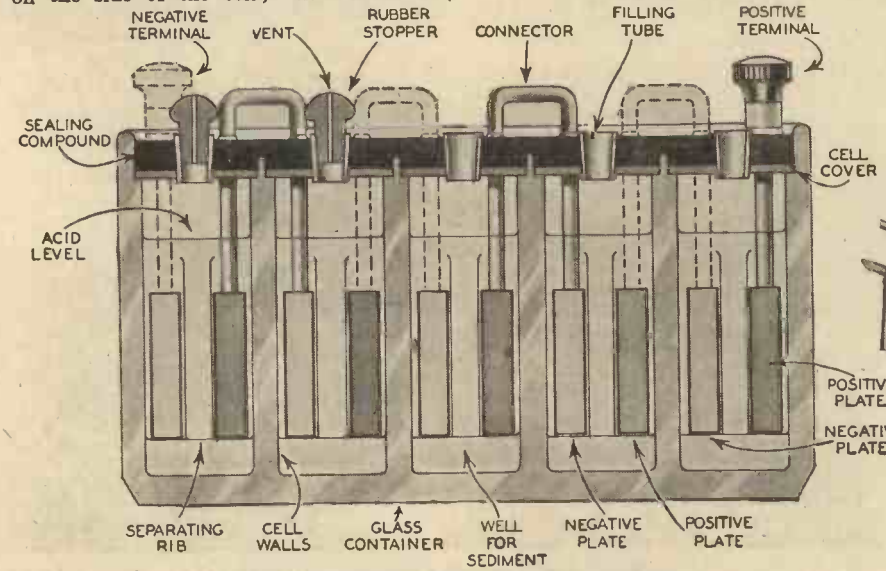
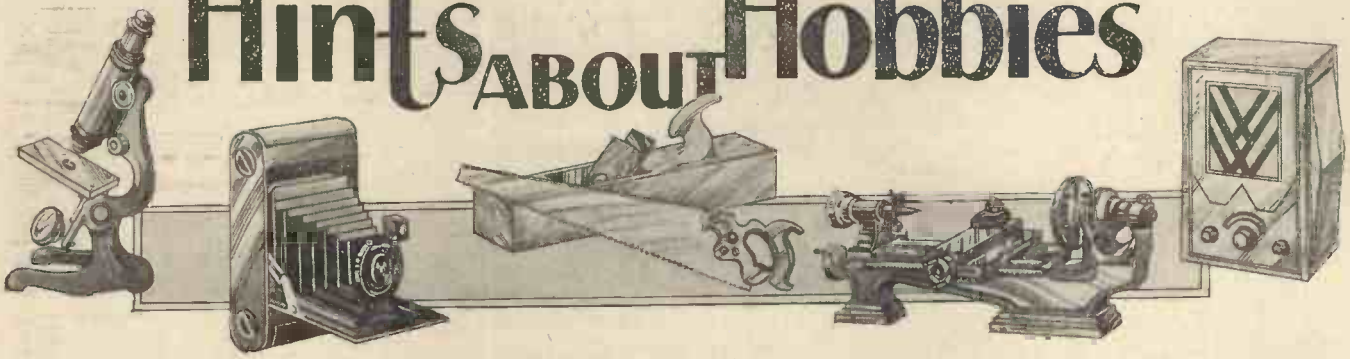


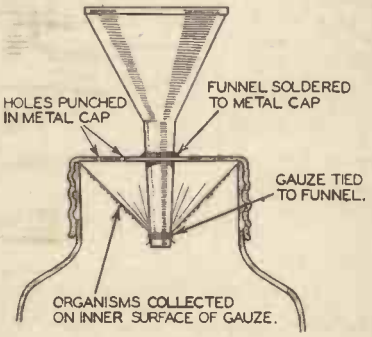
Fig. 5.—Cross-section through a typical 10-volt cell unit.

Hints About Hobbies



A Novel Collecting Vessel

ALL that is necessary is a glass jar with a screw cap, which can be obtained from a well-known store for 3*d*. complete, and a tin funnel, from the same place at the same price. The cap is pierced in the centre and the funnel soldered so that it projects about 1½ in. into the bottle when the cap is screwed on. A few holes are then pierced in the cap and a circular piece of gauze or straining cloth is tied round the stem of the funnel, and the apparatus is complete.

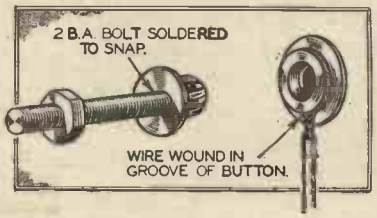


An ingenious collecting bottle which enables a large quantity of specimens to be concentrated in a small space.

When the cap is screwed on over the gauze, the pond water is poured in the funnel, and escapes through the holes in the lid, but all the organisms are retained by the gauze, and thus it is possible to take home in a jar the contents of dozens of buckets of water. This concentrating bottle may be made more convenient by buying another jar and retaining the lid to replace the funnelled one when the jar is full. It can thus be carried in perfect safety. The illustration should make the whole thing quite clear.—E. W. (Devizes.)

Panel Connectors for a Wireless Set

A COUPLE of snaps from an old pair of gloves will come in handy as will be seen from the sketch. Into the snaps solder small sections of $\frac{3}{32}$-in. bolts, as illustrated, and secure the other part to the panel. Now for the connectors, wind the lead wire round the groove in the button, binding the wire as tightly as possible for a good connection. When you want a connection simply press the button into the snap.—H. D. (Stockton.)



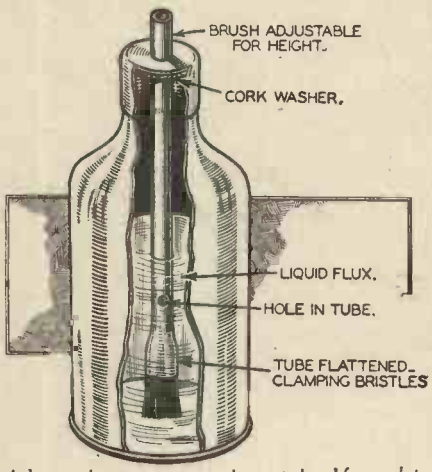
Showing how an efficient connector can be made from a glove fastener.

THAT HINT OF YOURS

Every reader of PRACTICAL MECHANICS must have originated some little dodge which would be of interest to other readers. Why not pass it on to us? For every item published on this page we will pay 5s. Address your envelope to "Hint," PRACTICAL MECHANICS, George Newnes Ltd., 8-11 Southampton Street, W.C. Put your name and address on every item. Please note that every hint sent in must be original.

A Useful Soldering Hint

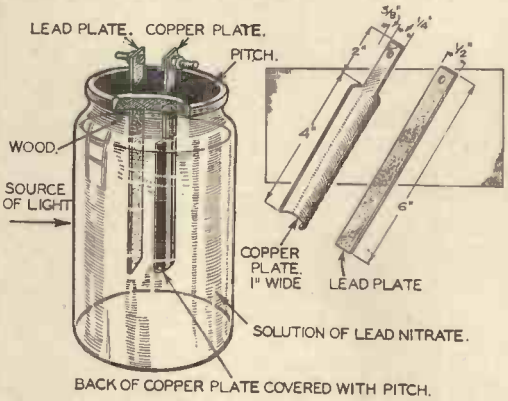
WHEN soft soldering many mechanics use a liquid flux sold in a screwed top container. A better way of transferring the flux to the work than by a wooden splinter is by a brush, and one can easily be made by cutting a few soft bristles from a brush, inserting them in a piece of copper or other tubing ($\frac{5}{16}$ in. diameter is convenient) and fastening by squeezing the end of the tube in a vice or by a blow. Drill a small hole next at a convenient distance from bristles, thus allowing a "head of flux" to be always in brush. To always have brush handy punch or drill a hole, the same diameter as tube, in screwed top and cork washer, and push brush through.—P. T. (Newcastle-on-Tyne.)



A device whereby a brush is always to hand for applying liquid flux. Note the hole in the brush for holding a supply of the liquid.

A Photo Electric Cell

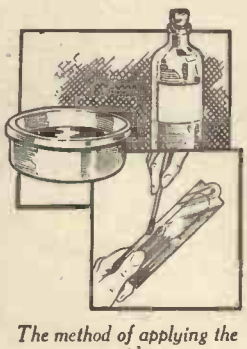
THE materials required are: a lead strip 6 in. × ½ in., a copper plate 6 in. × 1 in., ¼ lb. lead nitrate and a jam jar. The copper strips are cut as shown in the sketch and a hole is drilled as shown. It is then treated as follows: One side of the plate is burnished with emery cloth and then held in a hot gas or bunsen flame until the surface of the copper becomes black due to the formation of capric oxide. The plate is allowed to cool and the coating of CuO is dissolved off with ammonia solution leaving a film of cuprous oxide on the plate. The back of the plate is now painted with tar or pitch, and both the lead and copper strips are inserted in the jar through a disc of wood cut to fit the jar tightly. The prepared copper surface should be facing the lead strip and be about ½ in. away from the lead and curved towards it as shown. Terminals are now fitted to the top of each electrode, and electrolyte is next poured into the jar, consisting of 1 oz. of lead nitrate crystals to each gill of water. The whole top of the cell is covered with shot pitch to make the cell air-tight and leak-proof. The cell is really a photo voltaic cell and is polarised, the copper plate being positive and the lead plate negative. With a 60-watt lamp 3 ft. from the cell, 1 milliamp. current flows, and at 6 in. 4 milliamp. flows.—K. B. (Chester-le-Street.)



Construction details for making a photo electric cell.

