

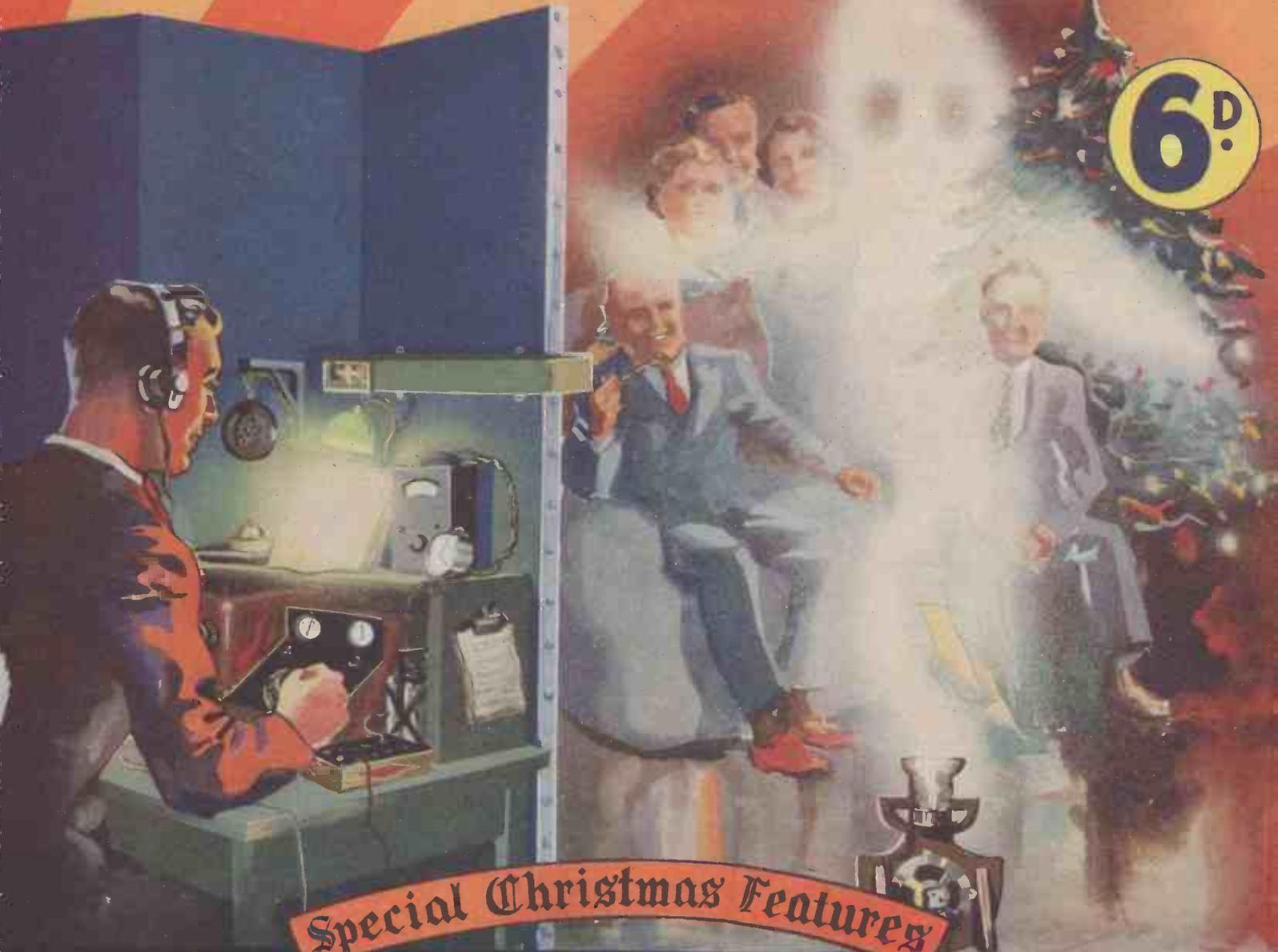
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DECEMBER

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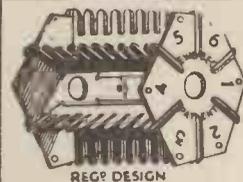
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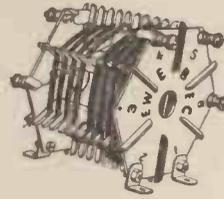
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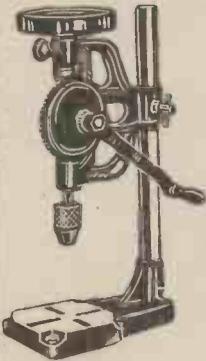
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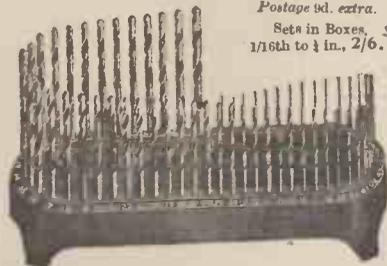
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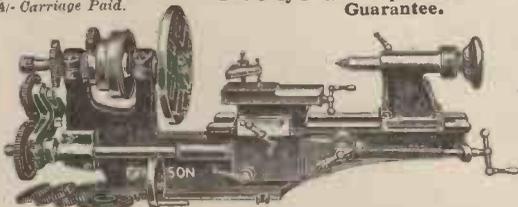
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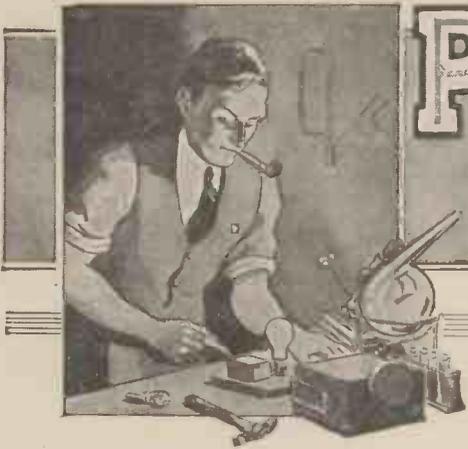
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Practical Mechanics

VOL. II. No. 15
DECEMBER
1934

Edited by **F.J. CAMM**

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Notes, News and Views

Practical Mechanics "Annual

READERS will welcome the statement that we have decided to issue **PRACTICAL MECHANICS** as a Christmas Annual Volume, at 8s. 6d. or by post 9s. 6d. from George Newnes Ltd., 8/11 Southampton Street, Strand, W.C.2. Here is a golden opportunity for you to obtain an attractively bound treasury of facts, interestingly written and lavishly illustrated, of all of the most interesting scientific achievements, and a consultant on all the developments in the world of invention, mechanics, and progress.

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"Working Models"

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"Hobbies New Annual"

HOBBIES **NEW ANNUAL** makes its welcome appearance for the fourth year in succession. Absolutely packed, almost brimming over, in fact, with "how-to-make" articles of every description—electric motors, flapping-wing models, garden sprays, midget wireless receivers, rowing machine, games, a cycle lighting dynamo, breech-loading guns, model railways, suspension railways, model aeroplanes, a dancing robot, magic lantern slides, a simple lathe, cranes, a working model chairplane—these are but a few of the many subjects exhaustively treated in this attractive new annual.

Additionally, the parts are given for making a discus pistol, an indoor tail-first monoplane, a set of conjuring cards, a magic book, and a model motor cycle, as well as a free fretwork design. This annual, too, costs 3s. 6d., or 4s. by post from George Newnes Ltd. (address as above).

British Engineering Accuracy

ACCORDING to a recent report from Portuguese East Africa the last span of

THE MONTH'S SCIENCE SIFTINGS

The problem of getting a heavy transmission cable across the turbulent Bridge River in British Columbia, which is 300 ft. wide at that part, was solved by first sending over a light line on a kite, then hauling over a heavier line, and finally the cable.

A young Dutch inventor has claimed to have devised a motor suitable for ordinary motor-cars, omnibuses, and commercial vehicles, which can be run on compressed air.

German chemists have produced a new type of newsprint intended for newspapers, and containing 80 per cent. of fir timber.

A talking tape machine has just been invented by Professor Holst in the research laboratories at Eindhoven, Holland. The machine is worked by strips of paper treated chemically so as to record the human voice.

A remarkable machine, the only one of its kind in the world, has just been put into service for keeping the Mersey Tunnel clean. The appliance weighs 14 tons, and is designed to clean and polish the walls of the Tunnel with revolving cloths and brushes which pass over the interior surfaces at great speed.

the two-and-a-quarter mile bridge across the Zambesi River has been successfully put into place. Notwithstanding the great length of the bridge, and the fact that the mid-stream foundations were sunk 100 ft. in the river bed, the alignment was so accurate that the two sides of the bridge were less than $\frac{1}{4}$ in. out when the middle span was placed in position.

A Rocket Mail

THE first ship-to-shore rocket mail in the world was inaugurated last month on the River Hooghly, in India. A letter mail was successfully rocketed 1,000 yards from a steamer passing through the estuary, thus obviating the mail-boat being delayed in shoal-infested waters.

A Robot Letter-Sorter

POST office engineers are experimenting with a mechanical sorter which has been installed at the Brighton Post Office. The machine is in the form of a huge typewriter, and the letters pass into it on a running belt. When the operator sees a letter addressed to London, for instance, he just presses the London button—and so on. The letters then fall into their respective pigeon-holes, ready to be bundled. The machine is capable of handling letters three times quicker than by hand.

Radio Photography

A REMARKABLE achievement in connection with the recent England-Melbourne air race was the transmitting by beam wireless from Australia to London of a film showing the arrival of Scott and Campbell Black in Melbourne. The film was shown in many cinemas throughout Great Britain, and each separate picture making up the film took only twenty-five minutes to transmit.

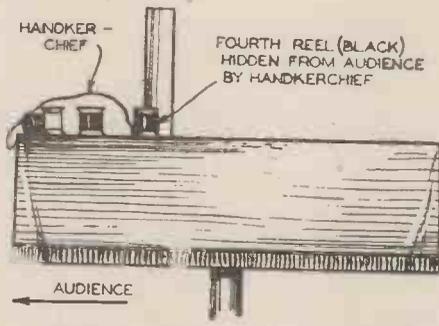
An Ingenious Bulb-making Machine

A WONDERFUL appliance, known as the Westlake Automatic Bulb Blowing Machine, is capable of turning out 50,000 electric lamp bulbs a day. It is driven by an electric motor, and is controlled by one man. Twenty-four iron arms dip one at a time into a molten glass furnace, each picking up exactly the right amount of glass to make one bulb. Each blob of glass is then dropped into a cup at the end of a blowpipe, and formed by compressed air into the required bulbous shape, which is completed by iron moulds. After being formed, the bulbs are released from the moulds, dropped into cooling baths, and passed through annealing furnaces.

The
Editor and
Staff Join in
Wishing Every
Reader a Very
Happy
Christmas

MECHANICAL MAGIC ENTERTAINMENT

By MYSTIC



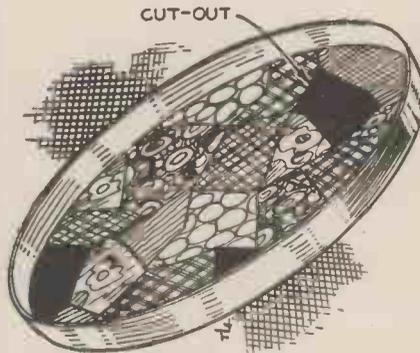
The arrangement of the apparatus for "A Reel" Mystery.

There are two types of illusion, firstly, that which relies upon what is known as sleight of hand, and secondly, that which is performed through the medium of some carefully-designed apparatus. But, with either form there must be some skill in carrying out a movement which disguises a fact which would reveal the *modus operandi* of the illusion. This is generally referred to as misdirection, and without it no illusion is worth while. In the following effects I shall describe first the effect as it is seen from the audience's point of view; then explain the apparatus which is needed for that effect, and finally explain the move. The misdirection will be carefully explained, and that particular point should be carefully studied, and then practised before a mirror in order that the necessary moves may be made in such a manner that the critical point is carried out without defect. The remainder of the effect need not be carried out with such perfection, although to present a programme containing these effects it is necessary to go through them two or three times, preferably before a full-length mirror, so as to make quite certain that every move blends and thus the effect appears natural.

A "Reel" Mystery

Effect.—Standing on the magician's table is a small round tray, a short narrow paper tube, three reels of cotton or thread, two black and one white, and a handkerchief. The latter is lying loosely bunched up. The performer picks up the tray and then takes the reels of thread one at a time and shows them to the audience, placing them upon the tray as they are shown; and when the three have been thus presented he walks to the front row of the audience and permits them to be removed from the tray for inspection. When the spectators are satisfied that the reels are perfectly genuine and unprepared, they place them back upon the tray and the performer returns to the

stage or table. Placing the tray down, he picks up the small paper tube and hands this for inspection. He stands the tube upright on the tray and drops one black reel into the tube; then drops the white reel in, and finally drops the remaining black reel upon the white. He then draws the attention of the audience to the order of things—three reels inside the tube, two black with a white in the centre. After uttering a few words or waving a magic wand, the tube is removed, and it is seen that the white reel is now at the top of the pile, the two blacks being underneath it. The paper tube is placed upon the table, and without touching the reels the performer walks to the audience and permits them to remove the reels for further examination.



The tray is covered with cretonne and a dark piece cut out, as shown here.

Upon being satisfied, they are returned to the tray and the performer announces his intention of repeating the effect. Accordingly they are restacked, white in the centre as before, the tube is placed over them and the tray is placed on the table whilst the performer addresses the audience concerning the impossibility of the reels changing places as the tube is such a tight fit over them, and if desired he gives a pseudo-scientific explanation of how it *might* be done. He then picks up the tray, and asks the audience to name the order in which they would like the reels to appear. The performer again utters the magic word and suddenly makes an action as though throwing tube and reels at the audience, when everyone is astounded to see the tube fall gracefully from the tray (owing, of course, to its lightness) and the reels have vanished!

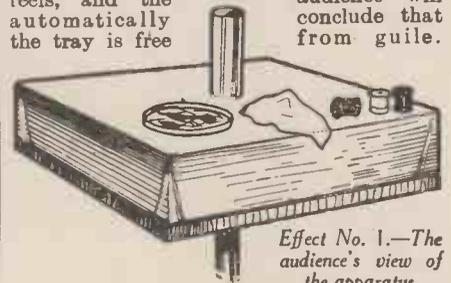
Apparatus Required

Four reels of thread or cotton. From the popular stores large reels of carpet thread are obtainable at 6d. each, and these are ideal, as they are sufficiently large to be seen from a distance. A paper cylinder made from stout note-paper and of a diameter just sufficient to pass easily over the reels, but long enough to project about 1/2 of an inch above four reels stacked, not three. The tray is made from three-ply wood, circular in shape and about 10 in. in diameter. A piece of thin wood 1/2 in. wide is carefully steamed and tacked round the edge of the tray to finish it off, and it is then prepared in the following

manner. Obtain a piece of cretonne of a jazz pattern in which black shapes are repeated rather often over an area as large as the tray surface. Carefully glue this to the upper side of the tray. With a fret-saw cut out one of the black shapes, ascertaining that the shape is large enough to permit each of the reels to pass through. On the back of the tray fit a thin slide, preferably of tin, with side runners and a bent end so that it may be moved with a finger tip. The top of the slide is covered with a piece of black material cut from the same cretonne, and the complete arrangement is as shown on the left. If carefully made the tray should bear a fairly close inspection without the removed section being discernible. The edges of the opening should of course be blackened, and if the wood is sufficiently thin the opening will only be visible when attention is drawn to it. The turned edge of the slide should be near enough to the edge of the tray to permit the finger to reach it easily. The table upon which the effect is performed should be provided with a small well, the bottom of which is covered with cotton-wool to a fair depth. The reason for this will be seen in the working instructions, which now follow.

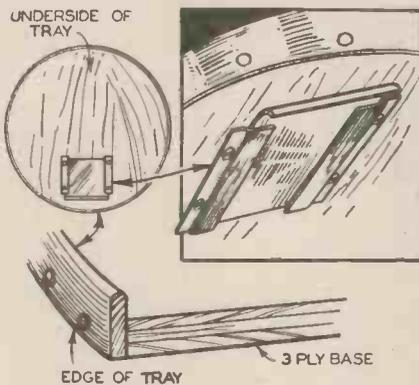
Presentation

The tray is placed on the table with the three reels standing side by side near it. A clean handkerchief is unfolded and carefully bunched to give it the appearance of having just been opened, and is then placed at the side of the tray. Behind this is stood the remaining (black) reel of thread, and by its side is placed the tube. It will be seen, therefore, that the handkerchief is used as a screen to hide the extra reel. The various items are now presented to the audience as already described, and if care is taken in handing the reels to the audience from the tray the cut-out will not be noticed as the attention is focussed on the reels, and the audience will automatically conclude that the tray is free



Effect No. 1.—The audience's view of the apparatus.

This is the first misdirection, and therefore some care should be exercised in placing the reels upon the tray so that when picked up they will not disclose the cut-out. Returning to the table the tray is placed upon it and the tube taken and shown. The first difficult move now arrives. On returning to the table the tube is carried in the right hand and the last member of the audience who examines the tube should be on the left of the hall or room as viewed from the performer's table. Thus, the return to the table is made from the performer's left. On arriving at the table the tube is placed over the black reel standing behind the



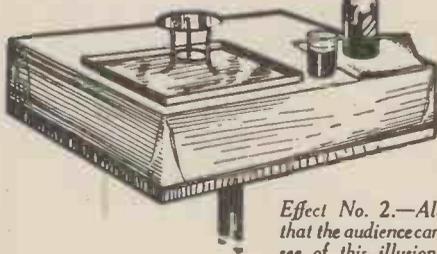
The method of faking the tray so as to cause the reel's to vanish.

FOR CHRISTMAS

A few interesting illusions which rely for their effect principally upon mechanical apparatus and which are suitable for drawing-room or stage presentation.

handkerchief, whilst the left hand picks up the handkerchief, and these two moves should be carefully combined so that the effect is merely that the tube has been placed down whilst the handkerchief has been picked up. When the latter is removed from the table the tube will be seen standing alone and no suspicion of trickery will arise. The hands are carefully wiped with the handkerchief, which is then tucked carelessly in a pocket or placed elsewhere on the table as the tray is picked up with the left hand. The right picks up the tube *by the bottom*, gripping the reel so that it will be removed at the same time, and in this condition they are stood upon the tray. Now a black reel is picked up and deliberately dropped down the tube, the noise of it falling upon the reel already concealed in the tube being mistaken by the audience for the noise of the reel striking the surface of the tray. Then the white reel is taken and dropped in, and finally the black. The attention of the audience is directed to the order of things, and then after the utterance of the magic words or the manipulation of the wand, the tube is removed by gripping the upper reel through the tube, which is placed upon the table with the reel downwards. Thus the tube is inverted. This move requires a little care in order to execute it cleanly, but there is little risk of detection as the attention of the audience is focussed upon the now rearranged reels upon the tray. I execute this move by standing to the left (my left) of the table, and then as the tube is lifted I commence to walk towards the audience on my right, passing the table *en route* and placing the tube thereon under cover of my body. By looking at the audience as you proceed, and not at the table, this move is undetectable.

When the reels are again examined you return to the table and repeat the procedure, the reel now in the tube becoming the bottom one; but, this time, stand the tube upon the moving

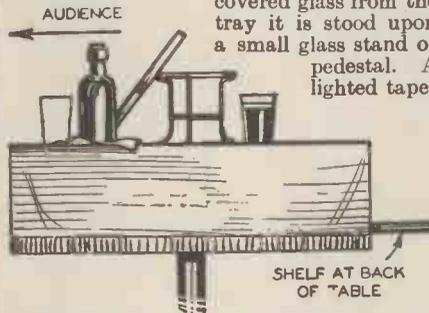


flap. Take up a position slightly at the rear of the table and when the reels are safely in the tube walk to the table and in placing the tray on it, slide the flap away, retaining the tube in position with the other hand, thus permitting the reels to drop into the well, the cotton-wool deadening the sound of their falling. As soon as you hear the last one go, or if you can look into the tube without it being too obvious, and see the last one go, slide back the flap and stand the tray firm. This may sound difficult but is actually very simple to accomplish. Now after addressing the audience, it only remains to pick up the

tray carefully (do not move it quickly or the draught will knock the tube over) and then jerk the tray towards the audience, when the tube will fall lightly and the vanish is thus effected. The complete effect takes approximately four minutes and is perfect in its action.

The Stout Trick

Effect—Performer picks up a tumbler from the table and also a bottle of stout. This is opened accompanied by the usual fizz, and he pours out a glass of the liquor. Toasting the audience, he drinks about half of it, or alternatively permits one of the audience to do so. A small tray is picked up from the table and the glass half full of stout is placed on the tray. A sheet of paper is next taken and placed over the glass and draped round it. Taking the covered glass from the tray it is stood upon a small glass stand or pedestal. A lighted taper



A side view of the table for Effect No. 2. Note the fake glass concealed from the audience's view by the tray.

is waved round the glass, the magic words are uttered, and there is a sudden flash which leaves the glass stand perfectly empty. Paper and glass of stout have vanished, leaving no trace!

Requirements—One ordinary drinking glass, one bottle stout (the darker the better), one ordinary tray prepared as follows. Affixed to the centre are two pieces of thin tin as shown above (right). The surface of the tray should be decorated in such a manner that the tin strips are hidden in the pattern. A small glass stand, conveniently made from a disc of plate glass supported upon three bent iron legs. As a makeshift, a glass cake stand can be used. One sheet flash-paper, and finally, a fake which has to be prepared in this manner: From thin celluloid make a tumbler as nearly as possible of the same shape and size as the real tumbler. A simple shape as shown in the sketches is easiest to make up. A disc of the same material is used for the bottom, and this is cemented in place by means of amyl acetate, or one of the film cements now obtainable from a good photographic dealer. Across the bottom a strip of stiff celluloid must be affixed, and this should project about 1/2 in. outside the bottom of the tumbler. The size must be such that it will fit inside the two strips of tin on the tray. To complete the fake, a strip of glazed black paper should be stuck inside the glass to resemble the stout, and the appearance should be completed by using brown paint to resemble the froth. If a glass of the above-mentioned liquor is poured out and half of it

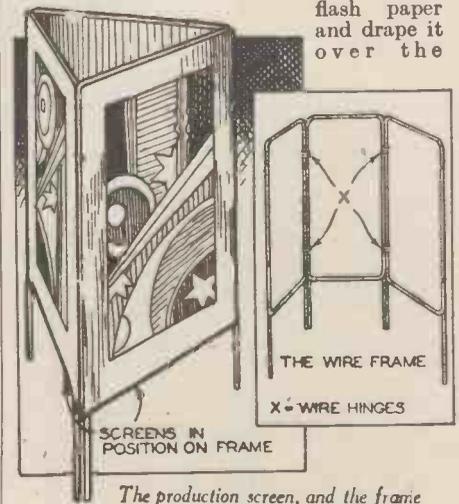


Full details for making the glass fake.

is drunk you will see how the froth remains on the side of the glass and it is very simple to copy this. On the back of the table a small flat shelf should be fixed. The actual method will depend upon the table in use.

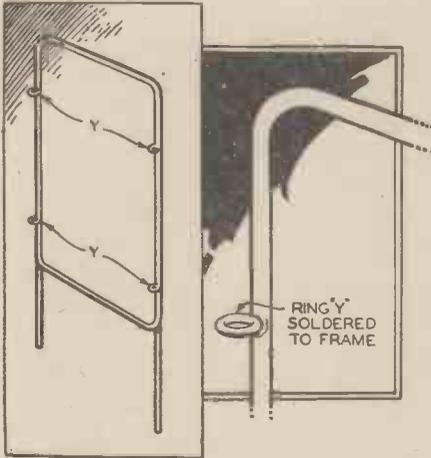
Presentation

The glass pedestal stands in the centre of the table, with the tray resting against it. Behind the pedestal stands the celluloid fake, and in front of the tray is the clean glass and bottle of stout. Picking up the latter, a glassful is poured out, suitable patter being delivered, and then half is drunk. Not much practice is required to drink sufficient to enable the remainder to resemble the hidden fake, although it is difficult for the audience to discern the difference of 1/2 in. or so. Now for the critical move. From the right-hand side of the table the glass held in the right hand is lowered to the shelf at the rear of the table whilst the left takes hold of the tray. Before this is removed the right is raised from the real glass and is placed just on the upper rim of the fake. At this moment the tray is removed, and if these moves are carried out cleanly the effect will be that the glass has simply been placed on the table whilst the tray has been picked up. Now pick up the glass "fake" and stand it inside the tin strips and a half-revolution will lock the strip inside the tin. Pick up the sheet of flash paper and drape it over the



The production screen, and the frame upon which it is assembled.

glass, shaping it as you do so and making certain that the lower edge bends and permits the paper to keep more or less firm. Now lower the tray, but don't raise the paper, and as the tray goes down let the back turn towards the audience. In this manner the fake, now securely held in the clip, will be supported on the side farthest from the audience and the tray may be



How rings are attached to the screen frame or attaching the panels.

placed on the floor resting against the table leg. By looking carefully at the hand holding the paper whilst this is done the mind of the audience is concentrated on the glass and the fact that the back of the tray is presented to them will be lost. Now stand the paper shape on the glass pedestal, and if the shape has been carefully made it will stay put. Light the taper, wave it over the shape, mutter the usual words, touch the paper, and in a flash everything is completed.

A Production Screen

Effect.—A triangular wire framework is produced and placed on the table. Next a board is picked up and shown both sides and then clipped on one side of the framework. Next a second board is produced and fitted to the frame, whilst finally a third is attached to the rear of the triangle. The whole is then turned round to show each side free from deception, when the conjuror places his hand inside and produces various goods. This is continued for some time, the screen being opened from time to time to show that it is empty. The boards are very thin three-ply and are obviously incapable of concealing the produced goods.

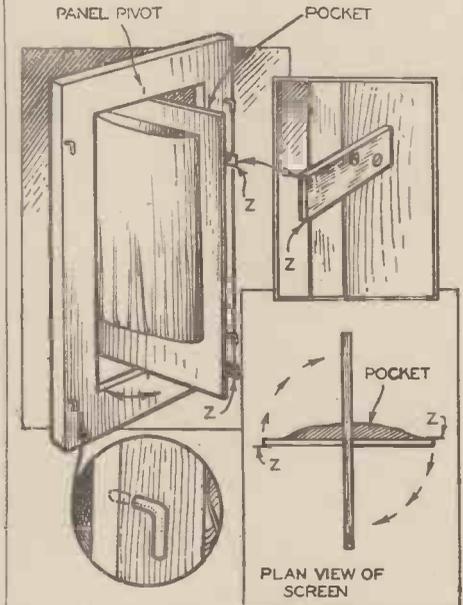
Requirements

Two solid wooden panels of the size chosen for the screen, and one faked as shown on the right. This may be carried out by using a very thin fret-saw blade and then using the removed piece for the panel. To conceal any possible saw-cut the screen panels should be suitably decorated. A stiff wire frame, hinged as shown, should be made up to hold the boards. Small brass rings soldered to the frame, with brass hooks or stiff wire to drop into them is quite sufficient. The goods to be produced should be of the collapsible type and packed into a small linen bag attached to the rotating panel by means of good press-studs.

Presentation

If the table has a well, the faked panel should be laid down on the table with the parcel resting in the well. The board will thus lie flat and be apparently free from deception. The remaining two panels rest upon this one. The wire frame is shown, stood up with one side away from the audience. The top board is picked up and shown both sides and then clipped on one side of the frame. The

second board is similarly fitted, leaving the last board to be fitted at the rear. Pick it up by tilting towards the audience and place it on the rear of the frame whilst square to the audience. As soon as it is in position, rotate the panel, and in the same movement turn the screen round. Thus the audience have apparently seen both sides of the last board and the whole screen is turned until this comes to the rear again. By placing the hand inside the screen the goods may be produced, and at any moment, as a particular item is removed, the panel may be swung back and the screen opened to show that it is free from deception.



The secret of the production screen, and working details.

To School by Air

AMONG the interesting facts noted recently by officials at the London air-port is the growth which is taking place in the number of children who make journeys by airway. Some of these juveniles, despite the fact that they are still so young, are already becoming experienced aerial travellers. Take, for example, the case of little John T. Fowle, aged five, who arrived at Croydon the other morning to make his fourth flight with his parents between London and Koweit, on the Persian Gulf. After greeting the captain of the air-liner, and taking a glance into the control-cabin, he sat down in one of the saloons and became engrossed at once with a jig-saw puzzle. An air journey was such a normal affair for him that he saw no reason at all to become excited. The matter-of-fact attitude of this little boy is typical of the majority of children who travel by air. No need to appeal to them to become "air-minded." They take to flying like ducks to water.

Just recently there was the case of a six weeks' old baby boy whose parents took him for a trip by air even before he had made a journey by train. Not long ago an American family, on alighting at Croydon from the Continent, declared that they had not used trains for several years, making all their journeys by air, except when crossing the Atlantic by steamer. But they added that they had made up their minds to go down to Southampton by train, just because the children

IN THE NEWS

had said that they wanted to try the novelty of a railway journey.

When the air-mail from Africa reached the London air-port the other day, one of its passengers was a child of three, who had flown more than 6,000 miles to London from Salisbury, in Southern Rhodesia.

Quite often one sees boys and girls of not more than six or seven alighting from our air-liners arriving from the Continent. Many of the children travelling by air are flying to and from their schools; and in addition to those who make such trips between London and the Continent, quite a number now fly for long distances on the Empire routes. Children who are at school in England, and whose parents may be living at points thousands of miles away, can now fly home for the holidays in a matter of days, whereas if they travelled by land and sea such journeys might take weeks and—remembering that the time of the trip both ways has to be taken into consideration—would often occupy so long that they would be out of the question. Frequently, nowadays, children travel alone by air, being placed in the care of the airway staff and making their journeys in perfect safety and comfort.

A Mammoth Camera

STATED to be one of the largest cameras in the world, a huge instrument has recently been installed at the U.S. Bureau

of Commerce building in Washington. Weighing about 14 tons, it is 31 ft. long, 20 ft. wide, and is capable of reproducing on one negative large charts, 50 in. square, with an accuracy of one or two-thousandths of an inch. The plate end of the camera is partitioned off to form a dark room in which the plates are sensitised, exposed, and developed.

Printing in the Air

THE U.S.S.R. have recently built and tested an aeroplane which is virtually a flying printing works. It contains a printing shop, an editorial office, a photographic laboratory, and a store-room for paper. The news can be received by wireless on board the aeroplane, and illustrations can be produced from photographs taken during the trip. All this material is passed on to the aeroplane's printing room, is printed, and then distributed in the required quarters.

A Gramophone for the Deaf

AGRAMOPHONE which enables stone-deaf people to hear music was shown at the London Medical Exhibition held in London recently. While the instrument plays a record, no sound can be heard no matter how near one stands to the revolving disc. The music is conveyed electrically to small pads mounted on handles. When the pads are held lightly against any part of the skull, a person, otherwise stone deaf, can hear through the bones of the head. The apparatus can be driven electrically from any house-lighting plug.

FUN WITH PHOTO-CELLS

A description of simple and interesting tricks that can be performed by the use of a photo-electric cell in conjunction with the wireless receiver

THE principles upon which photo-electric and similar light-sensitive cells depend for their functioning have been fully explained in previous issues of NEWNES PRACTICAL MECHANICS, whilst a number of methods of using them have also been dealt with. It is not intended in this article, therefore, to repeat any of the information which has been given before, but rather to supplement it by describing a number of interesting tricks and experiments which might be carried out. Perhaps it would be helpful to some readers, however, to know that the previous articles on light-sensitive cells were given in the issues dated February, March and September, since it might in some instances be desirable to refer back to these.

Connecting the Cell and Relay

There are innumerable amusing and apparently "magic" tricks to be performed with the aid of photo-cells, and these include the setting into operation of all kinds of electrical apparatus without the use of any visible switch, and merely by moving the hand in space. To make this statement quite clear it should be pointed out that any light-sensitive cell is an insulator when it is in darkness, but immediately a light is directed on to it the cell becomes a conductor of electricity. Thus, if a cell is included in an electric circuit, a flow of current will take place when the cell is illuminated, but will cease as soon as the light is cut off. Unfortunately, photo-cells are only capable of passing an extremely small amount of current, and thus they cannot generally be used directly to operate an electric circuit. Instead, they have to be connected to the input side of some form of (wireless) valve amplifier, the output circuit of which controls the main electric circuit. The general arrangement is shown in Fig. 1, where it will be seen that the low-frequency amplifying portion of an ordinary wireless receiver is used in conjunction with the photo-cell and a suitable relay; the latter is connected to the terminals normally provided for the loud-speaker.

The photo-cell is connected to the pick-up terminals in series with a 16-volt G.B. battery, whilst a 5-megohm grid leak is joined directly between the pick-up terminals. Connections to the pick-up terminals should be exactly as shown, care being taken to connect the anode of the photo-cell to that pick-up terminal which is joined to the grid of the amplifying valve. There are five terminals on the relay—which component, incidentally, can be bought from such firms as Electradix Radios, Grafton Electric Co., and Audiovisor Ltd.—and two of these go to the speaker terminals on the set, whilst two of the other three are joined to

the circuit it is wished to control. Of these three terminals, the centre one must always be employed, but it may be in conjunction with either of the other two. The point is that if, say, terminal 1 were used, the circuit would be "closed" (switched on) when the light was directed on to the cell, whilst if terminal 2 were employed the circuit would be "broken" as the light was shone on the cell.

photo-electric component, but it will generally be necessary to increase the voltage of the bias battery shown in Fig. 1 to a figure between 30 and 60.

Arranging the Cell and Light Source

When the apparatus is to be used for producing various "magical" effects, it will have to be disguised in some way, and rather different methods of directing light upon it will have to be employed from those dealt with in previous articles. One of the greatest difficulties, when using white light at any rate, is to shield the cell from the normal room illumination, and this can best be done as shown in Fig. 2. Here the cell is mounted in a small box fitted with a hood or cowl; the cell is placed directly behind a 1-in. diameter hole to which is fitted a focussing device. The latter is not absolutely essential, but it is very useful, and might consist of the focussing tube taken from a toy magic lantern.

The cell assembly must be placed in line with a beam of light, which might well be produced as also shown in Fig. 2. An ordinary electric lamp is placed in a second box provided with a hole, and also, if convenient, with a second focussing tube.

Supposing now that an electric motor and the battery used to operate it are connected in series with two terminals on the relay some interesting effects can be observed. For example, if the hand is held in the beam of light the motor can be started. If the alternative relay terminals were used a motor which was running could be stopped by placing the hand in the path of the light beam.

It will be apparent that the motor could be used to operate various kinds of mechanism, such as, for instance, a cam which touches the underside of a table or convenient board when it rotates. By this means some amusing "table-rapping" tricks can be performed, and by combining this with the "ghost" described on p. 139, a "seance" might be arranged. As an alternative, the motor might be used to wind up a length of string, carried over a couple of pulleys and attached to a door. Thus, when the hand was held between the light source and the cell, the door would open, as if by magic. The whirr of the motor would probably be heard, but this would add to the "mystic" effect.

