Making a 9·5mm Cine-Projector

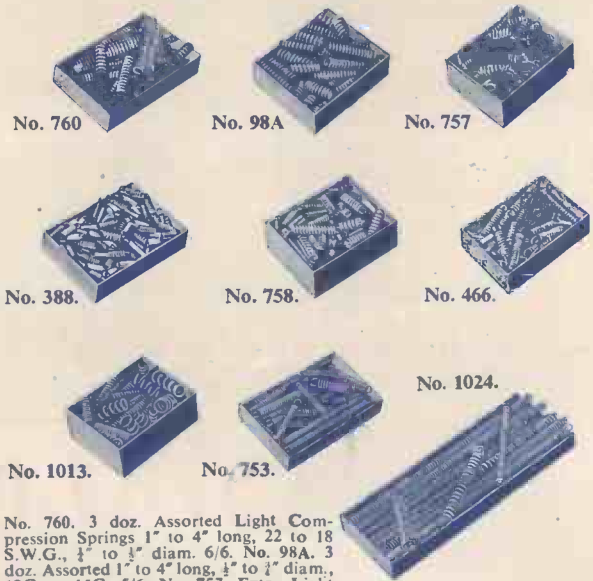
NEWNES

PRACTICAL MECHANICS

1/3

EDITOR: F. J. CAMM

DECEMBER 1956



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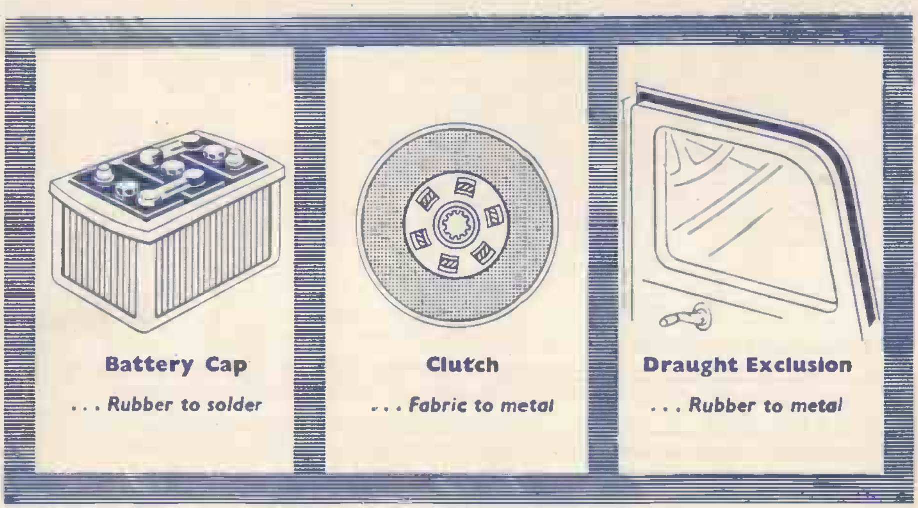

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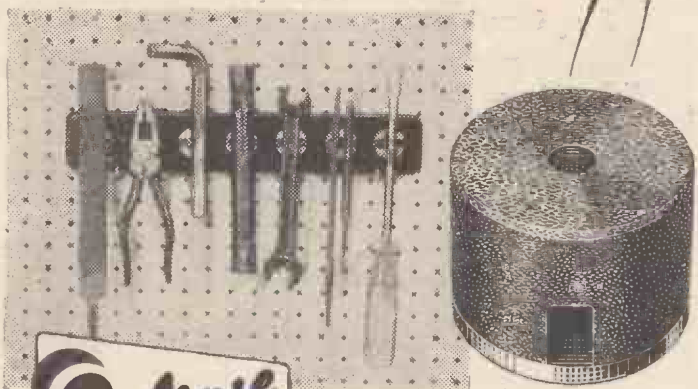

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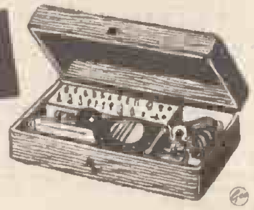

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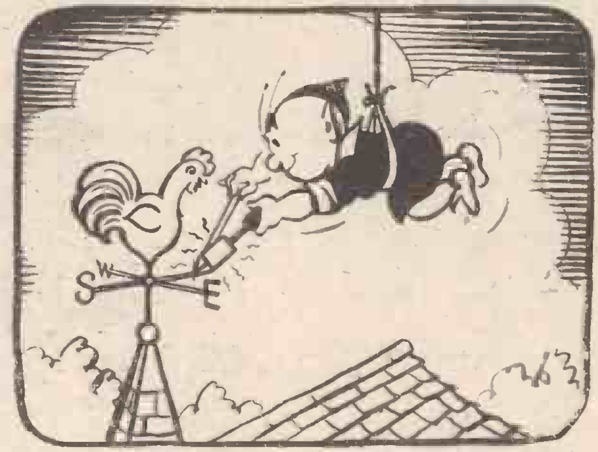

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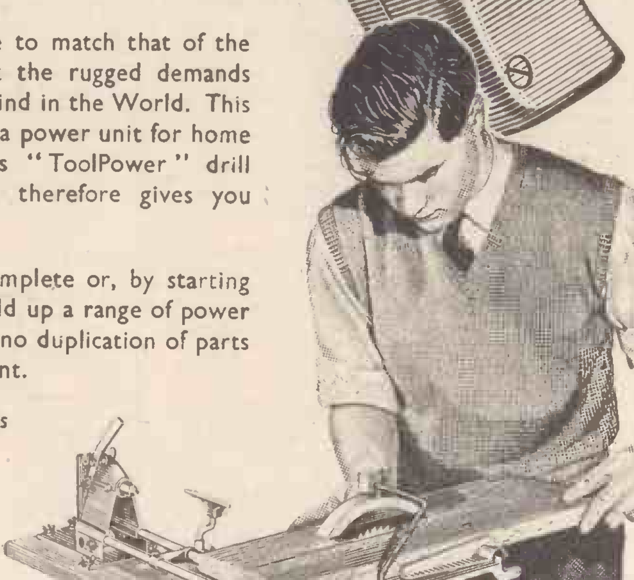

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Practical Mechanics

Vol. XXIV. No. 274 DECEMBER, 1956

"The Cyclist" and "Home Movies" are temporarily incorporated

FAIR COMMENT
by the Editor

The Status of the Inventor

IN delivering the Morgan-Morgan Memorial Lecture this year before the Institute of Patentees and Inventors, I drew attention to the unhappy plight of many of those having creative ability who are unable to develop and exploit their patents because of lack of funds, but chiefly because of lack of interest by the Government. I pointed out that, whilst the State subsidises such institutions as the British Standards Institution, and controls the National Physical Laboratory and the Department of Industrial and Scientific Research, these are all ancillary to invention. Unless there is invention, there is no need for any organisation to test it, nor to create standards for its manufacture. The prime source of all manufacture is invention, and inventors, therefore, should be a first concern of the State. The very reverse is the case. Some years ago, I made the suggestion that what was wanted was a sort of Ministry of Invention, whose special care it would be to analyse all worth-while inventions and to see that those having possibilities were developed. Sir Winston Churchill, before whom the suggestion was placed, replied, "What! Another Ministry?" I see no reason why not. It is important to our National economy to see that money-making, money-saving, health-promoting, labour-saving and labour-creating inventions, quite apart from those which could be used for national defence, are carefully considered by an independent staff of national experts and nationally developed. My suggestion was interpreted by some of those present at the lecture as meaning that the dead hand of some Government department would promptly stifle at birth every idea submitted to it. What I had in mind, however, was a body *subsidised* but not controlled by the State, as the British Standards Institution or D.I.S.R. are subsidised, although they operate as self-contained and autonomous entities. The State reserves the right to make use of any invention without permission of the inventor and it does not even undertake to pay him for its use, although it is true that a Commission on Awards to Inventors was set up after the war to consider claims by inventors. The claims, however, are ex gratia and cannot be demanded as a right.

I also made the suggestion that the process of obtaining a patent should be speeded up and that a separate department at the Patent Office should be created to investigate applications for patents and sort them into groups, so that the most important, from a national point of view, should receive priority.

The Editor and Staff

Join in Wishing Readers a

Merry Christmas

Remember that the copyright in the published specifications belongs to the State, although the inventor has prepared the specification. I suggest that the revenue from the sales should be used to meet the costs of the separate department.

The nucleus of an institution such as I have suggested subsidised by the Government and industry already exists in the Institute to which I have referred above, and their great experience could be used to advantage in the formation of such an institute. Something ought to be done, and that quickly, to organise the brain power of the State, which already gives so much attention to man power, and something ought to be done at once to speed up the slow machinery of the Patent Office. It takes from two to three years to get a patent through and every year there are tens of thousands of unexamined patent applications.

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How Many F. J. C. Books?

A READER, writing to compliment me on the publication of my three latest books, "The Elements of Mechanics and Mechanisms," "Model Engineering Practice" and the "Home Electrician," asked how many books I have written. It is well over 200, and my name occupies quite a number of pages in the official index at the British Museum. Many of my books have been translated into other languages and they have certainly been sold in every country in the world. All of them have been through many editions and well over 50 are currently on sale. The reader went on to ask what was my first book. It was entitled "The Design of Aeroplanes," and it had a foreword by Sir Frederick Handley-Page.

Radio Film Show

I RECENTLY witnessed some excellent films dealing with transistors, valves and cathode ray tubes and their methods of manufacture. These films were so interesting that I made the suggestion to the producers that they should be shown to a wider audience, and, accordingly, the films are to be shown at the Caxton Hall (Great Hall Site) on Thursday, February 21st, 1957. Admission will be free but by ticket. There will be an interval for refreshments. Readers wishing to attend this film show should send in requests for tickets immediately. Address your letters to "Film Show," PRACTICAL MECHANICS, address as on this page. The meeting will commence promptly at 8 o'clock in the evening.