Simple Etching

THIS is an excellent idea when one wants to make an etching of a photograph, newspaper photo or copy a small diagram. A piece of celluloid is firmly clamped over the material to be etched, and then the surface of the celluloid is moistened with vinegar. A needle will make deep cuts when copying the picture. When finished the celluloid is unclamped, washed in running water and hung up for some hours, when the celluloid can be inked as a copper plate.



The method of applying the acid.

A MODEL AEROPLANE OF THE FLYING SPAR TYPE

HOW TO BUILD A FINE LONG-DISTANCE R.O.G. MACHINE

By E. W. TWINING

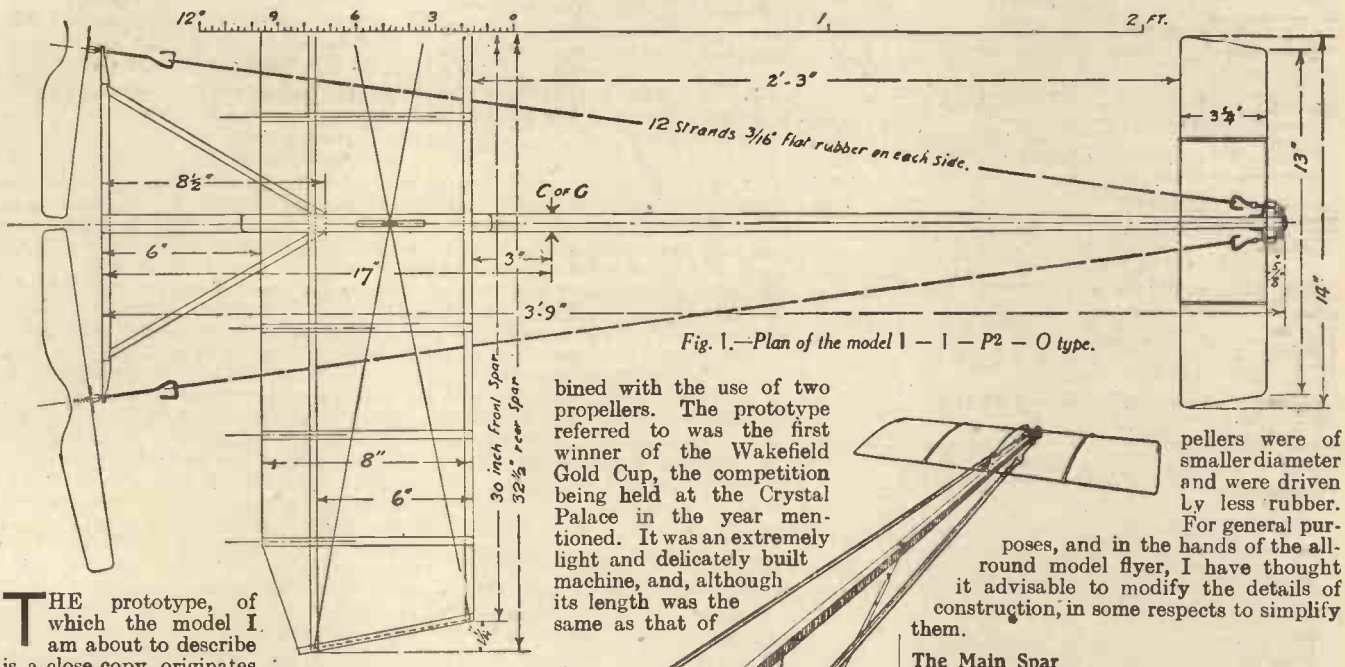
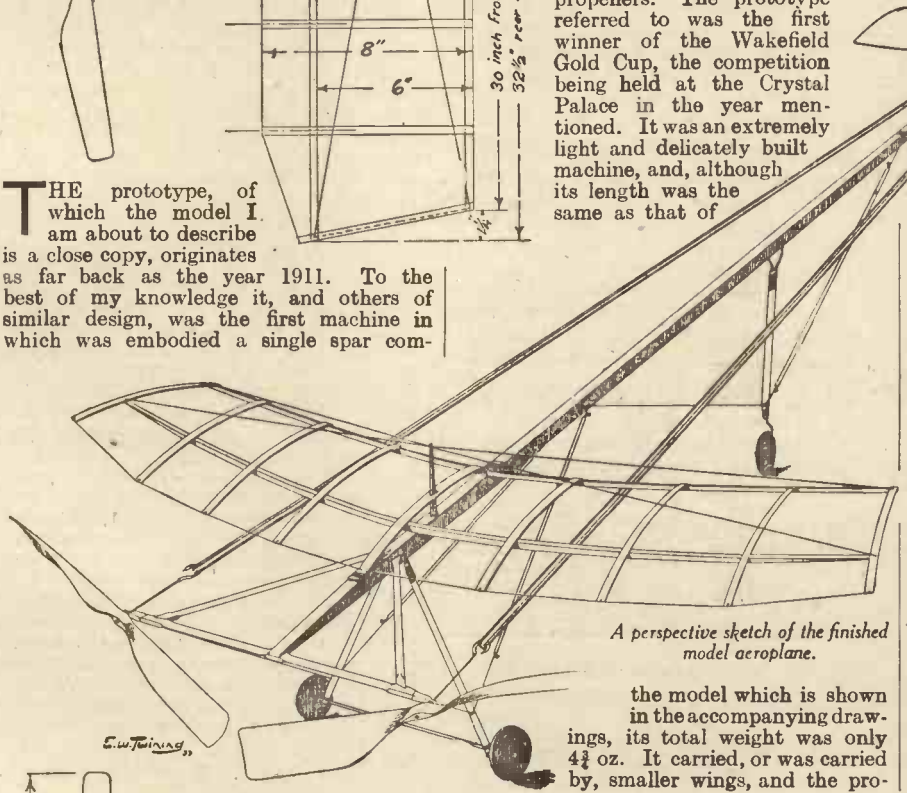


Fig. 1.—Plan of the model 1 — 1 — P² — O type.

THE prototype, of which the model I am about to describe is a close copy, originates as far back as the year 1911. To the best of my knowledge it, and others of similar design, was the first machine in which was embodied a single spar combined with the use of two propellers. The prototype referred to was the first winner of the Wakefield Gold Cup, the competition being held at the Crystal Palace in the year mentioned. It was an extremely light and delicately built machine, and, although its length was the same as that of the model which is shown in the accompanying drawings, its total weight was only 4¼ oz. It carried, or was carried by, smaller wings, and the propellers were of smaller diameter and were driven by less rubber. For general purposes, and in the hands of the all-round model flyer, I have thought it advisable to modify the details of construction, in some respects to simplify them.



A perspective sketch of the finished model aeroplane.

The Main Spar

The principal difference lies in the spar which originally was flat, pierced and wrapped with silk and was braced with a somewhat complicated system of wires, which converted it into a trussed girder. The present spar is to be a box girder, made in two halves from silver spruce, and its stiffness, although the actual thickness of wood is a bare $\frac{1}{16}$ in. for all sides of the box, will depend upon its cross-section. The length is to be 3 ft. 9 in., the vertical depth of the box at the centre is $\frac{7}{8}$ in. and the horizontal width $\frac{5}{8}$ in. Both the upper and under surfaces curve with a gradual taper towards both ends where the depth is $\frac{5}{16}$ in. The width is the same from the centre to the back, but towards the front it again tapers where it is $\frac{5}{16}$ in. square. This type of spar is extremely rigid, strong and light and dispenses entirely with all forms of bracings: its head resistance is, therefore, reduced to a minimum.

The Planes

Whereas in the Wakefield Cup machine

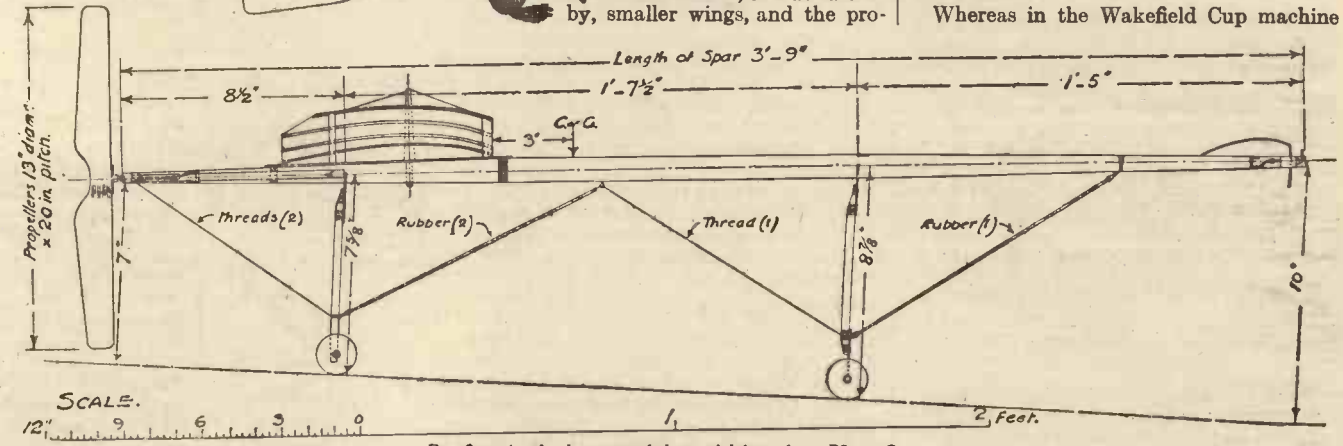


Fig. 2.—A side elevation of the model 1 — 1 — P² — O type.

the main plane (by the way, the machine is, of course, a monoplane) was single-surfaced, the present wing, although it will have single ribs only, is double-surfaced, and to carry the increased weight, which amounts to 9¾ oz. total, I have enlarged the area considerably. This wing proves to be quite efficient, since it is given a definite streamlined top camber which the original wing had not, it being very nearly flat. The model, which has recently been built to the accompanying drawings (Figs. 1 and 2), has put up a better performance than did its prototype, and is obviously, therefore, more efficient. In the next article I shall give detailed sketches showing the camber and construction of the wing and cross-sections of the spar.