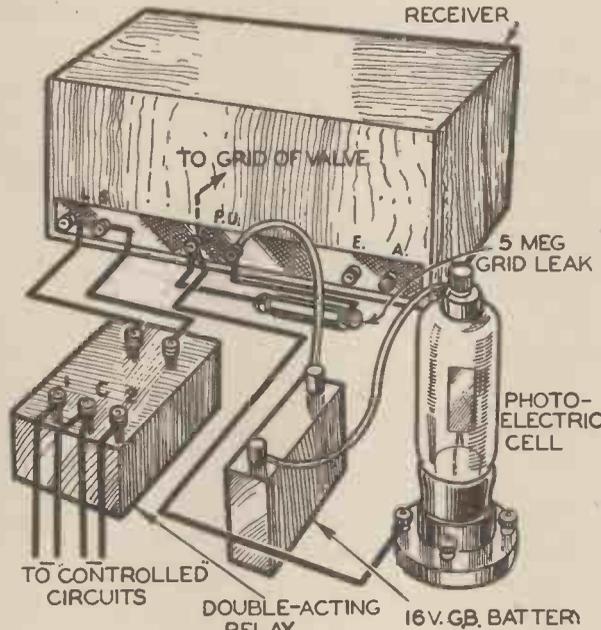


Fig. 1.—Showing the method of connecting a photo-cell and relay switch to an ordinary wireless receiver (battery or mains type).

Using a Selenium Cell

With regard to the photo-cell, it should be explained that this is the most expensive item required, but as it can be used for a variety of experiments quite apart from the amusing ones to be dealt with, the expense will, in most cases, be justified. If the cell is not likely to be used very often it might be considered desirable to save expense by making a selenium cell (as described in the March issue), or to buy a cell of this type from Messrs. Audiovisors. The selenium cell can be used in exactly the same manner as the more-sensitive

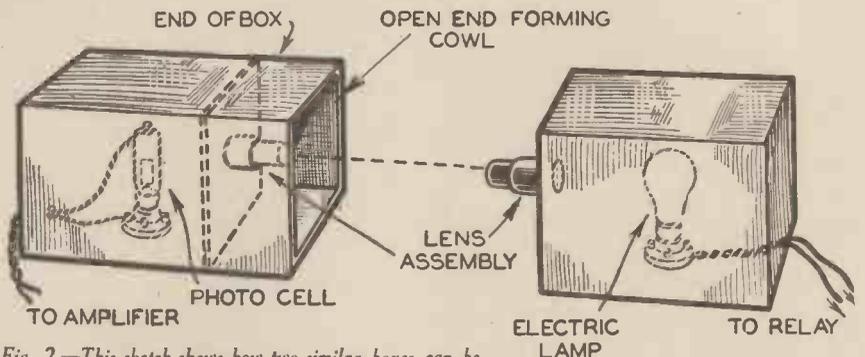


Fig. 2.—This sketch shows how two similar boxes can be used to house the photo-cell and light source. The lens assemblies are not essential, but help to concentrate the light.

Using "Invisible" Light

If it were desired to perform these tricks in semi-darkness it would be necessary to use a form of "light" which was not visible. Infra-red is very suitable for this, and can be produced by the very simple

Another interesting trick, where there are children in the party who have an electric railway, is to break one of the leads from the battery or transformer to the track and connect the two ends to the relay terminals. The train can then be started

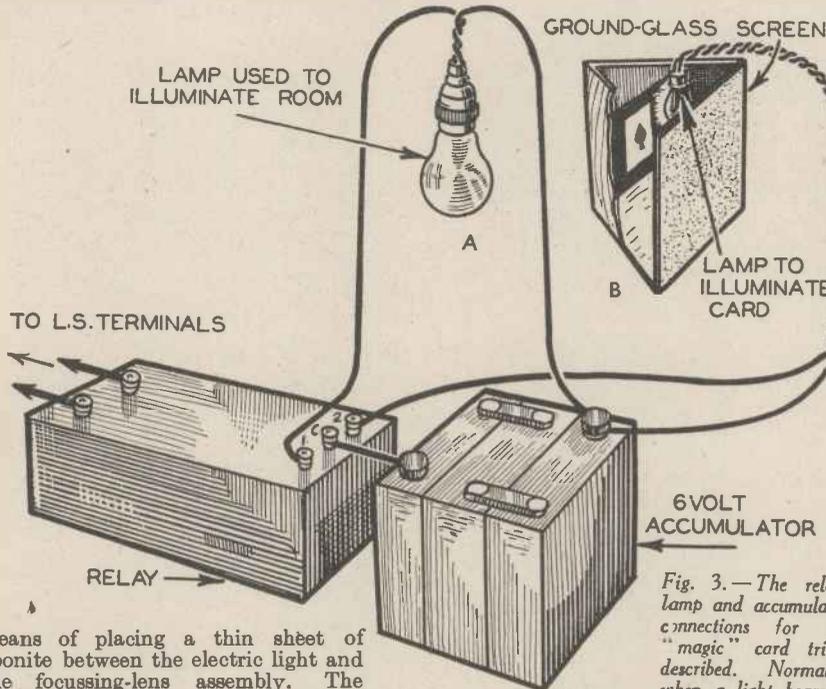


Fig. 3.—The relay, lamp and accumulator connections for the "magic" card tricks described. Normally, when a light beam is directed on to the photo-cell, lamp A is alight and B is not. When the light beam is interrupted, A goes out and B comes in, revealing the "magic" card.

means of placing a thin sheet of ebonite between the electric light and the focussing-lens assembly. The ebonite should be as thin as ever possible, otherwise it will absorb too much of the light, so that there will be insufficient to operate the photo-cell. When a suitably thin sheet is not available a strip of thicker material can be rubbed down on a sheet of emery cloth. It should be mentioned that infra-red illumination can only be used with photo-electric cells of suitable type, although selenium cells are all responsive to infra-red.

by movement of the hand, as before; by reversing the connections to the relay it can be arranged that the train is stopped when the light is intercepted.

For Conjurers

A rather more complicated trick, which

will appeal to conjurers, is to hold a card in the hand and show it to the audience. When this has been done, pretence is made to throw the card into the air. As soon as the hand has been waved the card is seen, rather hazily but illuminated, in a corner of the room. The idea of this trick is that a card has previously been placed behind a ground-glass, or semi-opaque, screen in a dark corner, whilst a concealed light has also been arranged to show on to the card. When the conjuror pretends to throw the card away he merely conceals it, but his hand intercepts the photo-cell light beam, so switching on the lamp that illuminated the concealed card. This trick can be made still more effective if the room is rather dimly lighted by means of a small 6-volt lamp connected, as shown in Fig. 3, to the relay and a 6-volt car accumulator. In this case, as soon as the light beam is interrupted the normal room light is extinguished and the concealed light brought into circuit with the accumulator. It will be seen that, as soon as the conjuror's hand is removed from the photo-cell beam the light connections return to normal.

An alternative is to place the "magic" card on a sheet of black cloth in such a position that it can be seen by the audience through a mirror. Again, a lamp is arranged to illuminate the card when the light beam is interrupted.

Another fascinating, though rather startling, trick can be performed by pretending to throw a card, coin or other object at the wall. When this is done the room light goes out and a bright flash is seen where the object "hits" the wall. This is done by replacing the lamp marked B in Fig. 3 by a short length of $\frac{1}{4}$ -amp. fuse wire running through a small pile of photographic flash powder. Both this and the previous trick could be done by using the mains electric supply, provided that the relay has a sufficiently high current-carrying capacity, but this is not recommended unless the reader is thoroughly conversant with electric wiring and has a convenient power point available.

The Weighing Machine Fraud

Five children with ingenuity worthy of a better cause hit on the idea of getting themselves all weighed at an automatic machine at the cost of a single penny. Two of them got on the stand at the same time and one of them changed places with another until all the ten possible pairs had been weighed. The results recorded in pounds were as follows: 114, 115, 118, 119, 121, 123, 125, 126, and 129. A big brother succeeded in working out from these figures the individual weights of the five. Can you do it?

Which House does He Live In?

The houses in a terrace are numbered 1, 2, 3, 4, 5, etc. A man lives in a certain house, and all the numbers on one side of him, added together, equal the numbers on the other side. How many houses are there, and what is the number of his house? It is known that there are more than 50 houses in the terrace and fewer than 500.

How Old was Mary?

The combined ages of Mary and Ann are forty-four years, and Mary is twice as old as Ann was when Mary was half as old as Ann will be when Ann is three times as old as Mary was when Mary was three times as old as Ann. How old is Mary?

Average Speed

In a recent motor ride it was found that

PROBLEMS AND POSERS

the driver had travelled at the rate of ten miles an hour, but he did the return journey over the same route, owing to the roads being more clear of traffic, at fifteen miles per hour. What was the average speed?

A Mathematical Nut

A piece of marble weighing 40 lbs., falling upon the pavement was, by a most singular accident, broken into four pieces of such varying weights that by means of them a neighbouring groceryman was able to weigh articles of any integral weight from 1 to 40 lbs. Required, the weights of the four pieces.

How to Tell a Person's Age

Let the person whose age is to be discovered do the figuring. Suppose, for example, if it is a girl, that her age is fifteen, and that she was born in August. Let her put down the number of the month in which she was born and proceed as follows:—

Number of month	8
Multiply by two	16
Add 5	21
Multiply by 50	1,050
Then add her age 15	1,065

Then subtract 365, leaving 700
Then add 115 815

She then announces the result, 815, whereupon she may be informed that her age is fifteen and August, or the eighth month, is the month of her birth. The two figures to the right in the result will always indicate the age and the remaining figure or figures the month the birthday comes in. This rule never fails for all ages up to 100. For ages under 10 a cipher will appear prefixed in the result, but no account is taken of this.

A Time Puzzle

How many minutes is it until six o'clock if fifty minutes ago it was four times as many minutes past three o'clock?

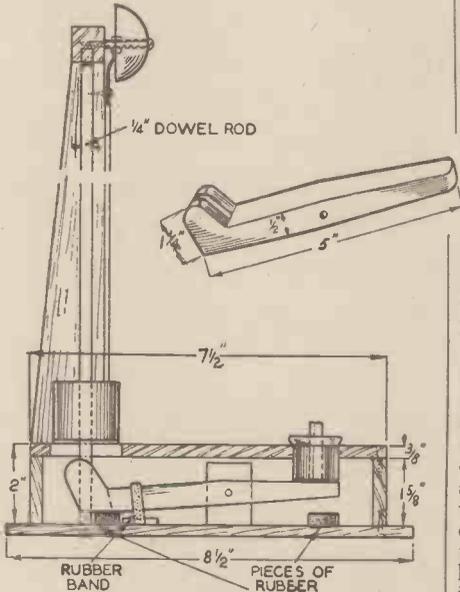
What was Her Surname?

Five ladies, each accompanied by her daughter, purchased cloth at the same shop. Each of the ten bought as many feet of cloth as she paid farthings per foot. Each mother spent 8s. 5 $\frac{1}{2}$ d. more than her daughter. Mrs. Robinson spent 6s. more than Mrs. Evans, who only spent about $\frac{1}{4}$ of what Mrs. Jones did, while Mrs. Smith spent most of all. Mrs. Brown bought 21 yards more than did Bessie, one of the girls, while of the other girls Annie bought sixteen yards more than Mary, and spent £3 0s. 8d. more than Emily. The other girl's Christian name was Ada; what was her surname?

(Answers will appear next month.—Ed.)

piece, to act as buffers, and a rubber band, held in place by a strip of wood nailed to the baseboard, holds the slotted end of the trigger down till the plunger is hit with the mallet.

A piece of $\frac{1}{4}$ -in. dowel rod, 20 in. long, will now be required, and also a cotton reel. Choose one with narrow flanges and enlarge the central hole so that it is an easy sliding fit on the dowel rod. Through the side of the reel bore a $\frac{1}{8}$ -in. hole, at right-angles to the central hole, and cut a short piece of rod which fits the hole loosely, and projects about $\frac{1}{8}$ in. when the inner end touches the dowel rod. Cut a notch in the projecting end of the short piece of rod and pass a fine



Figs. 6 and 7.—Section through the base of the "Nokitup" game, and details of the striker trigger.

rubber band round the cotton reel so as to engage in the notch, as shown in Fig. 8. The pressure on the little plunger must be sufficient to hold the cotton reel in any position as it is knocked up the dowel rod.

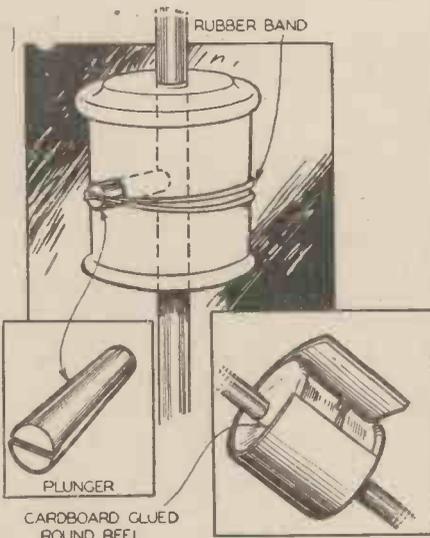


Fig. 8.—Details of the cotton reel and plunger.

It may be found necessary to double the band twice round the reel to give the required pressure. The cotton reel can be covered with a casing of thin cardboard, as indicated in the accompanying sketches.

Fixing the Upright Rod

For supporting the dowel rod, two side pieces, each 20 in. long and shaped as shown in Fig. 5, are screwed on each side of the box, and between the top ends of the side pieces a cross-piece of $\frac{1}{2}$ -in. square wood is screwed. In the centre of this cross-piece a $\frac{1}{4}$ -in. hole, $\frac{3}{8}$ in. deep, is made, to take the top end of the dowel rod, the lower end of which rests in a hole recessed into the baseboard. Two strips of $\frac{1}{4}$ -in. plywood or stiff white cardboard can be nailed on to the front edges of the side-pieces, after marking a scale on them for scoring purposes, as shown in Fig. 9.

For a game of this sort we must, of course, have a bell, and one taken from a discarded alarm clock will answer the purpose admirably. Fix it to the middle of the cross-piece

with a long screw, using a piece of brass or other tubing as a distance piece. For the hammer, bend a piece of iron wire to the shape shown, solder a small iron disc on one end, and screw it loosely to one of the side-pieces so that the hammer strikes the bell on the inside edge when the player scores 100.

The Striker Mallet

The little mallet for striking the plunger is easily made from two pieces of dowel rod of the sizes given in Fig. 5. After the

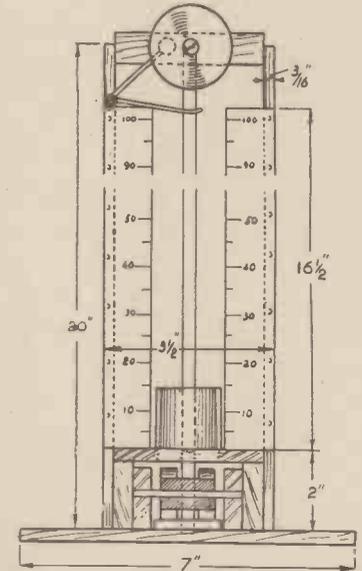


Fig. 9.—Part sectional front view of the "Nokitup" game, showing the scoring scales.

cotton reel has been knocked to any position up the dowel rod, it is simply pushed down again to its starting position ready for the next blow of the mallet.

A coating of cellulose paint in one or two different colours would enhance the appearance of the finished toy, but the dowel rod up which the cotton reel works must be left plain.

EXTENSIONS to the famous "His Master's Voice" research laboratories at Hayes, Middlesex, will be completed shortly, which will make them the largest of their kind in the British Empire. At the same time, new canteens are being built at Hayes to cater for the increased number of employees. More than 3,000 workers will be accommodated at one sitting. The new building containing rooms specially designed for radio research is at present being equipped with novel apparatus for testing and designing new radio instruments. The walls and ceilings of some of the rooms are completely covered with wire netting in order that scientific tests of apparatus can be made without being affected by atmospheric or other electrical disturbances.

Special Apparatus

Some of the special apparatus used in the laboratories is believed to be the only type of its kind in the world, and the buildings are guarded night and day. Each of the 523 expert radio and acoustic engineers have taken an oath not to divulge any details of his work. More than 400 different radio experimental models are evolved in the course of a year, from which production models are chosen. All these laboratory receivers and radio-gramophones

NEW RESEARCH LABORATORIES FOR RADIO

are burnt in order that details of the experiments may remain secret. Many of the new rooms are soundproof, and have dummy walls, being ventilated by an air conditioning plant. A high-powered generating equipment which can produce up to 15,000 volts is being installed in order that tests may be carried out to ensure that the components of new radio instruments will not break down in use.

12,000 Employees

These extensions are part of an ambitious scheme to make 1935 the largest year in British radio marketing. More than 12,000 employees are at present at work in the great 80-acre H.M.V. factories. Practically every part is made in the factories, where 1,150 tons of raw material are used each week. They now have their own foundry, electric generating station, bakelite moulding plant, timber yard and saw mill and railway sidings.

Within the next few days the fifty-thousandth popular-priced radio-gramophone will be produced. At the same time,

"His Master's Voice" are introducing a new radio-gramophone of their Five-Forty series, which incorporates "silent tuning." This feature ensures that even the most distant foreign station is heard at equal strength throughout a programme, counteracting fading, and cuts all atmospheric and electrical noises between the stations. The H.M.V. Five-Forty-A, as the new instrument is called, is to be marketed at 22 guineas, and is believed to be the first inexpensive radio-gramophone to incorporate this feature. Hitherto "silent tuning" has only been fitted to radio-gramophones costing double the price.

A Large Demand

Mr. Richard Haigh, English Manager of "His Master's Voice," said in an interview: "We anticipate such a large demand for this new popular-priced radio-gramophone that we have made arrangements to work night and day on many shifts in the factories between now and Christmas, and expect to produce more radio-gramophones in this period than at any other time in our history." An official of the H.M.V. factories said that a special catering staff were being engaged to supply meals to night workers. Some thousands of men would have their "lunch" at 2 a.m.



A typical example of fireside photography.

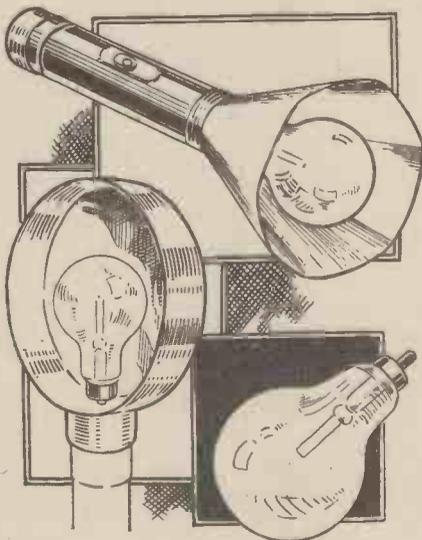
FIRESIDE photography presents no real difficulties, and beyond the usual apparatus required for ordinary photography, nothing else is required except a few feet of magnesium ribbon. This is very cheap and can usually be obtained at any photographic store.

The arrangements should be made on the lines of the sketch, Fig. 1. The sitters who are to appear on the photograph should be grouped to one side of the fireplace so that the firelight illuminates their faces, and a pleasing group is formed when viewed from the position of the camera. Arrange the people closely together, and as far as possible keep them at the same distance from the camera.

Firing the Magnesium

The operator should sit on the other side of the fireplace, holding the burning magnesium ribbon in a pair of tongs in such a manner that the light shines on the group but not on to the lens.

If the camera has visual focussing, this



Various types of flashlight bulbs which are now on the market.

can be done by holding an electric torch about the centre of the group so that it shines towards the camera; the filament of the torch can then be focussed quite easily. Some such provision is necessary because the image will probably be too dark to be seen on the screen. A camera which has a scale for focussing can be set for the appropriate distance in the usual manner, while

FIRESIDE PHOTOGRAPHY

Photography by the fireside opens up a new field to the amateur who has previously limited his activities to outdoor "snaps," and enables him to obtain a lasting record of his Xmas festivities.

with a box camera the portrait attachment for "close-ups" may be required.

Having arranged the group and focussed the camera, the room lights should be switched off and the shutter opened. The exposure will, of course, commence immediately, but the light from the fire will have very little effect on the plate in the few seconds it will be allowed to act; but do not let the firelight shine direct into the

way taken with magnesium ribbon in the manner described above.

The photo of the man lighting a cigarette shows another application of the magnesium ribbon as a source of illumination. The photographer can take his own photo in this case. He just stands in front of the camera at a suitable distance which he knows to be in focus and holds a match in one hand and about 2 in. of magnesium ribbon in the

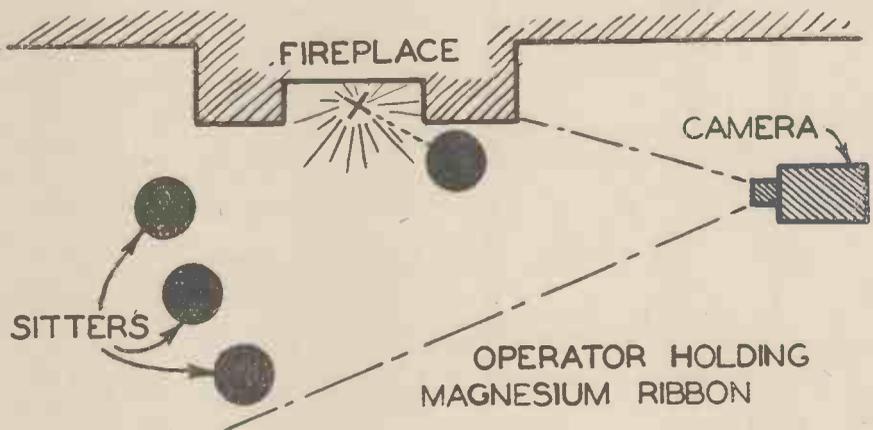


Fig. 1.—The sitters who are to appear in the photograph should be grouped as shown.

lens. The operator should then seat himself between the fire and the lens and ignite the magnesium ribbon with a match. It does not ignite very readily, but will eventually burn with an intense white light. About 6 in. to a foot of ribbon will give a suitable exposure. It must be held fairly still, must not be allowed to shine on to the lens and the sitter must, of course, keep still while the ribbon is burning.

An alternative method of fireside photography is to use flash powder. The group and camera are arranged as already described and the required quantity of flash powder screwed up in a loose packet of tissue paper and thrown on to the fire. In this case the operator can take his place in the group before throwing the little packet of powder on the fire, having taken precautions to shield the lens from direct light. The exposure in this case is an instantaneous one.

A Flashlight Bulb

Perhaps the best method of all is to use a flashlight bulb connected up to a pocket-lamp battery. In this case the flashlight material is enclosed in a glass bulb like an electric lamp and is ignited by the battery. The flash then takes place inside the bulb, so is free from danger, smoke or smell. Naturally, however, the bulbs are considerably more costly than a small piece of magnesium ribbon, and they can only be used once.

The illustrations to this article

other; a wire paper clip will serve to hold the ribbon. The magnesium is then ignited and allowed to burn out while one keeps quite still. The light is, of course, very bright, and one feels almost blinded for a few minutes after, but this soon passes off. It probably does no harm on a single occasion, but might be harmful if repeated frequently. The photograph should, of course, be taken in a darkened room and the lens opened before lighting up the magnesium ribbon.



A family group round the fire.

MAKING A FOUR-INCH SPARK COIL

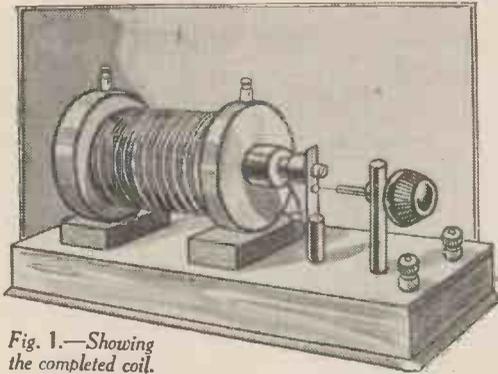


Fig. 1.—Showing the completed coil.

THE coil shown above, which is simple to make, and efficient in use, will work a small X-ray tube and quite a large Tesla Coil, providing sufficient entertainment for the home mechanic for several years, as there is always something new to X-ray. A list of the required materials is given below with the approximate prices (these will, of course, vary slightly), and the exact outlay will depend on the material in the scrap box, as wood, sheet brass, screws, etc., have not been listed.

LIST OF MATERIALS REQUIRED

5 lb. No. 36 S.C.C. Wire	£2 0 0
9-in. Ebonite Tube, 1½ in. outside diameter, 1½ in. inside diameter	0 2 0
½ lb. No. 22 Soft Iron Wire, 9 in. long	0 0 9
¼ in. No. 16 Platinum Wire	0 6 6
2 lb. Paraffin Wax	0 1 2
1 lb. Thin Tinfoil; 25 sheets 14 × 11 in.	0 2 6
1 lb. No. 17 D.C.C. Wire	0 1 9

About a ream of paper suitable for the condenser and the insulating discs is required, and also a piece of clock spring and odd bits of brass and iron rod.

There is quite a large amount of woodwork to be done in the construction, and it is essential that this should be undertaken before the electrical work is commenced. The base is made in the form of a shallow wooden box from ¾- or 1-in. wood. A small felt washer or disc should be glued at each corner to act as a foot. The coil is assembled and tested before the woodwork is finally finished, as this would be damaged during the subsequent operations. Fig. 1 shows the construction of the base.

The Coil Checks

The cheeks are cut from ¼-in. wood and are bored to fit tightly on the ebonite tube; this may most easily be done in a lathe, otherwise a pad or fret saw must be used. The cheeks are planed on one edge, and when they have been sandpapered and finished they are immersed in a bath of

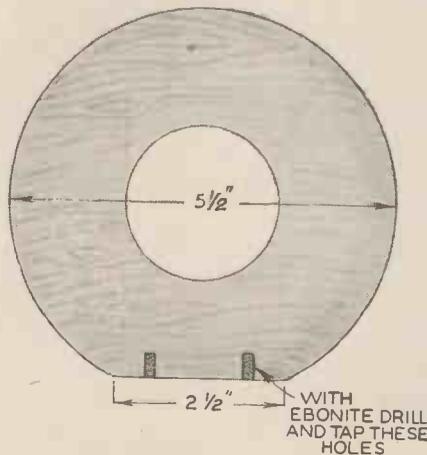


Fig. 2.—Details of the cheeks.

molten paraffin wax for about 30 minutes. Take care during this operation to see that the cheeks do not rest on the bottom of the bath; if they do, charring will result. The coil cheeks are supported on two wooden blocks measuring 1½ in. × 5½ in. × ¼ in.; after the coil is wound these are secured to

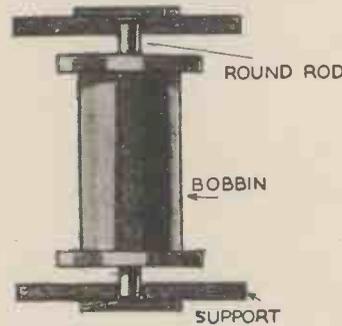


Fig. 3.—A plan view of the coil holder.

the cheeks and are fixed to the base. Fig. 2 shows a complete cheek.

After finishing the woodwork, the next task is to make the coil-winding apparatus.

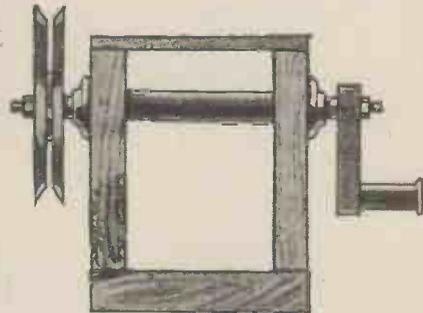


Fig. 4.—How the coil-winding device is made.

The secondary of the coil is wound in a large number of sections approximately ¼ in. thick. The wire used is so arranged that it passes from the main bobbin through

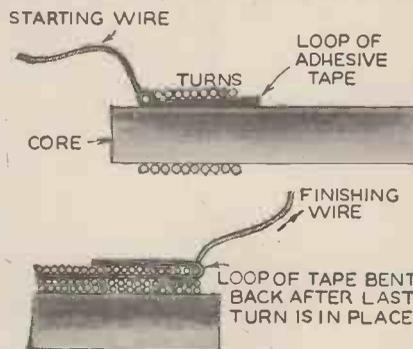


Fig. 5.—The starting and finishing ends of the wire for the core.

molten paraffin wax and then to the coil winder. It is essential that these parts be made perfectly rigid so that there is no fear of them collapsing when in use; the appearance does not matter, and hence any number of screws and strengthening pieces may be used. A holder for the bobbin is first made, and this consists of two uprights firmly fixed to a base with a cross-piece between, two deep slots about ¼ in. wide and 2 in. deep being cut in them. On the outsides of the uprights two thin pieces of wood are secured over the slots so that when a rod is cut down to fit in between them it cannot possibly slip out. The bobbin should be a slack fit on this rod. Fig. 3 shows a view of the coil holder.

The wire must pass through molten paraffin wax before it is wound into sections, and this is done in the following manner: obtain a tin that is paraffin-wax-tight, measuring 8 in. × 4 in. × 1½ in. To the bottom of the tin a small bracket, in which a pulley revolves, is soldered; the bracket may be made from a short length of round rod with a groove filed in it. It is essential that the pulley revolve freely and be covered with wax; if it does not the enamel will be scraped off. The winding machine consists essentially of a rotating spindle on which a suitable former is mounted. The former must be made of wood at least ¾ in. thick, otherwise the sides will warp, causing some turns to slip down on to the shaft. File one end of the spindle square so that a crank may be slipped on. It is made from a length of ¾-in. wood, the handle being a cotton reel secured with a large round-headed wood screw and washer; the bobbin should be quite free so that it will not turn in the hand. Cut two discs of ¾-in. wood 4 in. in diameter, and drill them to fit on the spindle. The inner faces of the discs should be perfectly smooth and the edges should be bevelled over. A disc 1½ in. in diameter must be made from metal ⅜ in. thick; this should have flat edges and be drilled to fit on the spindle (see Fig. 4).

Keep the Wax molten

As it takes from 15 to 30 minutes to wind a section, the wax will solidify unless some precautions are taken. The easiest way to keep the wax molten is to place a Bunsen burner underneath the tin and suitably regulate the flame to prevent the wax from burning. Small immersion heaters to work off 12 volts are available, but as these only consume about 18 watts they would be successful only in very small tins.

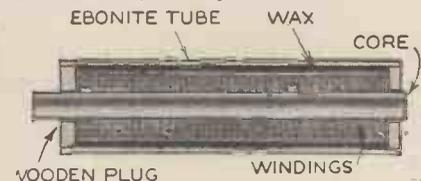


Fig. 6.—A section through the primary.

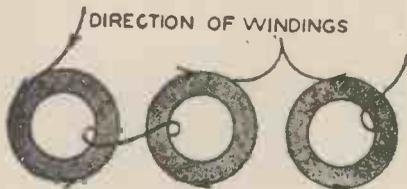


Fig. 7.—How the sections are connected. The arrows indicate the directions in which the coils are wound.

The wax bath must be securely fixed between the bobbin and the winder; this will present some difficulty, as the bath must always be easily removable for remelting. A very simple and yet effective plan is to cast a lead bar of 1 in. section and 8 or 9 in. long; this is placed across the bath in the region of the pulley.

In theory each section of the coil should be $\frac{1}{2}$ in. wide and 1 in. thick, but it will be found that the thickness varies considerably as does the width; this does not matter as long as the instructions as regards the insulation are carefully followed. Those makers who wind by hand will not get so much wire on as those using a power-driven machine, this will not matter as long as the number of sections is between 37 and 43.

A large flat vessel measuring 22 in. \times 14 in. is required in which to melt the wax and immerse the paper for the condenser and insulating discs. The paper for the condenser and the coil discs must be cut to shape before it is waxed. The discs are 4 in. in diameter with a centre hole just large enough to slip on the ebonite tube—about 200 will be required. Test each disc to see that it fits tightly on the ebonite tube. Exactly four discs may be cut from each sheet of paper. Melt the wax to a depth of $\frac{1}{2}$ in. in the tray and immerse the discs a few at a time. When air bubbles have ceased to rise remove the papers, hold them for a moment until any surplus wax has run off and then place them singly on a sheet of clean paper to set. This part of the construction may be left until the sections are assembled, as 200 discs, when spread out, occupy a considerable area. Some special discs without the centre holes are required, and about 20 should be made and waxed; these are for use with the section winder and must have a hole cut in their centres just large enough to pass on to the spindle. The apparatus is now ready for the commencement of the winding operations.

Winding Operations

Screw the bobbin holder and winder firmly to the bench, melt the wax and place the tin in between them and arrange the apparatus for heating the wax. On to the two winder discs press a piece of paper and fix it in place by warming it over a Bunsen flame—the wax will melt and secure the paper. Put one disc on the spindle and push up to it the metal washer. Now take the end of the wire, after it has been passed round the pulley, and place it between the washer and the disc, put on the next disc and screw the nut up tightly. This method of securing the wire will be found both simple and effective. Make sure that the wire is passing round the pulley and that it is revolving and not sticking. To wind a section with this apparatus it is only necessary to turn the handle, as the tension on the wire will be just sufficient. When the wire is up to



Fig. 11.—The armature and contact screw.

the bevel, cut it between the former and the wax bath, allow the apparatus to stand for five minutes to give the last few turns time to set, unscrew the nut and securely grasp the former in one hand and unscrew it from the spindle. Insert the warm blade of a knife between a wooden and paper disc, not between the wire and paper, and remove the disc. Do not overheat the knife, as the paper will scorch very easily, losing its insulating properties. The section may be removed from the other disc in a similar manner. The wax will still be in a fairly plastic condition, and as the centre washer has been removed with the coil one paper disc must

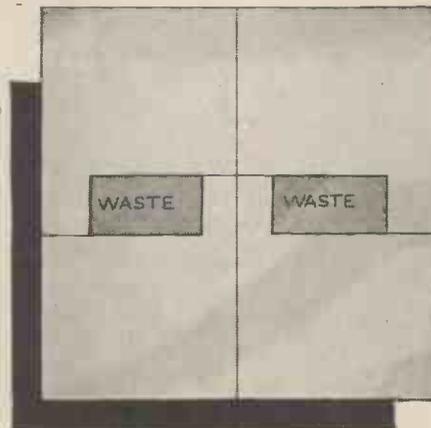


Fig. 8.—The foil should be cut as shown to avoid waste.

be stripped off before winding can be recommenced. Wait until the wax has set quite hard before this is attempted, and peel the paper off with a circular motion, and not across the section. To save time when waiting for the wax to set, it is a good plan to make two metal washers, as one section may be wound while the wax on the other

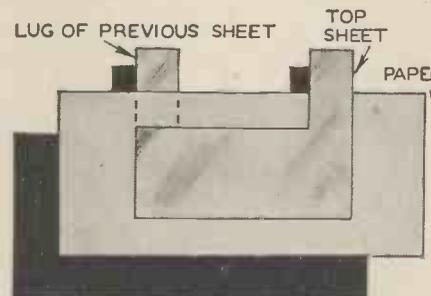
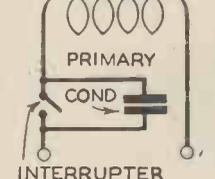


Fig. 9.—Details of the condenser.

is setting. The paper discs may be used several times over. Continue winding until all the wire has been used or about 40 sections have been wound.