There is bound to be a large demand for seats and accommodation is limited. Please, therefore, apply early. I shall be in the chair.—F. J. C.

AN ELECTRICAL GAME

"9-square" is a Game for Two Players

By F. G. RAYER

THE game operates from a dry battery or accumulator. It is for two players, and is begun by placing nine numbered counters on a board. Each player has a selector board, which is operated out of sight of the opponent, and counters are taken alternately by each player, each trying to gain a high number for himself and force his opponent to take a low number. The manner in which this is arranged will become clear from Fig. 1, which shows the electrical circuit.

The "pips" of the bulbs are wired together in threes, left, centre and right-hand rows going to left, centre and right switch contacts on the "Y" selector. The outsides of the bulbs are similarly taken to the three contacts of the "X" selector, the circuit being completed to the battery. The circuits are completed at 90 deg., and in actual play selector

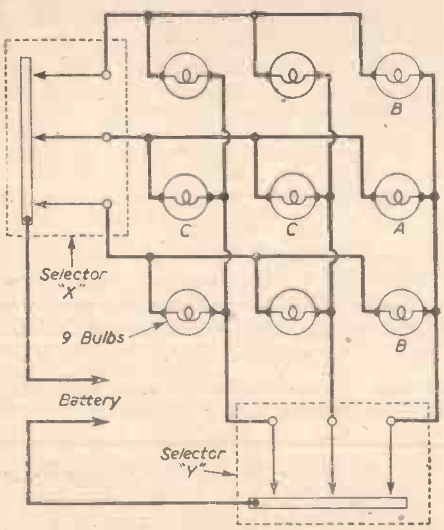


Fig. 1.—The theoretical circuit of "9-square."

boards and bulbs would be situated as in Fig. 1. Assuming that "X" is to take the first counter, "Y" might decide that the counters to his right offer the least chance of a good score, and therefore press his right-hand contact. As the circuit is not completed until both selectors are operated, "X" does not know (except by deduction) which row "Y" has chosen. He may consider, after examining the counters, that the centre row offers the best chance, and so he depresses his centre contact. At the point where the rows selected by "X" and "Y" cross the bulb will light at full brilliance, so that "X" takes the counter at A. Due to the series circuit through the whole board, bulbs B light at half brilliance (denoting the line "Y" chose), those marked C also lighting at half brilliance, to show the line "X" chose. Play continues, competitors taking counters alternately, until the board is cleared. No competitor may select a row from which all counters have been removed.

Before beginning, the counters are placed one at a time upon the board, each of the two players placing a counter in turn. Careful thought as to their placing will aid a win. For example, if "Y" had placed low counters at A, B and B, "X" will be forced to have one of these when "Y" operates his right-hand contact. But if "X" had placed high counters at A, C and C he would inevitably secure one of these by choosing his middle row, no matter which circuit "Y" closes.

Counters are best numbered from 0 to 8, to avoid confusion between 6 and 9, and further methods of securing a win will be considered later.

The Board

This is made from two pieces of ½in. wood, as shown in Fig. 2, a piece 2¾in. square being cut out of the larger to accommodate connections, etc. No bulb holders are necessary, the bulbs being a push fit in the board. Nine ½in. diameter holes are drilled to a depth of about ⅜in. The centre of each depression is then drilled right through. If a drill of exact size is not to hand, then the holes may be made a trifle smaller, and enlarged with the tang of a file until the bulbs can be pushed in, seeing that none projects above the top of the board.

The bulbs must all be of the same voltage and current rating for proper operation, and should be purchased together. Nine will cost 3s. and will have an almost indefinite life if not overrun. For a 2-volt accumulator, 2.5 volts .3 amps. bulbs will do well, with 3.5 volts .3 amps. bulbs for a large 2-cell (3-volt) dry battery.

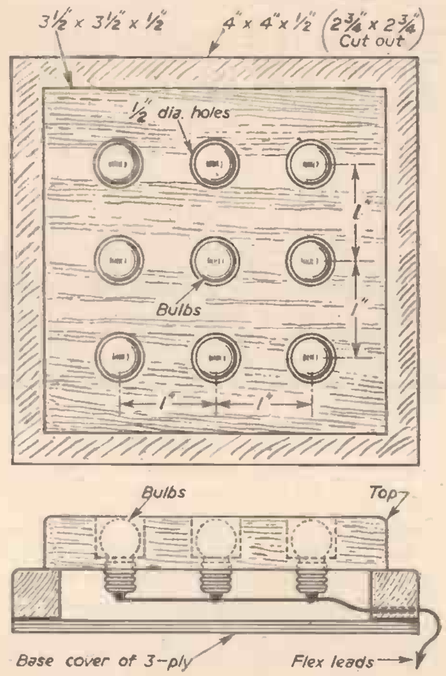


Fig. 2.—Board construction.

The two thicker pieces are held together by ¾in. panel pins driven in from below, this being done before the bulbs are fitted. When wiring is completed a 3-ply base 4in. square is screwed on to protect connections and clamp the flex where it emerges from the

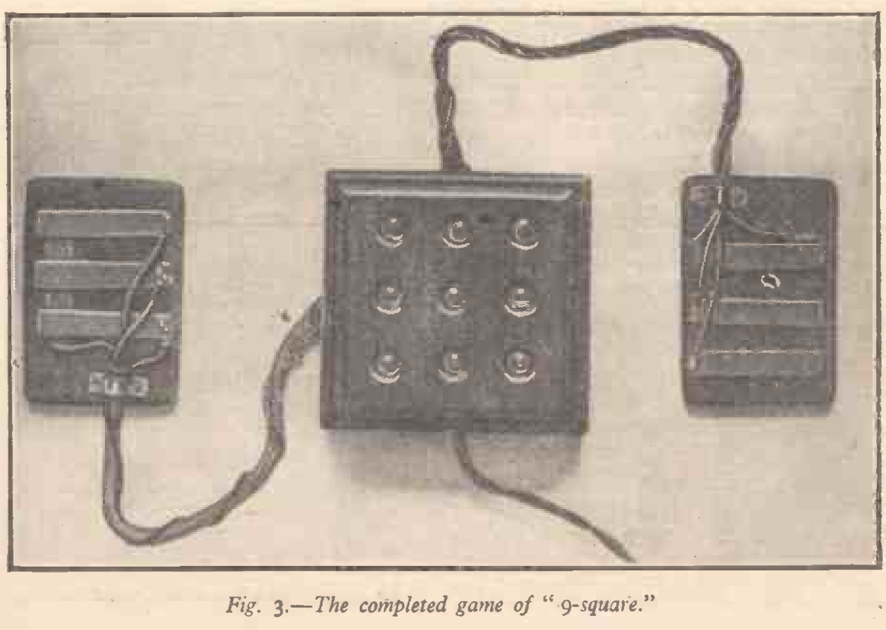


Fig. 3.—The completed game of "9-square."

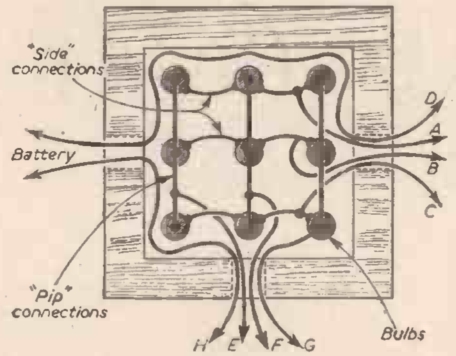


Fig. 4.—Underneath connections.

board. It is wise to test each bulb before fitting it. Fig. 3 shows the completed board.

Board Connections

These will appear as in Fig. 4. Inside the board, 20 s.w.g. tinned-copper wire is best, and ordinary 2-amp. flex is used for leads which emerge. To make the "side" connections, the 20 s.w.g. wire is twisted round the thread of the bulb, close against the wood. It is then looped once or twice round the next bulb, then taken round the last bulb of the row and twisted. No soldering is required here if the wire is tight.

When each row has been done three 2in. lengths of 20 s.w.g. wire are cut and soldered directly to the bulb pips, at right angles to the previous connections. In Fig. 4 flexible leads A, B and C go from the three lots of "side" connections, and E, F and G from the three "pip" connections. Identification of connections can be by coloured leads or by touching the flex leads on the battery and wiring to the appropriate selector board contact strips.

The selector boards themselves are shown in Fig. 5, two being required. Thin wood is used for the base, and brass is most suitable for the contact strips, which are held in position by two small screws in each case. As an aid to good contact, three raised points are made on the 2¼in. by ⅜in. strip, by placing on a wooden surface and punching with a large nail or pointed tool. Contact is completed when any of the three strips is pressed down.

Leads may be soldered to the strips or held by the screws. All the flexes are twisted together, and held by a clip screwed down tightly. "D" goes to the battery, as does "H" of the second selector, these connections being taken with the others for convenience, and passing out through the board, as in Fig. 4. With the second selector E, F and G will go to the contacts, corresponding to C, B and A in Fig. 5. (In order that left, centre and right-hand rows of bulbs may be selected by the correct contact strips it is necessary to remember that Fig. 4 shows the *underside* of the board and Fig. 5 the *top* of the selector.)

With wiring completed and a battery connected a few moments' testing will show if connections are in order. If any row fails to light the circuit is not complete, probably due to dirty contact surfaces. If the wrong row lights, then the leads have been incorrectly wired to the selector board in question and must be changed to obtain correct operation. In all cases the bulb lighting at full brilliance must be that where the rows chosen by "X" and "Y" *cross*, as illustrated by Fig. 1.

Counters

As it is necessary that the lit bulb be seen the counters are best made from some transparent material, clear or tinted, or should have a hole in the centre. They need to be ¾in. or so in diameter, and the plastic counters from some children's games are satisfactory when numbered.