The Elevator

This is, apart from its greater area, exactly the same as its original. It is constructed, as regards its framework, wholly of steel wire, with four cross ribs of very thin tinned plate. Three gauges of wire are used; the heaviest, No. 18 S.W.G., being used for the centre rib and continuous in one piece, the stem, which is shown in Fig. 2, passing down through the spar near its nose. The second gauge is No. 20, and this is used only for the entering edge. The ends and trailing edge are of No. 22. All the wires are, of course, tempered steel or piano wire. The joints are soldered, but I think, in order to make construction clear, I had better give a sketch later amongst other details.

Analysis of Weight

In constructing such a machine as this to a given design it is desirable that the reader should know how this total is likely to come out when he is making each of the separate parts, and I therefore give an analysis which should prove useful. The items constituting the whole model should weigh as follows:—

Spar, including undercarriages, propeller, crossbar and bearings, front rubber hooks and bearings	3 oz.
Propellers (2), each ⅛ oz.	1¼ oz.
Elevator	⅜ oz.
Rubber, 2 skeins, each 1¼ oz.	3½ oz.
Main Plane	1⅜ oz.
Total	9¾ oz.

Angle of Incidence and Weight

It will be seen from the side elevation drawing (Fig. 2) that the main plane is placed on the upward slope of the top of the spar. This, therefore, gives the wing its angle of incidence which, in a model of this sort, will be very fine, not more than about 2 degrees. Since this machine is of the I—I—P^2—O arrangement, that is to say, it is of the type which depends for its stability upon a loaded leading surface, its elevator will make a greater angle of incidence. This angle should work out at about 4½ degrees. The stem referred to, which is made of the heaviest gauge wire, in passing through a hole in the spar provides us with a means of adjusting the angle. The stem, when the elevator is made, should make a decided angle backwards in relation to the chord of the surface, then, when the stem is pushed through the spar, the trailing edge of the surface will press downwards on the top of the spar, so locking the stem in the hole. This method of adjustment has proved itself so simple and yet so efficient that I have never departed from it in the many dozens of models which I have made of this type.

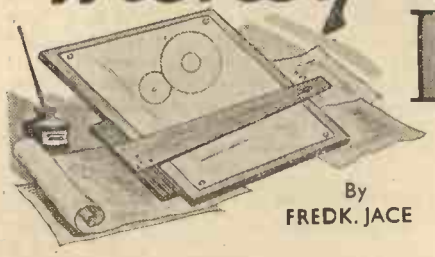
Propeller Shaft Bearings.

The rear end of the spar is notched out to take a streamlined crossbar, near the ends of which two struts are notched in. These struts are so shaped at their inner ends that they form tenons which fit into rectangular slots in the main spar. The bearings themselves are channel-shaped brass plates fitting over the ends of the crossbar and bound into place with tinned iron wire, soldered.

Double Winding of Rubber Motors.

At the front end of the spar is the attachment carrying the hooks for the rubber. These are not the usual type of fixed hooks, but they form spindles, each spindle carried in two bearings. The bearings on each side are one continuous strip of brass plate. A detailed sketch of this will be given in the next article, but what I want to explain to the reader, and what I am publishing for the first time, is the system by which both the skeins of rubber, which form the motors, will be wound at the same time and wound in opposite directions; this opposite winding being, of course, necessary because the propellers are right and left-hand-pitched screws. The spindles referred to at their inner ends form the usual hooks, but at their front ends are bent sharply at right angles. Each spindle has two little brass ferrules soldered upon it to act as stops, and the distance between these ferrules is greater than the length over the two bearings. The spindles are, therefore, built to slide forward against the tension of the rubber and the bent-up ends pass clear of the end of the spar. Over these turned-up ends two eyes are passed in the ends of a converted double-geared egg whisk. A sketch will be given later showing how the egg whisk is altered to adapt it to its new purpose. It suffices, therefore, for me to say here that this instrument, which I shall call a double winder, is slipped over the bent ends of the spindles, an assistant is obtained to hold the propellers while the operator pulls the spindles forward by means of the winder clear of the spar. He then turns the handle attached to the gear wheel. The gear ratio of the winder which I have, and have previously made, is 3 : 1. If, therefore, one wishes to get 600 turns on each of the propeller motors, all one does is to pull gently at the handle on the back of the winder, which is held in the left hand, and with the right hand revolve the gear wheel 200 revolutions, then release the tension, allowing the rubbers to draw the spindles in, turn the winder up at right angles to the spar and slip it off the bent-up spindle ends, when they will, of course, spring round and engage with the nose of the machine. In this way one can get the 600 turns, or 1,200 in all, in about 30 seconds.

Money Making IDEAS



By FREDK. JACE

Practical Facts, Formulæ and Recipes

which may be turned to profitable account. Address all correspondence relating thereto to: The Editor, PRACTICAL MECHANICS, Geo. Newnes Ltd., 8–11 Southampton St., Strand, W.C.2.

Rust and Ink Spot Remover

AN excellent rust-spot remover can be made by dissolving 1 part potassium bioxalate in 5 parts of distilled water, adding 6 parts of glycerine. The solution should be filtered, and a drop applied to the affected part of the fabric. Put aside for four hours and then rinse in water.

Invisible Ink

A WEAK solution of nitrate of copper is a suitable invisible ink which becomes visible as a red tint when the paper is heated

Soldering Glass

USE a metal alloy consisting of 95 parts of tin and 5 parts of zinc, having a melting point of about 425°. The glass to be soldered is first carefully heated to the above temperature, and the alloy is then spread on the glass with the aid of a soldering bit, and on cooling it will be firmly attached to the glass.

Bronzing Castings

THE best method of bronzing castings is to coat them with goldsize and then dust the bronze powder on to the surface. You may also use a bronze lacquer, which contains the powder mixed with a suitable vehicle.

Earn Money with your Pen

EDITORS of country newspapers are usually willing to appoint local correspondents in villages in their area. Paragraphs about such events as weddings, church socials, dances, concerts, etc., and interviews with centenarians, golden wedding couples, and so on, are used. The payment, of course, is small, and may be as low as a halfpenny per line as printed, but a correspondent who keeps closely in touch with local affairs can look forward to receiving a very useful monthly cheque.

Making Dry Batteries at Home

IN the early days of the Great War the general manager of a number of theatres was faced with the difficulty of obtaining dry-cell batteries for lighting patrons to their seats owing to war-time restrictions upon output for strictly commercial purposes. Being a man to whom obstacles were only a spur, he came to a characteristic decision!

He decided to *make his own batteries!*

Little did he dream how far-reaching were to be the effects of that decision! Little did he dream that his necessity for torch batteries to show his patrons to their seats was destined to mother the invention of a dry-cell battery which is to-day manufactured in every quarter of the globe!

For the man was Mr. V. England-Richards and thus was commenced his well-known home-employment battery making industry.

He worked on entirely original lines, for he had no knowledge of how these things were produced in the factories. Being of the resourceful type and not easily thwarted, his first failures stimulated him to further experiments and in the end he succeeded in achieving a result which some experts have declared to be a better form of dry-cell battery.

With the end of the war batteries became free in the market again, and there the matter might have dropped, for there was no further need for him to make his own batteries. But Mr. Richards and others had found these batteries so efficient, and, foreseeing the great future of wireless and the fact that all the world would soon need such a battery, he continued with the scheme. But how, he wondered, could he possibly manufacture enough to meet the overwhelming demand? And then the great idea dawned! The batteries were easy to make. He had made them in his home, so why shouldn't industrious men and women who wanted to earn extra money make them in *their* own homes?

He patented his method and started to grant licences, giving licensees full instructions how to produce his special type of dry-cell batteries. The business rapidly developed, the present company was formed and to-day there is hardly a country in the world in which his licensees do not operate.

But even Mr. England-Richards could not cover all the ground. Nor could 100 nor 100,000 of his licensees possibly supply the world's demand for wireless batteries. So it is that every day more licences are being taken out while old licensees are constantly renewing them, in many cases turning it from a spare-time employment to a full-time business. The proposition is the only one of its kind in the world, and is consequently ever growing. Surely a great achievement in so short a space of time considering the obstacles and extremely modest beginning.

Gold Ink

TAKE equal parts of honey and gold leaf, thoroughly grind together until the gold is reduced, agitate with 30 parts of hot water, and allow to settle. Strain off the water, washing again many times; finally dry the gold For use, mix with a little weak gum water.

Picture Framing

KEEN woodworkers can considerably augment their incomes by developing a picture frame sideline with local photographers. Supplies of a printed scale of charges should be given to the photographer, who, by arrangement, includes one with the prints sent out and draws a commission on frame orders. Mouldings in all patterns can now be obtained at cheap rates, and the tools required include a mounting knife, mitre cramp, tenon saw, panel-pin hammer, and mitre cutter.

Toymaking for Amateurs

TOYMAKING is always a profitable hobby, and interested readers should obtain a copy of "Toymaking for Amateurs," 1*s.*, or 1*s.* 2*d.* by post from George Newnes Ltd., 8–11 Southampton Street, Strand, W.C.2. Other helpful volumes in the same series (uniform in style and price) are:—

"Handyman's Enquire Within."
"Model Aeroplanes and Airships."
"Model Boat Building."
"Motor car Upkeep and Overhaul."
"Motor Cyclists' Reference Year Book."
"The Home Woodworker."
"Simple Electric Apparatus."
"Twenty-five Simple Working Models."
"Accumulators: Charging, Maintenance and Care."
"Twenty-five Tested Wireless Circuits."