The Primary

Take the core wires firmly in one hand and wrap the core from end to end with insulating tape so as to hold the wires firmly together. The core is wound with three layers of No. 17 insulated wire, double cotton covered, leaving 12 in. over at each end for connections.



Start the wire by the method shown in Fig. 5 and finish in a similar manner. The wire must be

Fig. 13.—The connections for the coils.

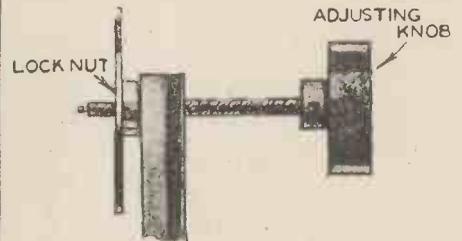


Fig. 12.—Constructional details of the contact screw.

wound within $\frac{1}{2}$ in. of each end of the core, because small plugs are made to support the core in the ebonite tube. Cut two plugs from $\frac{1}{2}$ -in. wood to fit tightly in the tube and on the core. The end of the tube at which the uneven end of the core projects has all spaces filled with plastic wood to make a wax-tight joint. Heat some wax until it just smokes and pour it into the tube until it covers the turns. Some contraction takes place due to the absorption by the cotton, and this should be made good before the wax sets hard. Insert the end plug and fill up any cracks as before. When the wax is quite set the secondary may be assembled on the ebonite tube (see Fig. 6).

Take one of the cheeks and push it on to the 'ebonite' tube for a distance of 1 in. until about $\frac{1}{2}$ in. projects through it; this distance will depend on the number of the segments and should be adjusted to the special requirements of each coil. Have the tray of molten wax ready with a supply of paper discs; the discs may be taken straight from the wax or allowed to cool. Place four discs over the tube and press them down, using a warm flat iron; on this place a coil section with two discs on its upper surface and press the whole well down. If any of the papers are burnt they must be removed and new ones substituted. The arrangement of the coils will seem queer, but there is a definite reason for it which will become clear when they are connected together: they are put on so that the first is wound clockwise, the second anti-clockwise and the third again clockwise, and so on. If we consider the sections as wound in opposite directions, the end of the first coil is left free and the beginning is connected to the start of the second. The work is best performed in the following way: stick two paraffined discs on to each face of the segments before they are pushed down the tube, using the warm iron; place on the tube and push down until there is a space of about 1 in. between the two segments; draw out the wires and solder, making a small neat joint. The loop of wire is then twisted round the tube and the top section pressed into place, making sure that the joint is on the ebonite. Fig. 7 shows how the sections are connected together. A non-corrosive flux must be used on all these wires. The end of the second segment is connected to the end of the third, and the start of the third to the start of the fourth, and so on

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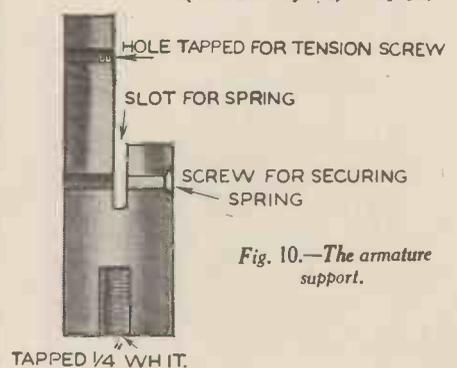
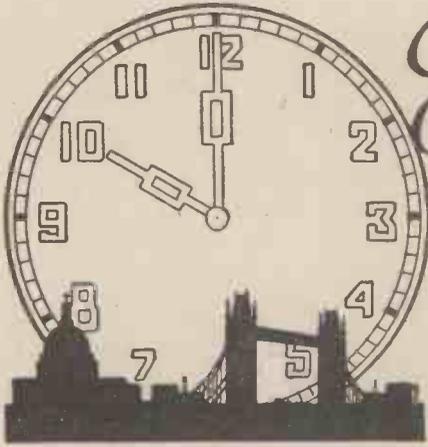
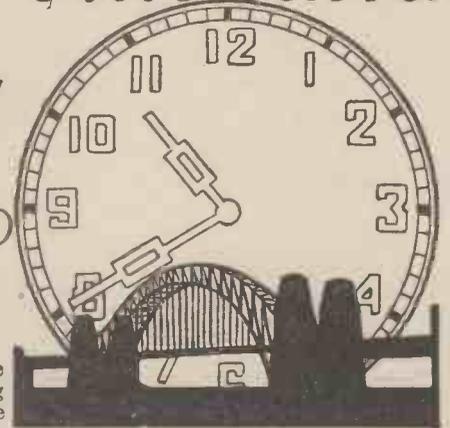


Fig. 10.—The armature support.



England to Australia in Forty Minutes



THE POSSIBILITIES OF A GRAVITY RAILWAY

LET us imagine that a tunnel has been constructed right through the centre of the earth from England to Australia, and that down this bottomless pit falls a man; what would happen to him?

First assume that the tunnel is full of air, and secondly that the air has all been pumped out.

In the first case the man should fall faster and faster until he reached the earth's centre, but, owing to air friction, would never get there, having been burnt up long before, just as a "shooting star" is burnt up by air friction on entering our atmosphere.

You may say that a man is not burnt up when he falls from a balloon, but he only falls a few miles at the most, and it is about 4,000 miles to the earth's centre. Moreover, the air gets denser and denser as you go down, actually increasing roughly by a thousandth of its amount for every 26 ft. you descend.

Falling in a Vacuum

Now let us take the second case and see what would happen supposing the man was enclosed in a suitable structure to enable him to make the journey in an airless tunnel. He would fall (according to the laws of falling bodies) with an ever-increasing acceleration, until he reached the earth's centre, and there being nothing to

stop him, carry on because of his terrific impetus. But from the moment of passing the earth's centre he would no longer be falling in the ordinary sense, but shooting upwards towards its opposite surface, his velocity quickly diminishing because he is now travelling against gravity, which always acts towards the earth's centre. Supposing that the centre of the earth was equidistant from the ends of the tunnel, he would just reach the opposite end of the tunnel from which he started. He must then be "caught" or "landed" or he would fall back again and perform the whole of his journey in the opposite direction, arriving back exactly where he started from, and continue falling backwards and forwards so long as the earth and gravity endured.

Seven Miles a Second

How long would it take to perform a single journey and what would be your greatest velocity when passing the earth's centre? Your maximum velocity would be some *seven miles a second* and the time of your journey *a trifle under forty minutes*.

Supposing the two ends of the tunnel were at the same sea level, then you would, as already stated, come to rest at the end of the tunnel.

But suppose one end started from the top of Ben Nevis, 4,406 ft. high, and the

other end in Australia was at sea level, then a person who jumped in at the top of Ben Nevis would not stop at sea level, but would shoot out like a rocket with a velocity sufficient to carry him to the height of Ben Nevis above the Australian plain. Likewise, a journey in the other direction would be impossible because he would never reach the mouth of the tunnel through Ben Nevis.

Notice that these journeys would be made at no cost of power whatsoever. Unfortunately, however, this very rapid and convenient means of transport can never be put into operation.

A Further Supposition

Now let us consider a third case where a *little* air had been left in the tunnel. Then there would be some air friction, but not enough to burn up anything.

Let us suppose the ends of the tunnel equidistant from the earth's centre, then a man jumping in at one end will not quite reach the other end; he will thus fall back and travel not quite so far towards the other end of the tunnel and so on, vibrating like a pendulum up and down about the earth's centre and finally coming to rest at the very centre of the earth.

MAKING A FOUR-INCH SPARK COIL—continued

until the last segment is in place. When the coil is complete, test it for continuity and solder the end wires to telephone type terminals screwed into the cheeks. Fix the two coil feet to the cheeks and secure the whole to the base by means of screws and glue.

A condenser is made for connection across the interrupter, and consists of 100 sheets of tinfoil interleaved with paraffined paper. The sheets must measure about 6 in. \times 5½ in., with a 2-in. lug projecting. The size of the individual sheets can vary as long as the total area remains the same. Fig. 8 shows how a piece of foil measuring 14 \times 11 in., a standard size, can be cut to the required sizes with very little waste. The paper is cut to size before waxing, and measures 1½ in. larger each way than the foil. Start the work by waxing two pieces of stout cardboard the same size as the paper, place one on the bench and on it a piece of paraffined paper, next a piece of tinfoil with its lug projecting and then another piece of paper and then a piece of tinfoil with its lug at the opposite end of the paper to the first one; this is repeated for all the sheets (see Fig. 9), which shows how the pieces are arranged.

Cut a piece of ¼-in. round brass rod as shown in Fig. 10, file it to shape and drill and tap the necessary holes. The spring measures .025 in. \times ¼ in. \times 3½ in. and may be taken from a clockwork movement. The large washer is cut from ¼-in. brass and is 1½ in. in diameter; a similar washer is placed under the baseboard. The armature support and spring should be mounted and then the exact position of the armature may be found; this is a ¼-in. length of ¼-in. soft iron rod secured by an iron cheese-headed bolt passing through the spring. The contact is made so that it is removable without dismantling the whole of the interrupter; this is done by drilling the spring to take a ⅜-in. bolt to the end of which one of the platinum contacts is *silver soldered*; this contact is ¼ in. long. The nut when screwed off will remove any excess borax; the end of the platinum must be filed quite flat with a *very fine* file (see Fig. 11). The pillar supporting the contact screw is of ¼-in. brass rod with a ¼-in. hole drilled and tapped in its upper extremity; it is secured to the base in a similar manner to the armature. Before the contact screw hole is drilled the pillar should be mounted and then the exact position for it is marked. This is just opposite the contact on the

armature. A lock nut is made by either tapping a ⅜-in. piece of brass or soldering a suitable nut on to a piece of brass. The armature is mounted in an elongated hole so that its position in relation to the core may be adjusted or varied; no measurement is given for this, as it depends on the characteristics of the coil in question. The tension-adjusting screw is provided with a lock nut so that once it has been adjusted it may be left; a plain nut and bolt is quite suitable for this (see Figs. 11 and 12).

The connections in the base of the coil are made with two strands of No. 17 wire, sufficient of which will be left over from the core; when possible the joints should be soldered. The condenser is fixed in place in the base by means of thin strips of wood, and is connected across the interrupter (see Fig. 13).

Connect the coil in series with a 6-volt accumulator and a good switch, using heavy wire, pass two knitting needles through the secondary terminals and place the points about 3 in. apart, the other ends having balls or discs soldered to them to prevent excessive brush discharge. Adjust the contact screw and tension screw until sparks are passing freely, and using a 6-volt accumulator there should be no difficulty in obtaining sparks 4 to 4½ in. long.

AMUSING BALANCING TRICKS

Simple and amusing lunch-table tricks which can be performed with ordinary household utensils, etc.

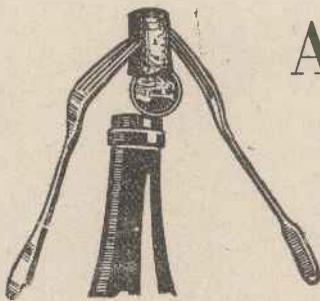


Fig. 1.—Balancing a coin on the edge of a bottle.

HERE are some amusing Christmas tricks that call for no special apparatus or stage setting, but which will provide an interesting half an hour's entertainment.

The first experiment is a very simple one. Partly fill a bottle with water; then take a cork, and make a slit in one end in the direction of its length, into which insert a coin. Next stick two forks into the cork, on opposite sides and near the other end, at angles of about 30 degrees. With the forks so placed, as balance weights, it is an easy matter to balance the coin upon one edge of the mouth of the bottle, as in Fig. 1. With a steady hand it is also possible to execute an effective finish to the experiment, i.e., to slope the bottle gradually so as to pour out a glass of the contents, at the same time retaining the coin in equilibrium upon the neck of the bottle.

A Coin Balanced on a Needle

By a slight variation of the previous arrangements the coin may be balanced edgewise upon a needle point and made to revolve rapidly thereupon. Fig. 2 shows the experiment in operation.

The Walking Cork

In this case a cork with two balance-weights attached in the shape of forks as previously employed is provided in addition with a pair of legs, formed by the insertion of a couple of stout pins or small round-headed nails into the bottom of the cork, as in Fig. 3. The figure is placed upon an inclined narrow slip of wood at the highest point of the incline and set gently oscillating, so that the weight is thrown alternately on one side and then on the other, which will cause the figure to make the descent of the incline in a series of jerks.

The Spinning Plate

A further application of similar principles to those in No. 3

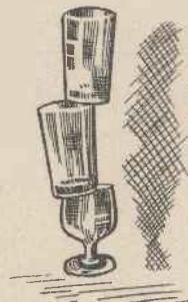


Fig. 8.—The balanced tumblers.

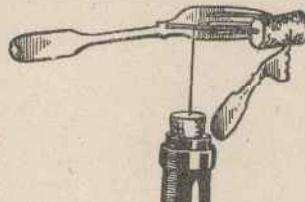


Fig. 7.—A pencil balanced in a horizontal position.

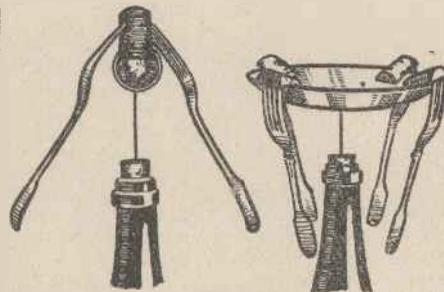
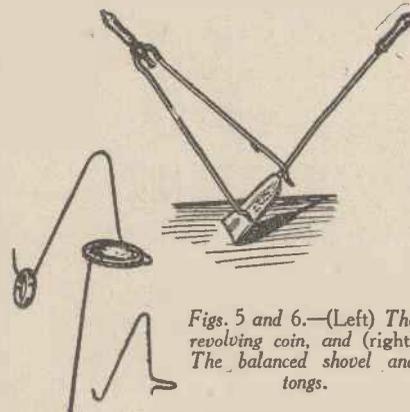


Fig. 2.—A coin balanced on a needle. Fig. 4.—The spinning plate.

and a plate may be balanced and spun upon the needle-point. The corked bottle with the needle in position remains as before. Two other corks are taken and split into two by a vertical cut. Into one end of each half-cork upon the flat side are stuck the prongs of a fork, and thus the forks are hung at equal distances around the edge of



Figs. 5 and 6.—(Left) The revolving coin, and (right) The balanced shovel and tongs.

the plate. Then, with a little care, the plate will be held in perfect equilibrium, as in Fig. 4.

The Revolving Coin

Bend up a piece of stiff wire, such as a hairpin, into the shape shown in the lower right-hand corner of Fig. 5, with a hook at one end and a clip at the other, the latter adjusted to grip a coin tightly. By hanging a fairly heavy finger-ring upon the hook as a counterweight, the whole may be balanced with the penny upon the point of a needle, and made to revolve on it.

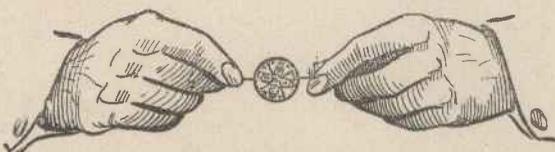


Fig. 9.—The revolving coin.

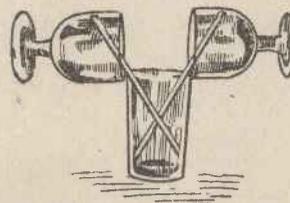


Fig. 10.—The balanced wine glasses.

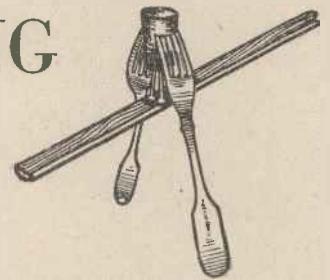


Fig. 3.—The walking cork.

The Balanced Shovel and Tongs

A delicate test of balancing may be attempted with the shovel and tongs. The position of the two implements is shown in the illustration, Fig. 6. The extremity of one arm of the tongs is rested against the inside of the shovel, and the other extremity is placed at an angle formed by the junction of the shovel with the handle. By delicate poising the two may be induced to remain in equilibrium in the position illustrated—a formation which permits of the tongs being engaged with the shovel after the manner shown is an important factor.

A Needle Balanced in a Horizontal Position

This experiment is practically a variation of some of the previous ones, the only difference being that a long needle is driven into the upper cork as well as in that of the bottle. By a little careful manipulation the forks can be made to balance in the position shown in Fig. 7, and by a gentle touch the whole may be made to revolve.

The Balanced Tumblers

Here is a little after-dinner experiment requiring some delicacy of manipulation. The end in view is to balance three tumblers one upon the edge of the other as in Fig. 8. With two tumblers the experiment is comparatively easy; with the third it becomes a genuine test of skill.

The Revolving Coin (Fig. 9).

A simple experiment for impromptu performances at the table can be made with a couple of pins and a coin. The accomplishment consists of picking up the coin by two opposite edges between the points of the two pins, in which position it may, with steady hands, safely be held. By blowing smartly upon one edge of the coin it may be made rapidly to revolve between two points. The feat has the appearance of an exhibition of considerable skill, but, as a trial will show, it is in no way difficult of execution. The selection of a milled-edged coin will facilitate the matter (see Fig. 9).

The Balanced Wine-Glasses

This experiment is not a case of pure balancing, but depends principally upon the nice adjustment of the two pieces of stick by means of which the position of the

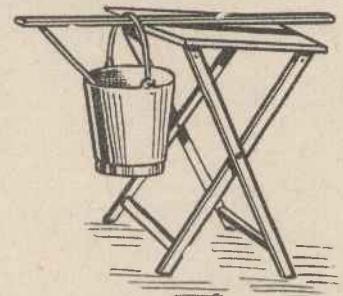


Fig. 11.—Balancing a pail of water.

two glasses is maintained. A couple of slender penholders may be used, and must be trimmed down at the ends until the right length is obtained. The position of the

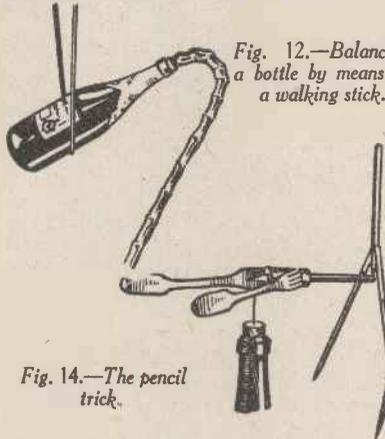


Fig. 12.—Balancing a bottle by means of a walking stick.

Fig. 14.—The pencil trick.

sticks and the manner in which the glasses are supported can best be gathered by a study of Fig. 10.

The Balanced Bottle

This is a very effective balancing feat, and all that is required is an ordinary

bottle, a crooked walking-stick or umbrella, and a piece of cord. Then insert the handle of the stick into the neck of the bottle, and the bottle may be balanced in the supported cord in the manner shown in Fig. 12.

The Balanced Pail of Water

Fig. 11 looks a little startling! There is, however, no risk if the experiment is properly conducted. The requirements are: a kitchen table, a pail of water, a stout flat stick 3 or 4 ft. long on which to hand the pail, and another and slighter piece of stick. The larger stick is first laid upon the table with about one-third of its length projecting over the edge. The pail—empty—is next hung upon the projecting end of the stick. The smaller stick is then placed with one end against the inside angle of the bottom of the pail at the point nearest the table, and the other end cut away at such a length as will permit it to wedge tightly against the underside of the main stick, at which point a notch may be cut in the latter to prevent slipping. The pail may then be partly filled with water, when it should remain balanced as shown.

The Egg Trick

For this experiment the bottle, cork, and forks are again brought into play. Before inserting the forks, however, a slight cavity

should be cut into one end of the cork so that it fits nicely over one end of an egg. Then rest the cork with the forks as counterweights upon the end of the egg to which the cork has been made to fit (see Fig. 13).

The Pencils

A pencil is first thrust through the centre of a cork, and two forks into the sides of the cork. This will permit of the pencil being

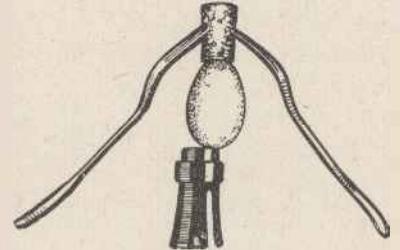


Fig. 13.—The egg trick.

balanced horizontally, as in Fig. 7. A second pencil is balanced by the insertion of two pen-holders into its side, and so arranged that it may be balanced upon the unsupported end of the first pencil (see Fig. 14).

SINCE the establishment by Imperial Airways, not long ago, of a department dealing with the transport of livestock by air, the work of this department has been increasing constantly. Many more pedigree dogs, among other animals, are now being consigned by the air routes from London to the Continent. The other afternoon, for example, a visit to the air port showed that the officials had in their care, just at that particular moment, seven dogs which had arrived from various consignors for dispatch by air liner to different points throughout Europe, each animal being housed in a comfortable travelling box.

"A good many of the dogs entrusted to us," explained one of the experts, "are travelling over to be exhibited at shows on the Continent. They not only complete their journeys so much sooner if they go by air, but they receive special care and attention from members of our staff while they are in transit. "Apart from livestock consigned to and from the Continent," he added, "there are some strange cargoes nowadays which reach us from destinations along the Empire routes.

Live Locusts!

"The other morning, when one of the services arrived from Africa, we found we were handling a big crate containing live locusts. These had been sent to England from the heart of Africa in order that scientists over here could try on them the effect of certain chemicals with which it is intended to fight the locust plague. On another occasion recently an incoming service from Africa had on board a special box which contained a number of live mosquitos. They, too, had been consigned for experimental purposes to laboratories in this country; and they had been kept alive during their air voyage to England by feeding them with stagnant swamp water, a supply of which, in glass containers, had been shipped with them.

A Cargo of Lady-birds

"The value of air travel in transporting

QUEER AIR TRAVELLERS

livestock rapidly from point to point was shown in a remarkable way in Tanganyika not long ago. Out there the coffee plantations are apt to suffer from a pest known as the 'mealy-bug.' The destruction of these insects by spraying is almost impossible owing to the expense involved, and the difficulty of exterminating them completely. But it appears that they have one natural enemy, the lady-bird. Lady-birds consider the mealy-bug a tasty morsel, and their presence in any locality keeps the pest in check. Unfortunately, there were no lady-birds in Tanganyika, and so the Government turned to the air service to remedy this defect. It was imperative that the lady-birds should arrive at the earliest possible moment as the mealy-bug pest was beginning to get a firm hold. Therefore an urgent cable was sent to the Government entomologist of the Union of South Africa at Port Elizabeth. He at once sent a number of live lady-birds by air to Tanganyika, where they were released immediately in the plantations with very beneficial results. The Government entomologist stated that, prior to the days of high-speed air transport, it had been most difficult to send beneficial insects for any considerable distance owing to the great mortality among them. But in this particular case, in spite of the length of the journey, only one of the lady-birds died on the way. They were, incidentally, furnished with a quantity of mealy-bugs on which to feed during their flight.

Monkeys, Crocodiles, Parrots, etc.

"A feature of animal transport by air is the contrast between some of the consignments we have to handle. One moment we may be dealing with a number of racing pigeons, going out in their cages to some point on the Continent, to be released for a

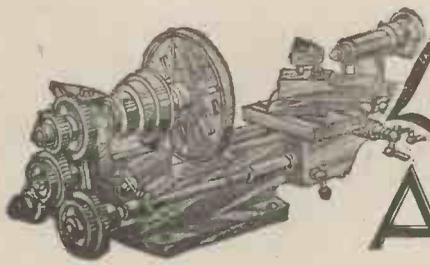
race back to England. And then we may go across to an incoming machine and find among its cargo a number of live crocodiles, monkeys, parrots, or tropical fish in tanks. There are regular dispatches to London by air from the Bay of Biscay, of the queer little fish known as sea horses. These are needed to replenish the tanks in the aquarium at the Zoo. They travel in metal containers full of Bay of Biscay water. These containers have an arrangement like a bicycle pump attached to them, and every few hours during the air journey one of the crew of the air liner has to make a few strokes with this pump in order to keep the water aerated.

Performing Animals

"Performing animals, travelling to and from menageries and circuses on the Continent often make their journeys by air. Not long ago a fully-grown lion flew over to London in a cage inside one of the cargo 'planes, its trainer travelling with it, sitting just outside the cage. It had been feared that the lion might become upset during its flight. But actually the animal seemed soothed, rather than otherwise, by being in the air, and by the time it reached Croydon it was so quiet that its trainer went into the cage, put a chain on the lion's collar, and walked out with it, just as though the animal had been a big dog. And the lion, perfectly docile, just stood looking quietly round until it was led into a travelling cage to be taken up to town.

Performing Tigers

"On another occasion a machine from the Continent brought in several performing tigers for a circus in London. On another day a performing horse—also travelling in a special compartment inside one of the big machines—was landed at Croydon from Paris; whilst just recently a clever chimpanzee, flying to London from the South of France to take part in films in this country, walked up to the air-liner captain, and shook hands with him solemnly, after its keeper had led it from the machine."



Lathe Work FOR AMATEURS

WORKING BETWEEN CENTRES

WORK of a shaft-like character that requires machining all over is finished between the centres. The work having previously been centred up, and where necessary roughed out as already described, remove the chuck from the nose of the lathe and fit the catch-plate. Of the two centres supplied with the lathe, the live one, or the one that fits into the headstock,

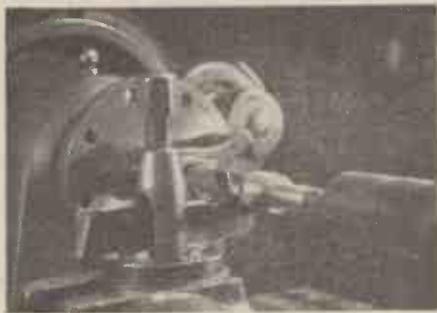


Fig. 1.—Showing a short shaft mounted between the centres.

is the soft one. One other point; this centre when in position must run perfectly true on the coned portion. It is obvious that if this is not so, when the work has been finished at one end and turned round to finish the opposite end, the two sets of machined surfaces will not be concentric.

A good plan is carefully to clean the taper hole in the nose of the lathe and clean the fitting end of the live centre. Put the centre in position and lightly tap home with a soft mallet. Start up the lathe and make absolutely sure that the centre runs true. Should any doubt on this point exist, set the top slide round to 30 degrees and lightly skim up the nose of the centre, finishing it off smoothly. Then make a small dot on the front of the nose of the lathe and a dot immediately opposite on the centre. Where a sleeve is fitted this should also be marked. These dots are then lined up each time the centres are used, and this simple precaution will ultimately save a lot of time.

Fig. 1 shows a short shaft mounted between the centres. A suitable carrier is attached



Fig. 2.—Most lathes are made with a set-over tail-stock, adjustment made by turning a screw as shown.

to one end of the work, the tail on it engaging with the driving pin in the catch plate. The centre at the tail-stock end must be well lubricated. At this point mention is again made of the importance of clean centres in the work. This applies to the smoothness of the countersink, the angle of same in relation to the nose of the lathe centre and adequate clearance at the bottom of the countersink. Where the holes have been drilled with a combination countersink drill, no trouble (providing that the short drill at the front has not been unduly reduced in length by grinding) will be experienced. Otherwise a small pilot hole should have first been drilled and opened out with a 60-degree countersink, leaving a little of the original pilot hole at the bottom.

A common fault is to drill a shallow pilot hole and open out at the front with a twist drill. Even with careful grinding, an indifferent centre will result, and owing to lack of a good bearing the countersink will



Fig. 3.—Sharper tapers are formed by adjusting the top slide round to the required angle and operating by hand.

wear quickly as the turning progresses. There is no guarantee that this wear will be even, and therefore different portions of the job may run out of truth with each other. When the pilot hole is drilled too shallow so that the point of the centre touches the bottom of it, oval work will be produced.

Setting the Lathe to cut Parallel

Where long portions have to be turned between the centres, a slight misalignment of the centres in relation to the ways of the bed will make itself noticeable by the tapering of the work. Most lathes are made with a set-over tail-stock, adjustment being made by turning a screw as shown in Fig. 2. Where the small end of the taper is at the tail-stock end, the centre is moved in a direction away from the tool or vice versa. Although a datum line is usually made on the adjoining edges of the fixed and movable portions of the tail-stock, the coincidence of these lines will seldom ensure that the lathe is going to cut parallel, owing to the slight lateral movement that is almost bound to occur when the tail-stock is locked to the lathe bed. Unless the centres are aligned with a test bar and indicator it

is usually a matter for trial and error to get the cut parallel over a respectable length.

General Remarks

Long, slender work will require additional support, either in the centre by means of a fixed three-point steady or by a travelling steady operating behind the cut. Where a fixed steady is used a true track is first turned for it near the centre of the shaft or bar, and when a travelling one is used it must be adjusted up to the work each time that a fresh cut is taken.



Fig. 4.—Carrying out a drilling operation.

After finishing the work at one end insert a brass pad under the end of the carrier screw to prevent it damaging the finished turning. For the same purpose, when one end has been screwed, put a nut on the thread to form a carrier hold. Sometimes it is desirable to finish light work without having to reverse it end for end. This can be done by square centring the driving end with a square 60-degree punch after centre drilling in the usual way. A special square centre in the head stock provides the means of driving. This is only suitable, however, for light operations, but is a method which is extremely useful on certain classes of work.

Taper Turning

In the same manner that the tail-stock can be adjusted for cutting parallel, so can it for the production of slow tapers. This applies only to work that is held between the centres. Sharper tapers are formed by

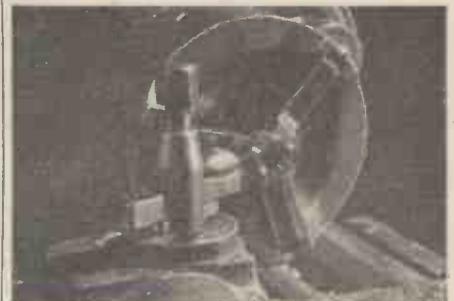


Fig. 5.—The parting tool shown has a specially sectioned blade ground throughout its entire length.

adjusting the top slide round to the required angle and operating by hand as shown in Fig. 3. The production of accurate tapers is not an easy matter and is an item that cannot be dismissed after such a casual reference, but as this is a subject which falls into an advanced stage it will be dealt with at length later on.

Drilling

Small bush-like and hollow parts not made from cored castings are roughed out internally by drilling and finished by boring, or drilled, and finished by reaming. In Fig. 4 a drilling operation is being carried

out. After facing and centring the front of the work, drill a pilot hole first where the hole is to be a large one. It is not advisable to carry out drilling operations after finishing the work externally. First rough the outside down to within reasonable limits of finished size, and carry out any drilling, reaming or boring afterwards. When this is not done, more often than not it will be noticed that after finishing the hole the roughed-out portion does not run true with the bore, hence the advice. Also when producing "thin walled" parts the drill is apt to expand the metal slightly, and even if the job does not move a fraction during the drilling, refinishing externally becomes necessary.

The remarks regarding the alignment of the tail-stock apply also to drilling and reaming. Particularly is this so when deep holes are to be drilled, as, if the drill has to be sprung into the centre when started, the resultant hole will most likely have "run" in its length. Sometimes it may be necessary to drill very long holes right through a shaft or bar. Where this length exceeds that of the drill the drilling is done from each end.

In such cases and where a true hole is required, true the bar up in the four-jaw

chuck, gripping it by $\frac{1}{2}$ in. or so. The outer end of the bar is then supported in the fixed steady so that it runs true throughout. After drilling as deeply as possible reverse the job and drill from the other end.

Parting off

So much depends on the tool when cutting off by this method that the points concern-

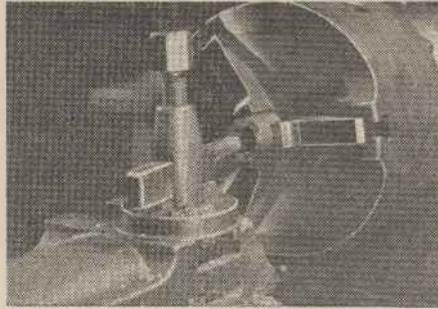


Fig. 6.—A solid type boring tool in use.

ing the tool will be dealt with first. In the first place the width of the tool should be in proportion to the size of the lathe. With

a solid tool see that the side clearance is accurately ground in relation to the base of the tool. The sides of the tool are also made slightly back, tapering from the nose.

To a large extent the front clearance controls the rate of feed, so that the angle of this should not be made too great. For brass leave the tool flat topped, but for steel grind a slight top rake by holding it against the radius of the grinding wheel. Set the tool exactly right for centre height and feed in slowly. Use plenty of lubricant for cutting steel, and see that the chips are coming off clean. If they have a rough appearance the tool will most probably break before it has penetrated to any depth.

The parting tool shown in Fig. 5 has a specially sectioned blade ground throughout its entire length with the correct side and back clearances. Reshaping therefore is only required at the front or top to provide top rake. Another advantage of this type of tool lies in the fact that only a sufficient portion of the blade need be projected to suit the requirements of the work in hand.

Fig. 6 illustrates a solid type boring tool in use. This is only one form in which boring operations may be carried out, and the next article in this series will deal with the matter fully.

SIMPLE HOME BROADCASTING

A GREAT deal of entertainment may be obtained from your wireless set with the simplest of apparatus that can be picked up second-hand for a few shillings. All that is required for the experiments to be described are a microphone, costing anything from 5s. upwards, and a telephone or microphone transformer that can be obtained from any dealer in second-hand electrical apparatus for about the same amount.

A glance at the accompanying illustration will show how simple the connections are. It is advisable to have the transformer and battery close to the microphone, and the extension leads can then be of any length from the secondary of the transformer to the pick-up terminals on the wireless set. If you have no pick-up terminals on the set, connect one wire to the grid of the detector, or first L.F. valve, and the other to L.T. negative or earth. To operate the microphone $1\frac{1}{2}$ or 3 volts will be necessary, so that a small 3-volt torch battery may be used instead of a 9-volt grid-bias battery. An on-off switch can be inserted in the microphone circuit, so that the microphone can be switched on and off quickly.

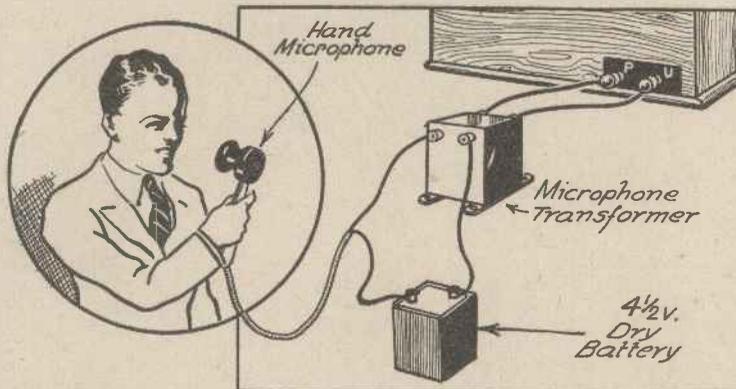
Simple Experiments

Now for one or two experiments that can be carried out with this simple hook-up. First of all let me warn you that if the microphone is at all sensitive and the amplifier is at all powerful, it will not be possible to operate the microphone anywhere near the set or loudspeaker, as low-frequency oscillations will be set up that will result in a deep howl.