It is also feasible to turn nine "men" with a lathe or to construct them from the pattern shown in Fig. 6. With such pieces the bulbs are visible between the "feet."

Typical Play

An illustrative game between two players who have reached a moderate degree of skill and are not easily "caught" will help to make the method of working clear. Referring to Fig. 7, "X" has started by selecting a counter and placing it (1) on the centre of the board. "Y" places a 3 on the corner, waiting to see what "X" plans. "X" then puts the Zero as shown, and "Y" sees that "X" plans to build up line B with 0, 1 and 2. If this is done, then "X" will choose line B with his selector for the first three turns during which "Y" will take a counter, so that "Y" will be forced to take the Zero, 1 and 2, while "X" takes three higher numbers. "Y" therefore puts the 8 at the end of this row. "X" will now hesitate to select the middle row when it is "Y's" turn to take a counter

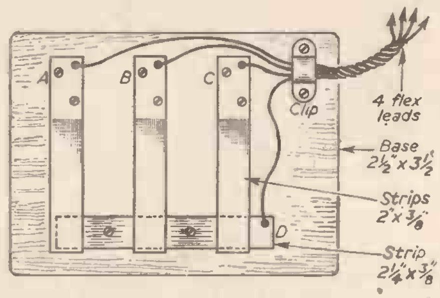


Fig. 5.—A selector board.

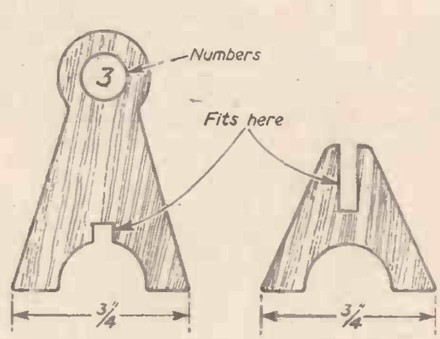


Fig. 6.—Design for counters.

since "Y" will probably be choosing line F and thus gain the 8.

"X" now decides that "Y" will like to choose line F because of the 8, so places the 2 on this line. This weakens "Y's" position since there is always the chance that selection of line F will result in a 2 if "X" is selecting C. He compensates by making the line as

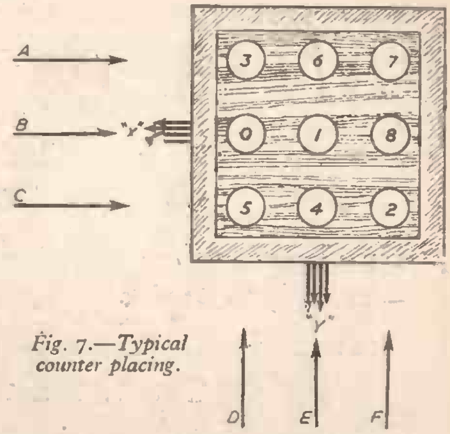


Fig. 7.—Typical counter placing.

strong as possible by placing the 7 to complete it. "X" now sees he has a fair chance of a reasonably good line at A, and fills it with the 6. "Y" decides that the 5 on his row D may give enough temptation for "X" to select row C, when the 2 can be passed off on "X" if "Y" has chosen line F, knowing it to be "X's" turn to take the counter. "X" places the last counter in the remaining vacant position.

Play now begins, each selector board being concealed from the opponent. "Y" is to take the first counter. "X" decides against line B for fear of giving away 8, and chooses C, so that if "Y" tries for the 8 he will get 2 only. "Y" thinks this may have happened, and chooses line D, getting the 5. Neither player knows which line the other has chosen until his own choice is also made, as no bulbs light until both selector strips are depressed.

As it is now "X's" turn to take a counter, "Y" chooses line D again. Since line B appears dangerous, "X" chooses A and gets 3.

It is now "Y's" turn to score. "X" chooses line C, so that only a 2 or 4 may be taken. "Y" sees that if he chooses line E he would gain a 4 or a 6 if "X" has chosen C or A, but he fears "X" may have selected B, hoping to pass off the 1. "Y" therefore selects line F, hoping to get the 8 if "X" has tried this bluff, but gets 2.

After "X" has taken the 6 "Y" gets the 4 and "X" the 7. "X" is now 16, easily beating "Y's" 11. However, "X" sees with dismay that his determination to avoid giving away the 8 has left only line B. Since he cannot choose line A or C, now they are cleared, he is forced to choose line B, which "Y" knows. "Y" can, therefore, give the Zero or 1 to "X" and take the 8 for himself when it is his turn, winning easily.

In some cases (especially with careless play) the bulb which lights may already have no counter. If so, then this counts Zero to the player whose turn it was to take a counter, and the next selection goes to the other player. Care should be taken to avoid such blanks, which rapidly spoil the score.

ENERGY from PERMANENT MAGNETS

Details of an Experiment in Magnetism, Conducted by S. Bramley-Moore, Which Proves that Perpetual Motion is a Practical Possibility. His Article Also Proves that Certain Basic Scientific Concepts are Not True. His Successful Tests Also Break the Law of the Conservation of Energy Which is a Prelude to Perpetual Motion

The Machine

THESE experiments on the Bramley/Moore Magnetic rotor were conducted in August, 1956, on Mr. J. A. Bashford's houseboat on the River Kennet, Newbury, Berks, and the diagram on this page shows the elements of the machine I used for the test. Eight horseshoe magnets M were mounted to form a ring and all were fixed to the frame of the machine. Nine pairs of mild steel blocks were bolted to the rotating member, and eight pairs of mild steel blocks were fixed to the frame. It will be noted that M. and F. are not in the same line, but were offset 12 degs. It is obvious that this throws the magnetic field out of balance, and thereby provides a magnetic differential. The mild steel blocks were ½in. square by 1½in. long, and the outer radius of R was 5in. The rotor shaft was driven by a 240 v. variable speed motor fitted with a worm reduction gear, and the final drive was by belt, through a ratio of 2½ to 1. It was noted that the electric motor always ran in the same direction. Reverse rotation was obtained by clamping the motor to the opposite side of the machine, and the driving shaft was double-ended for that purpose. The watt-hours meter used in these tests was calibrated by the Southern Electricity Board at Newbury.

The Tests

The first test, on August 28th, 1956, was anti-clockwise, and the average speed of rotation was 32.5 r.p.m. The time taken to consume precisely 200 watts was 8 hours 13 minutes (493 minutes); therefore, the watt consumption per hour was : $\frac{200 \times 60}{493} = 24.34$ watts. The second test was clockwise and the average speed of rotation was 28.25 r.p.m. In this test the time taken to consume precisely 200 watts was 7 hours 38 minutes (458 minutes) and the watt consumption per hour was : $\frac{200 \times 60}{458} = 26.20$ watts.

Thus, it required an extra 1.86 watts to rotate the rotor in a clockwise direction. The machine was run for 36 hours and no loss of magnetism could be detected. On the 24-hour run in the clockwise direction the extra energy expended by the magnets, if condensed into one hour, would be $1.86 \times 24 = 44.64$ watts. If condensed into one second, it would be 16,070 watts, and if condensed into .01 of a second, it would be 1,607,000 watts. Convert this to horsepower by dividing by 746, and the answer is 2,154 horsepower. But it takes only .01 second to magnetise the magnet at 14,000 ampere turns.

Therefore, 140 turns of wire would require 100 amperes.

At 200 volts the watts would be 20,000 watts = 27 horsepower.

There are eight magnets, hence total energy expended = 216 horsepower (.01 sec.).

Energy expended in one day running clockwise = 2,154 horsepower (.01 sec.).

Therefore, surplus horsepower = 1,938 horsepower (.01 sec.).

Add six more days running at 2,154 in .01 sec. per day = 12,924 horsepower (in .01 sec.).

Seven days running if condensed into .01 sec. = 14,862 horsepower.

Where Does the Extra Power Come From?

There is no truth in the orthodox concept that the energy which you get out of a magnet cannot exceed the energy which was put into the magnet during magnetisation.

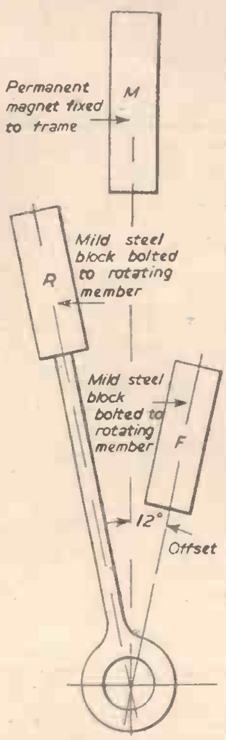


Diagram of the elements of the machine. The magnet M was of the horseshoe type.

When the steel was magnetised *no energy* was put into the magnet. Work was done in re-arranging the molecules. When so "regimented" the total magnetism in the magnet is "directed" and can do useful work. If the magnet is deliberately "de-magnetised" no magnetism is lost. Work is done in dis-arranging the molecules so that the total magnetism in the magnet is "undirected" and can do no useful work.

A mass of brass contains approximately the same magnetic energy as a similar mass of iron but the molecules of the brass exert such powerful repulsion on each other that they will not be "regimented" and, therefore, the magnetism which they contain is "undirected," acting promiscuously in all directions.

According to the law of the Conservation of Energy it is fundamental that the "positive" work done by mutual magnetic attraction on approach *must equal* the "negative" work done when the two magnetic members are pulled apart. The experiments carried out on the apparatus illustrated prove that this "man-made law" is not true.

After completion of the above tests, the 16 mild steel blocks F were removed and were replaced with 16 bar-type permanent magnets. The results obtained were quite different, providing additional confirmation of my theories. The differential disappeared.