Sensitising Paper and Cloth

A ONE-IN-TEN dichromate solution in water is required for this. Mix 1 oz. of the dichromate solution with 1½ oz. of pure gum arabic and thoroughly incorporate about 1 drachm of tube water colour. Brush this solution over a good quality drawing paper, streakiness being gently taken out with a camel-hair brush. The paper is now sensitised, and it should be allowed to dry in the dark. The exposure required is the same as that required by an ordinary self-toning paper. Canvas fire-screens, curtains, etc., can be sensitised and printed upon if they are first sized with a solution of gelatine and water.

Copper-Plating at Home—Correction

WE wish to point out a printer's error which occurred in our November issue under the above title. Ohm's Law was wrongly stated as "R = EC"; this should read R = E/C In the example taken, the current was 1 ampere and therefore the results obtained were perfectly correct, but had a different figure been used, this would not have been the case.

In the concluding paragraph of the same article the equation "External Resistance = (Mains voltage × current flowing) – resistance of cell" was given; the terms included between the brackets should, of course, be divided and not multiplied.

A large number of readers have been good enough to write and point out the mistake (which had previously been noticed too late for correction) and we thank them for their letters.

Glazing Photographs

FOR a high degree of gloss, use a glazing solution which may be purchased ready prepared, or made from a solution of prepared ox-gall 1 oz., mixed with 5 pints of water. The prints are soaked in this solution for two or three minutes, and then laid on the glasses without intermediate washing.

Drawings from Photographs

THE photograph should be outlined in Indian ink of the waterproof kind and then bleached out in a solution made by mixing together 13 minims of iodine solution, 5 minims of potassium cyanide, and 1 oz. of water.

Jewellers' Cement

A CEMENT suitable for spangles and pins can be made by melting together in a covered vessel 7 parts of indiarubber and 2 parts of sulphur. In using, a small quantity of the cement is melted and applied to the surfaces previously heated in the flame of a spirit lamp to remove all moisture

THE RANGE-FINDER

(*Continued from p. 142.*)

Automatic Focussing

In some cases the range-finder is actually linked up with the focussing movement of the camera. With this additional refinement, immediately the subject has been registered in the range-finder, the shutter can be fired, with the certainty that it will be in correct focus on the negative. Naturally these cameras are rather costly ones. An example is shown in Fig. 2.

How the Range-finder Works

A range-finder of any pattern consists of a set of prisms and lenses so arranged in a tube as to project two images of the subject, from points a little space apart, into a single eyepiece in which the two images can be viewed by one eye. The only mechanism required is for causing the images to be adjusted into register. This movement, as I have already stated, is greater as the subject is nearer, and consequently permits of a graduated scale being fitted which records its movement in terms of the distance of the subject.

In one kind this movement is performed very simply by the mechanism turning the right-hand prism. The inclination of the prism shifts its image across the one opposite the eyepiece, and consequently across the prism immediately below it, which transmits the left-hand image.

In other types these end prisms are fixed, as the lenses which project the images always are, but for moving the right-hand image an intermediate prism of wedge shape is used. This is slid to and fro along the tube, but along a slant, so that the wedge, as it slides one way or the other, interposes a greater or less thickness into the right-hand beam.

The only reason for the latter being of such comparatively great size is that its use is to define differences between far greater distances than matter in photography, and therefore a greater lateral separation of the two images is required. Consequently the end prisms have to be considerably further apart. It is an interesting point, of individual design rather than of working principle, that the military range-finder does not split the image viewed, like the little photographic ones do, but it shows an inverted image immediately over the dividing line, of exactly the same subject as is seen below it. These two images are widely separated laterally, to start with, but are brought into register quite easily and with extreme exactitude, when they present the effect seen in Fig. 5.

THE BLUE RIBAND OF THE ATLANTIC

(*Continued from p. 141.*)

of the *Leviathan*, the *Ile de France* and the *Majestic*. A mighty ship!

The Cunarder *Mauretania* has 70,000 horse-power directly coupled through turbines to her propeller shafts. The 110,000 horse-power of the *Bremen* and the *Europa* and the 120,000 horse-power of the *Rex* are also turbine driven, but by means of massive reduction gears; yet in the case of the *Normandie*, instead of driving direct through gearing, her four huge turbines drive great electric generators, and the electricity from these drives four huge motors, coupled direct to her propeller shafts, and altogether by this system it is expected to transmit 160,000 horse-power.

How the *New Cunarder No. 534*, a model of which is shown in the photograph, is to be driven is at present a secret, but we are all confident that when this great liner is completed, despite the efforts of the French and the Italians, Britain will again win back the much-coveted Blue Riband of the Atlantic.

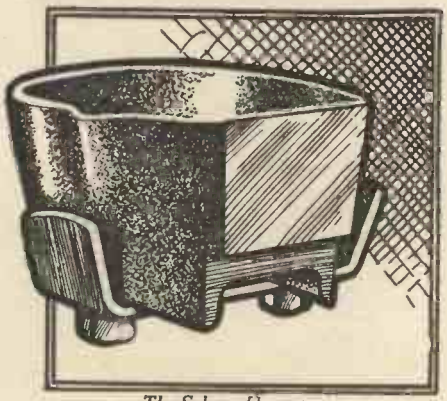
A Review of the Latest Devices for The Amateur Mechanic. *The address of the Makers of the Items mentioned can be had on application to the Editor. Please quote the number at the end of the paragraph.*

Solon Solder Pots

HERE is a useful addition to the workshop kit. It is a cast-iron pot with pouring lip approximately 1¾ × 1 × ⅞ in., which can be fitted, by means of a metal strap and two fixing screws, to the domestic type Solon electric soldering iron.

Melting solder electrically with the Solon solder pot is the most satisfactory, economical and convenient way.

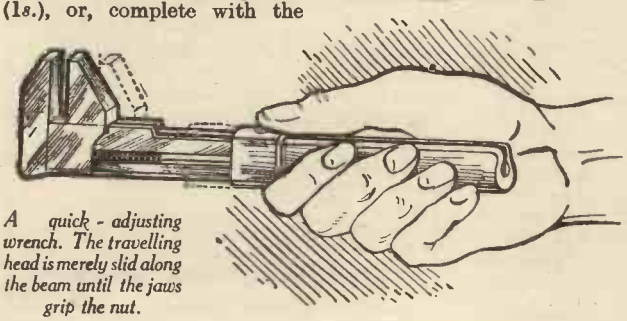
Satisfactory, as only a small quantity of solder is kept molten—but all that is necessary for the great majority of jobs! Economical, because, used with a Solon electric soldering iron, there is very little consumption of current, fifteen hours' use for the cost of one unit of electricity, and you can use up all the scraps of solder usually wasted. Convenient because it is simply a matter of attaching the Solon solder pot to a Solon electric soldering iron (fits domestic model only) and switching on the current.



The Solon solder pot.

Solder is kept in a molten state just as long as the current is switched on.

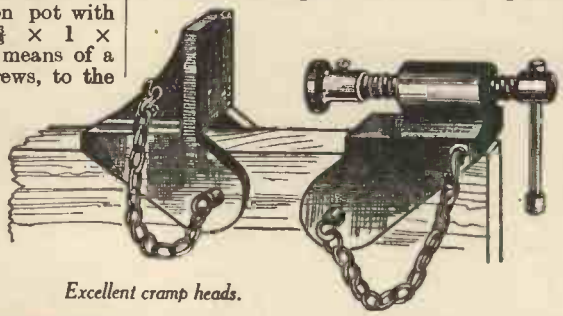
For tinning leads for wireless construction the Solon solder pot is the ideal accessory. But anywhere where soldering is done there is a place for this handy solder pot. It is obtainable independently of the Solon soldering iron (1*s.*), or, complete with the domestic type solon electric soldering iron (8*s.* 6*d.*) [14]



A quick-adjusting wrench. The travelling head is merely slid along the beam until the jaws grip the nut.

An Adjustable Wrench

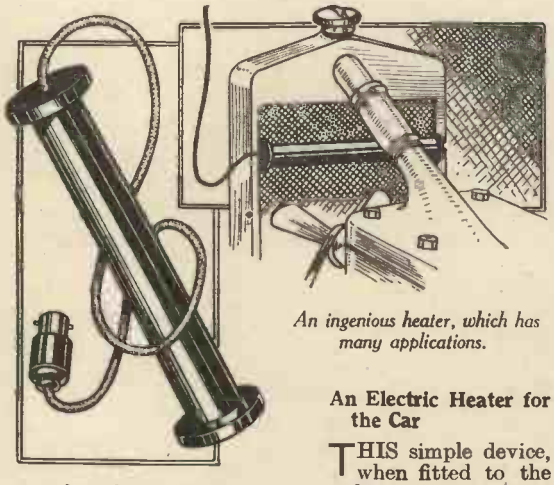
THE sketch at the foot of this column shows a new adjustable spanner which all handymen should have in their possession. It is made of drop-forged steel and can be instantly adjusted to fit any nut from ⅜-in. to 1¼ in., the adjustment being effected by moving a slide up or down the handle of the tool. The slide carries a hardened steel pin which meshes with a left-hand slow-spiral thread in a spindle mounted within the handle, and provided with an adjusting screw to take up end play. The upper end of this spindle is right-hand threaded, but in this case the threading is fine and meshes with the sliding jaw of the tool. The back of the wrench is squared off to act as a hammer. [15]



Excellent cramp heads.