If the microphone is very sensitive, you

HOW TO ARRANGE YOUR OWN WIRELESS PROGRAMMES

will then find that you will be able to hear low conversation that is going on in the room; or if the microphone is placed in the hedge in the garden, you will hear snatches of conversation of people as they pass by.



This sketch shows how a microphone, of the type not provided with a transformer and battery, can be connected to the pick-up terminals of the receiver.

A motor-car will sound like the end of the world! and you will be able to hear the footsteps of pedestrians quite a long way off. However, this abnormal amplification of sounds becomes tiring in time, so then you can try the following experiments, using two valves—i.e., one stage of L.F. transformer-coupled amplification. Suspend the microphone in a separate room at a convenient height to speak into, and then experiment with a friend and find out the right distance and the right tone in which to speak.

Novel Entertainment

Having done this, arrange for some

friends to come and listen to your special surprise item. With the audience in one room and you in the other with the microphone connected up, an evening's entertainment can easily be arranged.

Do not tell your friends that they are not listening to an ordinary broadcast item. While your assistant is performing you slip in the room where the others are listening and note what they are doing. One might be smoking a pipe or another eating. Just before the item is drawing to a close excuse yourself and slip out of the room into the next, and make an announcement such as the following: "Before going on to the next item will 'So-and-so'" (your friend's name) "please put out his pipe?" (Or stop eating sweets, etc.)

Eavesdropping

With the aid of one of the smaller microphone buttons some interesting eavesdropping may be carried out by an exactly similar means. Attach the button to the glass of a fairly large picture, or some other similar surface where the sound waves may have an amplifying effect before being picked up by the button. Run the wires from the button to the amplifier, but conceal them if possible. Now, by wearing headphones attached to the loud-speaker terminals, and fitting a suitable volume control, it will be possible to overhear conversations carried on at quite a fair distance from the concealed microphone, the only limiting factor being the secondary noises which arise. The volume control will prove of value in cutting down this noise and thus assisting in picking out the fainter sounds which normally would be drowned.

SOME FACTS ABOUT HYPNOTISM

CAN THE STRONG WILL OVERCOME THE WEAKER?

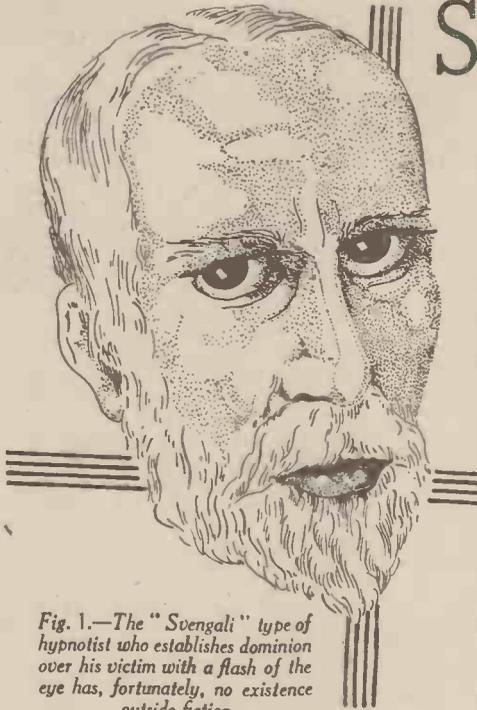


Fig. 1.—The "Svengali" type of hypnotist who establishes dominion over his victim with a flash of the eye has, fortunately, no existence outside fiction.

FAR from being a modern growth, the birth of hypnotism is well nigh lost in the dim mists of antiquity, for there is concrete proof that it was in frequent use among the Persian Magi thousands of years ago, and indeed it permeates the history of the Orient to a very remote time.

In the Western Hemisphere, however, it was not until the latter part of the eighteenth century that this strange force came into prominence through the experiments and teachings of Mesmer—a Viennese surgeon—who named it "mesmerism" or animal magnetism. His theory was, briefly, that all human beings were imbued with a mystic "fluid" of a magnetic nature, which was stored up in their bodies (much as the current is stored in the body of the Gymnotus or electric eel) and the concentration of the "fluid" enabled the operator to make the subject's will subservient to his own.

Crude as were Mesmer's methods, he did much really sound work on the subject and effected many genuine cures, but the faculty of his day looked askance at anything outside the old methods of bleeding and boluses, with the result that Mesmer's work was scoffed at unmercifully. For fully a generation the new science lay dormant, to be revived by serious investigators with, however, the taint of char-

latanry clinging to it—a taint which even to-day persists.

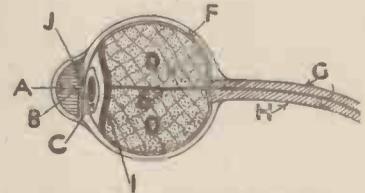
Braid, of Manchester, probably did more to put the science on a sound footing than any other individual worker, and it was he who introduced the term "hypnotism," specifically discarding the old "magnetic" theory. The word "hypnotism" is derived from the Greek, and signifies "plunging into sleep." Braid's work, however, was almost the only important investigation in this country at that period, while, in France, a proper school of hypnotic suggestion was founded at Nancy which has, ever since, been the world headquarters of hypnotic experiment.

The Inducement of Hypnosis

In brief, the hypnotic state is induced by the subject fixing his gaze on a bright object held slightly above and in front of the eyes. Ease and tranquillity of both mind and body are important contributing factors, so it is usual to compose the subject in a comfortable chair and a quiet room, while he is requested to purge his mind as far as possible of wandering thoughts, and attempt to make his mentality as nearly negative as possible. Once the subject has reached this stage, vocal suggestion is added and, in a quiet firm voice, pitched in a monotone, the operator repeats that he—the subject—is calm and peaceful, resting tranquilly and gradually becoming more and more drowsy. In this relation it may be stated that different methods apply to different types, and one type will react to a specific form of suggestion, or even sound, while another will not. In the East the interminable throb of a stringed instrument or sustained note of a gong is often used to this end, while the rhythmic "passes" so beloved of novelists, are little used nowadays. Given a willing subject, a very large percentage of humans can be hypnotised by one method or another, but the idea of any one being forcibly immersed in the hypnotic sleep is absurd. Acquiescence in, and concentration on, the desired result is of primary importance, and it is this fact, as much as any other, which makes it almost impossible to hypnotise young infants or mentally deficient adults.

With a view to making the production

of hypnosis easier, there has been in use for quite a long time, a simple yet ingenious device known, after its inventor, as "Luy's Miroir Rotatif," and this is shown in Fig. 3. The arms of the device, fitted with mirrors, whirl quickly and silently round, reflecting into the subject's eyes gleaming discs or rings of bright light. In difficult cases this instrument relieves the operator of much strain and will induce hypnosis in many



- A. FRONT CHAMBER OF EYE CONTAINING WATERY HUMOUR.
- B. PUPIL THROUGH WHICH RAYS PASS TO
- C. CRYSTALLINE LENS.
- D. D. VITREOUS HUMOUR ENCLOSED IN CELLS.
- E. ARTERY SUPPLYING BLOOD TO G & ACTING AS SCORF G.
- F. COATS OR WALLS OF EYE.
- G. OPTIC NERVE.
- H. SHEATH FOR SAME.
- I. RETINA.
- J. IRIS.

Fig. 2.—A vertical section of the human eye.

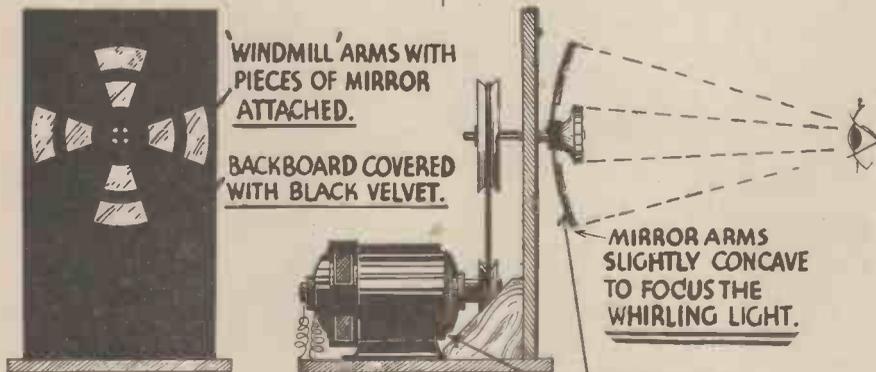
instances when all other methods fail. Once the sleep has supervened the operator takes control and procedure is as usual.

Forms of Hypnosis

The hypnotic state is divided into various classes, but for our purpose may be regarded as "light" and "deep" hypnosis. In the first state the subject is utterly passive, cannot open his eyes unless ordered to do so, automatically duplicates the muscular action shown him, and generally acts like an automaton, though quite conscious of his actions. This muscular control has been the stock in trade of many "showmen" hypnotists who have used it to place the subjects in ludicrous positions and so provoke laughter on the part of the audience. It is good to note that the "showman" hypnotist and "bloodless surgeon" of the old music hall days are no longer with us.

In the deep hypnotic state the reactions are much more profound. The subject responds to practically all suggestions (with one important reservation to be dealt with later) and upon being awakened has no recollection of having performed these actions unless specifically ordered to do so.

In this state the entire sensory system may be played upon like an instrument in the operator's hands. For instance, sensation may be completely reversed, a good example being when a penny—or any other coin—is handed to the subject. He is told



WINDMILL ARMS WITH PIECES OF MIRROR ATTACHED.

BACKBOARD COVERED WITH BLACK VELVET.

MIRROR ARMS SLIGHTLY CONCAVE TO FOCUS THE WHIRLING LIGHT.

ARMS ROTATED BY SMALL MOTOR (OR CLOCKWORK)

Fig. 3.—Luy's "Miroir Rotatif" for the mechanical induction of the hypnotic state.

that the coin is normal and quite cold; then the operator in a series of cumulative sentences tells him the coin is becoming warm, hot, red-hot, burning his hand, and the patient suffers the sensation of burning so that he drops the coin in anguish. In rare cases the sensation has been so real as to leave marks on the hand exactly as though the skin had actually been scorched.

Again, a piece of soap, given with the assurance that it is a choice portion of cake or sweetmeat, will be eaten with relish and gusto, while a real piece of cake, if alleged to be something particularly nauseating, will not only revolt the subject, but, if persisted in, actually make him sick!

Lastly, we have catalepsy (from the Greek, meaning "to seize") in which the body and its muscular organism becomes rigid or fixed in the position predetermined, and to all intents and purposes becomes a rigid corpse save for the fact that the heart and lungs continue to function. In this state the subject may be laid across two stools so that his body forms a bridge and will support, without injury, the weight of several persons upon it or even allow a mass of stone to be broken with a sledge-hammer (see Fig. 4).

Hypnosis and Crime

A very curious phenomenon of hypnosis is "post-hypnotic suggestion," which means that a suggestion made to a patient while under control, and to the effect that he will perform such and such an action upon a given date and at a specified hour, will be

In many cases recently conclusive evidence has been forthcoming of the value of aircraft from a medical point of view. The other day Imperial Airways were consulted by a physician, one of whose patients had just undergone a serious operation, and who was in an extremely weak condition. It had become urgently necessary, however, that this patient should, if possible, travel to Zurich, in Switzerland, to undergo a special course of treatment at a clinic there.

A 7,000 Miles Journey

In view of the patient's condition, a train and boat journey was out of the question, and the only chance lay in making the trip by air. In these circumstances it was arranged that the forward saloon in one of the big four-engined air liners on the Croydon-Zurich service should be reserved for the patient's accommodation. A bed was arranged in this saloon in such a way that the patient, while lying in it, could obtain an excellent view outward through the windows of the air-liner, and there was ample space in the saloon, also, for the doctor, a nurse, and one of the relatives of the patient. A motor ambulance from a West-end nursing home was driven right up beside the air liner at Croydon, and the patient was conveyed immediately to the bed in the saloon. The flight began at 8 a.m. and by 2.15 p.m. the same afternoon Zurich was reached. The patient, who had suffered no ill-effects whatever from the aerial journey, was transferred at once to a waiting motor-ambulance, and an hour later was under treatment in the Zurich clinic.

Another recent case was that of a patient

performed though the patient is wide awake and far away from the operator. In fact, the subject knows nothing of the suggestion, and, as a rule, regards the action as the result of an overpowering impulse engendered in his own brain.

This is, of course, a rather dangerous weapon, for while it has been proved that a subject will not

an impossibility without that subject's consent and co-operation. It is easy to see that the amazing control of sensory nerves, muscles, and will-power places a powerful instrument in the hands of medical men and psychiatrists for the relieving of chronic phobias such as seasickness and claustrophobia (or fear of being closed in), while stammering, insomnia, and the whole galaxy of acquired bad habits are more or less amenable to suggestive treatment. Thus experimental work in hypnosis has contributed a vast amount to our knowledge of the brain and its working.

What the hypnotic sleep itself really is still remains much of an enigma. It is thought that, as the fixity of the gaze produces a form of paralysis in the optic nerve (see Fig. 2), this in turn causes a form of dissociation in the brain cells, certain of them becoming dormant, while others remain active; but the whole question is nebulous and little more than guess work. As regards the blind obedience of the subjects, psycho-analysts have formulated the interesting theory that, in the subject's sub-consciousness, the operator takes over the latent instinct of parental respect, and becomes a sort of projection of the all-knowing parent to the child mind of the hypnotised person,

who renders blind obedience to, and belief in, the operator.

Be these theories, and the many others extant, whatever they may, there is no evading the fact that hypnotism is a proved and powerful force for good or ill, and decidedly not a form of casual amusement as it was regarded not so very long ago.

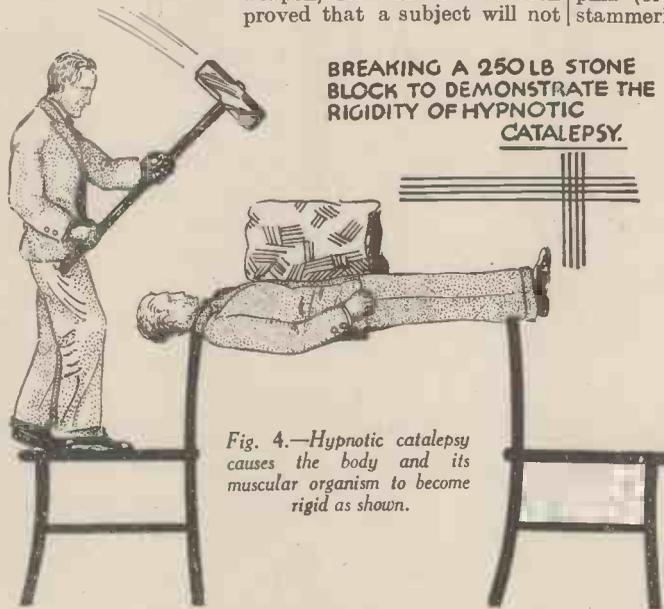


Fig. 4.—Hypnotic catalepsy causes the body and its muscular organism to become rigid as shown.

perform an action which is contradictory to his own fundamental instinct, there are cracks in the natures of many of us which only ourselves know, and depths in human instinct which do not bear too close scrutiny. It is, therefore, all to the good that the public should appreciate the fact that the first hypnotising of a subject is, as near as can be,

THE AMBULANCE 'PLANE

at Johannesburg, in South Africa, whose doctors wished him to go to London for a special form of treatment. At the same time, owing to his condition, only the smallest amount of physical movement was desirable, and for this reason the doctors were doubtful about allowing him to travel by train to the coast and on by steamer to England. It was decided, therefore, that the patient should be transported to London by air. Chairs and tables were removed from the saloon of one of the air liners, and a specially-arranged bed on which the patient could travel was substituted. Arriving at the Johannesburg airport in an ambulance, he was carried at once into the air liner, and a doctor accompanied him on the whole of the flight through to London. On arrival at Croydon, after an air journey of 7,000 miles, this patient seemed actually better in health than when he had left Johannesburg, and it is satisfactory to be able to record that the treatment he received in London had the desired effect.

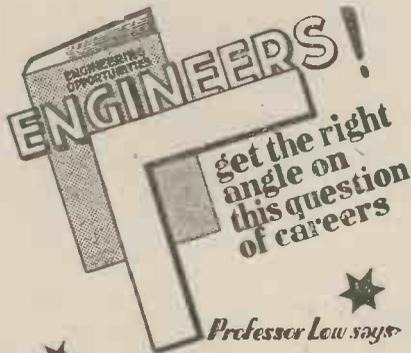
Avoiding Air Bumps

"It is the absence of jolting and fatigue in air transport which has such valuable aspects from a medical point of view," explained an official of the Special-Charter Department of Imperial Airways, "and a case not long ago illustrated this particularly. The patient was suffering from a grave spinal complaint, in which any sudden movement implied serious risk. Yet it was urgently necessary that a journey

should be made to the Continent for a course of treatment by a certain specialist.

"Surface transport, in such a case, could not be contemplated. So the doctors came to Imperial Airways, and the interior of one of our special-charter saloon 'planes was transformed into a flying ambulance, a bed for the patient being slung on springs in the centre of it. Provision was also made for a doctor and nurse, who flew with the patient, to have everything they might require close at hand. Thus well-equipped, the journey to the Continent was started, the pilot taking the machine up to a height where any bumps or disturbed air might be avoided. The result was a smooth, swift journey which the patient bore extremely well, the doctors concerned being delighted at the success of the experiment.

"Aircraft capable of flying long distances at high speeds are now at the disposal of patients and invalids who make journeys by air. As regards the question of cost, it may be interesting to note that a cabin aircraft, with all the comforts and security which goes with the multi-engined enclosed type of 'plane, and piloted by one of our route-captains, accompanied by an engineer wireless operator, can be chartered at a few minutes' notice to fly an invalid and doctor to any destination at a rate as low as eighteen pence a mile. In the cabin of such a machine a comfortable bed can be arranged, and patients can make their entire journey in a reclining or prone position. The use of ambulance-planes has, in fact, now become a regular and established feature of aerial travel, and they often enable patients to make journeys under medical supervision, which would be altogether impossible by any other means."



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THE PERIODIC LAW—ATOMIC WEIGHTS AND NUMBERS

LONG before the days of modern science, the early Greek philosophers dwelt upon the problem of the ultimate constitution of matter and developed two schools of thought. The first held all matter to be essentially continuous in its nature, so that one could divide and sub-divide it indefinitely without finding any gap or change in its make-up.

At first sight there is much to be said in favour of this point of view. The surface, for instance, of a clean liquid discloses no break or discontinuity even when examined under the most powerful microscope. Similarly, a drop of soluble dye will colour quite evenly and uniformly a volume of water many million times its own bulk.

The second school of thought favoured a different theory. They said that matter was fundamentally discontinuous in its structure—and that it filled the space it occupied, only in the way that a quantity of small shot can be said to fill the vessel into which it is poured. In other words, there are as many gaps or interstices in any kind of matter as there are solid points of substance.

Dalton's Atomic Theory

This, in fact, goes very close to the point of view reached by Dalton in the early part of the nineteenth century. Dalton's atomic theory is, however, based on actual quantitative experiment, whilst the Greeks were content to let the matter rest in the realm of pure speculation.

Dalton said: (1) The chemical elements are composed of very minute particles of matter, called atoms, which preserve their own individuality in all circumstances; (2) all the atoms of the same element are identical in all respects, though different elements have atoms of different weight.

He knew, of course, that the atom was almost infinitesimally small, and therefore made no attempt to measure its absolute weight. He did, however, succeed in finding out how the atomic weights of certain of the elements compared with that of hydrogen.

The superior weapons of the modern scientist have enabled him to solve the first problem, and we now know the absolute weight of the hydrogen atom, and therefore of all the rest.

It may be interesting to give a concrete example of the kind of dimension one is dealing with in the case of atoms. Take a cubic decimetre of lead weighing 11.37 kg. and imagine it to be cut along three lines at right angles, so as to form eight smaller cubes, each one-eighth the size and weight of the

In spite of its apparent diversity, all the known forms of matter can be reduced to a sum total of ninety-two different elements. These are the "bricks," so to speak, out of which Nature has built up the complicated structure of the world.

original piece. Consider all this as one complete cutting operation, and then proceed to repeat the performance a number of times in succession. At the twelfth cut, the resulting cube will just cease to be visible to the naked eye. At the eighteenth cut it can just be seen in a powerful microscope. At the twenty-sixth cut each cube will contain exactly sixty-four atoms.

Or again, instead of dividing the original cube into smaller cubes, imagine it cut first into thin plates one atom thick, and these plates next sliced up into threads or strings of atoms. If placed end to end the latter would stretch over six million million miles—which is roughly equal to the distance light will cover in a year, travelling at some-thing under 200,000 miles a second.

Measuring Atomic Weights

Although chemists were occupied in measuring atomic weights for more than half a century after Dalton, they did not discover any link tending to bind the different elements together, until Newlands, in 1863, observed that if they are arranged in the order of their atomic weights, every eighth element in the series "is a kind of repetition of the first—like the eighth note in an octave of music."

In 1869 the Russian chemist, Mendeléef, put this discovery on a more definite footing. He started with the assumption that there must be some bond of union between the individual properties of each element and

its atomic weight, and by carefully assorting and classifying the known elements and their typical properties, he drew up his famous Periodic table, which shows that as the atomic weights steadily increase, the properties of the elements periodically ebb and flow in regular succession.

Mendeléef arranged the elements progressively, first in horizontal rows of eight, called periods. He then split up the table so formed into eight vertical columns or groups. When so arranged the elements in one line turn out to be closely similar to those immediately above them in the preceding line. All the halogens, fluorine, chlorine, bromine and iodine, for instance, fall into the same column; similarly, the strongly alkaline elements are grouped on one side of the table with the acid-forming elements at the opposite side. Many other similarities occur which are too numerous to be set out in detail.

"Missing" Elements

One very practical result of the Periodic table is the fact that it indicated the position of certain "missing" elements, and allowed their properties to be predicted before they were actually discovered. Among the rare elements discovered in this way are Scandium, Gallium, and Germanium.

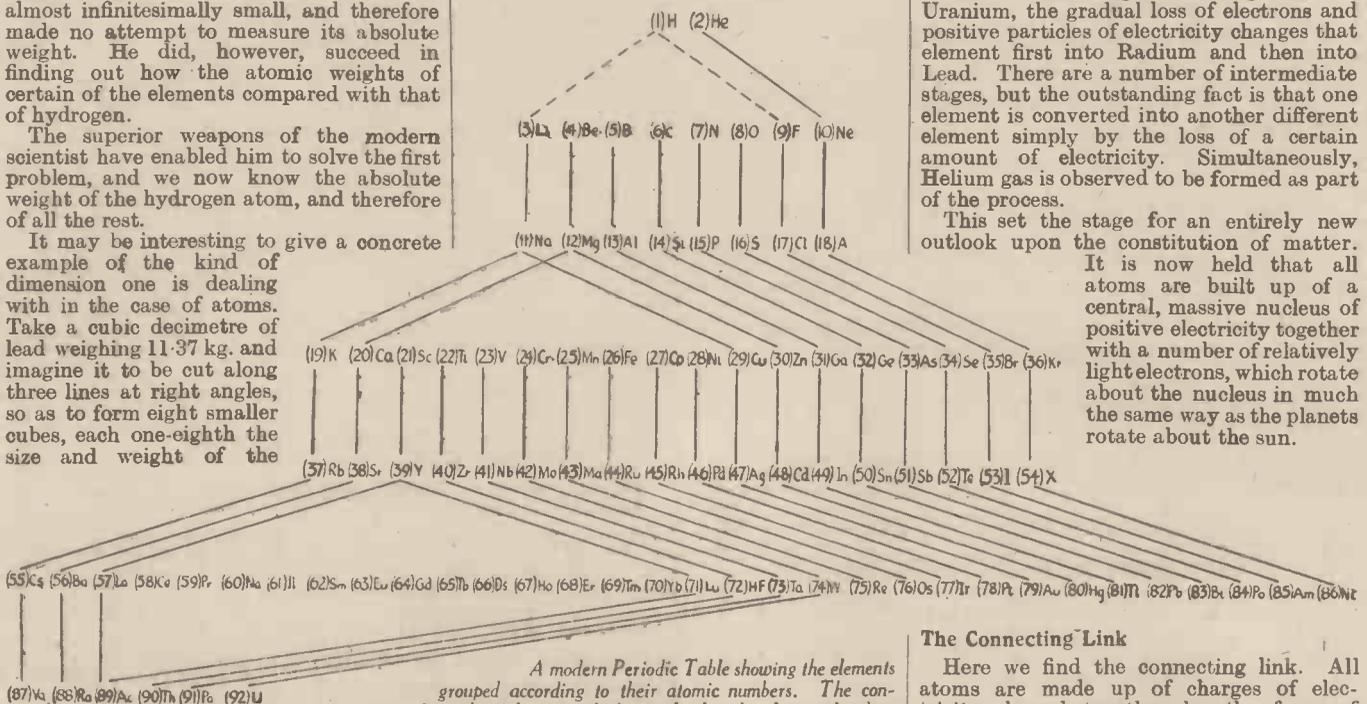
In 1897 Sir J. J. Thompson discovered the existence of the electron and proved it to be the ultimate negative charge or "atom" of electricity.

The behaviour of the so-called radioactive elements—of which radium is the outstanding example—next established the fact that the atoms of these elements are continually shooting off both electrons and positively charged particles.

As they do so the nature of the radioactive element changes. Starting first with Uranium, the gradual loss of electrons and positive particles of electricity changes that element first into Radium and then into Lead. There are a number of intermediate stages, but the outstanding fact is that one element is converted into another different element simply by the loss of a certain amount of electricity. Simultaneously, Helium gas is observed to be formed as part of the process.

This set the stage for an entirely new outlook upon the constitution of matter.

It is now held that all atoms are built up of a central, massive nucleus of positive electricity together with a number of relatively light electrons, which rotate about the nucleus in much the same way as the planets rotate about the sun.



A modern Periodic Table showing the elements grouped according to their atomic numbers. The connecting lines show elements which are closely related to each other.

The Connecting Link

Here we find the connecting link. All atoms are made up of charges of electricity, bound together by the force of

(Continued on page 122.)



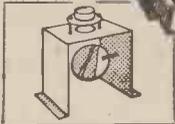
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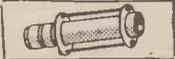
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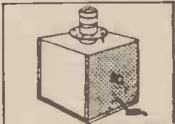
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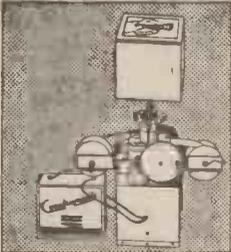
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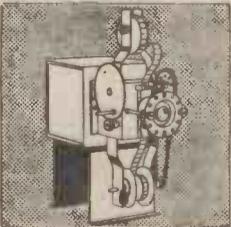
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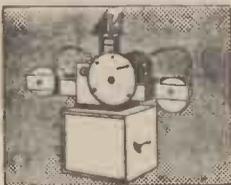
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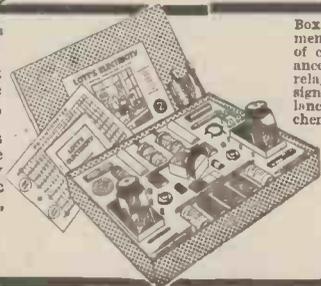
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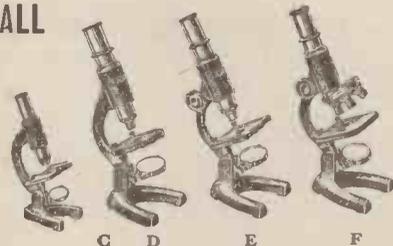
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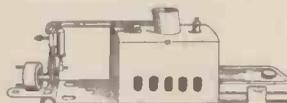
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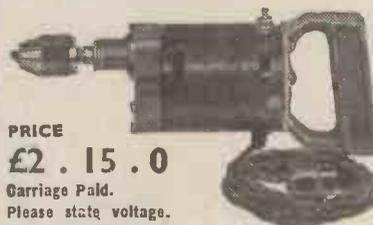
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THE CATHODE-RAY TUBE AND ITS APPLICATIONS

By H. J. BARTON CHAPPLE, Wh.Sch., B.Sc. (Hons.), etc.

IN its very broadest sense the cathode-ray tube is essentially an instrument for observing, measuring or photographing the behaviour of varying electrical voltages and currents, and now that the nature of its performance is becoming more clearly understood, together with material improvements in manufacture, it is proving of considerable value in nearly all branches of scientific and industrial research. Furthermore, the latest developments in television seem to hinge very considerably on the utilisation of the cathode-ray tube, especially at the receiving end, as a ready means for producing a modulated scanning field to build up the television image in a non-mechanical manner.

The tube itself consists of a pear-shaped glass bulb of varying length, according to the diameter of the circular end screen. This is joined to a cylindrical glass section which houses the electrode assembly, the construction of a standard tube of this character being seen clearly in Fig. 1, the electrodes being brought out to side studs which fit into an eight-contact base.

The large end of the bulb is flattened to form a viewing screen, and on the internal

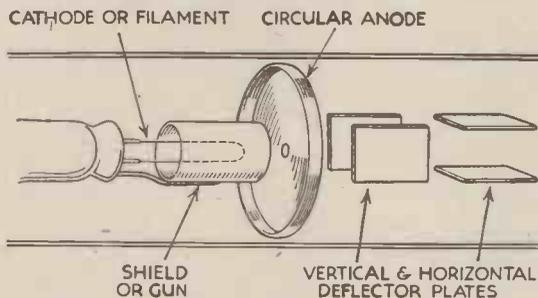


Fig. 2.—The arrangement of the electrode assembly for a standard cathode-ray tube.

surface of this is deposited a coating of fluorescent salts. This is for the purpose of rendering the pattern traced by the electron stream visible to the eye and also photographically active.

Electrode Details

According to the specific purpose for which the tube is used, the electrode configuration is varied, but as a general rule it follows somewhat on these lines. First of all, there is a cathode of the directly or indirectly heated type which is rendered "active" by the passage of an electric current through it, this current being furnished by means of a mains step-down transformer or large batteries. As in an ordinary thermionic valve, the current flow "boils off" or releases electrons (minute negative charges of electricity) from the cathode surface. Once these are released they must be guided towards the front screen, and this is done by first of all surrounding the cathode with a narrow metal cylinder open at both ends, and then placing before this combination an anode consisting of a flat circular disc having a small hole bored through its centre.

The anode is given a high positive potential with reference to the filament, and the free electrons are thus attracted towards it. In order to make the resultant electron

As was the case with the early valves and photo-electric cells, the cathode-ray tube has been regarded as a piece of highly-scientific apparatus. This position is now completely changed, however, and modern industry is using this device in increasing numbers. Learn how it functions by reading this particularly interesting article.

beam as narrow as possible, and so increase the number of electrons which actually pass through the anode hole and progress at an extremely high velocity to the front fluorescent screen, the gun or shield which surrounds the cathode is given a negative bias, and this acts as a focussing control.

Ionisation

Normally, the beam, consisting as it does of a stream of electrons, would diverge owing to the mutual repulsion of these minute negative electrical charges, and as a further aid to focussing many cathode-ray tubes have a small amount of gas introduced.

Then by a very careful adjustment of the gas pressure it can be arranged for the electrons during their passage from the filament towards the screen to "strike" the

a beam which cannot be made to converge satisfactorily, is sufficient to render the tube quite unsuitable for a large number of purposes.

Controlling Spot Movement

Under the cathode, anode and shield conditions just described the electron beam would be directed straight to the fluorescent screen, and appear as a bright stationary



Fig. 1.—Showing the appearance of a standard cathode-ray tube fitted into an eight-contact base.

spot owing to the electronic energy being transformed into visible light energy. For observation purposes, however, this spot must be made to move the screen area according to the physical or electrical conditions it is desired to investigate. For this purpose two pairs of small rectangular deflecting plates are introduced between the anode and the screen within the cylindrical glass part of the tube. In each pair of plates the surfaces are parallel to one another, but the two pairs are mutually at right angles, the complete electrode arrangement being indicated in Fig. 2.

Generally, one pair of plates is horizontal and the other pair vertical, and for reference purposes they are often called the *x* and *y* deflectors, just the same as we have the *x* and *y* co-ordinates in any graphical representation on squared paper.

Tracing on the Screen

Supposing now that the horizontal pair of plates is given an electrical charge while

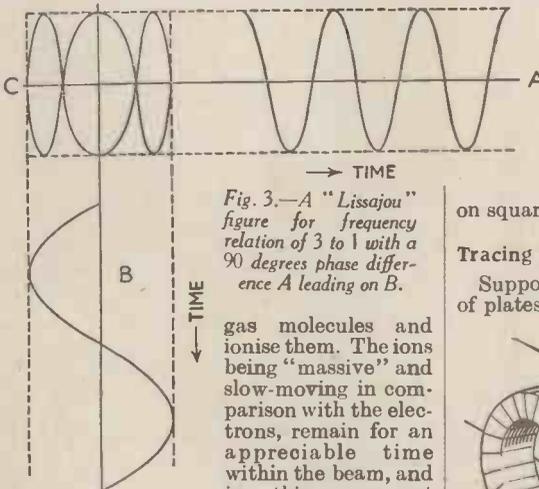


Fig. 3.—A "Lissajou" figure for frequency relation of 3 to 1 with a 90 degrees phase difference A leading on B.

gas molecules and ionise them. The ions being "massive" and slow-moving in comparison with the electrons, remain for an appreciable time within the beam, and in this way act

as a positively-charged guiding column which draws the electrons on the outside of the beam towards the centre. The focussing of the electron beam so that the ultimate visible spot seen on the fluorescent screen is both small in size and sharply defined is a very important feature of any cathode-ray tube. A spot which gives a "fluffy" appearance, or which results from

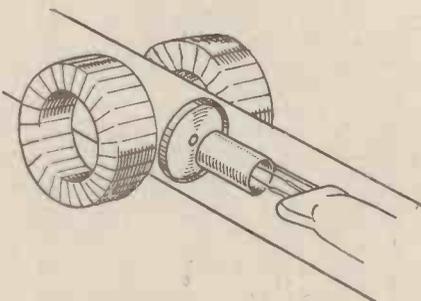


Fig. 4.—Using coils to produce a magnetic field for deflecting the electron stream.

the electron beam is passing between them on the way to the screen. If this charge is a steady one, the beam will be diverted from its previous straight path, being attracted towards the positively charged plate. The beam will therefore strike the screen at a different point vertically above its "quiescent" position, the amount of the deflection being proportional to the potential to which the plates have been charged.

A reversal of the plate potential will make the beam take up a position below the steady condition, and if this potential reversal is maintained, say, for example by applying an ordinary alternating voltage between the plates, then the spot will move vertically up and down at a rate corresponding to the frequency of the alternations and so draw or trace a thin vertical pencil of light on the screen. This will remain visible to the eye and appear as a steady line of constant length, provided the frequency of the voltage alternations is fast enough and that the changes are cyclic in character.