Further tests have yet to be made using "soft Swedish iron" or "Mumetal" or "Permalloy" in place of the mild steel blocks R and F. By such means the residual magnetism will be tremendously reduced and the results obtained will be quite different from those given in this report. Previous tests on earlier models prove that this is so.

Explanations

It is universally agreed that if two magnetic members pass each other, then the average pull forwards as they approach must equal the average pull backwards as they separate.

This law of action and reaction being equal and opposite is fundamental to the whole structure of modern science.

If it were ever proved that this law were not true, the results would be cataclysmic; basic scientific concepts would be turned upside down. Refer again to the diagram. The magnetic fields on either side of the permanent magnet M must balance out (according to orthodox science), otherwise this most remarkable phenomenon would take place : If, in a clockwise direction, the magnetic pull forwards, on approach, were greater than the magnetic pull backwards, on separation, then the rotor would keep on rotating (friction regarded as negligible). This would be nothing more or less than Perpetual Motion.

If, however, in a clockwise direction the magnetic pull backwards on separation were greater than the magnetic pull forwards, on approach, then the rotor, if rotated in the opposite direction, would once again keep on rotating so long as the difference between the two forces were greater than the frictional losses of the machine.

My theories are disclosed in my Patent Applications, Nos. 14571, 15127 and 15128, all of 1956. I have now the evidence, by actual experiment, that the orthodox concepts are not true, because my test proved that I can create a magnetic differential. If the machine were precision-made and if appropriate materials were used (reducing residual magnetism to a minimum) and if the magnetic members were built up from thin laminated insulated strips (reducing eddy currents to a minimum) then the rotor would undoubtedly keep on rotating.

The differential referred to earlier—an extra 1.86 watts to rotate in a clockwise direction—is only part of the truth, because that referred to power consumption only and ignored the difference in speed of rotation, which must also be taken into account if a true comparison is to be made.

32.5 r.p.m. anti-clockwise and 28.25 r.p.m. clockwise.

Difference 4.25 r.p.m. and $\frac{4.25 \times 100}{28.25} =$ 15.04 per cent. more work on a rev. basis.

493 minutes − 458 minutes = 35 minutes.

And 35 minutes' difference (same consumption) = $\frac{35 \times 100}{458} = 7.64$ per cent. more work on a power basis.

The total differential is therefore $15.04 + 7.64 = 22.68$ per cent.

After Dinner TRICKS

An Entertainment With a Scientific Flavour

The Serpent Mystery

SKETCH out a coiled snake as shown in Fig. 1 on a sheet of thin paper. Cut along the line and then balance the "reptile" on the point of a pencil. The coils fall by their own weight and form a spiral. Get everyone to watch carefully, and without any seeming reason the serpent will begin to revolve. Why does it revolve? Here is a talking point!

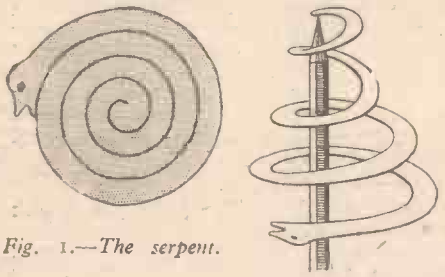


Fig. 1.—The serpent.

Walking Matches

Sharpen the end of a match and carefully split the end of another. Put the sharpened end in the notch and then place the two matches spread at an angle over the blade of a dinner knife, held vertically (Fig. 2). The matches must rest on the cloth, but the blade must be slightly above it. Hold the knife very firmly and in a moment or so the matches will start to walk along the steel in a most mysterious manner. This is because, although you seem to be holding firmly, there is always a small vibration from your pulse which brings about a minute rise and fall of the blade, that in its turn causes the travelling movement. If you look closely you will see why.

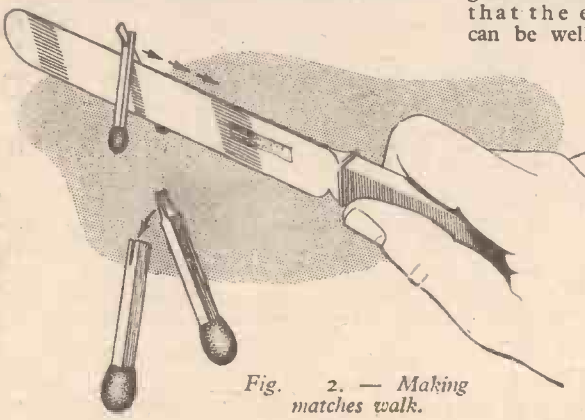


Fig. 2. — Making matches walk.

Spinning a Penny

Ask anyone if they can make a penny revolve at a high rate by means of two pins. It is done by holding the pins between the forefinger and thumb of each hand and bringing them slowly to the edge of a penny, the point of the pins touching the edges opposite one another across a diameter. Press slightly inward and the penny can be raised from the table held only by the two pin points (Fig. 3). Now blow gently on the edge of the coin and it will begin to revolve, the pin-points acting as pivots. By steadily blowing the penny will get up such a high speed that it is just a blur.

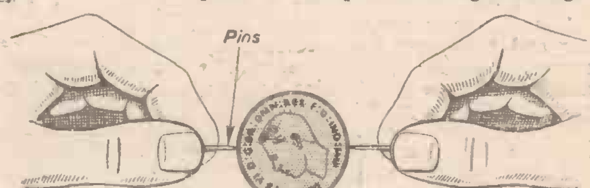


Fig. 3.—(Right) Spinning a penny.

The Floating Needle

Making a needle float on water as in Fig. 4 is a trick that always holds the attention of watchers for a few moments. Fill a glass to the brim so that the experiment can be well seen by all. Cut a small rectangle of tissue paper and, laying the needle on this carefully, place on the surface of the water, when it will ride with the needle on it. In a few moments the paper will become soaked and sink, but the needle will remain floating on the surface.

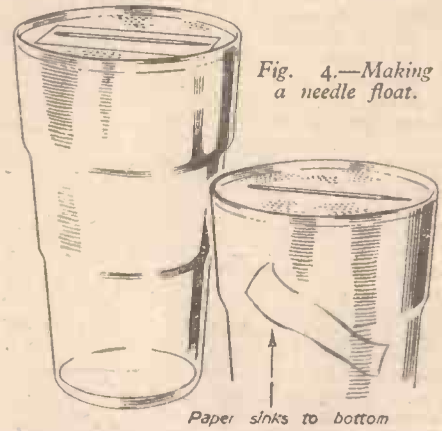


Fig. 4.—Making a needle float.

Holding a Glass of Water Upside Down

This can easily be done, but care must be taken if you want to avoid a splash. Fill the glass to the brim, put a postcard over it and, pressing the card into tight contact with the rim with the fingers of the one hand, hold the glass with the other as in Fig. 5. Still holding

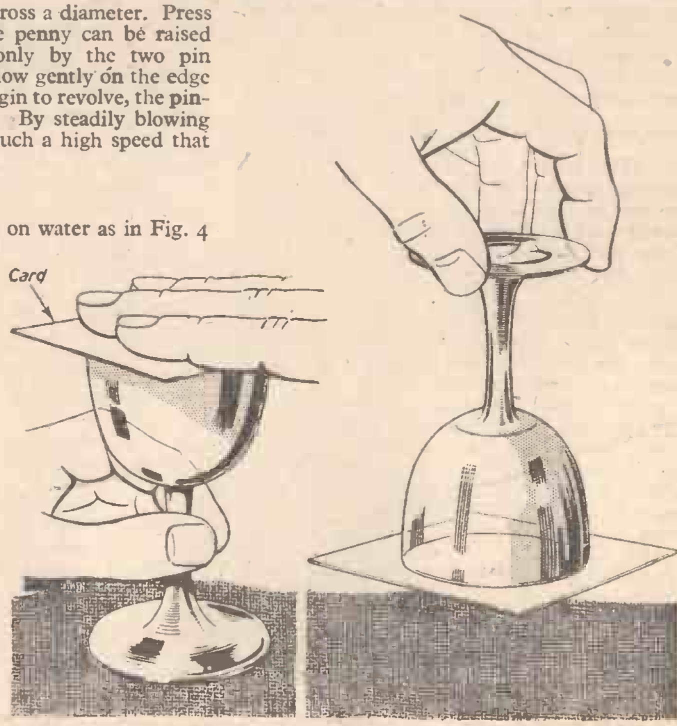


Fig. 5.—Holding a glass of water upside down.

this way, turn the glass smartly upside down. The fingers pressing on the card can now be removed, the card staying in position and the water keeping in. This is because the 15lb./sq. in. of air pressing on the underside of the card is greater than the weight of the water on top.

The Strength of Corrugation

The strength given by corrugation is well demonstrated by this trick. Show the guests a sheet of paper and then place two drinking glasses well apart. Ask if anyone can support a third glass on the two using only the paper as a help. It is impossible till the paper is folded as indicated in Fig. 6, when a quite heavy glass can be safely held.

Making a Head in a Picture Smoke

Get a strip of celluloid about 1in. long and 1/16in. wide, cut from a discarded collar stiffener. Roll this in cigarette paper till it looks like a miniature cigarette. Prop up a magazine open at a picture of a fair-sized head. Make a hole at the mouth and push in the "cigarette." Apply a light to the end long enough to make the celluloid smoulder, but not burst into flame. From now on for quite a time the cigarette will continue to smoke on its own, sending out most realistic puffs from time to time.

Domino Magic

Write something on a piece of paper which you tell the guests is a prediction. Fold the paper and give it to someone to hold. Ask for a set of dominoes and get someone to lay them out as you would in a game, end to end. Doubles must be laid out in the line, not across it. Also, the series must not start with a double. When all the blocks are down, get the holder of the paper to undo it and read the prediction, which is that there will be a certain number (given) at one end of the line and another number (also given) at the other.