"Hibernia" Cramp Heads

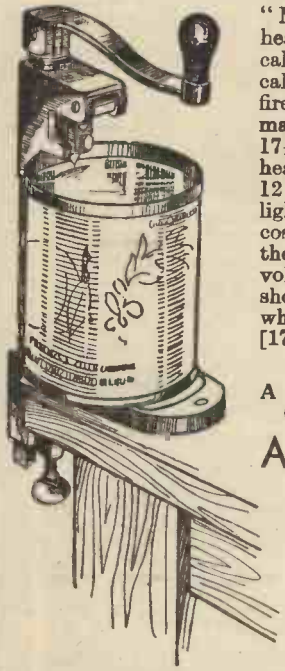
ONE of the most useful woodworkers' tools is the beam clamp which accommodates work up to 3 or 4 ft. in length. Its drawback is its unwieldiness and also it is not a tool of the portable variety. The two cramp heads shown, however, are merely attached to any 1-in. board of the required length to convert them into a bench cramp. They are light and easily carried in the tool bag, and cost 3*s.* 6*d.* per set. [16]



An ingenious heater, which has many applications.

An Electric Heater for the Car

THIS simple device, when fitted to the radiator of a car as shown in the sketch, keeps it warm in the coldest weather and ensures quick, easy starting, no matter how long the car has been garaged. It is fitted with 5 yards of flexible cord and can be connected to an ordinary lampholder and switched on when desired. The

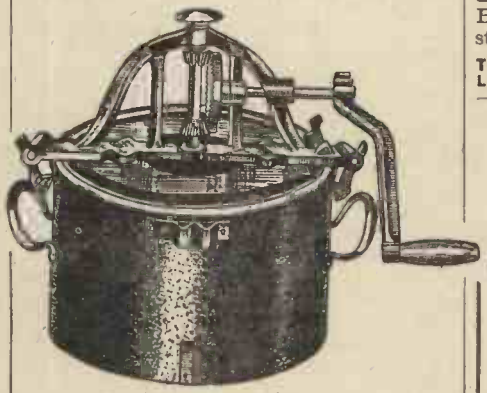


A can opener which removes the risk of cut fingers.

"Mepio" electric heater, as it is called, is hermetically sealed and fireproof. It is made in two sizes, 17¾ in. long for heavy cars, and 12 in. long for light cars. Each costs 17*s.* 6*d.*, and the model and voltage required should be stated when ordering. [17]

A Simple Can Opener

AN easily operated device, known as the "Edlund" can opener, which has recently appeared on the market opens any can, oval, square or round, large and small, and leaves a smooth rounded edge which permits the contents to be emptied whole. The can is securely held and need not be supported by the hand, therefore the contents will not spill. It is absolutely impossible to cut or injure the fingers in any way with this opener. It is attractively finished. [18]



A new potato peeler.

The Ideal Rapid Potato Peeler

THIS labour-saving device is easily handled, foolproof, quickly cleaned and avoids waste. It is knifeless, and, being enamelled throughout, the possibility of rust or clogging is entirely eliminated. By a scientific method of an abrasive process the most valuable nourishing properties of vegetables and fruits are fully preserved. It is obtainable in three sizes:—small size £1 5*s.*, medium size £2, large size £3 2*s.* 6*d.* These prices include packing. [19]

A new hydrometer of the tell-tale type.

A Midget Ball Hydrometer

THE little device shown at the foot of this page is used for testing high and low tension accumulators. It is fitted with genuine "Chaslyn Balls" which sink or swim, indicating fully charged, half charged and discharged. It costs 9*d.* [20]

What the Clubs are Doing

Club Reports for inclusion in this feature should not exceed 250 words in length, and should be received not later than the 14th of each month for inclusion in the subsequent month's issue.

THE MODEL RAILWAY CLUB

THURSDAY, September 28th, was the first Track Night since the holiday season, and was well attended. Voting took place in accordance with the rules of the Models Competition, which resulted in Colonel R. Henvey, C.M.G., D.S.O., Mr. C. R. Wood and Mr. L. R. Ellis winning first, second and third place, respectively. Thursday, October 12th, was the date of the Annual Rummage Sale. A very large number of models and parts of models were on view, the selling of which provided a very interesting evening.

Fixtures for November were as follows: Thursday, November 9th, General Meeting. Thursday, November 23rd, Track Night. Full particulars of the Club may be had from Hon. Secretary, J. C. Watts, 85 Wood Vale, N. 10.

ILFORD AND DISTRICT MODEL RAILWAY CLUB

THE Club commenced its winter programme with the Annual Dinner at the Gatehouse Restaurant, Ilford, on September 12th, a very enjoyable evening being spent by all present.

On Saturday, the 18th, we were entertained by our President at his country house, where we spent an enjoyable time operating his 7½-in. gauge garden railway. Our sincere thanks are due to Dr. and Mrs. Watts for making the time spent so happy.

On Wednesday, October 4th, we had a very welcome visit from Mr. Shepherd, of the Wimbledon Club. A very instructive and entertaining evening was spent in hearing of some of the humorous and interesting sidelines of real railway working. The fine spirit of model engineering was amply shown by the fact that he travelled up from the South coast to speak.

The Club extends a very hearty welcome to all interested in model railways to pay us a visit. The chief item last month was a lantern lecture on the Romney, Hythe and Dymchurch Railway at the Club Headquarters, Richmond Hall, Grosvenor Road, Ilford, at 8.15 p.m.

Further particulars will be gladly sent upon application to the Hon. Sec., R. L. Riddle, 19 Northfield Road, E.6.

THE MODEL ENGINEERS AND WIRELESS SOCIETY

(LIVERPOOL AND SOUTHPORT)

THE object of this Club is to assist all those interested in model engineering and radio by means of lectures, debates, meetings, etc., and to provide a centre and workshop for those wishing to carry out practical experiments.

The first meeting of the Winter Season will be held on Tuesday December 12th, at Southport, when the rules and programme will be discussed. The meeting-place will be announced in the *Liverpool Echo* and *Southport Visitor* on Saturday, November 25th.

Subscription is 7*s*. 6*d*. per annum (under 19, 3*s*. 6*d*.) Entrance fee is 2*s*. 6*d*.

The meeting on December 12th will be preceded by an interesting scientific lecture.

Those interested should not fail to attend this meeting and anyone interested in (1) wireless, (2) model railways, (3) model aeronautics, (4) mechanics, (5) electricity, should communicate immediately with C. C. H. Turner, 62 Zetland Street, Southport, enclosing stamp for particulars.

Note.—Mr. Turner will receive on behalf of the Society, queries and problems from any reader of PRACTICAL MECHANICS. Address all problems (enclosing stamp for reply given free) to C. H. Turner (Problems), 62 Zetland Street, Southport.

STREATHAM COMMON MODEL RAILWAY CLUB

OUR clubroom at 201 Gleneldon Mews, Streatham High Road, is open every evening for members' use. Each night has been allotted to a definite object, and in December, Monday, Wednesday and Friday evenings are devoted to Track Nights. Tuesdays and Saturdays are devoted to Workshop Nights, and the Friday evening meetings are as follows:

December 1st: "Cornish Riviera" Lantern Lecture. Notes read by W. F. Gentry, Esq.

„ 8th: Talks and Demonstration Meeting.

December 15th: "Britain's Largest Railway" Lantern Lecture. Notes read by the Chairman.

We have had two very interesting lectures already. One by Mr. W. H. Hart on "My Engines" and another by W. F. Gentry, Esq., on "Mass Production to Super Detail," describing what can be done to a Bing 2-4-0 tank locomotive.

We welcome new members and any friends to our meetings. Further particulars from General Secretary, L. J. Ling, Brooke House, Rotherhill Avenue Streatham, S.W.16.

THE PARK MODEL AIRCRAFT LEAGUE

MEMBERS of the above Club have been flying on Tooting Common for the past eighteen months. Permission has now been granted to fly on Mitcham Common, and a branch has been started there. The two flying grounds are within easy reach of Balham, Clapham, Croydon, Hackbridge, Mitcham, Norbury, Streatham, Tooting and surrounding neighbourhoods. The Mitcham Common ground is situated at the terminus of the 5 and 50 'bus routes and the tramway from Croydon to Mitcham passes the field. Present membership number is 48. Entrance Fee, 2*s*. 6*d*. Annual subscription, 3*s*. seniors and 2*s*. school members. Further details will be sent to any interested Aero-modellist on application to the Hon. Secretary, 112 Rodenhurst Road, Clapham Park, S.W. 4.

Next evening meeting at the Streatham Hall on Friday, January 5th.

Annual General Meeting and Election of Officers on Friday, February 2nd.

THE BRITISH INTERPLANETARY SOCIETY

MEETINGS for the reading and discussion of papers of the above Club on Rocketry and kindred subjects are held at 81 Dale Street, Liverpool, in Room 15, on the 2nd Floor, from 6.30 to 9 p.m. every other Friday from November 10th. Subscription: Fellows, £2 2*s*. per annum; Members, 10*s*. 6*d*. per annum; Juniors, under 21 years, 5*s*. Subscriptions are payable quarterly. All members will receive free copies of the Journal of the Society, which is published quarterly, and contains news of developments in matters of interest to the Society. President: Mr. P. E. Cleator, A.M.I.R.E., A.M.I.E.T. Honorary Secretary: Mr. Leslie J. Johnson, 46 Mill Lane, Old Swan, Liverpool, 13.

THE NORTHAMPTON COLLEGE OF TECHNOLOGY, EXPERIMENTAL AND MODEL ENGINEERS

WILL all interested, residing in Northampton and district, wishing to become associate members of the above, please communicate with Mr. J. Parsons, 67 Broad Street, Northampton?

THE WIMBLEDON AND DISTRICT MODEL RAILWAY CLUB

THE above club is holding its annual exhibition at its Headquarters, Locomotion Hall, High Street Mews, Belvedere Grove, Wimbledon, on December 13th–16th.