"Lissajou" Figures

If now a second variable voltage is applied to the vertical pair of plates, the deflection due to this will be horizontal—that is, at right angles to the previous traverse. Of course the beam cannot move in both directions at the same time, and what happens is that the spot of light registers the resultant direction and a plain figure is traced on the screen. When both variables are cyclic and the ratio of their frequencies is a small integer, then a stationary figure will result, this being known technically as a "Lissajou" figure. This constitutes an actual plotting or tracing in rectangular co-ordinates by the spot of light, and has a most useful application in that it enables frequency ratios to be identified and the effects of phase shift to be examined.

As a simple example of this, reference can be made to Fig. 3. Here the sine-wave voltage variation A applied to the vertical pair of deflecting plates is three times the frequency of the sine-wave voltage B applied to the horizontal pair of deflecting plates, while in addition A leads B by 90 degrees. The pattern or "Lissajou" figure shown at C is the result.

Further Details

In addition to employing electrostatic deflection by means of the deflector plates just described, the movement of the electron beam can be accomplished quite readily by the use of two magnetic fields or, alternatively, one magnetic field and one electrostatic field. These coils are placed at a constriction in the tube neck, Fig. 4 showing

a tube with coils in position for this purpose.

Owing to the very nature of its assembly and mode of operation, the direction of the electron stream is particularly susceptible to both magnetic and electric external influences, and it is preferable therefore in many cases to house the tube in a screened box assembly, somewhat as shown in Fig. 5. Local sources of interference, such as transformers, generators and so on, do not then upset quantitative measurements. Furthermore, if the terrestrial magnetic field has to be neutralised, this can be done very readily by the field from a permanent magnet or from a coil-carrying current. A magnet of this character is also particularly useful for centring the light spot

where

the subject being televised from the transmitting end.

Linear time bases form a very essential part of the auxiliary equipment for television reception under these conditions, together with mains-exciter units and amplifiers. Under service conditions the complete assembly is built preferably as one complete structure. The tube is encased in a metal shroud, being arranged at average eye level for observation purposes.

Other periodic phenomena which can be observed very conveniently are wave-form studies of alternators, transformers, valve oscillators, amplifiers, D.C. ripples on

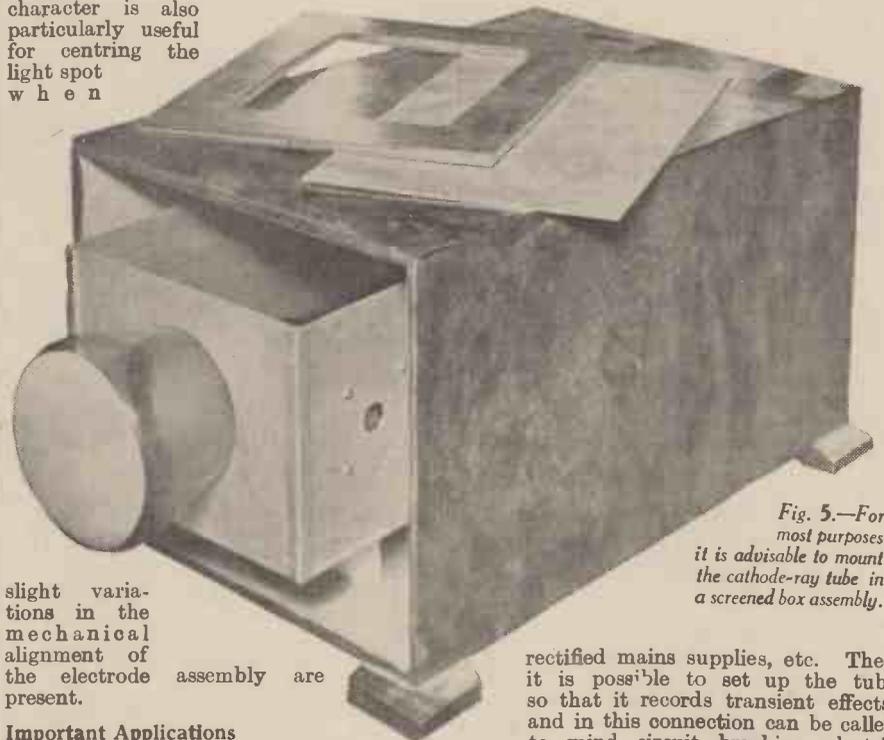


Fig. 5.—For most purposes it is advisable to mount the cathode-ray tube in a screened box assembly.

slight variations in the mechanical alignment of the electrode assembly are present.

Important Applications

Coming now to the applications of the cathode-ray tube, that dealing with frequency comparisons and the effects of phase displacement has been mentioned. In addition, there are many other uses which necessitate the employment of what is termed a linear time-base potential. This is a voltage generating device which makes the spot move in one direction at a constant speed and then return very rapidly to its original position, when it commences the same action all over again. One very modern use in this connection is in tracing out a television image in the form of a large number of parallel light lines whose intrinsic intensity in the direction of the spot scan is proportional to the light and shade of

rectified mains supplies, etc. Then it is possible to set up the tube so that it records transient effects, and in this connection can be called to mind circuit breaking, electric sparks and atmospherics, the last named being a particularly important phase of research now being carried out at Slough by the Radio Research Board.

When both sets of deflecting plates or coils derive their operating voltages from the circuit itself as apart from an independent time-base function, the utility of the tube is very broad in character. By its simple "mechanism" we can observe valve characteristics; compare amplifier input and output; study modulation and detection; carry out monitoring work in gramophone recording, talking-picture and aural radio; or make the tube function as an ammeter or voltmeter at ultra-high frequencies.

THE PERIODIC LAW

(Continued from page 118.)

mutual attraction. They only differ, one from another, in the number and disposition of these charges.

One method of investigating the structure of an atom is to examine the way in which it responds to light and similar short-wave radiation. By using the methods of spectrum analysis, Rydberg found that the "lines" given by elements occupying similar positions in the Periodic table were closely alike.

Further light was thrown on the subject by Moseley, who in 1913 devised an ingenious method of analysis by means of X-rays. These rays, it should perhaps be

explained, are produced by the impact of the electron stream against the anode of a high-voltage cathode-ray tube.

Moseley employed, in turn, anodes made of the different elements, and he resolved the X-rays into a spectrum by passing them through a crystal of potassium ferrocyanide. Just as Rydberg discovered a definite link of connection between the lines in ordinary spectrum analysis, so the X-ray spectrum produced by each chemical element shows a "line" which shifts up or down the scale according to the atomic weight of the element in question.

If now we classify the various elements in the order of the X-ray frequencies they produce, we find that they fall automatically into the same order as that given by

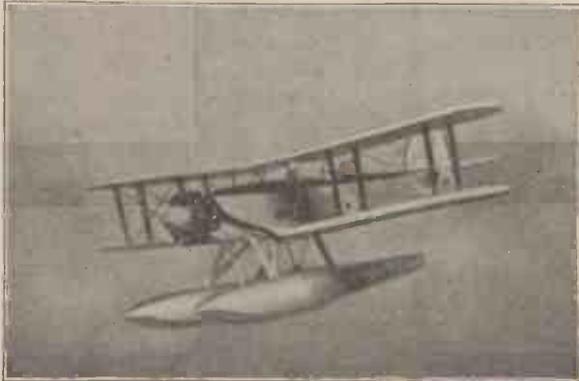
Mendeléef's table (given on page 558 of our September issue). The property of each atom is defined by a whole number which varies by unity in passing from one atom to the next. Moseley showed that his experiment could be completely explained on the assumption that the progressive change in his X-ray spectrum was due to a progressive increase in the nuclear charge on each atom.

The nuclear charge—which must, of course, be balanced by an equal number of free or "satellite" electrons—is now called the Atomic Number. It defines the position of each element in Mendeléef's original Periodic table, and in modern practice is widely used in place of the older atomic weight.

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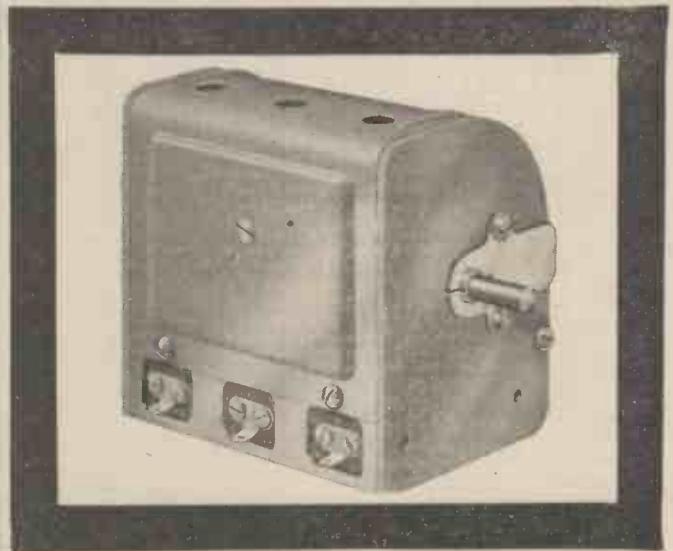
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In next month's issue Mr. F. J. Camm, the Editor of "Newnes Practical Mechanics," will publish a full test report on the "Amplion"; in the meantime, we quote you extracts from other test reports. We are confident that Mr. Camm will be able to confirm the high opinions expressed by the Editors of the papers quoted.

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The PRACTICAL MECHANICS Wireless Experimenter

THE £5 Superhet Three described in recent issues of our companion journal, *Practical Wireless*, has met with such phenomenal success that it was decided to design a somewhat similar receiver for the benefit of PRACTICAL MECHANICS readers. Most constructors will find no difficulty in building this set with the aid of the wiring diagram, but for the sake of beginners it is proposed to give full constructional details. The constructional work should be commenced by drilling the chassis holes for the valve-holders, on/off switch, terminal strips, and the numbered wiring holes. A 1½-in. drill is used for the first valve-holder, and a 1-in. drill for the remaining two holders. When the strips and holders are fitted, care should be taken to keep the pins clear of the metallised edge of the hole, in order to avoid short-circuits. All the components, except the fixed resistances and the Westector may then be soldered to the baseboard, care being taken to scrape away the metallised surface beneath the potentiometer bracket. It should also be noted that the moving vanes of the ganged-condenser connect to the common negative line through the condenser casing, and therefore this should be tightly screwed to the baseboard, and a metal washer should be placed under every screw marked M.B., in order to ensure effective contact with the metallised surface.

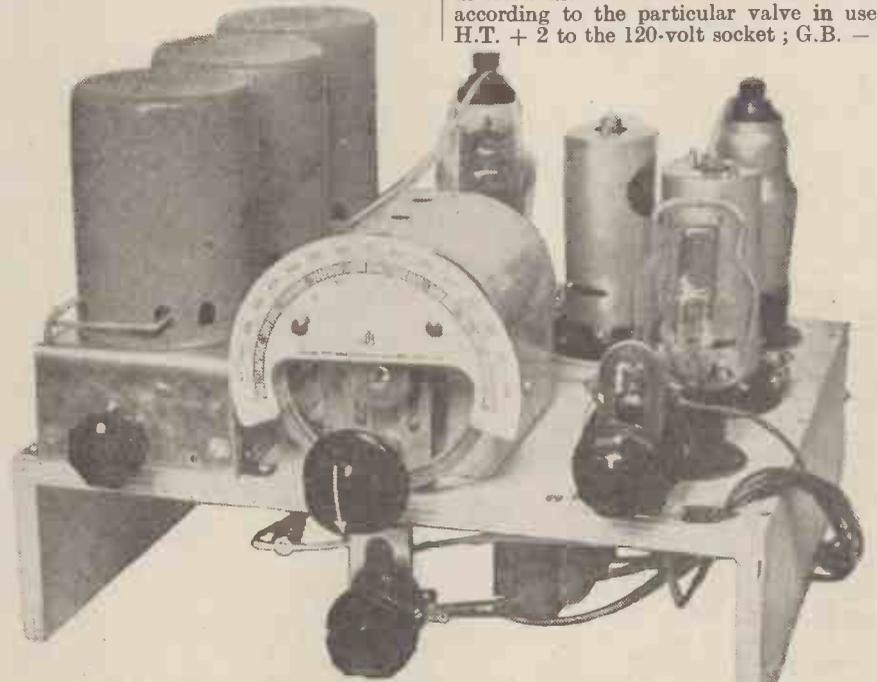
Wiring

The wiring is very straightforward and no special instructions are necessary in this respect, but as the filament wires are nearest to the baseboard it will be advisable to fit these first and then continue with the remaining wiring, commencing with the

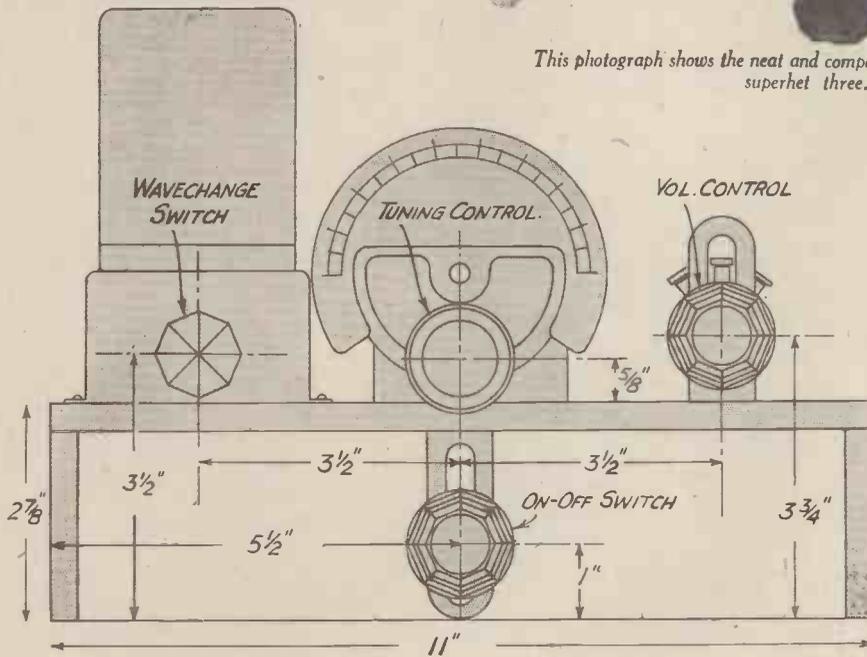
—THE "MECHANICS" THREE—
VALVE SUPERHET
 Full constructional details of a superheterodyne receiver which employs only three valves

coils and the tuning condensers and following the valve sequence—V.1, V.2, V.3—as indicated on the wiring plan. A .01 mfd. condenser is included in the list of compon-

ents, but this is not shown on the diagram as it is not necessary if the set is used in conjunction with an Amplion "Lion" speaker. Some speakers accentuate the treble, however, and for these a tone control is required—the .01 mfd. condenser will serve this purpose if connected between the P terminal of V.3 and the metallised baseboard. After the wiring has been completed the batteries should be connected, L.T. + and L.T. - leads being connected to the accumulator, H.T. + 1 then being inserted into the 60- or 72-volt socket, according to the particular valve in use; H.T. + 2 to the 120-volt socket; G.B. - 1



This photograph shows the neat and compact layout of the "Mechanics" superhet three.



Details of the knob layout.

to the 9-volt negative socket of the grid bias battery, and G.B. - 2 to the 4.5-volt negative socket. The G.B. + plug should then be inserted into the positive socket of the grid bias battery and the H.T. - lead into the negative socket of the H.T. battery, when the battery circuits will be completed.

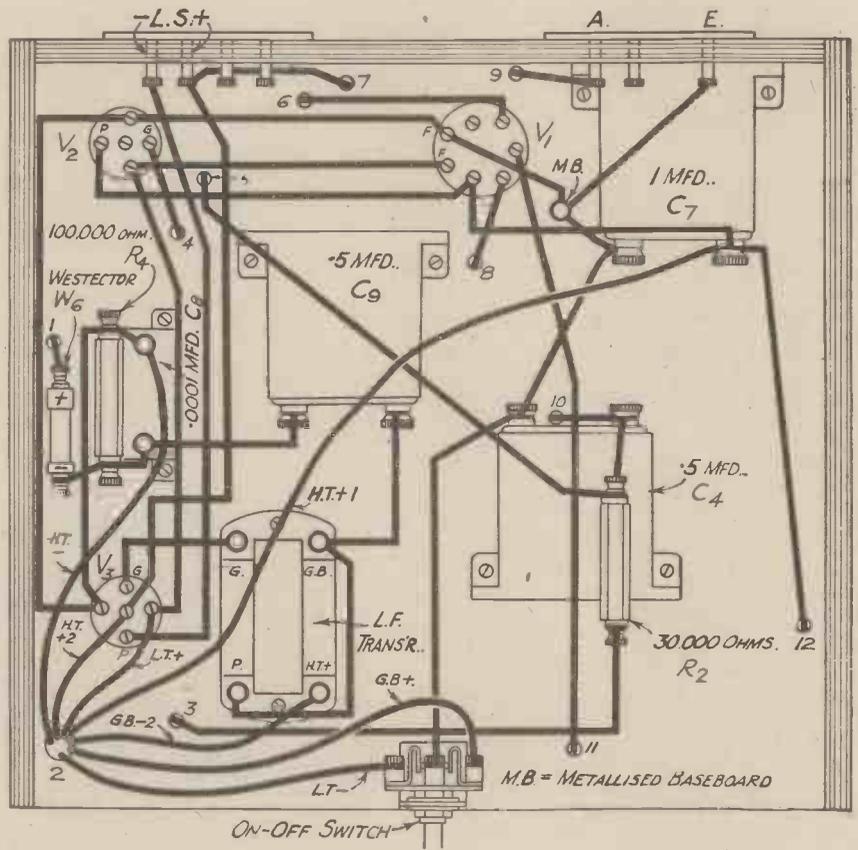
Economy of Operation

It may be mentioned here that the current consumption of the last valve may be reduced by increasing the voltage applied to G.B. - 2, the 6-volt or 7.5-volt socket of the grid-bias battery being tried in order to reduce the voltage where economy is of prime importance. On the other hand, a power pentode may be used in the last stage if H.T. current is being supplied from a wet battery or an eliminator, and the G.B. - 2 plug should then be inserted in the 9-volt socket. The use of a power pentode will increase the maximum undistorted output and better quality reproduction will be obtained than with the economy type of pentode.

LIST OF COMPONENTS

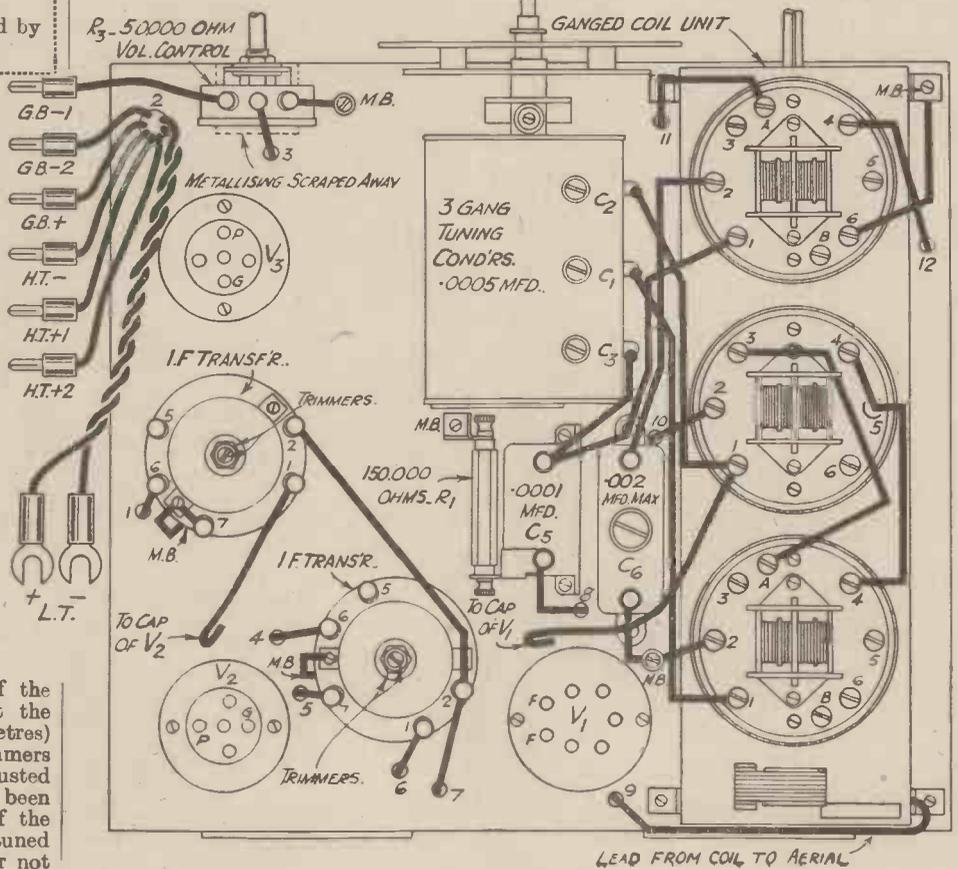
- One Set 3-gang Superhet Coils (Ward & Goldstone).
 - One 3-gang Superhet Midget Variable Condenser, Type 2124B and Disc Drive (J.B.) [(Varley).
 - Two I.F. Transformers (110 kc/s.)
 - One .002 mfd. Formodenser (Formo).
 - One 50,000 ohm Potentiometer (Graham Farish).
 - One 1 mfd. Fixed Condenser (Graham Farish).
 - Two .5 mfd. Fixed Condensers (Graham Farish).
 - One .01 Tubular Condenser (Graham Farish).
 - Two .0001 mfd. Fixed Condensers (Graham Farish).
 - Three Ohmite Resistances, 150,000, 100,000, 30,000 (Graham Farish).
 - One L.F. Transformer (B.T.S.).
 - Two Potentiometer Brackets (Peto-Scott).
 - One 3-point on/off Switch (Graham Farish).
 - One 7-pin Sub-baseboard Valve-holder, Terminal Type (Clix).
 - One 5-pin Sub-baseboard Valve-holder, Terminal Type (Clix).
 - One 4-pin Sub-baseboard Valve-holder, Terminal Type (Clix).
 - One Westector, Type W.6 (Westing-Three Wander Plugs (H.T. + 1, H.T. + 2, H.T. -) (Ealex). [Ealex).
 - Two Spade Terminals, L.T. +, L.T. -
 - Three G.B. Plugs, G.B. +, G.B. - 1, G.B. - 2 (Ealex).
 - Two Terminal Strips, A.E. and L.S. (Clix).
 - One Metaplex Chassis, 11 x 10 in. with 2½-in. Runners (Peto-Scott).
 - Three Valves 210 P.G. (Cossor), VP.215 and Y.220 (Hivac).
 - One Amplion "Lion" Loud-speaker.
 - One 120-volt H.T. Battery.
 - One G.B. 16½-volt Battery.
 - One L.T. 2-volt Accumulator.
- Kits or separate parts are supplied by Peto-Scott Ltd.

COMPLETE WIRING PLANS OF THE "MECHANICS" SUPERHET THREE, FROM WHICH YOU CAN EASILY TRACE EVERY CONNECTION



Operating the Receiver

The aerial and earth leads and speaker leads may now be plugged into their respective sockets and the receiver switched on by means of the three-point switch. Satisfactory reception of the local station will probably be obtained if the tuning dial is rotated to the appropriate setting, and the volume control is set near its maximum position. But it will be necessary to adjust the gang condenser and the I.F. transformer trimmers in order to obtain optimum sensitivity. The trimming should be effected in the following manner: Switch to the medium waves by means of the coil switch (white spot at the top) and tune in a moderately strong transmission. Now adjust the I.F. transformer trimmers for maximum response. It should be noted that there are two trimmers on each of the transformers, one being of the concentric type adjustable by means of a small screw-driver, and the other by means of the hexagonal brass nut. A station at the lower end of the scale (about 250 metres) should then be tuned in and the trimmers of the gang condensers C₁ and C₂ adjusted for maximum response. After this has been done, a station at the upper end of the scale (about 500 metres) should be tuned in, and it should be noted whether or not



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1 J.B. 3-gang Superhet Condenser with disc drive	0	19	9
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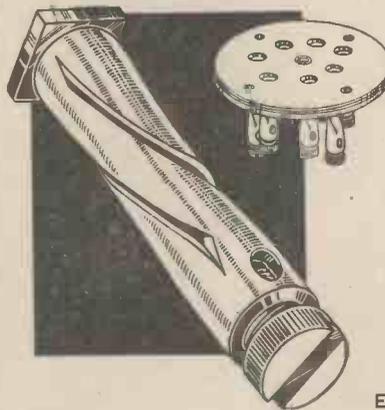
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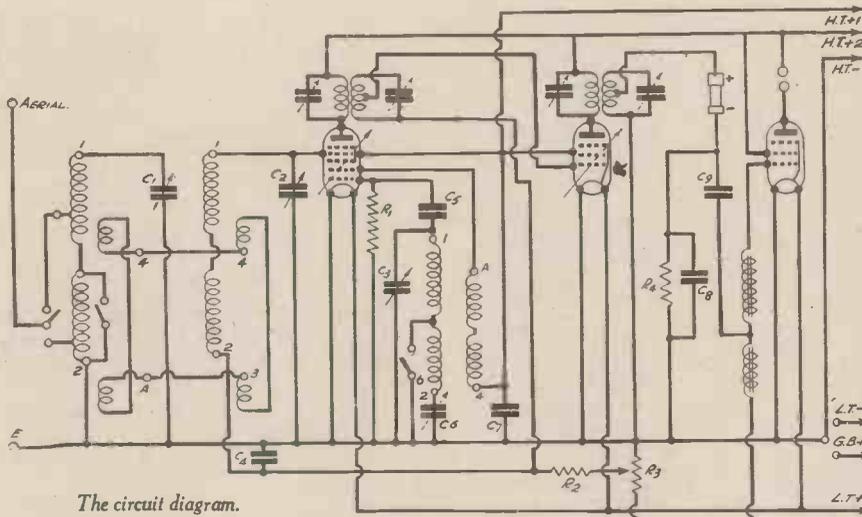
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The circuit diagram.

an alteration of the setting of C1 and C2 trimmers is necessary in order to obtain maximum volume. If so, C3 trimmer should be adjusted one way or the other until a position is found where the settings of C1 and C2 trimmers hold at both ends of the tuning range. A slight readjustment of the I.F. transformer trimmers may then be tried in conjunction with the setting of the I.F. transformer coupling adjustment, this being the small screw which protrudes through the slot in the side of the transformer. It has been found that very satisfactory results are obtainable with the adjuster set at the half-way position.

The Long Waves

After good medium-wave reception has been obtained the coil wave change switch should be turned to the long-wave position (white spot at the bottom) and the Droitwich transmission tuned in. The small pre-set padding condenser should then be adjusted until maximum volume is obtained, the setting probably being found where the adjuster is screwed fully home.

Gramophone Record Reproduction

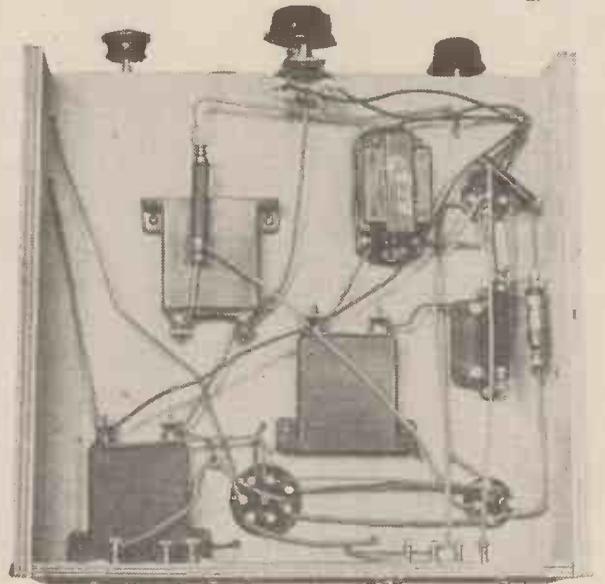
The receiver may be employed for the reproduction of gramophone records,

although, owing to the fact that there is only one L.F. stage, the amplification which is afforded will not permit of very loud signals being obtained. The first consideration, therefore, is to obtain a really sensitive pick-up, one which will give an output requiring not more than one L.F. stage. There are two or three components of this type at present obtainable, and your local dealer will no doubt be able to assist you in your choice. The most suitable connection is across the secondary of the L.F. transformer, although it is also possible to include it direct in the grid circuit of the output valve. For this connection, one side of the pick-up is joined to the grid of the pentode valve, and the other side of the pick-up is joined to the grid-bias battery, at about the 9-volt tapping. To enable a change-over to be effected, and to

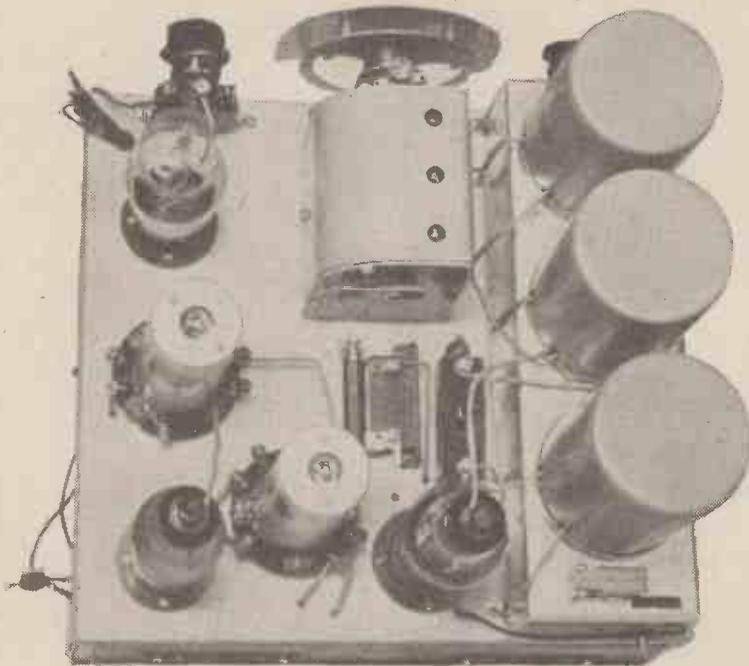
examining the wiring diagram it will be seen that these two points are connected to the L.F. transformer, and leads from these two points may be taken to the pick-up sockets.

Automatic Volume Control

By a simple modification it is also possible to introduce a small amount of automatic volume control to counteract fading on weak or distant stations. Firstly, the value of resistance R2 must be increased to .25 meg. (250,000), and secondly, a separate 9-volt grid bias must be obtained; this must be joined across resistance R3, the negative pole of this battery being joined to the negative pole of the Westector. The control thus afforded will help to relieve the effects of ordinary fading, and the manual volume control will still be operative to control the output on the local or other high-powered stations as desired. Obviously it must not be expected that this type of A.V.C. will maintain all stations at the same strength, but there are many high-powered stations which provide good entertainment, but which are spoiled by slight reductions in strength due to fading, and



An underneath chassis view showing the component layout.



A plan view of the set.

exclude the radio programmes when records are being played, a simple single-pole change-over switch may be used, the arm of the switch being joined to the grid, and one side of the switch to the L.F. transformer. The remaining side on the switch is then joined to the pick-up; the alternative method is to connect the pick-up between condenser C9 and the G.B. negative 2 lead. By

these are admirably controlled by the modified circuit.

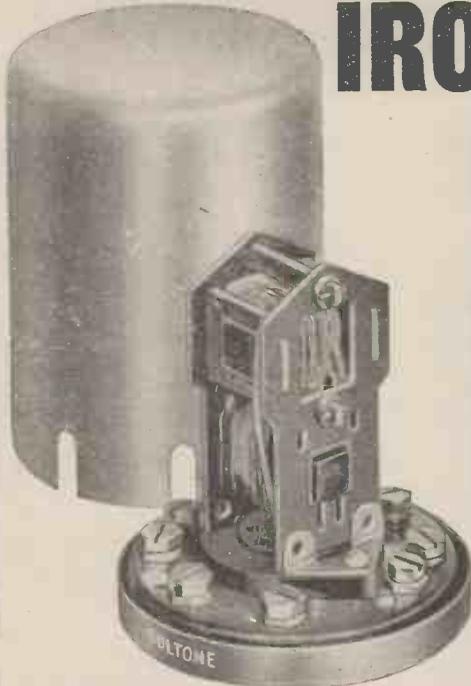
It should be noted that the circuit in its present form represents the most advanced technological practice, and the full super-heterodyne principle is thus employed with the smallest number of valves which is possible to-day. With mains valves of the A.C. type, it is possible to dispense with the Westector, by employing a double-diode-pentode or triode in the outputs stage, and utilising one of the diodes for rectification in its place. The benefit of this, is, however, very doubtful, and the Westector probably functions quite as efficiently, with the added advantage of being able to employ a step-up transformer between the rectifier and the output valve.

Amplion Radiolux Superhet Receiver

Owing to lack of space, we are unable this month to publish a test report on the above receiver, but we shall do so in next month's issue. In the meantime, all readers interested in purchasing a superhet ready for immediate use are invited to get full details of this receiver from Messrs. Amplion (1932) Ltd., 82-84 Rosoman Street Rosebery Avenue London E.C.1.

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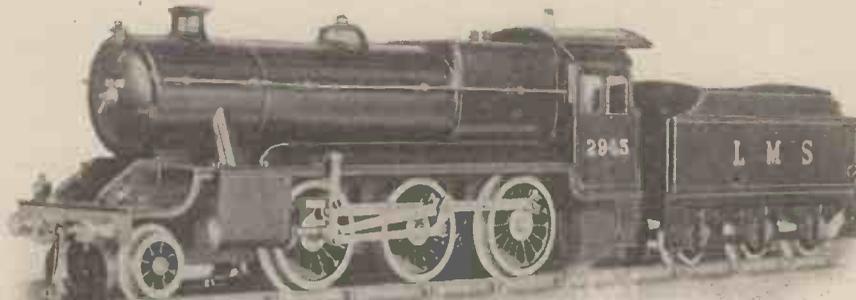
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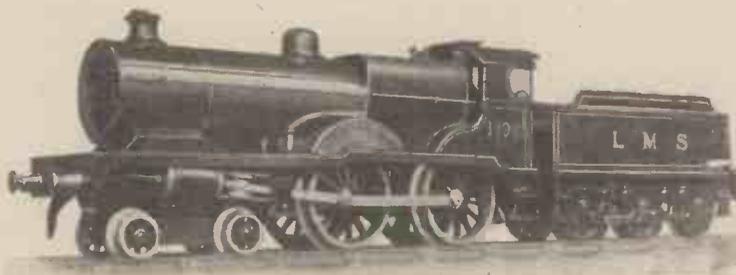
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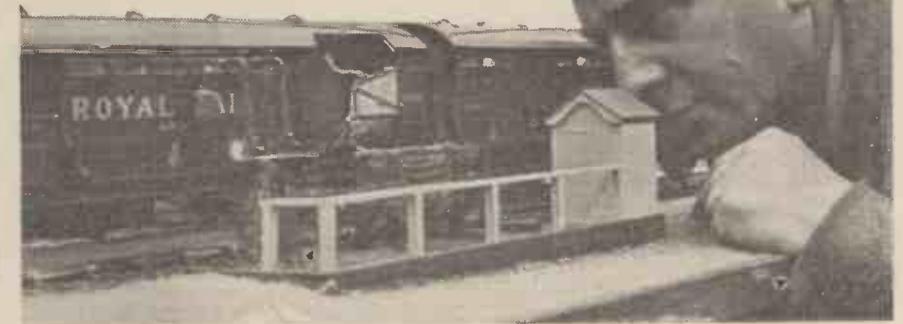
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A WORKING MODEL TRAVELLING POST OFFICE

Below we give details of the model travelling post office which was on view at this year's Radiolympia.