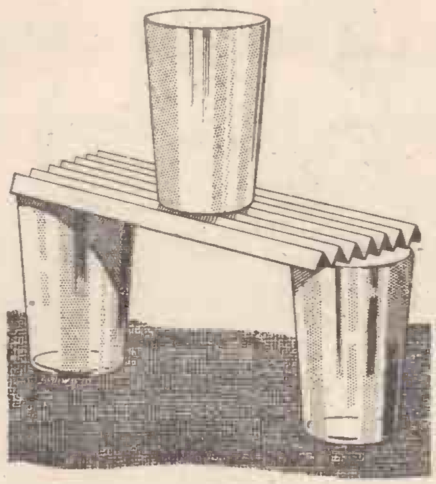


Fig. 6.—Showing the strength of corrugations.

Examination of the domino line shows your prediction to be correct.

The secret is that if you extract the domino carrying those numbers from the set so that the line is made up without it, the ends will always carry those numbers.

The Strange Cigarette

Most of the guests will be smoking. One by one the ash falls off their cigarettes, but yours remains intact, sticking firmly out in front. Draw attention to this and make a joke about it being through careful and steady handling, etc. The secret is that, unnoticed, you ran a long fine needle down the whole length of your smoke which is having the effect of keeping the ash in position.

The Magnetised Cigarette

Tell your guests that you can magnetise a cigarette. Turn back the cloth and place one on the polished surface (or on a tray will do). Rub a pencil vigorously and bring it slowly down to the cigarette, which immediately rolls away before it is touched. This is a trick and is done by bringing your face down to the pencil—a very natural act—and when the point is about 1½in. away, blowing a gentle stream of air on to the cigarette which causes it to roll away. If carefully carried out the illusion that the cigarette is repelled is very complete.

Rejuvenating an Apple

This holds the attention well for a few minutes. Show an old wrinkled apple and say that you will bring it back to roundness of youth. Have handy a glass jar and short piece of candle. Place the candle and apple on a plate and, lighting the candle, invert the jar and put it over both. Tell your "audience" to watch carefully. For a short time the candle just burns and nothing happens. Then the air becomes exhausted, and quite suddenly the apple fills out and becomes as smooth and plump as when it was picked.

American Wind Tunnel

AN unusual 10ft. x 10ft. wind tunnel set up in a Cleveland, Ohio, flight propulsion laboratory feeds all kinds of information into a central system, on a completely automatic and almost instantaneous basis. The director of the laboratory says a central automatic data codifier machine in the tunnel building is the only system of its type. It is part of a centre to handle data, which in turn is connected directly to the tunnel and other major research installations on the grounds. One of these is three-quarters of a mile away.

The equipment includes devices for recording and translating data provided by the tunnel, facsimile plotters, control room monitors, devices for checking errors and a general purpose electronic computer.

This tunnel will be used for the research and development of propulsion systems for aircraft and guided missiles.

The main drive compressor that drives air at the rate of 2,000 lb. per sec. in the 10ft. × 10ft. Cleveland, Ohio, wind tunnel.

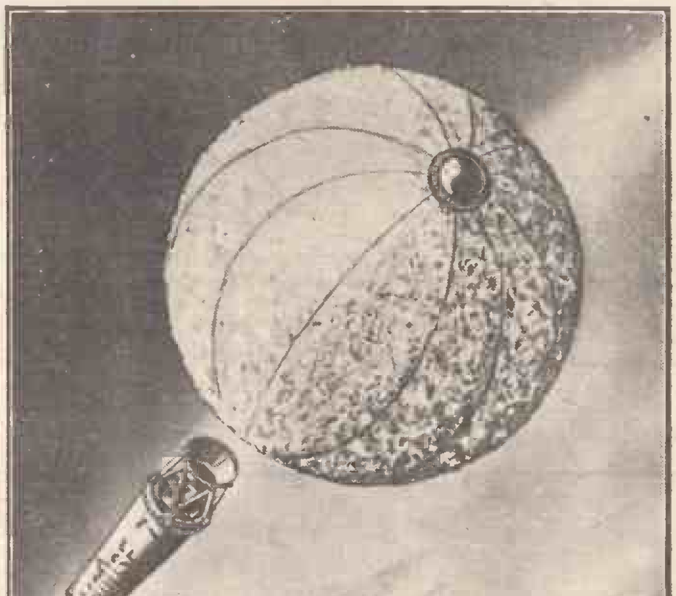
Some Unique Watches

ON exhibition at Besançon, France, recently, were what were claimed to be the world's smallest and the world's most complicated watches. The smallest watch measures 3/16in. x 9/16in. and has no fewer than 74 parts. The most complicated watch does many other things besides indicate the time; it is also an altimeter, a barometer and a thermometer, and gives the time in a number of cities throughout the world. It also has a three-bell chime.

ASDIC for Fishermen

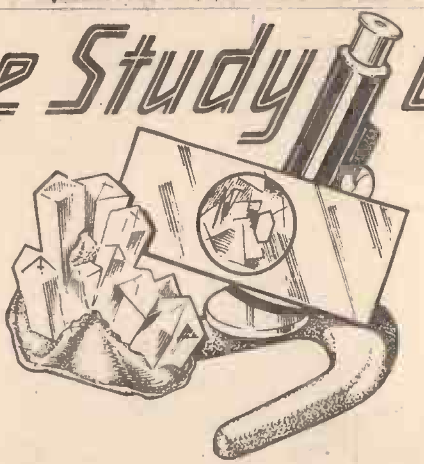
THE Kelvin Hughes Fisherman's ASDIC is a fully automatic high power combined echo-ranging and echo-sounding equipment, designed specifically for pelagic fish shoal detection.

It has an operating range of 0-2,000 yards, and the training control system includes provision for automatic step training over any sector of between 10 and 180 degrees. This is a development of the Echo Whalefinder which is now well established in the whaling industry.



A sixteen-ton three-stage rocket was the subject of a design study presented at the second International Congress on Astronautics. It was designed to carry either a small payload of instruments or a light-weight metal foil inflatable satellite into a circular orbit round the earth. The photograph shows artist J. W. Wood's impression of the release of the "fully-grown" foil satellite 6ft. to 8ft. in diameter. The satellite would circle the Earth every 90 minutes. Photo by courtesy of British Interplanetary Society.

Aids in the Study of Geology



No. 1.—The Adaptation of a Microscope for the Study of Geological Slides

By E. J. WILKINSON

A PETROLOGICAL microscope is fundamentally the same as any other microscope, though it possesses a few special aids to enable the student to deal with mineral rather than organic specimens. The ordinary biological instrument can be adapted to make a more complete study of rock slides possible, while in no way preventing its use in other fields.

Polarised Light

An essential addition if minerals are to be studied is the means whereby light may be polarised twice between its source and the eye.

Polarised light consists of light waves vibrating in one direction only, all other waves having been dispersed and thereby prevented from reaching the eye. Crystals of calcite (Icelandic spar), specially cut and mounted and known as nicols prisms, were once used to give polarised light for microscopic work, and if one's instrument is equipped with these they should be entirely satisfactory. However, if not the simplest method (and the cheapest) is to purchase a

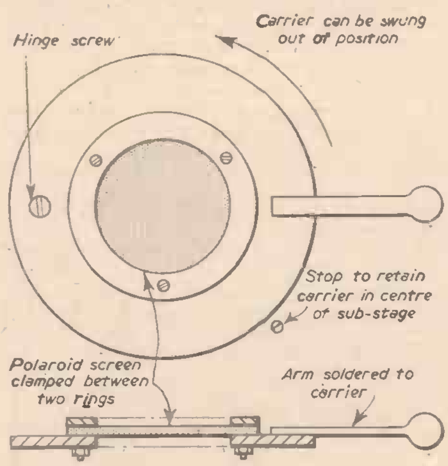


Fig. 1.—The carrier for the polariser.

piece of polarised screen, obtainable in laboratory grade from J. K. Holmes, who advertises in PRACTICAL MECHANICS. This can easily be cut with scissors to any shape and enough for two pieces will be required.

If the sub-stage of the microscope is equipped with a filter carrier which can be swung into and out of position one piece of screen can be cut to fit its recess. Where no such holder is available one could be made on the lines suggested in Fig. 1. No measurements can be given for the obvious reason that microscopes vary so greatly with age and make, but the unit can be made with the simplest of hand tools and should present no difficulty. In all probability the underside of the stage would need to be drilled and tapped to provide anchorage, though the body of a sub-stage condenser, if fitted, would be more suitable. There would be no problem of attachment on instruments equipped with the rotating disc method of controlling the amount of light entering the instrument, for the screw at the centre of the disc would serve to take the screen carrier as well.

This attachment, called the *polariser*, will when swung into line with the optical axis of the microscope give polarised light, with which certain tests for the analysis of minerals can be made.

In the professional microscope the second piece of screen, called the *analyser*, is situated in a sliding carrier in the body tube, and can be pushed into or out of action as required. There is no reason, however, why this screen should not be cut to fit snugly inside the eyecap which covers the ocular (Fig. 2). The author uses two of these eyecaps, one with and one without polaroid screen. With the unadapted eyecap and the polariser swung out of position ordinary light is available; with polariser alone, polarised light; with polariser and analyser, crossed nicols is the term used.

Crossed Nicols

This term originated with the use of the calcite prisms (named after Professor Nicols, who developed them). As polarised light is vibrating in one direction only, when the analyser is adjusted so that it will only pass light vibrating at right angles to that direction, the nicols prisms (polaroid screens) are described as being crossed. This arrangement naturally results in darkness when looking down the instrument with an empty stage. If after adjusting the mirror of the microscope both polariser and analyser are put into place and the ocular rotated (carrying with it the screen in the eyecap) the screens will be crossed when the point giving maximum darkness is reached. Fig. 3 should make this arrangement clear.