The Show will be open from 5.30 p.m. to 10 p.m. on Wednesday, Thursday and Friday, and 11 a.m. to 10 p.m. on the Saturday. There will be something to interest everyone interested in model railways, including a working layout of models of the Rainhill Trials.

Tickets may be obtained from the undersigned at 7½*d*. post free, or at the Hall, 90 High Street Mews, Belvedere Grove, Wimbledon.

SHEFFIELD AERO CLUB

THE above Club is anticipating reviving the activities early in the new year by holding Model Flying competitions. It was founded on February 8th, 1911, when some fine duration records were accomplished by Mr. R. E. Rayner with R.O.G., 108 seconds, and Mr. G. Askew 125 seconds with hand-launched machines. Early in 1913, two brothers, Messrs. G. H. and C. Dewsnap, built a full-sized glider; it aroused a great deal of interest in which some wonderful flights were accomplished. The late Mr. W. E. Colver was President; he presented three Cups to the Club for competition.

Anyone interested in the construction and flying of model aeroplanes should communicate with Mr. Cudworth, 25 Randall Street, Highfields, Sheffield, 2.

Part of the showrooms of A. W. Hambling & Co., the suppliers of model railway and wireless accessories.

MOVIE MAKING FOR BEGINNERS

(*Continued from page* 124.)

square of 8 is 64, and the square of 11 is 121. Now twice 64 is 128, and it can be seen there is a slight difference between 121 and 128. This is due to the fact that the stop is not really *f*/11 but *f*/11·3; but it is not necessary to mark it so accurately as this.

Now see how *f*/3·5 compares with *f*/8. The square of 8 is 64, the square of 3·5 is 12·25. It will thus be seen that a 3·5 lens is more than five times as fast as an *f*/8 lens.

Some cameras are even fitted with an *f*/1·5 lens. Work this out in the same way, and it will be found that it is no less than twenty-eight times as fast as *f*/8 and quite skilled handling is required to get the best results with these big lenses!

While it is very nice to have such large apertures available when required, they are not unmixed blessings. One of the most important things in a picture is "depth of focus," by which is meant the depth of the scene over which everything is satisfactorily sharp.

Sharpening Detail in a Photograph

How much of a scene is sharp depends on the size of the lens opening (the "*f*" number) *and* the focal length of the lens (distance from the lens to the film). For the same lens aperture or "*f*" number, the shorter the focus the greater the depth, and thus it happens that as cine lenses have very short focuses, generally something between $\frac{5}{8}$ in. and 1 in., the depth of focus even with an *f*/3·5 lens is sufficient for all practical purposes except very near close-ups. For this reason the majority of cine cameras have what are called "fixed focus" lenses, which means lenses definitely focussed on the middle distance so that everything is sharp and that no focussing adjustment is needed. However, with the larger apertures than *f*/3·5 (and in many cases even with this aperture), it is a great convenience to have some means of focussing or adjusting the depth of field to suit our purpose. With large aperture lenses such as *f*/1·9, it is absolutely essential to have a focussing mount, otherwise, if the lens is set for distant views, nothing will be sharp within 30 or 40 ft. of the camera, while if we focus on the nearby foreground the background will be "fuzzy." When using these large aperture lenses, determine what needs to be sharp, and focus on that which requires a little skill—sometimes even actual measurement of the distance between the camera and the object.

There are two tasks that the lens must perform—to give a sharp picture and to allow the right amount of light to reach the film so that a proper exposure is obtained. Sharpness (assuming a good lens) is obtained quite simply in a fixed focus lens camera, for everything will be automatically sharp save for distances closer than about 6 or 8 ft. In most cases with cameras fitted with focussing lenses, leave the lens set at "infinity" unless using a very large opening, or else wish to photograph things at closer range. So far as the amount of light reaching the film is concerned, this is purely dependent upon the size of the stop or "*f*" number.

CONSTRUMENTS CHEMISTRY SETS

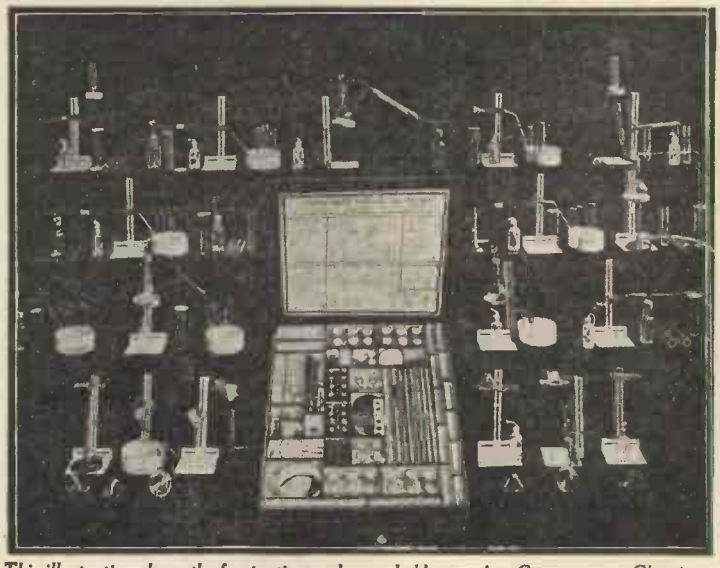
An Illustration of Progress combined with Economy and Efficiency

CONSTRUMENTS Chemistry Sets give expression to the most modern ideas, both as regards design of the apparatus, and methods of procedure, and bring at once within the reach of every student the opportunity to adopt rational and normal methods. Construments Sets are copies of standard laboratory apparatus, but on a small scale, and make provision for carrying out all the usual demonstrations, reactions and processes. The amount of material used up by the adoption of small-scale chemistry apparatus is almost negligible, and the necessary space required for carrying out the work is reduced to a minimum.

By the use of a watch glass to which is fitted a magnifier, chemical reactions between two single drops of solution may be seen and studied much more closely than by the older test-tube method. Furthermore, neither a supply of gas nor of running water is necessary, and, although a Bunsen is provided, the small spirit lamp which is also part of the equipment is all that is required as a source of heat for most purposes. Construments also open up another fascinating branch of chemical science—namely electro-chemistry.

Within the space occupied by a shilling, the student may observe the action of the simple cell and the storage battery. Every type of primary cell may be reproduced in miniature, and their actions studied under the microscope—and this with but a few drops of liquid which may be disposed of by a duster—thus obviating the necessity of a sink and similar expensive equipment. This method of approach to chemical study has been adopted for some time by many of our leading research chemists and technological laboratories.

The Educational Chemistry Sets make provision for a complete course, both in qualitative and quantitative work, and the Sets in general have been designed to enable the student with the most restricted means to adopt a technique which is at once modern, economical and efficient.



This illustration shows the fascinating and remarkably complete Construments Chemistry Outfit and a few of the experiments which can be carried out.

AROUND THE TRADE

BRIEF ITEMS AND TOPICAL THOUGHTS CONCERNING MANUFACTURERS AND THEIR PRODUCTS

Engineering Opportunities

WHATEVER your requirements, whether you desire a complete course of instruction, or tuition in some specialised subject, the organisation of the British Institute of Engineering Technology, 410 Shakespeare House, 29-31 Oxford Street, W.1, is so planned that it will dovetail into your needs exactly. Readers should send for a free copy of "Engineering Opportunities," a 256-page guide which shows clearly and definitely the way in which you may carve out a successful career.

Make Money from Printing

MOST readers would like to add to their income, so why not start right away and purchase an Adana all-steel automatic self-inking printing machine, and start a spare time printing business. The possibilities are enormous—the market huge. Tradesmen, dance and concert organisers, etc., etc., all must have a regular supply. You could easily supply this. Only 45*s.* is needed to purchase this machine that will print anything from a chemist's label to a magazine. An instruction booklet is supplied free with the machine.

The Handyman's Vade Mecum

FURNITURE making, concreting, boot repairing, paper-hanging, watch-repairing, are a few of the hundred and one things that are taught you in four handsome bound volumes entitled "The New Amateur Mechanic," published by the Waverley Book Co., 96-7 Farringdon Road, E.C.4. They will be sent to you to examine for seven days without the slightest charge or obligation, when they may be sent back at their expense if you do not desire to keep them. They are fully recommended to readers, and 3*s.* down and fourteen further monthly payments of 3*s.* makes you the owner of these handsome volumes.

A Wireless Career

IF you desire a career with a future, let the Wireless College, Colwyn Bay, help you. They train students for all branches of the wireless profession. They state that the demand for their qualified students is much greater than the supply. Many more could have been placed in good appointments recently had these been qualified and available. Write at once for their free prospectus.

Movies at home for a few shillings

CITY SALE & EXCHANGE (1929) LTD., of 59 Cheapside, London, E.C.2, have a wonderful selection of Home Cines from 55*s.* which can be obtained for a payment of only 6*s.* 8*d.* down. Their library of films contains the latest film successes, and all the popular stars, including Mickey Mouse. These films can be bought outright, or hired for a day, a week-end, or a week for very little. Full particulars of their library and a hundred-page catalogue will be sent post free. The catalogue contains every home cine on the market, as well as cine cameras and ordinary cameras at every possible price, and some great bargains in slightly used, but good as new, apparatus. Readers are advised to write early.