AT Euston Station every evening about 7.30 familiar scarlet post office vans begin arriving with bags of mails for the famous 8.30 p.m. "down special" postal train from Euston to Aberdeen. This travelling post office is made up of baggage vans, stowage vans and postal sorting vans, with the pick-up apparatus for dropping and collecting mails, and is usually hauled by a "Royal Scot" type locomotive.

Recently the Public Relations Department of the General Post Office decided to make this famous mail train the basis for a great working model showing the operations of the well-known railway "post." The designing and making of this huge

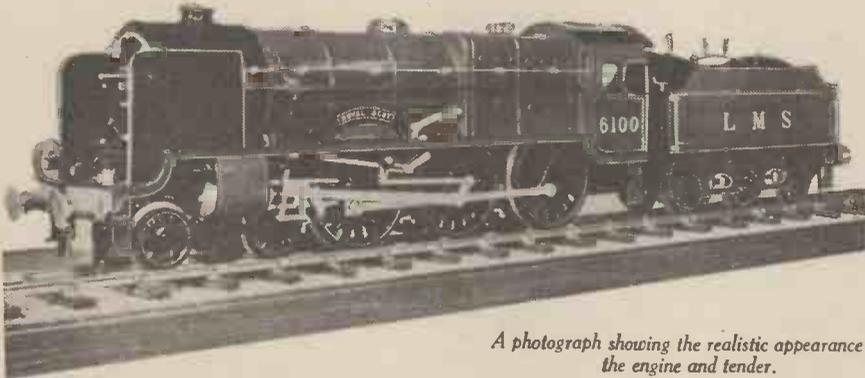


and all those accessories which go to make a railway realistic.

At two positions along the track, scale model wayside pick-up and delivery

The size of the model may be gathered by comparison with the man shown in the photograph.

From the model point of view the exhibit has several very special features. In the first place, the whole of the locomotives, rolling stock, signals and railway buildings are made to the exact scale of 10 mm. to the inch and run on the standard gauge track of 1½ in. The two locomotives, one as a reserve in case of running trouble, are the L.M.S. "Royal Scot," No. 6100, and the "Black Watch," No. 6102, of the same type.



A photograph showing the realistic appearance of the engine and tender.

model was entrusted to Bassett-Lowke Ltd., who for years have made a speciality of high-class exhibition models for publicity purposes.

The Size of the Track

The complete exhibit is laid out on a table 120 ft. long, and consists of 1½-in. gauge scale model double track, arranged for continuous running, with loops at each end, 12 ft. in diameter, so that the direction of the train can be reversed. Practically the whole of one loop is in the form of a hill tunnel, giving scope for artistic scenic effects, grass, trees, hedges, etc., and the total length of the track is 320 ft. The centre of the track is occupied by a modern design station with the usual equipment, booking offices, waiting rooms, station-masters' offices, bookstalls, notice-boards,

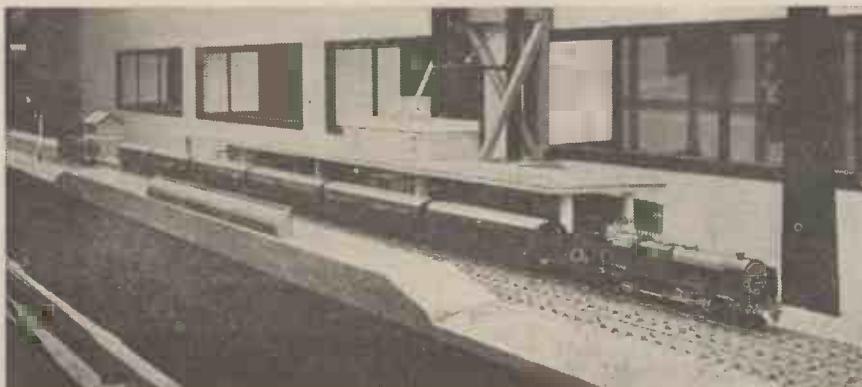


apparatus is fitted, which enables the model pouches (mail bags) to be delivered and collected while the train is travelling at full speed. This operation has been very skilfully reproduced in miniature, even to the ringing of the bell as in real practice.

The model emerging from a tunnel. Note the realistic appearance of the scenery.

quickly with constant wear, can be easily replaced. The gearing is worm and wheel type, the steel worm driving a bronze worm wheel in a gearing ratio of 20-1. The motor brush gear is of a special type with copper carbon brushes and brake section easily renewable. The commutator is of phosphor bronze and the lubrication of the motor is a special feature. Small tubes are laid to each of the parts needing lubrication and these are carried into a receptacle in the dome, and the motor can therefore be properly oiled from the outside through a small hole in the dome. The control and operation of the model is from a signal box near the station, where the controller and resistance are housed. The signals are of standard upper quadrant pattern.

This attractive model was first seen at Radiolympia, and during the short period the exhibition was open attracted many thousands of spectators, and the locomotives ran a distance of over 125 actual miles



Showing the model running round the track at this year's Radiolympia.

A CONTROL SYSTEM FOR AN ELECTRIC MODEL RAILWAY

(Continued from page 534, August, 1934, issue)

THE next point to be dealt with is the sectioning, so that proper shunting can take place. The outer rails will all be joined together for each main section of the layout, but the third rail will be divided into separate sections so that a train can be stopped on any particular line while another is running on adjacent lines. The way in which this can be done was shown in our August issue. The diagram showed how a branch line or siding is wired up to give proper control. The main line is divided on each side of the point, and the third section is formed by the siding. Three single-pole switches are used to make any of these sections "live" or "dead" as required, these being connected as shown in the diagram. By this means a train can be standing in section 1 while another train is run into the siding from section 2.

In order to show which section a switch controls it is a good idea to make the control board a miniature plan of the section which it controls. For the simple example taken in Fig. 3 the control board would look like Fig. 4 (see August issue). By this means the operator can see at a glance which switch to move to make any section "alive."

A Double-way Through Station

The sectioning necessary for a double-way through station is given in Fig. 5—the key diagram on the control board being drawn underneath. It will be seen that there is a separate section at each end of the platform. This is very useful for running the loco round a train when it has brought it up to the platform. Or another loco can be brought on to the other end to take the coaches away while the first loco is still standing at the platform ready to go back to the engine shed. This operation looks very well if the coupling and uncoupling is done automatically. The small lengths of third rail in the cross-overs

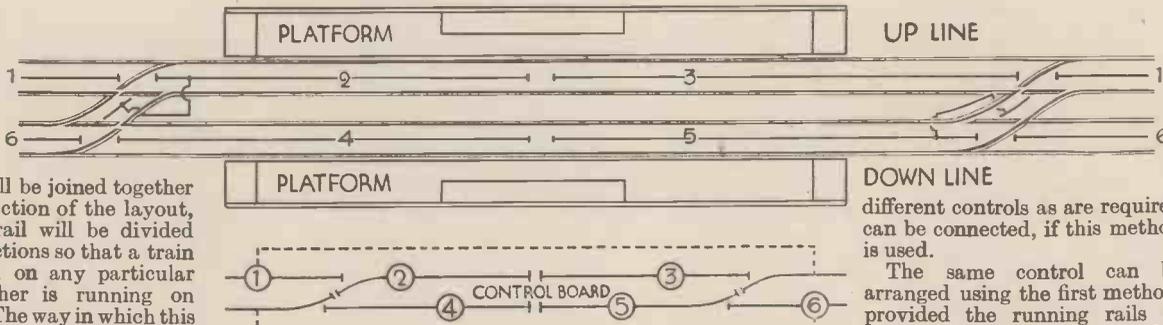


Fig. 5.—Sections for a through station with two trailing cross-overs.

Fig. 6. The positive and negative leads from the battery are taken to each side of a single pole change-over switch, and from there to the live rail through the rheostat. The actual section switches are not shown in this diagram, but are put in between the rheostat and the live rails, as was explained previously.

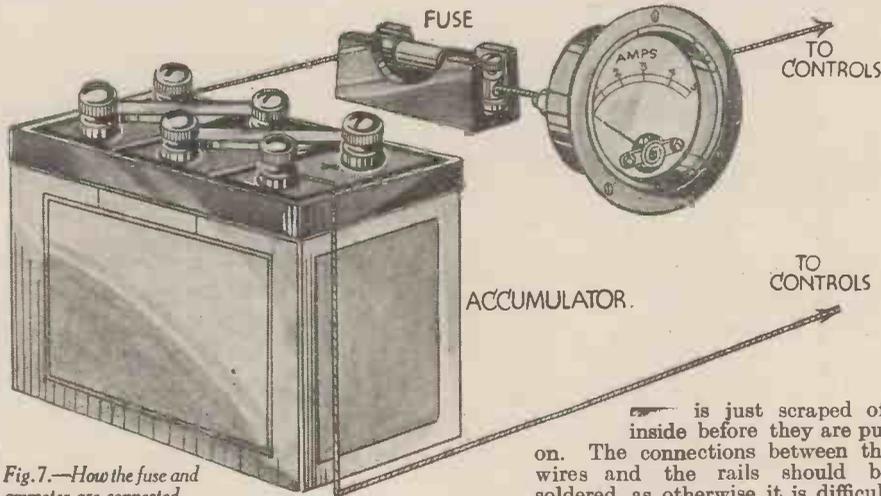


Fig. 7.—How the fuse and ammeter are connected.

A second control is shown in the diagram, and as many

different controls as are required can be connected, if this method is used.

The same control can be arranged using the first method, provided the running rails as well as the third rail are divided into sections. This sometimes makes matters somewhat complicated and does not lend itself to further extensions as well as the 12-volt system, with the centre point taken to the running rails.

Laying Track

Brass fishplates are better than the steel ones, although the latter will do if the enamel

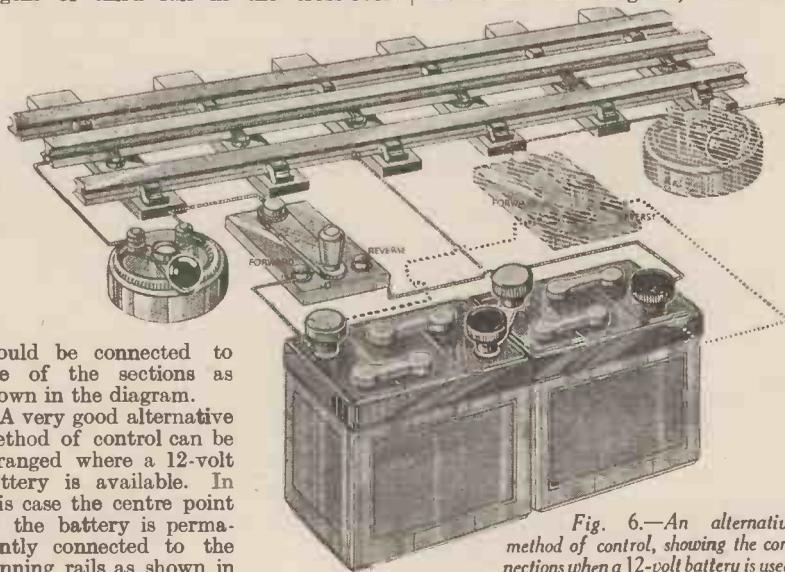


Fig. 6.—An alternative method of control, showing the connections when a 12-volt battery is used.

should be connected to one of the sections as shown in the diagram.

A very good alternative method of control can be arranged where a 12-volt battery is available. In this case the centre point of the battery is permanently connected to the running rails as shown in

is just scraped off inside before they are put on. The connections between the wires and the rails should be soldered, as otherwise it is difficult to get a good contact. In some cases the wire is put under one of the chairs, but this is not really satisfactory, as the contact works loose in time.

Especially where there are a number of points, bonds should be connected across the outer rails, as already shown. These consist of pieces of wire soldered on, so that both the running rails form the return path for the current.

In order to avoid the battery being overloaded it is advisable to fit a fuse in the circuit. This will prevent the battery being run down in case of a short-circuit. This can occur through some metal article getting across the lines or through a derailment. Another useful "gadget" is an ammeter which will tell how much current is being used. The connections for the fuse and for the ammeter are shown in Fig. 7. Both these should be fitted as near to the battery as possible. The ammeter gives a very good indication when anything is wrong, as it will show whether any current is being delivered to the loco, or, on the other hand, whether the current taken is excessive. In the latter case the fault should be looked for and remedied.

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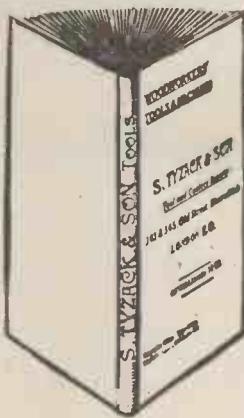
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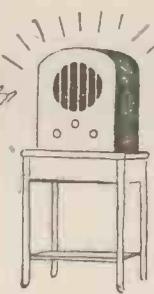
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CHEMICAL REACTIONS AS A SOURCE OF PARTY ENTERTAINMENT

SIMPLE chemical reactions are often turned to good account by the professional magician in the performance of his tricks, and even an amateur can give a short entertainment with a few chemicals, and as such a show usually "goes down" well at parties a programme is worth devising. In our last Xmas issue a complete entertainment was given in detail and those who followed it out will no doubt be interested in further suggestions. It is to be hoped that the following will "fill the bill" when the party flags. For convenience the "Magic" is divided into two categories—Tricks, and Jokes.

The Chameleon Pencil

Effect.—The magician requests a member of his audience to write his name with a copying-ink pencil on a piece of paper which is handed to him. To the amusement of all, the writing turns from purple to green as the pencil passes over the paper.

Explanation.—The paper is damped immediately beforehand with a dilute solution of hydrochloric acid.

Magic Blotting Paper

A sheet of paper is handed to a member of the audience who is invited to write a query on it in ink. The audience gather round the table and see the query written. It is then blotted and on the removal of the blotting paper the question is found to have vanished and in its place is seen the answer!

Explanation.—The trick requires a confederate who writes a question previously decided upon, the answer being written beforehand with an ink made by adding a little potassium iodide to a solution of starch. The blotting paper is well damped with a solution of sodium hypochlorite (Milton disinfectant may also be used). It is advisable for the confederate to linger for a moment over the blotting process in order that the reaction may be complete when the paper is examined.

Snake Eggs

These are always a great favourite with children and consist of small cones which when ignited at the apex disgorge long "snakes"—a curiously voluminous ash which forms as the cone burns away. Formerly these novelties were made of mercuric thiocyanate but as this substance is now deemed too poisonous they are made as follows:—

Potassium bichromate	2 parts
Potassium nitrate	1 part
Icing sugar	1 part

The first two ingredients are finely powdered separately and then mixed well with the sugar. Small paper cones about 1 in. long are tightly packed with the powder and sealed.

Impromptu Dyeing

Effect.—The performer borrows a handkerchief from someone in his audience and to the horror of the owner and the amusement of everyone else drops it into a bowl apparently containing water where it turns black!

Explanation.—The handkerchief is prepared beforehand by soaking it in a solution of ferric ammonium sulphate and then drying. The "water" in the bowl is a solution of tannic acid and the "owner" our old friend the confederate.

Chemical Vegetation

This is an interesting form of decoration and the pretty effects attract a good deal of attention. A little mercury is poured into a glass jar and over it is poured a solution of silver nitrate. After standing a few days an impressive "tree" will have grown. Carrying the idea still further a chemical garden may be produced. A glass bowl or trough is obtained and its bottom covered with a layer of fine sand. This is studded with crystals of the sulphates of iron, copper, alum, magnesium and manganese. A one in four solution of water glass is poured in gently until the bowl is almost full.

After standing undisturbed for a day or so the "garden" will have developed most interestingly.

Ghostly Effect in Darkened Room

Lights are extinguished and the room is suddenly illuminated by a ghostly yellow light imparting to everyone a corpse-like appearance. As this dies away it is replaced by an unearthly green flair and then darkness. After a few moments a gleaming skull appears and floats about in mid-air.

Explanation.—The yellow light is obtained by making a mound of common salt on a plate and soaking it in methylated spirit. It is ignited with a match. The green is similarly obtained, using boric acid instead of salt. The skull is a cardboard "cut out" liberally painted with a solution of phosphorus in olive oil and produced from some place of concealment when the room is in darkness.

Three Mysterious Jars

Three apparently empty jars are shown. The cover is removed from the first and an unlighted taper inserted when it ignites immediately. When transferred to the second jar it burns with intense brilliance and when plunged into the third it is mysteriously extinguished!

Explanation.—The jars are not quite as empty as they appear. They are prepared as follows:—

No. 1.—Contains a little potassium permanganate and a small quantity of hydrochloric acid.

No. 2.—Contains a little potassium permanganate and a small quantity of 20-volume hydrogen peroxide solution.

No. 3.—Contains a little potassium permanganate and oxalic acid solution.

Each is covered with a vaselined glass lid a moment or two after charging, and after the experiment is performed the jars are quickly removed from the room. This precaution must be taken as No. 1 contains chlorine gas. The tip of the taper is soaked in turpentine.



The size of the Scoota-Car may be gathered by comparison with the racing car shown.

MINIATURE CARS

THE small car shown on the right, and known as the "Rytcraft Scoota-Car," is extremely novel, inasmuch as that it is propelled under its own power. It is fitted with a 1-h.p. Villiers engine, having the crankshaft supported in ball bearings. The engine is coupled to a clutch which comes into operation when the engine speed exceeds 800 r.p.m. A small cylindrical fuel tank is fitted sufficient to give nearly eight hours' running at full speed. The car's maximum speed is 15 m.p.h., and it costs £70.

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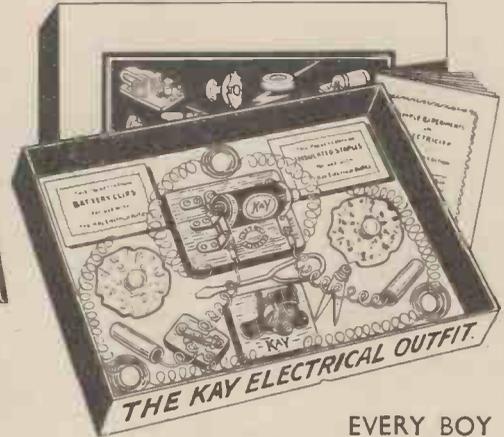
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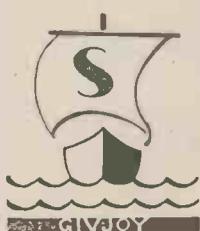
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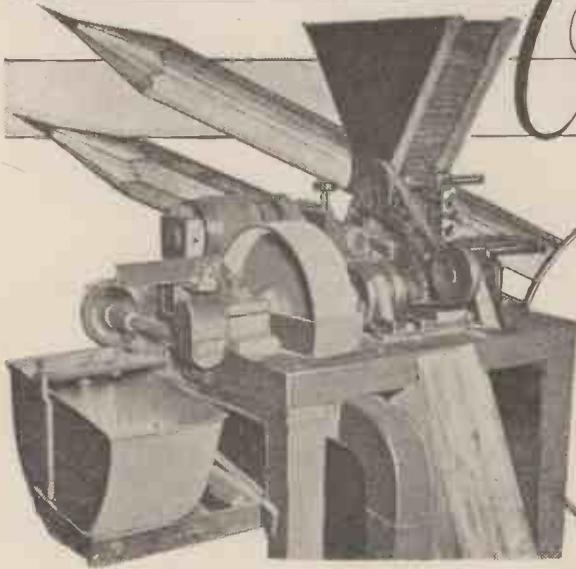
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The MANUFACTURE OF

Cedar Wood Pencils



The machine for glass-papering the surface of round pencils.

Expressing one's thoughts and words by means of signs and pictures dates back to the dim past. Pencils were invented and perfected for writing and drawing

greatly improved their manufacture and is followed in principle even to-day. The raw graphite was cleaned by washing, and then, by filtering and kneading, a dough was obtained which was mixed with clay that had been treated in a similar manner. The graphite was then ground in a mill, and from the substance thus obtained, soft sticks were moulded. After a special treatment these were used for the manufacture of lead pencils. Thus at last a usable mixture was obtained, whilst a large quantity of the graphite, which had become expensive at that time, was saved.

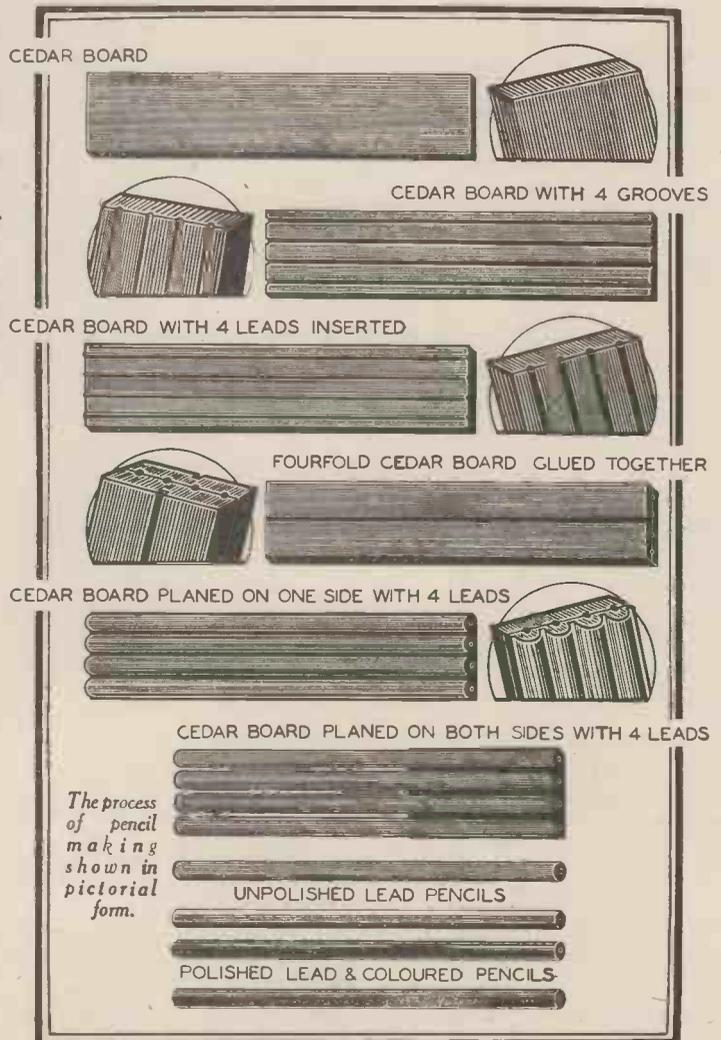
The First Process

"Lead," of which graphite and clay are the principal ingredients, is the main factor of the lead pencil. The raw material is first subjected to a most careful refining process, and after thorough washing and chemical cleaning, the raw materials are carefully mixed and the whole substance is reduced to a consistency of thick cream by adding water. All inequalities are then

THE lead pencil of to-day is by far the most used writing and drawing medium, and yet it is scarcely five hundred years since its first practical manufacture. Prior to this, however, an instrument was found in ancient Greece which, if one considers the purpose for which it was used, can be looked upon as a forerunner of to-day's lead pencil. This was a flat lead disc which was used for ruling the papyrus rolls and was called "Paragraphos," while the Romans had a similar disc under the name "Praeductal," or more commonly "Plumbum." The real forerunner of the lead pencil in its present form appeared, judging by historical notes, only in the fourteenth century, and chronicles of this time report that the celebrated Dutch painter, Jan van Eyck, made drawings on chalked paper with an implement similar to the lead pencil, while in Italy it is proved that sticks made out of a mixture of lead and zinc were used

for drawing at the time of Michael Angelo. In Germany they were called "silver style" (a name also used in Italy), and it is recorded in history that drawings with such sticks were made on planed firwood covered with calcined bones.

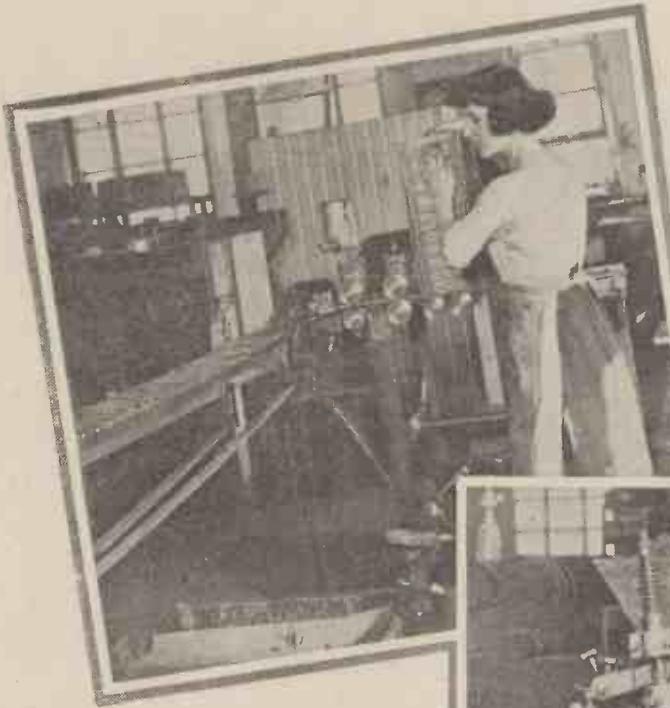
A considerable time elapsed, during which various forms of pencil were produced, but it was not until the end of the eighteenth century that a process was discovered which



The process of pencil making shown in pictorial form.



Grinding graphite mixture into paste form.



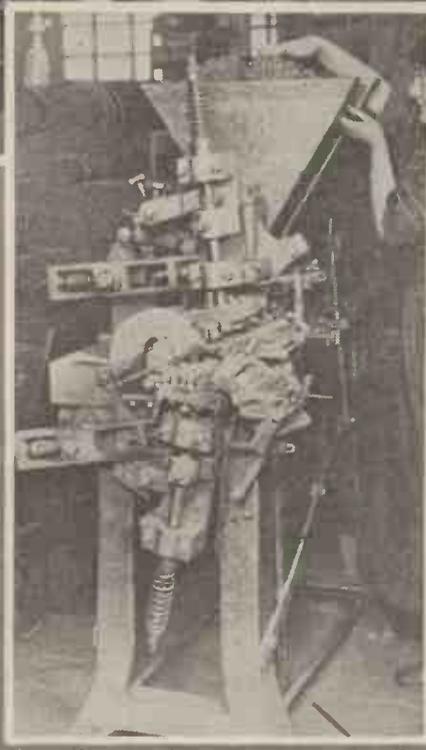
The automatic colouring machine. Pencils are carried on a slow-moving endless conveyor on which they rest separately whilst drying.

eliminated by grinding the substance in lead mills. This process takes weeks, and in the finer grades of pencils it is as long as two months before a sufficient degree of refinement is obtained. When sufficiently refined, the lead is passed through a filtering process which drains off the water and leaves the cakes of lead sufficiently solid to permit of handling. These cakes are then stored in underground vaults until required.

To obtain the leads for the pencils, the cakes of mixed graphite are placed in a cylinder with an opening of the required diameter in the bottom. Hydraulic presses are then brought into operation and the lead is forced through the hole in long threads. The threads are then placed on boards and cut to the required lengths. Durability and hardness are obtained by baking, the leads being packed in air-tight crucibles and placed in furnaces, where they are left for varying periods.

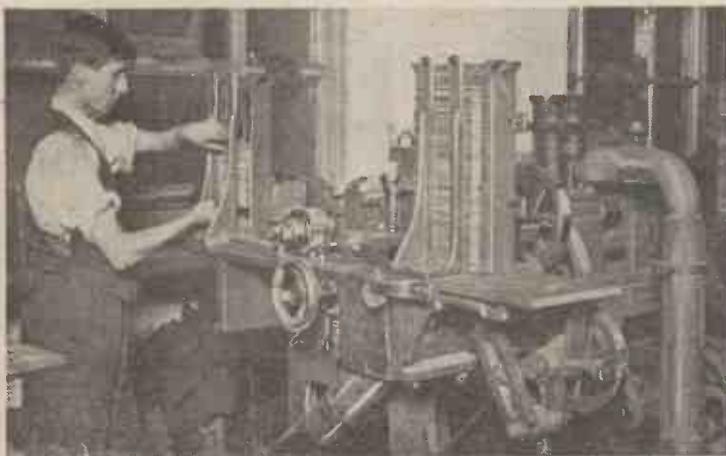
The Saw-mills

The wooden casing for the manufactured lead is made from American cedarwood, which is cut into slats, the thickness of half a lead pencil and the length of the pencil. This is used for the best quality type, but in the cheaper grades it has been found possible, after special treatment, to utilise home-grown wood, thus conserving the supplies of cedar, which are steadily becoming exhausted. After leaving the saw-mills, the slats are examined and sorted according to quality and softness of the wood, and then taken to the grooving department. Here grooves to accommodate the lead are rapidly cut by machinery. On an average there are six grooves in each board. They are then sent to the gluing room, where the grooved boards are thoroughly coated with glue. The leads are then inserted



Automatic machines for stamping the name, degree, brand, etc. This machine will stamp both sides simultaneously.

and covered with a correspondingly grooved board. After being in presses for



The machine for grooving cedar slats.



An automatic friction polishing machine with drying apparatus.

some hours the boards are trimmed to exact lengths and cleaned on a grinding machine.

The Planing Room

The shaping of the pencils, hexagonal, round, etc., is done by machine planes. The glued boards containing the lead are automatically run through the machines and come out in the form of pencils ready for polishing. Sandpaper is used to obtain a thoroughly smooth surface, and the pencils are then coated with the required colour and run through the polishing machines from seven to fourteen times, according to the quality of finish required. They then enter the cleaning and pointing room, where the polished pencils are carefully cleaned at both ends, and, if required, pointed. The general appearance is next examined, and any that are imperfect are rejected.

The Finishing Process

Finally, the pencil arrives at the stamping room, where the imprinting is done by machinery and by hand. Cheap and medium qualities are stamped in silver, gilt or blank by machinery, but the finest grades are done by hand with real gold. After every pencil has again been examined to ensure the standard of quality they are packed in various ways ready for dispatch to the customers. The sketch on the previous page shows the process of lead pencil making in pictorial form. Two cedar boards are first grooved as shown, the leads are inserted and the two boards are then glued together. The four pencils produced are separated, and they finally finish up polished and stamped as depicted at the foot of the illustration. We are indebted to Messrs. A. W. Faber, the well-known pencil manufacturers, for the above information.

THE GHOST AT THE PARTY

A simple but effective method of producing a real talking ghost at the Xmas party. For illustration of the complete scheme see the cover illustration of this month's issue.

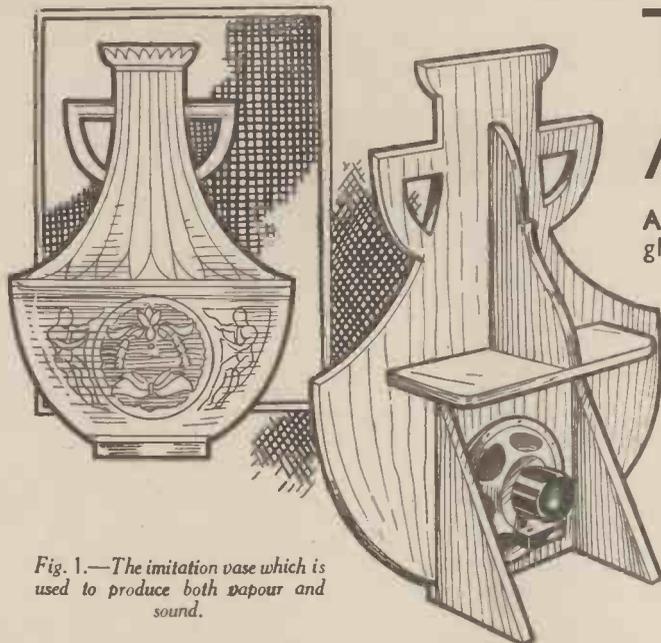


Fig. 1.—The imitation vase which is used to produce both vapour and sound.

NO real Xmas would be complete without a ghost, but it is sometimes rather difficult to get a real one to walk at the required time. Here, however, is a method by which not only will the ghost walk, but he will answer questions about the past, present and future, and provided the party spirit is of the required kind, everything should go well. The simplest method of producing the ghost is to use a rather heavy cloud of vapour, and to project on this, by means of a cinema film, a fairly good ghost picture. Drape yourself or a friend with a good white sheet, but make the eyes or other desired features very much heavier than would normally be necessary by means of grease paint. This is desirable as certain details will be lost on the vapour screen.

Use one of the modern home cinemas to take a fairly long strip of film of the ghost moving in a really ghostly manner, and have this piece developed and join it up for continuous projection. The method of carrying out this part of the procedure will depend upon the particular projector which is employed.

The Magic Bottle

The ghost should appear from a magic bottle and this is cut from plywood, but is flat in shape. The method of building it up is shown in Fig. 1. A loud speaker forms the stand, and a hole is cut to permit the sound to come through; the material covering the hole being afterwards worked into the design of the bottle to complete the illusion of a pattern. At the rear two shelves are provided for the purpose of holding the vapour-producing

vessels. These may take many forms. A dish of hydrochloric acid and one of ammonia placed side by side will form volumes of vapour, but it is rather pungent. The two vapours must be mixed, and one way of doing this is to place a saucer of the spirits of salts on one shelf and the saucer of ammonia on the other shelf. The vapours will mix and give off a dense smoke. Alternatively, damp blotting paper if lit will give good but brief volumes of smoke, although it is advisable to avoid real fire if possible and to rely upon chemicals. The lead from the speaker may be taken beneath a convenient carpet.

The Projection Box

Behind the seats for the audience a screen should be fitted up and in here must be the projector, a microphone and a suitable amplifier. Also a control for the lights of the room will be desirable should some member of the audience be frightened and a sudden light become necessary. Before the actual production, some experiment should be carried out with a view to finding the type of lighting which will produce the most effective ghost. Probably a green bulb or glass screen arranged in one corner will make the atmosphere sufficiently weird to heighten the illusion, and about 15 watts is the maximum which should be used, and this must be well screened from direct rays.