The polariser should lie in such a position

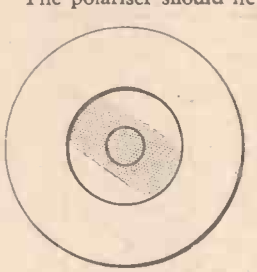


Fig. 2.—The analyser, which is a strip of polaroid screen, fitted in eyecap of ocular.

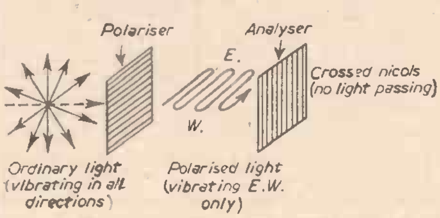


Fig. 3.—Diagram to illustrate the working of polaroid screens.

that the light waves transmitted by it vibrate in an east to west direction. For those readers who are unfamiliar with direction related to the microscope, as one normally sits behind the instrument the left-hand side of the stage is the west side. When crossed the analyser will lie N.-S.

Now certain minerals possess a property known as pleochroism, and this provides a valuable means of distinguishing them. Under polarised light a pleochroic mineral will, on being rotated on the stage, change its colour. Biotite, one of the micas, is a striking example. If a rock section containing biotite is rotated the mineral changes its colour from dark brown to light brown, a rotation of 90 deg. producing

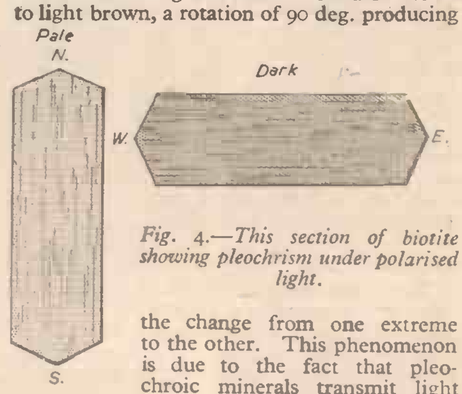


Fig. 4.—This section of biotite showing pleochrism under polarised light.

the change from one extreme to the other. This phenomenon is due to the fact that pleochroic minerals transmit light vibrations in two directions only—in the case of biotite, parallel and perpendicular to its cleavage direction. When the polarised light is vibrating parallel with the cleavage direction the

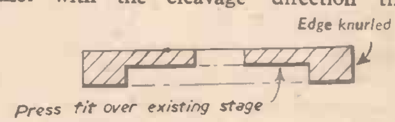


Fig. 5.—Duralumin cover to enlarge surface of stage.

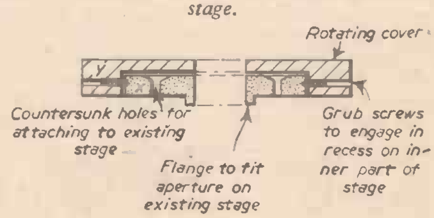


Fig. 6.—Details for making a rotating stage.

mineral absorbs its maximum amount of light and appears dark brown; on rotation through 90 deg., however, the polarised light is vibrating at right angles to the cleavages and the mineral absorbs its minimum amount of light, thus appearing light brown in colour (Fig. 4).

This fact can be utilised for the correct alignment of the polaroid screen mounted beneath the stage of the microscope. By examining a specimen of biotite lying with its cleavages in an E.-W. direction the polariser can be rotated in its holder until the mineral shows its strongest colour. The polariser will then be transmitting light waves having an E.-W. vibration.

As biotite is not a commonly occurring mineral (any other pleochroic mineral would serve as well, though biotite demonstrates this property most clearly) the beginner might consider the purchase of a commercially prepared section for the job. The Geological Supplies Department of Thomas Murby & Co., at 40, Museum Street, London, W.C., offer, amongst a good selection of thin rock sections, one of a biotite granite. (See lists at back of "Minerals and the Microscope," by H. G. Smith.)

The Stage

Another important feature of the petrological microscope is the rotating stage. Certain tests, for example that for pleochroism, require the rotation of the specimen under examination.

Fig. 7.—The modified stage.

Some earlier instruments were equipped with rotating stages, but are often too small in diameter, so that when the rock slide is moved to one side in order to examine those minerals on the perimeter of the slice the glass slip protrudes beyond the edge of the stage and is invariably knocked out of position as the stage is rotated. This trouble was eradicated by having a duralumin cover turned, which was a press fit over the existing stage and added an extra inch to its diameter (Fig. 5). The edge of the stage cover was suitably knurled for ease of manipulation.

For those with microscopes having a non-rotating stage only a possible method of adaptation can be suggested.

Any addition of this kind to the existing stage must be fitted so that the centre of rotation coincides with the optical axis of the instrument. Should it not be so minerals under observation will quite likely pass out of view at some point in each revolution.

Something on the lines of Fig. 6 would be required. X, of any suitable diameter, would be a fixture secured to the stage by B.A. bolts. The lip on its base would be turned to fit the aperture on the old stage so as to ensure correct alignment, while the groove around the side would enable the cover to be locked in place by means of at least three grub screws. The latter should be carefully adjusted so as to eliminate any side play, yet permit rotation with a minimum of effort.

Fitting Protractors

Some means of measuring the angle through which a mineral has been rotated (in order perhaps to determine angles made by crystal faces or cleavage planes) is an asset. This can be easily arranged by attaching to the stage two 180 deg. protractors, or one of 360 deg. if obtainable. The former should have the surplus celluloid below their base lines cut away so that they will meet accurately edge to edge. Small countersunk B.A. bolts should be used for attaching these to the stage, this being drilled and tapped to receive them. These bolts must not, of course, project beyond the underside of the rotating stage.

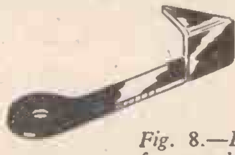


Fig. 8.—Pointer for attaching to stage.

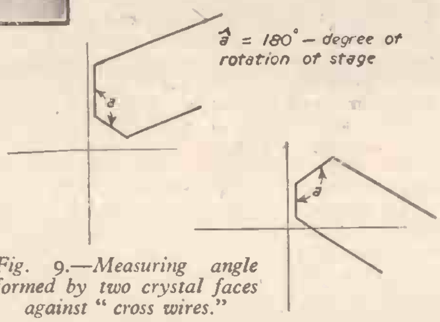


Fig. 9.—Measuring angle formed by two crystal faces against "cross wires."

Fixing Bolts

The bolts which secure spring clips for holding slides in position on the stage can serve also to hold down the protractors. A block of wood chiselled to fit into the aperture of the stage and held in a vice will enable an adjustable cutter of the type used for cutting holes in plywood to be used for removing the centre portion of the protractors so as to leave the aperture clear.

It is then necessary to secure a pointer to some stationary part of the stage. The S.-E. edge is out of the way of the hand when the stage is being rotated and can be seen from the working position in Fig. 7. The pointer should be shaped so as to come close to the edge of the protractor to provide a mark against which readings can be taken. If made in brass and painted black, a line cut through the paint and into the metal as in Fig. 8 is clearly visible.

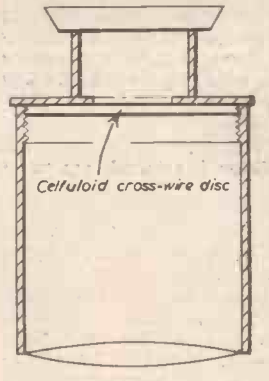


Fig. 10.—How the celluloid cross-wire disc is positioned in the ocular.

Cross Wires

Cross wires in focus with the image of the slide are needed to provide lines to which objects for measurement of angles can be moved (Fig. 9). A disc of thin perspex or celluloid cut to fit in the ocular and marked with two fine cuts at right angles to each other will do the trick. Any serious scratches on the perspex can be removed by rubbing with metal polish. In this respect, unless it is desired to take any micro-photographs with the "cross wires" in position, there is no need to worry about any slight optical effect the perspex may have on the image, nor the fact that all scratches have not been eliminated, for this device need only be used when a specific test requiring its aid has to be executed.

The author found that the best position for the perspex disc in his own instrument was as shown in Fig. 10, though some variation may be required in other cases.

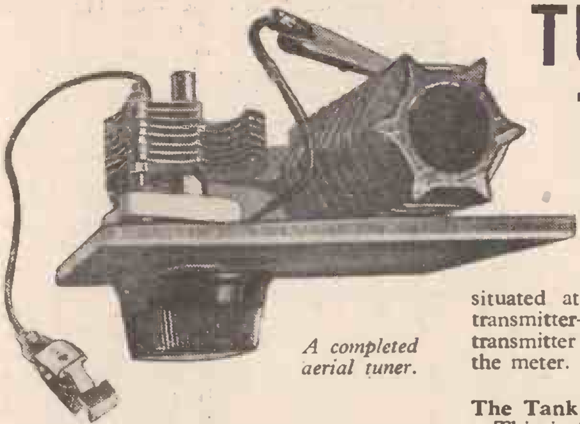
With the "cross wires" in place and the ocular inserted in the microscope tube it is only necessary to rotate the ocular until the lines lie N.-S., E.-W.

Books Recommended for Further Study

Introductory: "Minerals and the Microscope," by H. G. Smith (Murby). "Rutley's Mineralogy," by H. H. Read (Murby).

Advanced: "Optical Mineralogy," by Rogers and Kerr (McGraw Hill). "The Petrology of the Sedimentary Rocks," by Hatch, Rastall and Black (Murby). "The Petrology of the Igneous Rocks," by Hatch, Wells and Wells (Murby).

ANDY MANN THE PRACTICAL MECHANIC



A completed aerial tuner.