Model Engineering Supplies

MODEL engineering enthusiasts will do well to obtain for the nominal sum of 4*d.* the fine illustrated catalogue published by the well-known firm of A. J. Culham, 21 Strathmore Gardens, Romford, Essex. Some of the new lines he is introducing are castings, materials, and blue prints for "The Flying Scotsman" L.N.E.R. 4-6-2, Pacific, in 5-in. and 4-in. gauge. Castings in malleable iron are also obtainable for many locomotive parts of L.B.S.C. design, replacing many parts usually cast in gunmetal. Apart from the prices being lower than gunmetal, they have a more realistic appearance, also being much easier to machine and file. He also introduces A.J.C. small pipe taps and dies, sixty threads per inch to overcome the difficulty of threading small light tubing, where a Whitworth B.A. or M.E. thread is too deep. Petrol engine casting sets, etc., are also obtainable.

Aircraft Products

AN interesting pamphlet containing a number of bargains in watches, binoculars, opera glasses, etc., is obtainable free from the above firm, whose offices are situated at 87 New Oxford Street, W.C.1. All readers interested should write at once for this list, as these bargains are all moderately priced and are excellent value for money.

REPLIES TO QUERIES & ENQUIRIES

If a postal reply is desired, a stamped addressed envelope must be enclosed. Every query and drawing which is sent must bear the name and address of the sender and be accompanied by the coupon appearing on page 156. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes Ltd., 8–11 Southampton Street, Strand, London, W.C.2.

Silvering Liquid

"CAN you please oblige me with a formula for silvering liquid? It is a colourless, oily liquid and is rubbed over metals, depositing a beautiful surface like chromium plating. It is not permanent, lasting only three or four days." (Potsdam, Middlesbrough).

A solution of potassium argenticyanide is probably what you require. This applied to brass or copper leaves a fine deposit of metallic silver which may be burnished with gentle application of a soft rag and whitening. The whitening may well be incorporated in the fluid, which, being of a poisonous nature, should preferably be made up by a chemist. A solution of silver nitrate in distilled water is prepared. To this is added slowly an aqueous solution of potassium cyanide (POISON) until the white precipitate at first thrown down is just redissolved by excess of cyanide. The solution is then ready for use. Contact with the skin should be avoided.

Note.—Chromium plating cannot be accomplished in any similar way. Chromium can only be deposited electrolytically and needs a large current to obtain a good "throw"—about 200 amperes.

Decomposition of Water by Electrolysis

"In the decomposition of water by electricity, oxygen and hydrogen are formed. If mixed, is the explosive which is now formed lighter than air? Also can it be exploded by a violent blow?" (P.S., Kemstom.)

Water on electrolysis yields a mixture of hydrogen and oxygen in the proportions by volume of roughly two and one. Such a mixture of gases is lighter than air, as a consideration of the following figures will show:—

Weight of 1 litre hydrogen . .	= 0·08987 grms.
,, ,, oxygen . .	= 1·42900 ,,
,, ,, air . . .	= 1·29300 ,,
Weight of a mixture consisting of 2 litres hydrogen and 1 litre oxygen.	= 1·60874 ,,
Weight of 3 litres of air . .	= 3·87900 ,,

Comparative weights of a volume of mixture and an equal volume of air are as 1·60874 to 3·87900, and therefore the oxy-hydrogen mixture is roughly about 2·4 times as light as air.

At ordinary temperatures the mixture is perfectly stable. It explodes only at about 700° and therefore contact with a red-hot body is necessary. It is difficult to conceive how one could give a gas a violent blow. Compression would not at normal temperatures be sufficient to explode the gas.

Blueing Gun-Barrels

"I shall be glad if you will tell me how to blue gun-barrels." (F. H. F., Salisbury.)

To blue gun-barrels, etc., dissolve 2 parts of crystallised chloride of iron; 2 parts solid chloride of antimony; 1 part of gallic acid in 4 or 5 parts of water; apply with a small sponge and let dry in the air. Repeat this two or three times, then wash with water, and dry. Rub with boiled linseed oil to deepen the shade. Repeat this until satisfied with the result. The blueing of gun-barrels is effected by heating evenly in a muffle until the desired blue colour is raised, the barrel being first made clean and bright with emery cloth, leaving no marks of grease or dirt upon the metal when the blueing takes place, and then allow to cool in the air. It requires considerable experience to obtain an even clear blue.

Interesting Facts about Heat

"I shall be glad to know the weight of heat, and whether heat rays pass through metal." (L. F., Southminster.)

Heat has no weight; a hot body weighs no more than when cold, although its density may decrease owing to increase of volume by expansion. The amount of coal in a fire-box decreases, because in burning, the carbon of which it is composed combines with the oxygen of the air which feeds the flame to form carbon dioxide and monoxide. The heat is merely a manifestation of chemical reaction and represents exactly the amount of sunlight energy originally absorbed by the coal when a plant, in extracting carbon from the atmosphere. Heat rays travel through the ether like radio waves, but unlike these they cannot permeate everything. Most substances are opaque to heat (or infra-red) radiations. Rock salt is transparent whilst glass is more or less opaque. Ebonite in thin sheets is transparent even in the *visible* red region of the spectrum. There is one generalisation that can be made of heat-transparent solid substances; they are all good electrical insulators. Metals are therefore opaque and do not pass heat rays. Hence, returning to correspondent's fire-box, we may assume that heat from the burning coal does not pass through the fire-box sides. What actually happens is that they absorb the heat rays and become themselves hot and re-radiate the heat they are absorbing. *The heat rays do not pass through the metal;* you have been misinformed. The distinction between radiant heat and light has long ceased to exist. Radiations, whether of the visible or invisible spectrum band absorbed by an opaque body, are transformed into heat. Conversely, when a solid is heated it radiates heat rays which we can feel, but cannot see, since they occupy the infra-red end of the spectrum which is (to coin a term) "sub-optical." As the temperature of the body increases it reaches a stage at about 500° C. when it commences to radiate visible light as "red heat," and on further heating emits a visible white light. It can be shown that as the amount of visible rays radiated during the heating increased, the heat ray (invisible) radiation increased enormously. Thus white-hot bodies radiate far more energy as heat waves than light waves.

An Interlid for Tins of Polish, etc.

My invention is an interlid for tins of polish in order that the hands do not get soiled. This comprises a thin tin disc with a V-shaped cut-out, leaving room to get enough polish on a cloth. It has a small metal head attached to the centre in order to twist this round as the polish is used. It would be slightly grooved down over the tin." (G. M., West Wimbledon).

The invention of applying an "interlid" to tins of polish is ingenious, but it is questionable whether it is broadly new. If novel, it would certainly form fit subject matter for protection by Letters Patent, but the commercial value of the invention is problematical, since the device would materially add to the cost of the tins or containers, and for that reason it is believed that great difficulty would be experienced in getting manufacturers to adopt the idea.

Temperature of Jupiter

"Can you inform me which one of the following statements is more generally accepted as probably correct re the temperature of Jupiter. Simon Newcome states in a contemporary, 'It is therefore probable that Jupiter is not yet covered by a solid crust as our Earth is, but that his white-hot interior, whether liquid or gaseous, has nothing to cover it but the dense vapours to which the heat gives rise.' Sir James Jeans states that 'Even Jupiter is almost unimaginably cold—the amount of heat we receive from it shows that its temperature must be about 270 degrees below zero on the Fahrenheit scale.'" (H.C.R., Hartburn.)

Modern radiometric measurements have failed to detect any warmth on Jupiter beyond that reflected by the feeble sunshine falling upon it. This implies an entire absence of internal heat and, consequently, an extremely low surface temperature. The new view appears to be gaining general acceptance, though the undue brightness of the planet, considering its great distance from the sun, remains unaccounted for.

The Great Nebula in Orion

"Can you give me a diagram showing the position of the Nebula in Orion with its surrounding stars which can be seen in a 2-in. astronomical telescope, using an eye-piece magnifying 75 diameters?" (B. J., Davyhulme.)

On a dark clear night this object can be seen with the unaided eye as a patch of hazy light surrounding a row of five or six stars which marks the "Sword" not far beneath the well-known belt. A good 2-in. astronomical telescope, using an eye-piece magnifying 75 diameters,

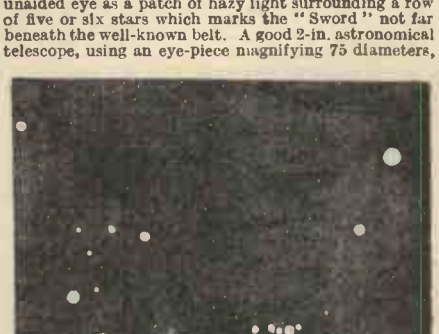


Diagram showing the position of the Great Nebula in Orion.

should show it distinctly as a faintly luminous greenish mist. In the accompanying diagram the situation of the nebula relative to the "Belt" is indicated by a cluster of tiny dots.

Patent Advice

By A. MILWARD

The services of a professional Patent Expert are available free to every reader. He will advise you on the validity, novelty, and value of any idea you may have. No charge is made for this service, but the Query Coupon appearing in our advertisement pages must be enclosed with every query.

Improving a Floor Polish

"SIR,—A few weeks ago I came across a recipe for making a liquid floor polish which I decided could be improved and turned into a solid polish. Is it possible to patent and sell this polish without exposing myself to any liability of infringement ?" (A. H., Surrey.)

It is possible to patent a floor polish, provided invention is required to compound it and it is novel. It is, however, doubtful if any valid patent could be obtained for utilising the recipe of a known liquid polish and omitting the liquid to obtain a solid product, or merely adding a known solidifying material, or an excess of one of the solid ingredients to convert the known liquid polish into a solid one. It is presumed that the liquid polish is not a patented preparation, in which case you, or anyone, can make and sell it. You would probably only require a hawker's licence if you sold the polish from door to door, but an enquiry at your local police station would give you the information you require. If it is not possible to patent your preparation, you could obtain a certain measure of protection by selling it under a registered Trade Mark.