The Production

The whole scheme is now apparent. Arrange the bottle near one wall, the audience being situated between it and the projection box. Extinguish all lights, and then through the mike and amplifier make a suitable "ghostly" speech, dropping the voice in order to produce a deep unrecognisable tone. Then bring on the green light and at the same time project the ghost on to the vapour. The effect should be very good, as the darkness preceding the production sets all nerves tingling and practically anything will be taken for a ghost, especially when the green light accompanies it. As soon as the vapour cloud is sufficiently large, start the projector and endeavour to keep the ghost from this on the vapour. If the original picture was taken with a light enough sheet, the vapour will appear to form the ghost and any outside the actual figure will be lost in the green light. The effect is most realistic. Then the ghost may be asked questions and suitable replies may be made by the operator. If it is desired to prolong the display, some arrangement should be made for a second supply of vapour, as it does not last a great length of time. Keep windows and doors shut whilst the display is proceeding to avoid draughts dispersing the vapour, but open them immediately afterwards to clear

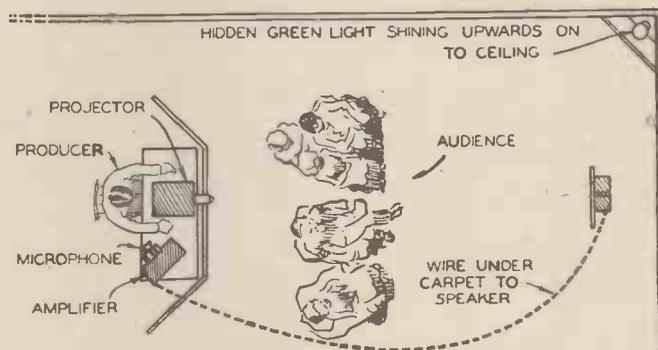


Fig. 2.—The arrangement of audience and projector for producing ghosts.

the fumes. Remember that if you use ammonia it may set the eyes smarting and therefore only a short display should be given.

War at Sea

A sketch of two warships in action is made on thin paper. To the centre of one a trace of photographic flash powder is attached with a little gum. A line is painted with strong solution of potassium nitrate between the powder and the gun of the other warship. When dry the paper is placed on a plate and the gun "fired" by applying to it a red-hot needle. The "shot" quickly travels to the other ship, which explodes with a flash.

The Ink Joke

Consternation at the party when an over-

SIMPLE AMUSEMENTS

turned inkwell and a pool of ink are seen on the tablecloth. After enjoying the situation for a moment the culprit picks up the "pool" of ink and puts it in his pocket!

The "ink" is made by soaking gelatine in water for an hour, transferring it to a pan, melting it by gentle heat, adding a little black dye, and finally pouring it out in an artistic pool on to a piece of greased glass where it sets.

The Tantalising Wineglass

The joker offers a glass of wine to his victim, who after vainly trying to drink it discovers it to be solid!

The "wine" is made in the same way as the "ink" in the previous trick, but dyed red.

The Falling Feathers

The room is full of white feathers which fall thickly upon everybody while the joker smokes his cigarette.

"Meta" solid fuel is the source of the feathers. A small pellet is placed on the glowing end of a cigarette and it slowly sublimes in light, feathery crystals.

THE PICK-UP AND THE PARTY

Some practical hints on the fitting, connection and operation of a gramophone pick-up will be welcomed at this time of the year when many radio listeners are contemplating the purchase of this accessory, either as a normal extension to their existing equipment, or as a Christmas present for the family.

TO fit a pick-up, all that is necessary is to remove the original sound-box from the tone arm of the gramophone and substitute the pick-up. In many cases, however, it is found better to incorporate a special tone arm, this being supplied complete with the pick-up together with

the pick-up must be connected to the grid of the detector valve and provision made for applying negative grid bias to the detector valve so that it may operate satisfactorily as a low-frequency amplifying stage while records are being played.

In receivers employing one or more high-frequency valves, these valves will not be used.

Fig. 1 shows the layouts (but not the circuits) of a number of typical receivers and indicates at what points the pick-up connection should be introduced, together with alternatives.

Whatever the stage at which the pick-up connection is made, one rule universally applies. It is: One lead from the pick-up to grid bias negative and the other wire from the pick-up to the grid of the valve. It is also desirable, but not always essential, that the "normal" connection to the grid of the valve should be broken when the pick-up is in use. In Fig. 2 A and B, diagrams are drawn to help make these clear. It shows the theoretical connections of a pick-up to a detector valve and to the first low-frequency valve in a battery-operated receiver. In the case of A.C. mains sets where automatic grid bias is provided, the arrangement is slightly different, but we will discuss this later.

A Pick-up Adapter

The very simplest method of making the connection and one which calls for no alteration of the wiring whatsoever, is by means of a piece of apparatus known as a "pick-up adapter." This is a plug having four pins in the base corresponding to the four sockets in the top to take the pins of the detector valve. Two terminals are provided at the side, and to one of these, usually marked "pick-up" or "grid," one wire from the pick-up is connected.

The other wire from the pick-up is joined either direct to the correct tapping on the grid bias battery, or in the case of certain detector valves which are operated at a low anode voltage and therefore require no grid bias when used as an amplifier, the second pick-up wire is connected to the second terminal of the adapter.

To fit the adapter, all that is necessary is to pull out the detector valve, insert the adapter with the

pick-up connections made in the detector valveholder, and replace the detector valve in the top of the adapter. Fig. 3 shows the adapter with the appropriate connections for this purpose.

It is far better to have the pick-up leads connected permanently to a pair of terminals at the back of the receiver and to install a switch somewhere in the set to make the

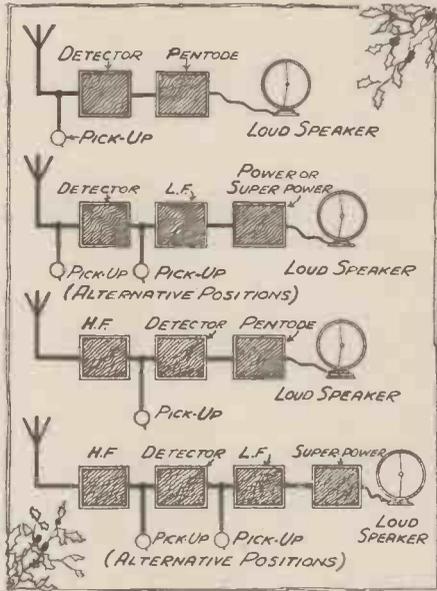
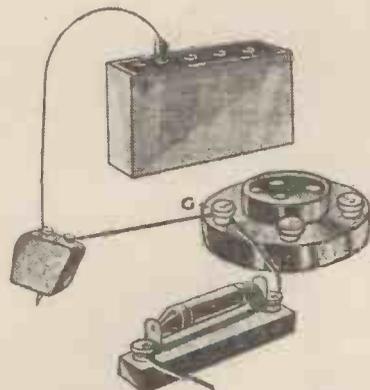
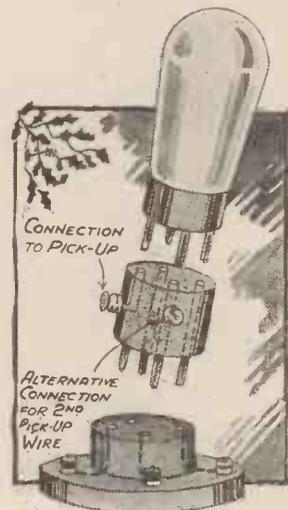


Fig. 1.—Diagrams showing various methods of connecting a pick-up.

fully instructions for mounting. The difficulty, for the amateur, usually lies in the method of connecting the pick-up to the receiver.

If a receiver employs two low-frequency stages after the detector valve, both these stages should be used for the pick-up, and the pick-up connection must be made to the grid circuit of the first low-frequency valve. How this connection is made we shall see later.

Many modern receivers, especially those employing a pentode output valve, have but one low-frequency stage. In such cases,



Figs. 3 and 4.—(Left) A simple plug-in adapter, and (right) How bias is applied through the pick-up.

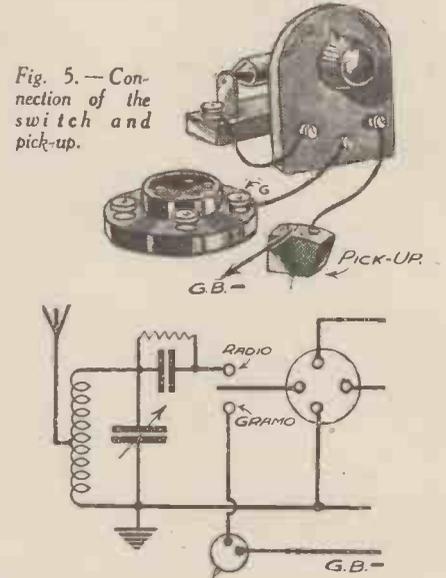


Fig. 5.—Connection of the switch and pick-up.

changeover at any time without the inconvenience of making additional connections or groping about inside the set. To those readers who contemplate the use of a pick-up for their Christmas festivities, it is preferable for them to make the slight alterations at the present time so that no

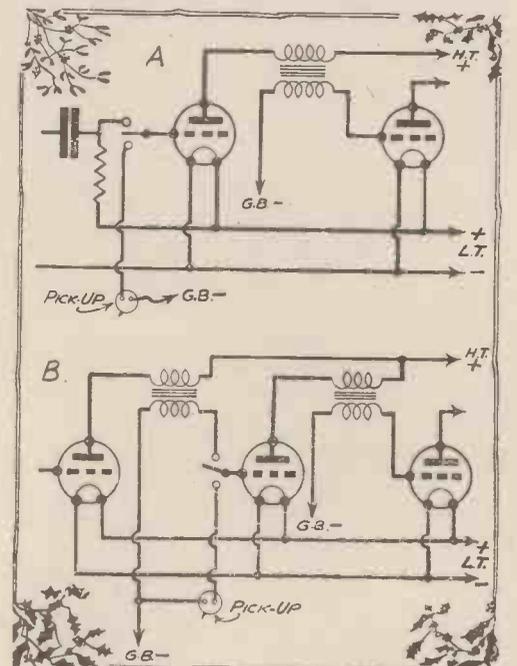


Fig. 2.—Two methods of fitting a pick-up switch.

delay will occur during the festive season when the pick-up may be required at very short notice. As a temporary measure, one lead from the pick-up can be joined direct to the grid of the valve (detector or low frequency, whichever is being chosen as the first stage of the gramo-amplifier) as indicated in Fig. 4.

Pick-up Terminals

If possible a pair of terminals should be fitted to take the pick-up wires. One of the

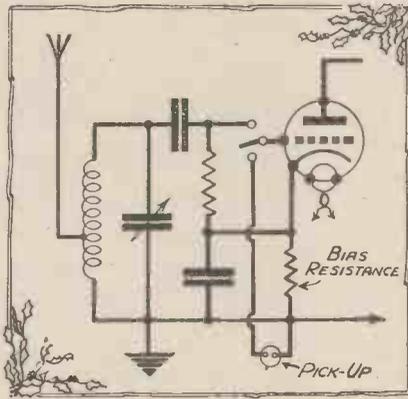


Fig. 6.—Biasing an indirectly heated valve.

many neat terminal mounts designed to accommodate two terminals may be fitted to the baseboard at the back of the receiver.

Pick-up Switch

A good many listeners make a very neat job by fitting a small compact changeover switch of the push-pull type on the terminal strip of their sets. Sometimes it is possible to cut a slot at the back of the receiver and insert a small plate of ebonite to carry both

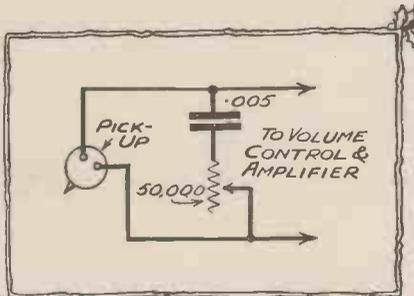


Fig. 8.—A circuit for a scratch filter.

terminals and switch. Failing this, a switch may be mounted on a small sub-panel inside the set carried by brackets from the baseboard or from the side of the cabinet.

Types of Switch

Any form of single-pole change over switch (see group in photograph, Fig. 9) is satisfactory, but the best is undoubtedly that of the "snap" variety. If the switch is to be mounted on a metal panel, see that the switch is of the "bushed" type.

As an alternative to a switch, a plug and jack may be employed. This should be of the "two circuit" type.

Switch Connections

Fig. 5 shows the theoretical connections for a switch to insert a pick-up in the detector grid circuit.

This arrangement holds good for battery-operated sets and also for A.C. mains receivers where battery bias is employed. If, however, it is desired to use automatic bias for the detector valve, the connections are rather different and are as indicated in Fig. 6.

The grid wires should pass to the switch in such a way that there is no risk of coupling between the grid wire and other parts of the circuit. This is of special importance in A.C. mains sets in which it is essential that the grid wires are well spaced from the low-tension leads carrying the heating current, otherwise there is a considerable risk of mains hum being induced in the grid circuit and thus upsetting reproduction.

Fitting a Volume Control

The method of control is to connect a potentiometer across the pick-up, the lead to the grid of the valve being taken from the slider as indicated in Fig. 7. The correct resistance for the potentiometer will be between 50,000 and 500,000 ohms. Fig. 8 is a scratch filter circuit.

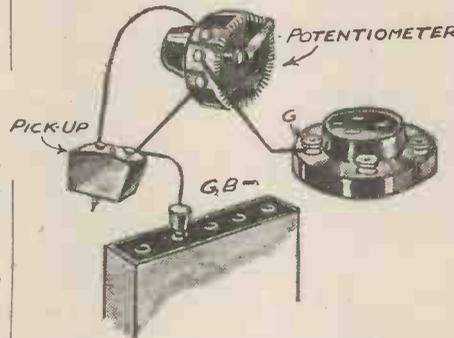


Fig. 7.—Connecting a volume control.

This is desirable if the record is of the quiet type, and the noise of the needle introduces above the item being reproduced. The control is effected by means of the variable resistance of 50,000 ohms. Movement of the arm will govern the frequency of the cut-off and thus enable a suitable degree of extinction to be given to the scratch without seriously affecting the reproduction of the higher notes of the music.

A Hint

Many of the more sensitive pick-ups have the needle arranged in such a manner that it is possible to hear quite loud music or noise direct from the instrument. Thus, if it is placed upon a record without switching on the amplifier, it is possible almost to hear the material on the record without any further amplification. A sort of chatter arises with this type of pick-up, and may sometimes intrude above the noise from the speaker. To obviate this, a lid should be fitted to the gramophone or radio-gramophone, and it should be lined with felt.

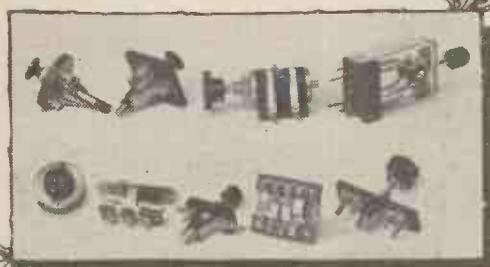


Fig. 9.—A representative group of suitable switches for pick-ups.



ALFRED J. BRITON,
Britain's Prominent Physical Director, Founder of "Health and Physical Culture" Magazine.

MAKE THIS TEST TO-NIGHT!

BEFORE you hop into bed to-night try this: Strip down to your birthday suit and stand in front of your mirror. Look yourself over. What do you see? A fine upstanding specimen of a MAN, splendidly proportioned, superbly muscled, glowing with health and vitality? Or do you see a flabby, sickly sort of fellow, with sunken chest, bloodless-looking flesh, scrawny arms, neck and legs?

What I can do for you in just 30 days

In the first 30 days I guarantee to add one whole inch of real live muscle on each of your arms, and two whole inches of rippling strength across your chest. I'll take the kinks out of your back, strengthen and broaden your shoulders, give you wrists of steel, and a fighting, powerful personality that just yells youth, vigour and vitality all over. I've done it for hundreds, and I can do it for you!

I want you for 95 days

WHAT I will have done for you in 30 days will be nothing to what I shall do for you in 95 days. I am not called the "Man-Maker" for nothing. My system scientifically builds real muscle faster than you ever imagined. I'll make you a healthy, forceful, red-blooded he-man. I not only say this—I'll guarantee it!

"The Secrets of Muscular Strength"

THE GREATEST BOOK OF THE CENTURY IS FREE!

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500 FREE BOOKS—POST NOW

ALFRED J. BRITON (Dept. P),
8 Broadway, London, W.6.

Please send me absolutely FREE a copy of your latest book, "The Secrets of Muscular Strength—and How To Acquire It."

NAME.....

ADDRESS.....

Enclose two 1½d. Stamps for Postage. Dec. 1934.

SOME SEASONAL SUGGESTIONS

THE problem of what to buy for Christmas is an annual one which causes considerable thought, for not only are manufacturers producing a greater variety of goods from which to select, but



The combined model railway unit and battery charger made by Messrs. Heayberd & Co.

prices are so low that the range of suitable presents has been considerably expanded. If you are at a loss to know what to buy, a glance through the advertisement columns of this paper may help you over your difficulty. The following suggestions have been selected at random, and most of them are obtainable for a small outlay.

A Unit for Model Railway Working

If you wish to obtain best results from your working models, you should run them from the mains. Messrs. Heayberd have introduced two new rectifier units particularly suited for working models which can also be used as battery chargers if so desired. The output is 12 volts at 1½-5 amperes. Tappings can be made at 2, 4, 6, 8, 10, and 12 volts; current regulation



The pocket-model humatagraph described in the text.

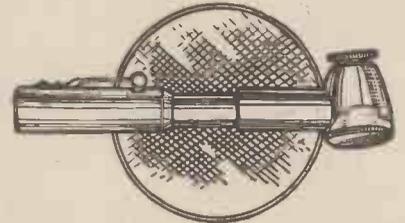
being by variable control and ammeter. The unit is fitted with rubber feet, thus ensuring perfect safety. Although marketed at £5 17s. 6d. it is definitely value for money.

A Pocket-model Humatagraph

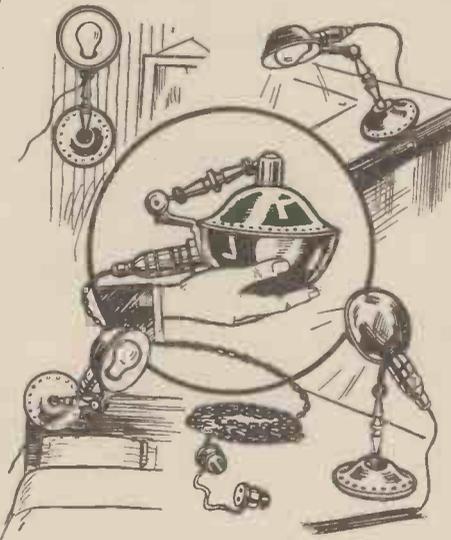
Sometimes the weather seems muggy, close, and uncomfortable; this is largely due to the moisture in the air. On other days it is fine and exhilarating. Perhaps you have a thermometer to tell you how

hot or cold it is, but in a scientific age every one is glad to dispense with "rule of thumb" methods and obtain correct information. The small accurate pocket hygrometer shown will give you what you want. The instrument is so sensitive that if it is held between the palms of the hands for two minutes it will be affected by their moisture and go over several points. This device introduces a new feature in registering hygrometers, as it can be whirled and gives very quick results. A folding arm or whirler is provided which enables the operator to secure the rapid movement of air over the sensitive absorbent fibre in the instrument and thus determine the humidity of the air in a few minutes. A few seconds' rapid whirling will give a very accurate reading. It can be obtained in a plush-lined leatherette case for 14s. 6d. and the folding pocket whirler costs 5s. 6d. It is also obtainable without a case at 12s. 6d., and a chromium-plated pocket model in a

ticular lamp can be used in a number of different positions, clamps anywhere, bends in any direction, and when packed as shown in the illustration, it takes up very little space. Its price is very moderate, being only 18s. 6d., which includes a neat torpedo switch and 3 yd. of the best silk



This pocket magnifier provides illumination for the object to be viewed under the magnifying lens incorporated in the head of the instrument.



Showing the various positions in which the "chummy" lamp can be placed.

flex. It is also fitted with the latest type of universal adaptor for connection either to a wall plug or lamp socket. The lamp has a beautiful copper-oxidised finish and any standard 15 or 25-watt bulb can be fitted. It is sold by Messrs. A. W. Gamage Ltd.

An Illuminated Magnifier

Most readers know that there is hardly any novelty in a pocket magnifier as there are a considerable number on the market. That shown on this page, however, is both ingenious and novel and will make an acceptable gift. This device provides illumination for the object that is to be examined under the magnifier. By placing it to the eye and pressing on the clip, light is thrown on to the object so that it may be examined when the light is rather dim. It is sold by A. W. Beck & Sons, and costs 21s.

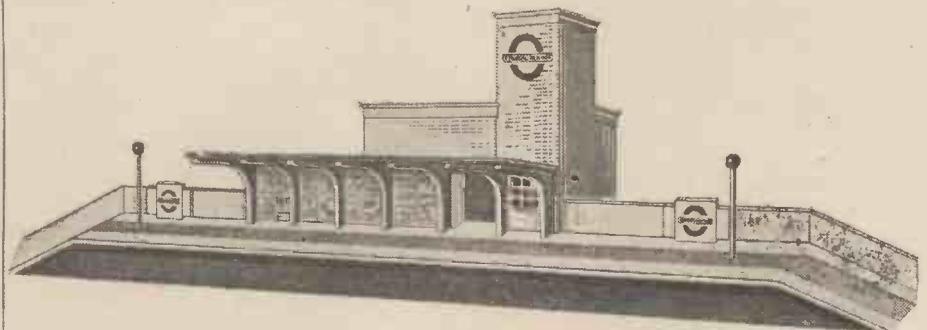
Realism in Models

The name of W. J. Bassett Lowke (the well-known model makers of Northampton) is synonymous with high-grade realistic models of every description. The model railway station shown at the foot of this page will look well in an O-gauge layout, and the design incorporates all the special features of the new overground stations of the underground railway. The length of the platform is 52½ in., is 3½ in. wide, and the height to the top of the tower shown is 9½ in. The size of the main building is 11 × 4½ in., and the covered portion of the platform 21 in. It is priced at 25s. and will no doubt be appreciated as an acceptable gift by younger readers.

case for 17s. 6d. Its novelty makes it an acceptable present for Christmas.

The "Chummy" Lamp

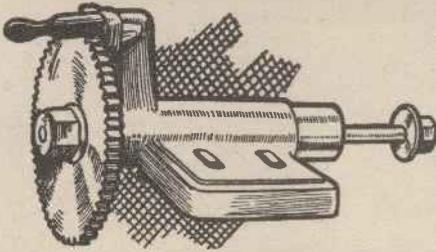
Reading lamps generally find favour during Christmas time, and a glance at the illustrations shown in the centre of this page will give you a rough idea of the amazing possibilities of a multi-purpose type of lamp of this character. This par-



The realistic model railway station made by Bassett Lowke Ltd., of Northampton.

An Acceptable Gift

What better Christmas gift could you give than Success and Prosperity? Imagine the satisfaction of knowing that the recipient would be grateful to you for the rest of his life for having given him the

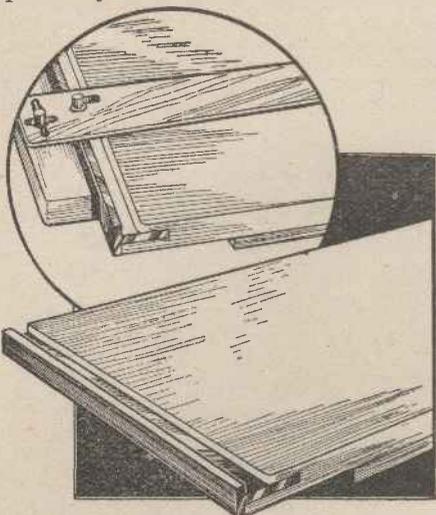


An accessory for the lathe marketed by T. Senior, of Liversedge.

opportunity of qualifying for a well-paid position in the Radio Industry. If you have any relative or friend who is interested in Radio, offer to pay the very reasonable fee or first instalment for a Correspondence Course of Training in Radio, as offered by the TECHNICAL AND COMMERCIAL RADIO COLLEGE. The T.C.R.C. specialises in Radio training, and in addition to giving its students a very thorough and up-to-date knowledge of the subject, also teaches them how to earn money in their spare time, as well as helping them to find employment should they require it. Perhaps you may be interested on your own account? In any case, why not send for a free copy of their interesting prospectus? The address is: To The Principal, The Technical and Commercial Radio College, Cromwell House, High Holborn, London, W.C. 1.

For the Mechanic

No doubt you have a number of friends interested in lathe work, and the improved wheel-cutting attachment shown will prove a very satisfactory present. This device is intended to be used in conjunction with the vertical slide made by T. Senior, Atlas Works, High Town, Liversedge, by fastening to the slotted table of same, which is fixed at right angles to the lathe centres in which the cutters revolve. The division plates have machine-cut teeth and are accurately divided; one mandrel and one division base are included with each attachment. It sells at 20s., $\frac{1}{16}$ in. spindle diameter; 22s., $\frac{3}{16}$ in. spindle diameter; and 25s., $\frac{1}{4}$ in. spindle diameter. This vertical slide is also made by the firm previously mentioned.

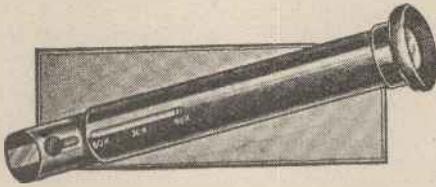


An ingenious gun-metal edged drawing board and clamping T-square.

Books for Christmas

A book that will be fully appreciated by your friends is the new revised and improved 1934 edition of "Henley's Twentieth Century Book of 10,000 Money Making Formulas, Processes and Trade Secrets," published by the Scientific Commercial Publishing Co., Artillery House, Artillery Row, S.W. 1. It is impossible to estimate the value of this wonderful book which cost a large sum of money to compile and it can easily be worth £25 upwards each week to any ambitious man or woman. The formulas of this book are relative to every kind of business and will show you how to expand your trade and increase your turnover.

A four-volume work by the Waverley Book Co. Ltd., 96/7 Farringdon Street, E.C. 4, is also to be recommended. It tells you how to do, how to make, and how to repair hundreds of jobs. By sending $\frac{1}{2}$ d. stamp to cover postage to the above firm,

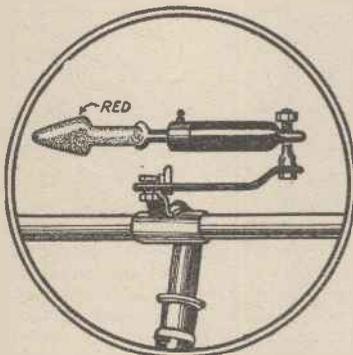


A pocket magnifier marketed by W. F. Stanley, of Holborn.

you will receive a free booklet giving you details of these volumes should you desire to purchase them.

A Vest Pocket Microscope

The simple little microscope shown on this page satisfies the demand for an instrument giving a greater magnification than any pocket lens can give without the disadvantage of bulk and expense inseparable from the simplest of standard microscopes. The instrument can be adjusted for three different magnifications—40, 50 and 60—a range which makes it suitable for a great variety of purposes. It is marketed by



Most cyclists will appreciate this illuminated direction indicator which fits on the handlebars of the cycle.

W. F. Stanley & Co., 286 High Holborn, W.C. 1, at 17s. 6d., and can also be obtained in a soft leather case for 1s. 6d. extra.

Every draughtsman will appreciate the great accuracy and convenience of the Stanley gun-metal edged drawing board and clamping T-square. The T-square slides in the usual manner on the edge of the board, but may be instantly clamped in any position by a cam sliding in a groove. It is sold in various sizes, the prices ranging from £1 to £3.

For the Cyclist

The cycle director illustrated indicates, as with a motor car, the direction in which the

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Johnson's Court, Fleet Street
LONDON, E.C.4



Run Your Models from the Mains

if you wish to obtain the best results from your working models, run them from the mains. Heayberd have introduced two new Rectifier Units for Model Railway Working. Fitted with Rubber Feet, ensuring perfect safety.

Model T.V.5. Output 12 volts at 1 to 5 amps. Tappings: 6, 8, 10 and 12 volts. PRICE **£5 17 6**

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Model 22c. Output 15 volts at .5 to 3 amps. Fitted with Special Forward and Reverse Switch, and Centre Zero Ammeter. PRICE **£5 17 6**

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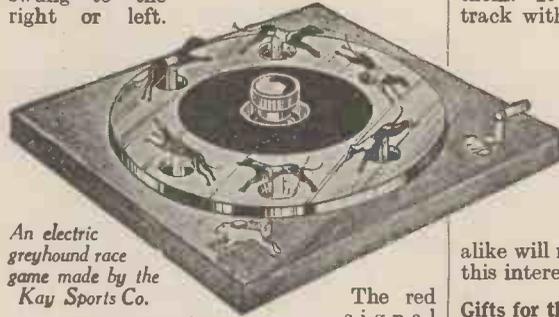
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F. C. HEAYBERD & CO.
 10 FINSBURY STREET, LONDON, E.C.2.

cyclist is about to turn, the indication being by means of a red light. It fits under the expander bolt or on the handlebars, and is swung to the right or left.



An electric greyhound race game made by the Kay Sports Co.

The red signal

lights automatically. It is a Pifeco product and costs 4s. 6d., finished matt black with nickel-plated fittings.

For Young Scientists

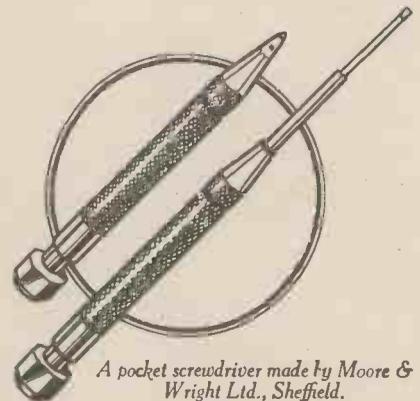
A really suitable gift and one that will give endless enjoyment and instruction to any intelligent boy, is a Lotts Chemistry or Electricity set. In the chemistry sets are all the necessary chemicals and apparatus for performing hundreds of experiments with colour changes in liquids, secret inks, crystal formations, evolution of gases, fire-proofing, oxidation, dyeing, bleaching and coloured fire. The electricity sets contain materials for constructing instruments and models such as a buzzer, relay, electrically operated railway and traffic signals, gold-leaf electroscope, electric motor, etc., with which a remarkable range of demonstrations in magnetism, static and current

amount of fun can be had at a party with this type of machine. The fascinating race game which is also shown is also made by them. It is an electric greyhound racing track with six greyhounds chasing a hare.

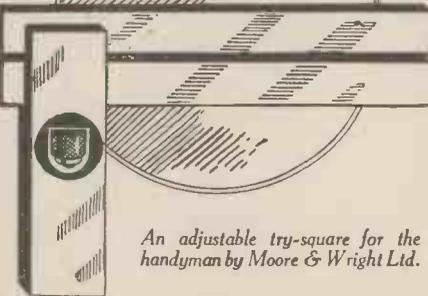
All of the colours flash up as the greyhounds reach the hare and all doubt as to who is the winner is removed because the colour of the winner will remain illuminated at the finish. It is, of course, similar in principle to the game of roulette, and costs 10s. 6d. Youngsters and grown-ups alike will no doubt find pleasure in playing this interesting game.

Gifts for the Handyman

If you have any friends interested in carpentry then you cannot do better than send them an adjustable try square similar to that shown herewith. This precision square has all faces ground and hardened,



A pocket screwdriver made by Moore & Wright Ltd., Sheffield.



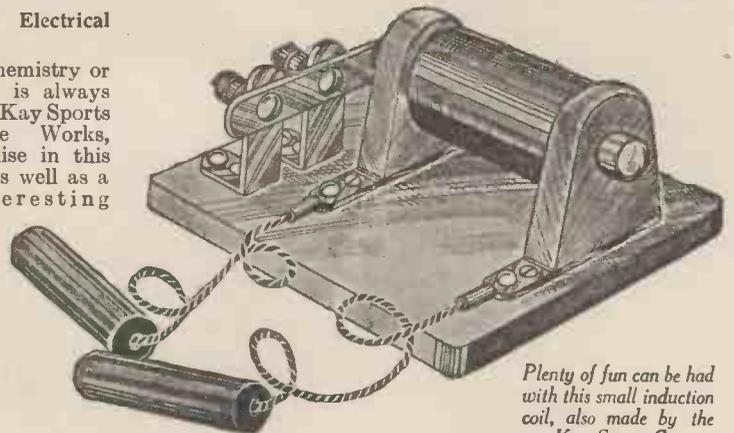
An adjustable try-square for the handyman by Moore & Wright Ltd.

the blade is 4 in. long and the stop 2½ in. It is a very handy tool and has a range of usefulness not possible with an ordinary fixed square. The stock of this square can be instantly set at any position on the blade. It is made in only one size and is obtainable complete with one blade as shown for 8s 6d.. It is also obtainable with a narrow graduated blade in addition to the standard one, which is obtainable for 10s. Another interesting tool is the pocket screwdriver shown, which is made from steel tubing, knurled. The butt of the blade fits a solid block in the tube which prevents it from turning. It is prevented from coming out by a slight turn of the chuck. To carry in the pocket, reverse the blade, insert it in the handle and give a slight turn of the chuck to keep it there. It takes no more room than an ordinary penknife, and the blades are made of best cast steel and are properly hardened and tempered. Costing only 1s. it is wonderful value for money.

electricity can be carried out. Every set, in each subject, has plainly written instructions and explanations by an expert to guide the young scientists along the most instructive and interesting lines.

Chemistry and Electrical Outfits

A gift of a chemistry or electrical outfit is always acceptable, and Kay Sports Co., Pembroke Works, London, specialise in this type of outfit as well as a number of interesting games. The induction coil which we show on this page is also made by this firm and is capable of producing harmless shocks. A considerable



Plenty of fun can be had with this small induction coil, also made by the Kay Sports Co.

REALISM!

The aim of every Model Railway maker is now achieved with the new OO GAUGE. It is possible to construct a scale layout in a limited space.

Our Technical staff are always willing to help you with any railway problems.

To introduce our new G.W.R. Coaches on Solid bodies we are offering during December completed Scale coaches at 9/6 each, post Free. (List 10/6).

Our Showrooms are open from 10 a.m. to 7 p.m. Saturday 10 a.m. to 2.30 p.m. during December. Call or write for lists (post 1½d.) to

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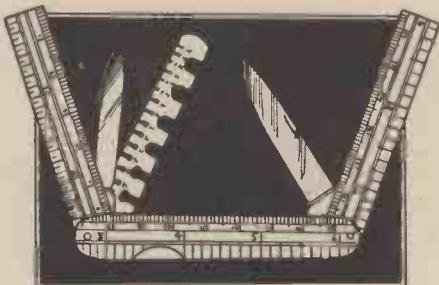
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Sold in 6d. and 1/- tins at all Cycle Accessory Dealers, Tool Shops, Ironmongers, etc.

Write for your free copy "Joining of Metals" to

SIR W. M. BURNETT & CO. LTD. (CHEMICALS)
 GREAT WEST ROAD, Uxbridge, MIDDLESEX

Combination tools are always handy and that illustrated combines a 9-in. folding rule, two knife blades and a wire gauge



A combination pocket-knife, folding rule, and wire gauge.

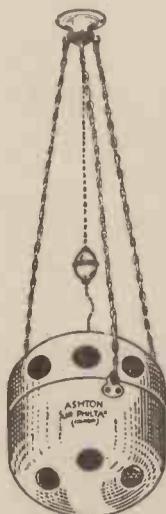
from 4-26 I.S.W.G. Costing only 7s. 6d., it is definitely cheap at the price. All the above tools are made and marketed by Messrs. Moore & Wright (Sheffield) Ltd., England.