TUNING *Model Control* TRANSMITTING AERIALS

Notes on Using the Tuned Type of Aerial

By F. G. RAYER

A POWERFUL radiated signal is very useful indeed when maximum reliability of control is wanted, great range is required, or a very small receiver aerial is desirable because of the type of model. With a given transmitter, the power radiated will depend almost entirely upon the efficiency of the transmitter aerial. Quite often a vertical rod or wire of no particular length is used, this generally being from 3ft. or so up to 8ft. or so in all. Such aerials may give good results. Nevertheless, the actual radiated signal may

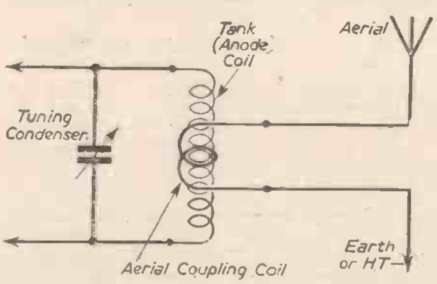


Fig. 1.—Usual method of aerial coupling.

be increased in strength by using some form of tuned or resonant aerial, and this can often be worth while. The various advantages arising from maximum efficiency will readily come to mind. For example, a single valve transmitter will frequently be sufficient for a model on a boating pond, thus doubling the battery life available with a two-valve transmitter. Again, control up to 50 yds. or more will be possible with no aerial at all on the receiver, or with a vertical wire aerial only a few inches long, and this is particularly convenient in very small models. If a valveless receiver is used, the extra signal strength will help to increase range and assure reliable control.

For these reasons, then, it is often useful to bring the aerial system more into line with that employed by commercial stations or in amateur transmitter single-wire systems. The actual increase in the power of the radiated signal will depend upon the efficiency of the old aerial and the method employed. A two-fold increase is not unusual, but in any particular case only measurement will show exactly what improvement arises. Some method of measuring results is, indeed, essential when tuning the aerial, and a bulb, R.F. meter, or field-strength meter can be used.

The bulb is the simplest, and should be included in series with the aerial. A thermocouple R.F. meter may also be included in this position, and will give a more exact indication than the bulb. Neither method will give any useful indication with small-power (one-valve) transmitters.

For *any* transmitter, the field-strength meter will be most satisfactory. This consists of a coil tuned to the 27 Mc/s band, crystal-diode, and meter of 0-100 microamp or similar type. A few inches of wire will form an aerial, and the field-strength meter can be situated at some small distance from the transmitter—say 10 to 30ft., according to transmitter power and length of aerial on the meter.

The Tank Circuit

This is formed by the anode tuning coil and variable condenser already in the transmitter. Energy is usually drawn from the tank by means of an aerial coupling coil, as shown in Fig. 1. The coupling coil is about two turns, near the anode coil or over-wound upon it.

For maximum efficiency the coupling should be adjusted to an optimum value. If coupling is loose (coils too far apart) then little R.F. energy is transferred to the aerial. On the other hand, if coupling is very tight, the oscillations in the tank coil will be much damped. With the usual self-excited oscillator type of transmitter, this will reduce power. For the aerial systems to be described, the aerial loop may be left in its usual position. But if attempts are later made to obtain the maximum possible output from the transmitter, adjustment to the loop may be required, even with a commercially-made set.

One end of the aerial coupling loop is usually returned to the chassis or earth line of the transmitter. With some forms of aerial tuning this can be left, but with others it will be necessary to remove this lead, so that two connections can be taken from the coupling loop.

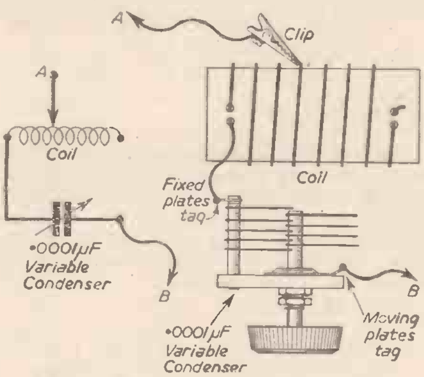


Fig. 2.—Aerial tuner.

Resonant Lengths

It should not be overlooked that the aerial itself may be of such a length that it is resonant. As the full resonant length is impossible in any type of portable equipment, a fraction of this is frequently used, around 8ft. 6in. being popular. The exact optimum length will depend upon the position in the band used, and has to be found by trial. To do this, a sliding rod can be fitted in the uppermost tube of the aerial, making good contact with it, and held by a collar or spring clip. The length can then be changed a little at a time until radiation is at maximum, as shown by maximum reading on the field strength meter, or maximum input to the aerial on the R.F. meter.

In practice, adjustment is a little difficult, since readings cannot be taken with the operator touching the aerial, or near it. It also sets a limit to aerial dimensions, which may itself be undesirable. These limitations are overcome by tuning the aerial externally, when it may be of virtually any length. There is then no need that the aerial length even be known.

Aerial Tuner

This is shown in theoretical and practical form in Figs. 2 and 3 and can be used in various ways. The variable condenser is an ordinary short-wave type with a maximum capacity of around .0001μF (sometimes written 100 pF), the actual value not being very important. It requires a knob, and can be mounted on a small paxolin panel, with the coil.

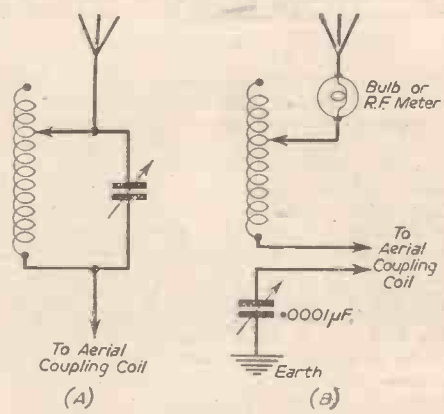


Fig. 4.—Methods of series tuning.

The latter is best of a type which can easily be tapped, as is so if turns are well spaced, and the former is ribbed. For such a coil, seven turns of 20 s.w.g. tinned-copper wire, occupying 2in. winding length in all, on a 1½in. former, will be satisfactory. If space is limited, or a smaller former to hand, then 11 turns, occupying 1in. on a ⅝in. diameter former, will be suitable. If the former is not ribbed, small loops should be twisted for tapping points. The lead "A" affords one

Fig. 3.—The aerial tuner shown in Fig. 2.

tapping. An alternative is to find the correct position by trial, and then solder the lead to this point.

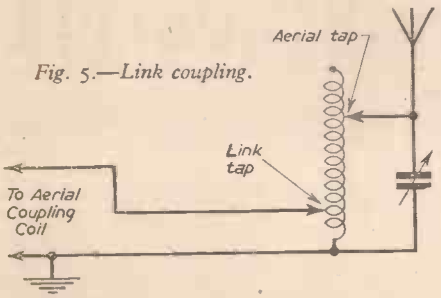


Fig. 5.—Link coupling.

Series Tuning

The simplest method of tuning the aerial is shown at A in Fig. 4. To do this, A and B in Fig. 2 are joined together, and taken to the aerial. The other condenser tag is taken to the transmitter aerial terminal.

If a bulb or R.F. meter is used to show the current flowing into the aerial, then it is always included in series with the lower end of the aerial itself, never between tuner and transmitter. If the transmitter is of low power, a bulb cannot be used. If of medium power, a .06 amp-type bulb will be required, whereas a powerful transmitter will blow a bulb of this rating. In each case the bulb is shorted out after adjustment.

With transmitter on, the tuning condenser is rotated until R.F. or field-strength meters show maximum, or the bulb glows most brilliantly. If a definite tuning point cannot be found, then an unsuitable number of coil turns is in circuit. If resonance is being approached with the condenser at maximum, but cannot be reached, then an extra turn or two will be wanted. If, on the other hand, resonance is approached with the condenser open, then too many turns are in circuit, and the clip should be moved along the coil accordingly.

A method often used in larger equipment is shown at B in Fig. 4, and requires connections to both ends of the loop winding. The aerial tuning condenser and coil are disconnected, the coil being wired at the aerial end of the loop, and the condenser at its earthed end. The number of coil turns must now be adjusted by moving the clip, until resonance is possible with the variable condenser fairly well closed.

Link Couplings

These are highly effective, but require more adjustment. One method is shown in Fig. 5. Here, two leads are brought from the transmitter aerial loop, it not being necessary to break the earth connection. The link tap is taken to a position only one to three turns from the earthed end of the aerial tuning coil, whereas the aerial tapping is taken to such a position that the aerial can be tuned to resonance (usually around 6 turns, with the 1½in. diameter coil mentioned).

The exact position of the link tap will greatly influence output, and is found by trial, re-tuning being necessary after each modification of its position. Both taps must be adjusted for maximum signal strength, or reading on the R.F. meter.

If both ends of the transmitter aerial loop are available, two leads may be taken from these, to a similar loop wound round the aerial tuning coil. In Fig. 5, the turns near the earthed end of the coil replace this second loop.

It will be found that the current which can be made to flow into a short aerial will not be so great as with a longer aerial. It will, however, be greater than an equivalent length of aerial which is untuned.

All such adjustments to the aerial system may make necessary slight re-tuning of the transmitter tank circuit, to restore the equipment to the exact original frequency. With normal degrees of aerial coupling in the transmitter this retuning will be very slight.

Compact Aerial Unit

When equipment is to be carried about, it may be best to use a coil such as that shown in Fig. 6. For tuning, a 30 pF trimmer is used, held inside the coil by its tags passing through small slots, a hole opposite making adjustment possible with a shaped bakelite rod or tube, notched to fit the trimmer top.

A tube about 1in. in diameter and 2in. long will be amply large for this type of unit, and the ends may be closed with discs of wood or other insulating material. The number of turns will have to be found by trial, so that resonance is achieved by turning the trimmer, exactly as already described. Short flex leads terminating in crocodile clips will facilitate connecting up the unit and aerial when required. Such a unit is particularly easy to install in accordance with the series method in A, Fig. 4, though this will not quite approach results obtained with a link coupling correctly adjusted.