A Patent Collet

"Sir,—A certain firm have a patent Collet, and I wish to know the following :—

"Can I make one for my own use, to be used exclusively in my own shop ?

"(2) Can they refuse to sell me one ?

"(3) If they ask £50 for a £3 collet, have I any redress ?" (T. S., Wimbledon.)

It is a little difficult to answer the applicant's queries concisely, since a "Patent Collet" may mean so many things, *i.e.*, a collar, or neck band, the part of a ring or jewel in which gems are set, that part of glass vessels which sticks to the iron rod in removing glass from the melting pot, a collar applied to clocks and watches.

As the writer has not given any indication of his business, it is not possible to know what he actually intends to convey by the expression of a "Patent Collet."

However, speaking generally, in reply to (1), anyone can make a patented article for his own use by way of experiment, if the experimental use is with a view to improving the invention, but it is not allowable to make a patented article to avoid purchasing it from the patentee to save his profit and use it for the purpose intended. (2) A patentee is not bound to sell the patented article to anyone, but there is a redress (see reply to 3). (3) A patentee is entitled to charge any price he likes for his patented article, but it is possible under the Patents Acts to obtain redress if the demand for the patented article is not met to an adequate extent and on reasonable terms, but the cost of taking action to obtain such redress is a costly matter.

Automatically Basting Meat whilst Cooking

"Sir,—Enclosed are the details of an idea with regard to which I should be pleased to have your advice. It is supposed to be an instrument which automatically bastes a joint of meat with fat, thus eliminating the necessity of opening the oven door, doing it by hand, and a host of other inconveniences. I should be much obliged if you would advise me as to its validity and value as a commercial proposition." (W. R., Marble Arch.)

The object of the writer's invention for automatically basting a joint of meat whilst being cooked is not broadly novel, but the particular means proposed to effect this is probably new. If the invention has been provisionally protected by filing an Application for Letters Patent, it might be submitted to certain firms who specialise in cooking utensils, and if not novel, the applicant would probably soon be apprised of the fact. If, on the other hand, no Application for Patent has been made, it would be advisable to make or have made a search amongst prior patent specifications and literature dealing with this class of invention. Some years ago it was proposed to automatically baste joints whilst cooking, which was effected it is thought by means of automatically operated scoops.

The great disadvantage of the proposed construction is believed to reside in the fact that trouble would be experienced in thoroughly cleansing the inside of the container.

An Expired Patent

"Sir,—A certain firm are marketing an article, the patent of which I believe has expired.

"I have made a simpler, better and so cheaper article, which is similar in its function to the firm's article mentioned.

"Will you please let me know how I can ascertain whether this firm's patent has expired, also if I can lawfully put my article on the market ; finally, can I patent my article ?" (N. R., Clapham Junction.)

The patented article is presumably stamped with a patent number, in which case it can be readily ascertained if the patent is still in force by inspecting the Register of Patents at the Patent Office.

If the patent has in fact expired, it is a punishable offence to continue marking the patented article with any words implying the article is still patented.

It is open to you, or anyone, to patent an improvement on a patented article, even if the original patent is still in existence, but should the patent still be in force it may not be possible to manufacture, use or sell the improved article without infringing the original patent, in which case the patentee of the improvement can, subject to certain conditions, obtain a licence from the original patentees to make the patented improvement.

A New Manner of Manufacture

"Sir,—I have had an application (provisional specification) turned down, as it is not 'a manner of manufacture within the meaning of the P. and D. Acts, 1907—1932.' I am referred to 'Johnson's Application in Vol. 19, Reports of Patents Cases, p. 56.' I have consulted this volume and find that the unfortunate Johnson tried to patent some 'cover' (envelope or bag) in relation to a marketing scheme, and the Comptroller refused his application. He carried it further to the High Court, and judgment was given against him. Considering this ominous reference I think I had better abandon my application, but think you may be able to tell me whether it is worth while going further." (A. L., Nottingham.)

Patents are only granted for a "new manner of manufacture," and is based on the old Statute of Monopolies of James I. (1624, sect. 6). In "Patent Advice" in PRACTICAL MECHANICS, you will see it is distinctly stated that all inventions are not necessarily patentable. Unless a material product of a substantial character is realised or effected by the invention, it is unpatentable. A principle cannot be patented, but a means for carrying a principle into effect may be patented.

Applying the above to Johnson's application which has been cited by the Patent Office against your application and to your own idea, you will at once see that in neither case is a material product realised, and under the Patent Act, the Comptroller is bound to refuse protection for your idea. In view of the above, you will gather that the only opinion that can be given you is to abandon your application. In closing, it might be pointed out that had you sought professional advice in the first instance, you would have saved your time, trouble and money, as any reputable patent agent would at once have advised you that your idea was not fit subject matter for a patent.

A Musical Novelty

"Sir,—I am enclosing provisional specification protecting an idea about which I will be much indebted for your advice. I have submitted it to one or two people, including Messrs. The Electric and Music Industries, Ltd., who have not taken it up. As I am not able to develop it myself, I would like to sell it for what it is worth. I should be pleased to have your opinion as to its novelty and value and any suggestions you can offer for disposing of same." (E. B., Standon Park.)

The invention forming the subject matter of a Patent Application is ingenious and is novel so far as is known from personal knowledge as applied to gramophones, but the idea is not thought to be broadly novel of obtaining music in wireless sets by causing different sounds to be emitted on depressing one of a series of keys on a key-board. As the validity of a patent which would be granted on this application would depend on novelty, the applicant is advised to make or have made a search among prior literature and patent specifications dealing with this class of invention before incurring expense in development. On the face of it, the invention forms fit subject matter for Letters Patent, but the commercial value of such an invention is extremely problematical. Unless one of the gramophone or wireless firms could be induced to take an interest in developing the idea, it appears to be of small value since it does not appear to be an invention which could be successfully worked by the inventor.

The inventor is thanked for his offer, but for obvious reasons it is not an invention in which PRACTICAL MECHANICS could take a financial interest.

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Handbooks on Tools

S. TYZACK & SON LTD., the well-known tool and machinery manufacturers, of 341, 343, 345 Old Street, Shoreditch, have recently introduced three comprehensive and well-illustrated catalogues covering a full range of their enormous stock. Those readers interested in woodworking tools should write at once for their fine 275-page cloth-bound catalogue which has just been revised. The illustrations cover nearly every type of woodworkers' tool, and the prices are quite moderate. This catalogue is priced at 2*s.* post free, and will be sent on application. The other two catalogues deal with metal-workers' tools and machinery, are indexed in the front, and are obtainable free of charge on application. **(13.)**

Games for Everyone

THE Kay Sports Co. have just published an interesting pamphlet showing their latest novelties and games which should prove very popular during the Christmas holidays. They introduce conjuring sets, electrical outfits, solo skittles, make-up boxes for home theatricals, chemistry outfits, etc., all obtainable at popular prices. One of their features is the Kay telephone set, costing 25*s.*, which is a real telephone, and not a toy. It has automatic calling, is beautifully made, easy to install, and is full-sized and not a miniature. Readers should write at once for this pamphlet, which is free of charge, and will be sent on application. **(14.)**

The Scientific "Blue-Book"

A USEFUL and practical handbook, price 6*d.*, has recently been published by the Scientific Supply Stores (Wireless), Ltd., 126 Newington Causeway, Elephant and Castle, S.E.1., dealing with the microphone and its many applications. The book contains a large number of diagrams covering many experiments and uses for the microphone. Once the book has been studied and the many suggested experiments tried out the reader will be well equipped for further researches into "accoustics" as the science is called. Various types of microphones and other pieces of apparatus used in connection with the experiments are listed at the back of the handbook and are obtainable at reasonable prices. **[15.]**

Tools for the Handyman

MESSRS E. GREY & SON, LTD., 18/20 Clerkenwell Road, E.C.1, the well-known tool manufacturers, have just issued two fine catalogues and a number of folders on bench tools, materials and sundries, lathes and petrol engines. The well-illustrated handbook on materials and sundries is neat in appearance and easily fits into the coat pocket. It gives a complete range of stock metals, wire, rivets, screws, nuts and washers, chains, soldering flux and irons, etc., all obtainable at very reasonable prices. The other catalogues on bench tools, lathes, and petrol engines are just as comprehensive and are full of illustrations. All handymen should write for these booklets, which are obtainable free from the above address. **[16.]**

Model Aircraft Kits and Supplies

THE Northern Model Aircraft Co., 11A High Street, Manchester, has just produced a price list on model aeroplane kits and supplies, which is obtainable on application free of charge. Their models include the Condor "Cloud," the Condor "Comet," the Condor "Crusader," kits for which are made up in two types. They also give lists on wood, propellers, wires, tools, landing wheels, shaft, wing ribs, etc. Prints of wing sections, Japanese tissue and silk, strip elastic, dopes and cement are also listed. All model aeroplane enthusiasts should write at once for this valuable list. **[17.]**

Scale Model Locomotive Sets

MESSRS. BASSETT-LOWKE, LTD., St. Andrew's Street, Northampton, supply sets of parts for making scale models of every description, one set in particular—the L.N.E.R. 2–6–0 type scale model locomotive—is attractive, for it may be put together without engineering skill or knowledge and without the use of any machine tools. It is obtainable in sets of parts for 1½-in. gauge, the set comprising nearly 300 accurately made parts. A glance through the Bassett-Lowke Catalogue—"Everything for Models"—which is really a text-book of hundreds of pages on model engineering, will show the enormous extent to which this famous firm caters for the needs of the model engineer. The book costs 1*s.* Their other handbook, Ships and Ships' Models, costs 6*d.*; it is packed with interesting matter, diagrams and photographs of everything which will appeal to those interested in ships and ships' models. **[18.]**

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