Scale Model Aeroplanes

Aviation is very much in the news just now. A considerable interest was shown



The three Comets. A composite photograph made with Skybird models, representing the D.H. Comets entered in the Mildenhall-Melbourne air-race. The winning machine, piloted by Scott and Campbell, is seen climbing.



An air purifier for the home.

in the recent London-Melbourne race which started from Mildenhall Aerodrome on October 20th, and Skybirds have now made it possible for readers to obtain kits of parts for making scale models of some of the aeroplanes that competed in this race. The composite photograph shows models of the three D.H. Comets made with Skybird kits, and the winning machine flown by Messrs. C. W. A. Scott and T.C. Black is seen climbing. You cannot do better than making your friend a present of one of these kits.

Flying Models

Warneford Flying Aircraft, of Greenwich Rd. possess a large stock from

which you can take your choice. The prices of these models range from 1s. 6d. to 5 guineas, and an illustrated catalogue is available free, on request.

A Novel Gift

Whereas the ordinary table electric fans simply fan the air, the new Ashton "Airphilta," which is constructed on scientific principles, purifies and filters the air by passing it through fabric impregnated with substances which absorb and neutralise the

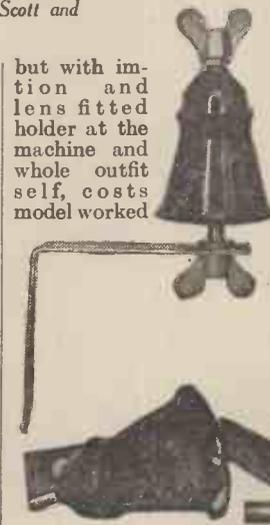


An ideal pocket compass marketed by Messrs. Broadhurst, Clarkson & Co. at the low price of 3s. 9d.

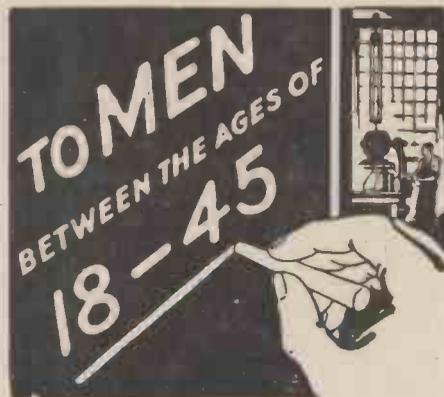
dangerous impurities of the air we breathe. After a process of refrigeration, the air is returned in a cool, fresh, and healthier condition. In addition to this the apparatus frees the air from infection. The deodoriser may be switched on at intervals, as this is a separately controlled attachment and the apparatus may be suspended from the ceiling as shown, or placed upon a table, shelf or wall bracket. The price of this air purifier and deodoriser is £4 15s. Other sizes to order.

Your Own Movie Show

A present that should be in large demand this Christmas is the Bing British Home Cinema. These projectors are not mere toys, and complete safety is assured when using the projector. It is made in a number of models, three working from pocket-lamp dry batteries or accumulators and two models direct from A.C. mains, by plugging into an ordinary electric light socket. One of the battery models with fixed focus taking 15 and 30 ft. films is remarkably cheap at 12s. 6d.,



A bakelite lightning arrester for a wireless set, which is sold complete with a galvanised iron bracket, massive metal parts and a strong bakelite cowl. (Ward & Goldstone.)



Things are happening to-day which vitally affect you!

If you are about 18, perhaps you are getting settled in your chosen work and already feeling the strain of competition for a better position. If you are in the 40's, your family responsibilities are near the peak, the necessity for money is tense—and younger men are challenging your job. And men of the ages between 18 and 45 face similar problems, in one form or another.

The most valuable employment security to-day is the security a man creates for himself—in himself! Through training, he is able to adapt himself to new conditions, to utilise experience without being handicapped by habit! He masters jobs and makes new jobs. He meets emergencies—and is not overwhelmed by them. **And this is an age of emergencies.**

For 43 years the International Correspondence Schools have helped thoughtful and ambitious men to acquire the training they need. To-day with this need more urgent than ever, this world-famous institution offers greater opportunities than ever. Why not permit us to show you the way to greater security and larger earnings? Our expert advice is free. Write to-day.

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Examinations, state which.....

The I.C.S. teach wherever the post reaches, and have a wide variety of courses of Study. If, therefore, your subject is not in the above list, write it here.

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Name..... Age.....
Address.....

59% GREATER PERFORMANCE!

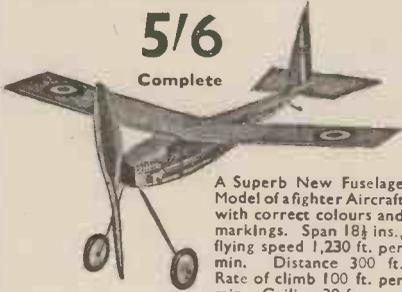
Warneford Aircraft are famed throughout the world for their unrivalled FLYING qualities.

Their design is based on sound, well-proved, aerodynamic principles and they are constructed of first-class materials (no paper is used) by skilled craftsmen. Maximum performance is thus assured.

Warneford Aircraft can loop or roll, and can be successfully flown by novice and expert alike.

At the "Les Ailles" Cup at Paris, Oct., 1934, Warneford's achieved 59% greater performance than any other competitor!

The TERROR 5/6



A Superb New Fuselage Model of a fighter Aircraft with correct colours and markings. Span 18½ ins., flying speed 1,230 ft. per min. Distance 300 ft. Rate of climb 100 ft. per min. Ceiling 30 ft.

The NIPPER 2/6



A full-sized model monoplane with an unrivalled performance at the price. Span 15 ins. Flying speed 1,098 ft. per minute. Distance 550 ft. Rate of climb 160 ft. per min. Ceiling 40 ft.

THIS XMAS GIVE ★ WARNEFORD FLYING MODEL AIRCRAFT

OTHER MODELS 1/6 to 5 gns.

And also these fascinating and instructive

WARNEFORD CONSTRUCTION SETS

Prices 2/-, 12/6 and 35/-

From good Stores and Toy Shops throughout the world. FULLY ILLUSTRATED PRICE LIST, WITH PERFORMANCE FIGURES AND DESCRIPTION OF ALL MODELS, POST FREE ON APPLICATION TO:-

WARNEFORD FLYING AIRCRAFT
(DEPT. P.M.1), GREENWICH ROAD, LONDON, S.E.10

by L. Rees & Co., Ltd., 12 Union Street, London, E.C.2.

For Wireless Fans

If you have any friends interested in wireless, and you are at a loss to know what to buy them, you cannot do better than consult the catalogue of Messrs. Ward & Goldstone.

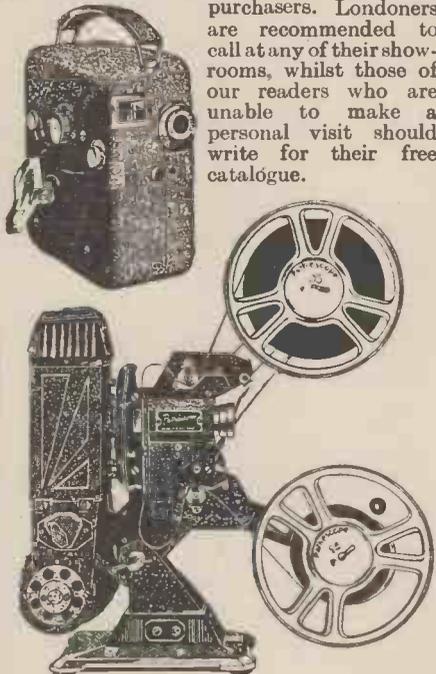


A pedometer for approximately measuring distances by walking, recording from a ¼ mile up to 100 miles, with a nearly zero setting arrangement. It is sold every type of wireless component.

The device shown on page 145 is made by this firm and is a very efficient lightning arrester. As may be seen from the complete and the dismantled apparatus, a small galvanised iron bracket is supplied together with the bakelite enclosed spark gap, and the latter is provided with large wing nuts to facilitate the connection of aerial and earth. The bakelite moulding is in the form of a hollow cowl and the lower wing nut is attached to a heavy gauge brass rod which is screwed into the upper portion of the cowl. The upper wing nut is similarly attached to a piece of rod and this is embedded in the bakelite and is non-rotatable. The ends of both of these rods are finished dead-flat, and before the lower rod is screwed into position, mica discs with a small central hole are dropped through the moulding. It costs 2s. 6d.

Movie Cameras

City Sale and Exchange Ltd., 59 Cheapside, E.C.2, can supply movie cameras, home cinés, photo apparatus of all kinds at rock-bottom prices to suit the needs of all classes of purchasers. Londoners are recommended to call at any of their show-rooms, whilst those of our readers who are unable to make a personal visit should write for their free catalogue.



The City Sale and Exchange Ltd. have a large stock of movie cameras from which you can make your choice.

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WATER COLOUR PENCILS FOR GRAPHS DRAWINGS AND ALL COLOUR WORK

Wonderful effects easily produced in unlimited rich shades of colour.

"AQUARELLO"

24 colours, non-fading. Colours can be super-imposed and blended.

FOREIGN

- 4601/A7. 6 colours and brush - 2/-
- 4601/A12. 12 colours and brush - 3/6
- 4601/A24. 24 colours and 2 brushes 7/-

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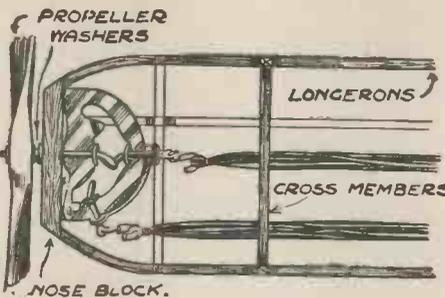
MODEL AERO TOPICS

"Power-driven Model Aircraft"

THE publication of "Power-driven Model Aircraft" at the popular price of 1s. (by post 1s. 3d.) by George Newnes Ltd., 8/11 Southampton Street, Strand, W.C.2, is timely. It is the first and only handbook on this latest and most interesting development in connection with model aircraft. Not only in England, but in Germany, France and America, flights of over thirty minutes' duration have been made with models driven by minute petrol engines. England, fortunately, has pioneered this development. The author of this handbook has done a vast amount of work in the past fifteen years in designing and producing minute engines driven by compressed air, steam and petrol, and it is worthy of record that there is hardly an English-speaking country in which his designs for these miniature power units have not been made. Many firms are now marketing miniature engines, and it would seem that in the near future elastic as a form of motive power will become obsolete. "Power-driven Model Aircraft" contains chapters on Types of Model Aircraft Engines, The Two-stroke Principle, A Three-cylinder Stationary Compressed Air Engine, A Five-cylinder Rotary Engine, A Flash Steam Plant, A Fifteen C.C. Two-stroke Engine, The Ignition System, Carburetters, A Beginner's Compressed Air Model, An Advanced Compressed Air Monoplane, More Advanced Compressed Air Models,

write to this firm for their lists. I can personally recommend the quality of their products.

It is not everyone, of course, who can afford to build a power-driven model aeroplane, for miniature petrol engines are not so cheap as elastic, and it is not everyone who possesses the necessary skill or equipment to make an engine from rough castings. Another point is that, whereas a large field suffices for the rubber-driven model, the petrol-driven model is likely to fly miles out of sight unless an automatic throttle-closing mechanism is incorporated or the petrol supply limited. Elastic-driven models have reached the peak of perfection. Flights of



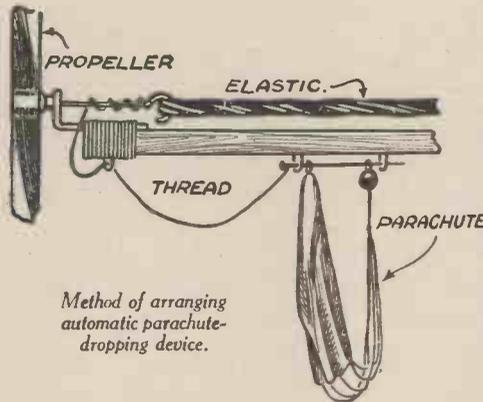
The delayed-action twin motor referred to.

many minutes' duration have been made by spar models and also by fuselage models, but they do not surpass in interest the fascination of the power-driven model.

Developments in America

A great deal of experiment is being conducted in America with the use of delayed action gears. In this system, two skeins of elastic are used, one consisting of a short skein of a comparatively high number of strands, which are wound to about 200 turns to give a burst of thrust so that the model climbs to a fair altitude. When this skein has become unwound, the loss of tension causes it to drop out of place, and in so doing to pull into place a second skein consisting of a smaller number of strands wound to a high number of turns. In this manner, enormous duration may be reached.

Another development with gears which is popular in America, is the use of gearless motors employing links which couple the two cranked shafts, which are hooked at their extremities to embrace the elastic skein. These consume very little power and are probably more efficient than gears.



Method of arranging automatic parachute-dropping device.

Steam-driven Models, Designs for Petrol-engined Models, Wheels for Engine-driven Models, etc. It has no less than 130 illustrations within its 96 pages. It is written by Mr. F. J. Camm, and should be in the hands of everyone interested in model aircraft.

"Elastic-driven Models"

But whilst there has been a remarkable increase in interest in power-driven models, there has been a corresponding increase in elastic-driven models. These have reached a very high standard of perfection indeed, due to the fact that there are now firms supplying high-class material and fittings. Such firms as Model Aircraft Supplies Ltd., of 171 New Kent Road, London, S.E.1, supply everything for the aeromodellist. Accurately machined woodwork, bearings, propellers, wheels, kits of parts, balsa wood, high quality elastic, blueprints; in fact, everything which the aeromodellist needs. They also supply in addition to the complete kit of parts, models completely assembled, and I recommend readers to

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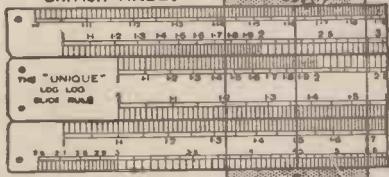
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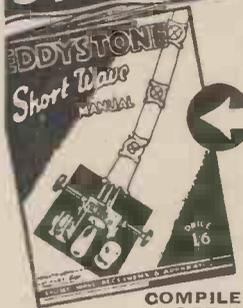


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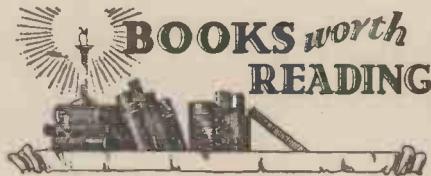


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PUBLISHED by B. T. Batsford Ltd. 5s. Crown Quarto, Cloth-lettered, with Coloured Wrapper. Including Colour Frontispiece and 150 superb Plates in Photogravure. This attractively-produced volume includes chapters as follows: The Quest for Speed, by Stephen King Hall; The Dawn of Flight, by Colonel P. T. Etherton; High Speed in the Air, by G. de Haviland; Four Hundred Miles an Hour, by C. H. Stainforth; Motor Racing and Record Breaking, by G. E. Eyston; What It Feels Like, by Sir Malcolm Campbell; Speed Boats and Racing, by H. R. Scott Paine; Motor Cycle Racing, by James Guthrie; High Speed by Rail, by Cecil J. Allan; Speed on the Ocean Routes, by Sir A. Rostron; Speed in Modern Warfare, by Major-General J. F. C. Fuller, etc. The illustrations naturally form a remarkable feature of this excellent volume, which makes a handsome gift.

History of British Aviation (1908-1914)

By R. DALLAS BRETT. Published by John Hamilton Ltd. 388 pages. 21s. net. This is the most important book on aviation published in recent times, and is a really authentic and accurate record of the inception of British aviation. It tells again the story of the work of such pioneers as A. V. Roe, S. F. Cody, F. P. Raynham, Handasyde, and all of the others who created the industry. The book is packed with incident, facts and figures; it is attractively illustrated and sets the present advanced position of aviation in its true perspective. The contents are excellently and chronologically arranged, and the indexing is perfect. No matter what fact, what name, what date, or what place connected with aviation prior to the War you wish to consult, it is here. It is a book you will read from cover to cover, again and again.

Practical Handbook on Electro-plating

Twelfth Edition. Published by W. Canning & Co., Great Hampton Street, Birmingham 18. 344 pages. (No price stated.) This famous work, which now reaches its twelfth edition and covers the subjects of electro-plating, polishing, bronzing, lacquering and enamelling, is probably the most exhaustive treatise on methods of finishing metal yet published. Its contents cover the subjects of grinding, the polishing shop and its equipment, tools for polishing, polishing methods, burnishing and lapping, polishing and burnishing by barrelling, cleaning, pickling and dipping, stripping, scratch brushing, the plating shop, the vats, the dynamo, resistance boards, batteries, nickel-plating, chromium-plating, copper-plating, electrotyping, brass-plating, silver-plating, gold-plating, cadmium-plating, zinc-plating, tin-plating, lead-, rhodium-, palladium-, platinum-, and cobalt-plating, barrel-plating, bronzing, lacquering and enamelling. Everyone interested in the finishing of metals should have this book, for the price of which write to the publishers (address as above).

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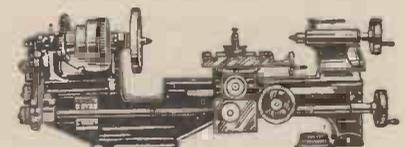
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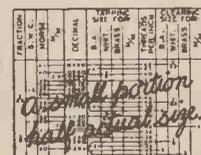
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MAKING IODINE

"Would you please tell me how to make Tincture of Iodine; strong and mild?"

"Being a member of the St. John Ambulance Brigade I use quite a considerable amount, and it becomes rather expensive at the retail price, so I would be greatly obliged if you would give me this information." (A. B., Yorks.)

The following are the various official formulæ (B.P. 1932) for Iodine Solutions:—

Liquor Iodi Fort. (Syn. = Strong Solution of Iodine.)

Iodine	100 grammes.
Potassium Iodide	60
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Alcohol (90 per cent.) to	1,000

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Iodine	25 grammes.
Potassium Iodide	15
Distilled Water	25 millilitres.
Alcohol (90 per cent.) to	1,000

Liquor Iodi Simplex. (Syn. = Simple Solution of Iodine.)

Iodine	90 grammes.
Alcohol (90 per cent.) to	1,000 millilitres.

Although I give the formulæ for the iodines I am afraid that querist will not be able to make use of them on account of the prohibitive cost of 90 per cent. alcohol upon which the Customs and Excise place a stupendous tax. Actually the alcohol would cost him about 1s. 6d. per ounce, and as he can already buy the tincture at probably 6s. per lb. (owing to Government rebate to chemists on the spirit used in the preparation of official formulæ) it would scarcely be economical to attempt to make it.

A CHOKE FOR AN ARC LAMP

"I am told that mercury vapour arc burners for A.C. must be in twin form; each side passing current in one direction only, and that to keep the inactive tube 'warm' a choke is fitted between the common electrode of the burner and the centre tapping of the transformer. Could you give me particulars of this choke to carry, say, 5 or 6 amps. max.? Could this or a similar choke be used instead of series resistance, or in conjunction with latter, to regulate, or stabilise, an A.C. carbon arc, so avoiding waste of power in the usual resistance?" (E. H., Bucks.)

We can give you details of a choke suitable for an arc lamp if you send us particulars of the arc in question and nature of the alternating supply. A good choking coil absorbs very little power. The core must be of a C section with a 3/4-in. air gap, and of 1-in. square section with an outside measurement of 6 in. x 4 in. Use stalloy stampings.

The coil is wound along the long limb with No. 18 enamelled wire to a depth of 1 1/2 in. including insulation. Insulate with two layers of brown paper and shellac varnish between each layer of wire. This choke is for the mercury arc and is connected in series with the transformer primary to limit the starting current. The point you mention goes straight to the centre tap of the transformer, and no choke is needed here.

AN ELECTRIC MOTOR QUERY

"I have an old electric motor which works from 100 volts and is of the usual four-pole type. I would like to know if I could use it as a dynamo, and what alterations if any would have to be made? Could you also tell me what output I could expect? Would a single cylinder engine of 4 h.p. be strong enough to drive it?" (A. T., Ayreshire.)

If the machine is shunt wound it will operate successfully as a dynamo, a series-wound machine only operates well on certain load conditions, such as a bank of lamps, and should not be used for accumulator charging unless an attendant is present, as the polarity is liable to reverse. You do not state the output of the machine, only its voltage. A 4-h.p. engine will drive a 2,000-watt dynamo of normal efficiency, that is, if your machine gives 20 amps.

TELEPHOTOGRAPHY

"I have been told of a person who photographed the dome of St. Paul's through a small portable telescope with an ordinary camera. The dome could easily be seen in the negative, but the photograph, I am told, was a failure because of an error in the time of exposure. Could you tell me how to work out the time of exposure with an astronomical telescope (a refracting telescope)?" (J. H., Surrey.)

The ordinary rules of focal length and relative aperture apply to telephotography, but the exposures are usually very long because the focal length is generally speaking much greater than on an ordinary camera, and the relative aperture consequently small.

Assuming that the diameter of the working aperture remains the same, the exposure will vary as the square of the magnification, i.e., if the magnification is ten times, the exposure must be 100 times the normal.

CHARGING BATTERIES

"I have a 28-v. lighting set installed in my house. I have only got eleven batteries, however, as three need new plates. The batteries are charged with a petrol engine and dynamo at 15 amps. I wondered whether I could charge my 120-v. wet H.T. from the batteries overnight and not from the dynamo.

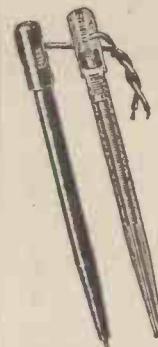
"Will you please tell me if this is possible? The H.T. batteries need charging at 1/2 amp. per hour. How long should I have to leave them on and what resistances should I require?" (W. B., Leeds.)

Charge your cells in parallel from the whole battery with a lamp in series to pass 3 amperes. A better plan would be to connect the cells as above to 14 volts of the battery with a series resistance to limit the current to 3 amperes at starting, a better charging regulation is obtained this way. It will take from ten to twelve hours to charge the battery properly.

A TELESCOPE QUERY

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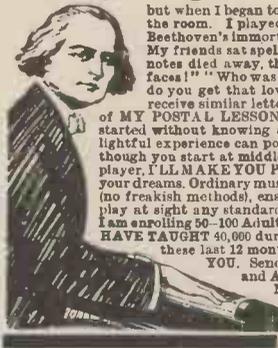
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speculum mirrors and a heavy tripod mounting and has great magnifying power, the sun taking three minutes to pass out of view! I have found, however, that a star appears to go along at a terrific speed, and suppose it is due to the rotation of the earth and the angle of view. Although I get the flaming edge of the sun sharp, a planet always has a kind of flare or tail at the side of it that will not focus out. Also is it possible to construct some sort of clockwork motor so as to keep the telescope following the object? How can this be done, and is there any publication dealing with the subject? Every book on the telescope I have fails to touch upon this item. I could easily construct it—but how is it arranged?" (G. M., North Wales.)

If one of the axes of the mount is vertical and the other horizontal, it is an altazimuth, giving movement only in altitude and azimuth, and a driving clock could not be employed. If an equatorial, the polar axis is at an angle with the base (about 52 degrees for your latitude) and capable of exact setting. The declination axis is at right angles to this with a heavy counterpoise to balance the weight of the telescope. It would, however, be useless to attach a clock unless the situation of the instrument is a permanent fixture and the polar axis accurately parallel with the axis of the earth and pointing to the celestial pole. The slightest deviation from precision would cause an object to gradually drift out of sight, notwithstanding that the clock might be perfectly synchronised with the speed of the earth's rotation. Given a carefully constructed equatorial, working easily without "backlash," a driving clock could probably be mounted on your tripod stand and connected to the polar axis by suitable gearing.

In regard to the appearances of star and planetary images, the "flares," "tails" and "flaming edges" indicate that the mirrors are either out of adjustment or not properly "figured." Assuming the telescope to be of the usual Cassegrain type, the former defect can be corrected by ensuring that the cone of light from the large mirror is projected centrally up the tube and that the smaller secondary mirror, after intercepting the upper part of the cone, reflects it down again through the centre of the hole in the main mirror. As you call them specula, they are presumed to be of metal and, in that case, they must be very old. They should both have their surfaces silvered and highly polished by those who understand how to carry out this rather delicate work, but it would be more satisfactory to replace with glass mirrors than to re-figure. When in correct adjustment, the discs of the sun, moon and planets should be well defined and the stars, except perhaps the brighter ones, merely brilliant points of light without rays. Much will depend on the quality of the mirrors and, to a lesser extent, the state of the atmosphere at the time. The period occupied by a celestial object in crossing the field of view of a telescope at rest varies according to how much the eyepiece magnifies the speed of the earth's rotation. The lower the power of the eyepiece, the slower the apparent motion, and vice versa.



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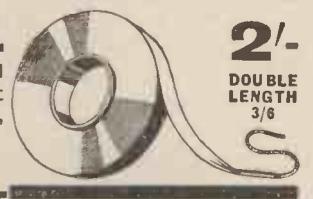
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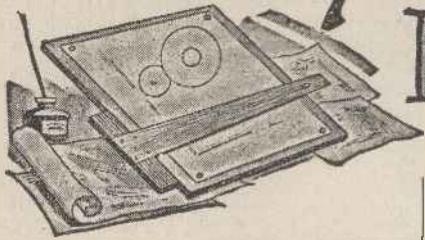
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AN AUTOMATIC FEED FOR A PRINTING MACHINE

"I have a printing machine which I use for notices, handbills, etc. The trouble and delay in picking up separate sheets for feeding the machine led me to devise a simple suction apparatus, worked by a small mains motor, which not only picks up the top sheet but counts a tally. The device is self-feeding, i.e., it will pick up every sheet separately from a pile about 5 inches high, and the 'exhaust' from the vacuum motor flutters the sides of the pile of paper to prevent more than one being picked up at a time. I am aware that some sort of suction apparatus is used in big printing works, etc., but I fancy mechanical means have to be applied to feed down to the pile, whereas my system is a gravity one and perfectly simple and infallible. It seems to me that if a cheap table model for office use were produced, there might be a market for it? Addressing numbers of envelopes, inserting handbills in envelopes (two machines used in this case or one with two lifters), etc., etc., are obvious instances to which such an apparatus might be of value. The top sheet, etc., is always there lifted ready to be taken.

"Is there any such apparatus already on the market, and if not, do you consider it worth taking out a provisional patent? The Patent Office, I understand, issues lists of patents under classifications, but I should be grateful if you could inform me under which heading such an apparatus might come, so that I may obtain a copy and see what has already been done in this direction." (V. Y., Kent.)

The suction feeding apparatus for small printing machines would appear to have commercial value. So far as is known from personal knowledge there is not such a machine at present on the market. As to how far the invention is novel can only be ascertained by making a search through prior Patent Specifications dealing with the subject. The Patent Office issue classified abridgments of all British Patent Specifications.

The following are the abridgments dealing with feeding apparatus for printing machines, from 1855 to 1908, Vol. 100; from 1909 to 1930, Vol. 100 (1), and from 1931 to date, Vol. XVI. These volumes can be obtained from the Patent Office (Sales Branch), 25 Southampton Buildings, London, W.C.2. It is not possible to express any opinion on the invention, since no particulars have been furnished, but it would appear to be worth while filing an Application for Patent with a Provisional Specification, which will give protection for about twelve months, which period should be sufficient time to ascertain if the invention is likely to be a commercial success.

A NEW CAKE TIN

"I have an idea for a cake tin that entirely encloses the cake while it is baking. It is

SUGGESTED BY OUR READERS

made in two parts and allows hot air to circulate all round the cake.

"Can you tell me if the idea is worth patenting and also the best way to get it on the market?"

"I have had one made for myself and find it very successful." (E. M., Oxon.)

The proposed baking tin for cakes forms fit subject matter for protection by Letters Patent, and the idea is novel so far as is known from personal knowledge.

The inventor is advised to apply for a Patent with a Provisional Specification, which will give protection for about twelve months and give sufficient time to ascertain if the invention is likely to be a commercial success before incurring any great expense. After the invention has been protected, it would be advisable to put it before a firm specialising in kitchen wares who would possibly be interested in the invention.

A COVERING FOR MOTOR CYCLISTS' SHOES

"Can you advise me of the novelty and possible commercial value of the following idea?"

"After noticing the wear on motor cyclists' shoes (both sole and upper), due to constant contact with the foot control of the gear-box, I thought of the advantage of an easily detachable covering for the shoe. The device consists of a slip-over of moulded rubber, to fit over the toe. A recess is moulded in it so that the gear lever can easily be gripped in wet weather.

"I estimate that the cost of production would be extremely low." (G. M., Lincs.)

The probable commercial value of the idea of a slip-over detachable covering for the soles of motor cyclists' shoes must depend very largely on the way the article is marketed. It may be possible to obtain a Patent for the specific construction, but it is thought that a Design Registration would probably give a certain measure of protection for the device, since it would not be possible to obtain any broad claims in a Patent in view of known slip-on coverings of moulded rubber, a species of galosh, for protecting boots and shoes in wet and muddy weather.

A GADGET FOR CYCLISTS

"I have just devised an idea for automatically switching on the parking light of a cycle when the cycle is stationary and therefore not working the dynamo.

"It consists of a governor—such as is used on a gramophone—driven either by the front wheel direct or by an extension of the dynamo shaft. When not rotating, the springs are flat, thereby causing a connection between the bottom and another segment in the side, which is insulated from the case. When set in motion the springs rise and break the connection, leaving the dynamo to light the lamp. The same idea can also be used, when a dynamo is not used, for automatically switching the light on and off.

"Would you advise me if this idea is novel and worth patenting?" (W. A., Sussex.)

The proposed form of switch for automatically switching on the light of a cycle

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A. M. SALDO

Photo by Lambert Weston, Folkestone, Oct. 1934.

C. SALDO, Clerk, Aged 23, Height 6 ft.

THE ILLUSTRATION IS FROM AN UNRETOUCHED PHOTOGRAPH OF MY SON, AGED 23.

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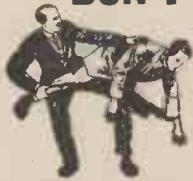
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when it comes to rest is thought, so far as is known from personal knowledge, to be novel and forms fit subject matter for protection by Letters Patent. It is, however, considered very problematical whether it is likely to be a commercial success.

PATENTING AN INDOOR GAME

"I along with two others have got provisional patents for an indoor game which is very much in favour in the Orient. We have filed Form No. 3 for a complete patent. We have no idea as to when it will be granted us. In the meantime I wish to have your expert advice on certain things appertaining to it.

"(1) Could we market the game now under its provisional patent number, and if so, what are our legal rights and titles? Also would we have to inform the Comptroller-General about it?

"(2) If it is already marketed by another firm not knowing that a patent is in the process of being taken out, could we legally stop him from marketing the same under any such rights given by provisional patenting? It is, of course, understood that those manufacturers have not already patented it. Could we effectively stop him from marketing it after we have received the full patent number? Could such a person file a form of objection for granting a patent to us on the strength that he has already put the game on the market? Are there any chances of our being successful if we file a suit against him?

"(3) If for any reason the patent is not granted to us, would the Comptroller-General refund the stamp money already spent by us?

"(4) Could anyone file an objection that the game is not a subject for a fit patent? Is it incumbent on us to prove that it is otherwise. Could he claim that the idea is not our original but brought from another country?" (J. S., Forest Hill.)

In reply to the various queries raised by the applicant:—

(1) It is possible for the applicants, who have two pending Patent Applications, to market their inventions under the Provisional Patent numbers, but articles made under such Patent Applications must not be marked "Patented"; if marked at all they should bear the words "Patent applied for" or "Provisionally protected," preferably the former. It is not necessary to inform the Comptroller-General about such marketing.

(2) It is not possible to prevent another firm marketing the same inventions under a Provisional Application for Patent. There is no such thing as a "Provisional Patent." It is not possible to stop infringement of an article provisionally protected, but it is possible to claim damages for infringement after the Complete Specification of a Patent has been accepted provided the infringer has been notified of such infringement, but no action can be taken until after a Patent has actually been sealed.

(3) If a Patent for any reason is not granted on an Application for Patent, none of the fees paid to the Patent Office is refunded.

(4) Any person may at any time within two months from the date of the advertisement of the acceptance of a Complete Specification, or within such further period not exceeding one month as the Comptroller may allow, give notice at the Patent Office of opposition to the grant of a Patent on a number of grounds, amongst which is fraud, or that the invention has been published in the United Kingdom within fifty years of the date of application.

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PRACTICAL MECHANICS, DECEMBER, 1934

CLUB NEWS

STREATHAM COMMON MODEL RAILWAY CLUB

OUR clubroom will be closed during December, but will re-open in the New Year.

We had a very interesting lecture by our Vice-Chairman early in October on "Possibilities in Model Electric Signalling." He had made some H.O. gauge signals that worked electrically, and gave them numerous trials. Another very interesting lecture was held on October 26th by Mr. J. Pells, Secretary of the West Essex M.R.C., on "Road Rail Containers."

A list of meetings, together with lectures, will be sent post free to anyone interested. Ask for a copy of "Concerning Ourselves" and quote PM12. For all particulars apply to the Secretary, Brooke House, Rotherhill Avenue, Streatham, S.W.16.

LANCASHIRE MODEL AIRCRAFT SOCIETY

THIS Society, which furthers the science and sport of model aeronautics in the north, is growing, and no aeromodellist should be content to play a "lone hand" when he can benefit by membership to such a body. Flying contests are arranged throughout the year, and meetings held each month at the Y.M.C.A., Manchester.

Forthcoming events are as follows:—
December 1st.—Hot Pot Supper and Prize Distribution.

December 5th.—Royal Aeronautical Society Lecture, College of Technology, Manchester, 7.30 p.m.

January 2nd to 12th.—"Hobbies and Models Exhibition," City Hall, Manchester. The Society will exhibit all types of machines on their stand at this annual exhibition.

For details of membership apply to the Hon. Secretary, Mr. F. Hemsall, 81 Queen's Road, Cheadle Hulme, Cheshire.

INSTITUTE OF SCIENTIFIC RESEARCH

ON Friday, November 2nd, a visit was paid to Meadow Lane Gas Works, Leeds, and on Saturday, November 3rd, a meeting was held at which P. W. Berry, Esq., gave a lecture entitled "Gyroscopes—Commercial and Scientific."

The next meeting, at which R. Nathan, Esq., will give a lecture entitled "Military Explosives," will be held on December 1st.

We are now forming a branch at Canterbury. All persons interested should communicate with J. H. Potts, Esq., 26 Whitstable Road, Canterbury.

May we once more remind readers of PRACTICAL MECHANICS that a Correspondence Section, for all persons interested in any branch of science, has been formed in conjunction with the Club, and we invite them to avail themselves of the benefits which this section offers?

For further information, please communicate with the Secretary, Mr. D. W. F. Mayer, 20 Hollin Park Road, Roundhay, Leeds 8.

THE JUNIOR OLYMPIC CLUB, AVIATION AND TECHNICAL SOCIETY

THE Technical Sections of the club are now being formed, and there are vacancies for a few more members interested in Flying, Model Engineering, Photography, Experimental Radio and Television, etc.

The recently acquired premises for clubroom and laboratory-workshop will be officially opened as soon as redecorations, etc., are completed. Those interested should write at once to the Secretary, 4 North Way, Ickenham Road, Uxbridge, Middlesex.

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