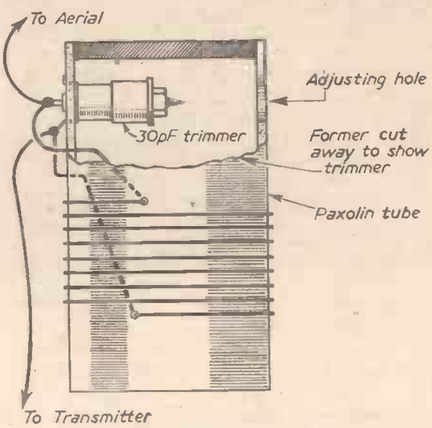


Fig. 6.—A small aerial resonator.

Science and Observation

Notes of Interest on Current Topics

Weather Control

IT is not at all impossible that the vast atomic energy which we shall one day direct, with the help of radio, will enable us to vary local weather to a modest extent. We can, perhaps, visualise the time when a seaside resort will complain that its sunshine has been grabbed by a jealous neighbour.

It will be possible to move a range of hills and, almost as important, to examine the upper stratosphere with the aid of rockets or satellites which will transmit to us good weather reports for the first time in history.

A Black Box

THERE is something very tragic in the black box which now forms part of the equipment of an experimental aeroplane. In this box is a recording cinema and various other instruments, which have for their sole object the keeping of notes of incidents which happen so quickly that no human brain could follow their action. Certainly not the pilot, who is otherwise engaged.

There has been more than one example of information taken from the box after a pilot has been killed, and it is strange to think that data of this kind is used by other generations to benefit from the knowledge which was found, but never known, by a pilot who has met his death.

In so many ways to-day life is quicker than we can follow, and the principle, which began by the photography of working bricklayers to discover how many of their movements were wasted, will be extended by means of types of electronic recordings. It is not impossible that, just as we waste much of the time in the cinema by sitting in darkness as each frame moves into place, so could a humiliatingly long period of our lives be shown as worthless by mechanical brains moving quicker than our own.

We are still building faster than we know. There is many a commonplace theory which can be shown to be wrong by electrical "senses" which have far outstripped the mind by which they were conceived.

Washing Day

ENGLAND has plenty of good things, but they are solely for export. However, we hope to see some of them sometime; notably, a method of washing clothes by near-ultrasonic sound.

This, of course, means waves of such high frequency as to be inaudible to anything or anyone but a bat, some kinds of small dog or a child. Even then it is doubtful if any normal mammal could hear waves at such short intervals.

Aircraft to-day travel faster than sound, and ultrasonic waves are liable to cause strange pressure changes on the wings. At short distances these high pressures can disintegrate small living organisms, while fish, unless they are pretty tough, can be destroyed in quantities by ultrasonic oscillations in their vicinity.

So instead of beating up clothes when it is required to remove buttons, tear collars and wreck our laundry, it is proposed to subject clothes, garments, washing soaps and everything else to high frequency waves which will disinfect, dislodge dirt and vastly increase the speed of washing. An expert has said that it should be possible for clothes to go in at one end dirty and to come out of the other end of the new machine clean and wrapped in transparent paper for delivery.

There is no reason why small home wash-tubs should not be near-ultrasonically operated. Human beings would not hear the noise and, in a sense, it would be another opportunity for electronics to take charge.

Hair Raising

THIS is not an electrical trick but concerns a weird story told by author, Algernon Blackwood. He tells of a boy who went out to fetch water from a well on a snowy night. The footprints ceased 30ft. from the well and the boy disappeared. Investigation produced nothing more than a strange cry of help which seemed to come from the air and lasted all day, until hot weather caused the phenomenon to cease.

Nothing, of course, can explain these mysterious occurrences, but one wonders if the poor boy was down the well and that his footprints had been covered up by a sudden gust of wind blowing snow over the traces; or was it a wind-echo from the well which anxiety made sound like a cry for help ?

There is a well from which you can hear the echo when the lid is tapped. It is, of course, the exact method used by the Kelvin Sounder to determine the depth of the ocean, or in modern ways it is rather like radar using wave reflection to determine the height of aircraft.

A NEW SERIES

Applications for FOREIGN PATENTS

By "ATTORNEY"

The Patent Office, Chancery Lane.

A BRITISH patent extends only to the United Kingdom and if patent protection is required abroad it is necessary to file a patent application in each country where protection is desired. Each country is wholly independent in its patent law and practice and careful regard must be paid to this in obtaining patents abroad.

Generally speaking, a patent abroad is vulnerable either before or after grant if there has been prior publication or use of the invention, irrespective of whether this originates with the inventor, proprietor or any other person. It follows, therefore, that an invention must be kept secret until the desired protection abroad has been applied for. There is, however, a valuable exception to this rule due to the existence of International Convention or equivalent arrangements under which an applicant who has first filed a patent application in the United Kingdom is entitled to apply in a Convention country abroad within one year of the British application date. When such an application is made abroad it cannot be harmed by any publication or use of the invention that takes place between the British and overseas filing dates. Also, the overseas application will be treated as to its effective priority date as though it had been filed on the same date as the basic United Kingdom application. Most, if not all, the principal countries of the world subscribe to the International Convention or equivalent arrangements.

A patent abroad will not be granted, or, if granted, will not be valid if before the application or priority date, whichever is applicable, the invention has been described in any published document, as, for instance, in a patent specification, technical book or periodical, printed publicity matter, transactions or journals of any institution or society, irrespective of the language in which the publication occurs. Such prior publication destroys the so-called "novelty" of an invention. In a few countries, only prior publication or prior use of the invention in the actual country can damage the "novelty" of an invention covered by a patent or patent application.

In most of the important countries patent applications are submitted to a novelty search by the Patent Office and the applicant's attention is drawn to relevant prior publications revealed by the search. It is usually necessary for the applicant to restrict his application and, in the case of some countries, to advance strong arguments to show that the invention gives rise to a substantial technical advance in the art. This is particularly necessary for U.S.A., Germany, Holland and Sweden, where the examination procedure is somewhat stringent.

The protection of inventions abroad is often of vital significance, not only to deal with competition, but also to enable licence and other arrangements to be made with overseas companies or concerns. It is usually necessary for the countries to be selected with some care owing, for example, to the cost of obtaining and maintaining overseas patents. In the choice consideration is wisely paid to the principal manufacturing countries and also to the principal "export" countries covering the field to which a particular invention relates.

Preparation of Application

It is necessary for overseas patent applications to be prepared and prosecuted with due care and with full regard to the practice of the country. This requires the services of reliable patent attorneys or agents abroad who are usually instructed by the patent agents responsible for the initial or basic United Kingdom application. Assuming the engagement of such professional help, the cost of preparing and filing a patent application abroad varies considerably with the nature of the invention, the length of the patent specification and the number of sheets of drawings that may be required. The costs are liable to vary also owing to changes of fees or practice abroad and changes in rates of exchange. Apart from application costs, additional costs normally arise in dealing with official objections; there are also official fees payable after allowance of an application, or charges that arise in certain countries for printing or officially advertising the specification on acceptance by the Patent Office of the country concerned. Moreover, in many countries it is necessary to pay official fees annually or at specified intervals in order to maintain the application and patent in force.

> Valuable Advice to the Inventor on Patent Provisions and Procedure Abroad

The applicant for a patent abroad must, in a few countries, be the actual inventor, but in most countries an assignee, whether an individual, firm or corporate body, can apply either alone or jointly with the inventor.

In some countries there is provision for the granting of patents of addition, i.e., patents for improvements or modifications of an invention already covered by a patent owned by the applicant for the patent of addition. These addition patents continue, usually without payment of renewal fees, for the unexpired term of the main or so called parent patent.

The term of the patent varies from country to country; in some countries the term starts from the date of application for patent in the overseas country, whereas in others the term runs from the date of publication or date of grant of the patent.

There are limitations on what may be patented abroad. Inventions contrary to law or morals, mere schemes and foods or medicines composed of a mixture of known ingredients are among the things that cannot be patented.

In certain countries a patent application having successfully passed examination in the Patent Office is laid open to public inspection for a limited period in order to allow interested parties to lodge opposition to the grant of the patent. In such oppositions an invention may be attacked on various grounds, but mostly on the ground that the invention is not new or does not involve a technical advance having regard to what was known or used prior to the effective date of the patent application. These oppositions are usually protracted and difficult and often require the assistance of expert witnesses in order to refute the opposition. A decision issued by the Opposition Department of the Patent Office concerned is usually subject to appeal to a higher authority in the Patent Office or to a court of law.

Once a patent is granted it may be assigned, but it is usually necessary to register the assignment in the Patent Offices abroad. In the case of U.S.A., where only the actual inventor or inventors can apply for a patent, an assignment can be executed at the same time as or subsequently to the filing date with a view to obtaining grant of the patent to the assignee.

Special mention needs to be made on protection available in the Crown Colonies and mandated territories where there is no independent patent system. A British patent may, within a certain period of its date of grant, be registered in most Crown Colonies and mandated territories. The registrations remain effective so long as the basic British patent remains in force.

So called patents of importation or revalidation patents may be obtained in Belgium, Spain and Argentine. Such patents may be taken out by the owner of a British patent, providing there has been no disclosure or practical working of the invention in the importation country prior to the date of applying for the importation or revalidation patent. The term of the latter is usually limited to the unexpired term of the corresponding British patent.

Provisions Abroad

The principal patent provisions of a number of countries will now be briefly mentioned, but many unspecified miscellaneous provisions and formal requirements apply to the patent systems of all the countries and information or advice in connection therewith can be obtained from patent agents practising in the United Kingdom.

The fees applicable in obtaining and maintaining patents abroad vary considerably from country to country and the fees given in the following brief résumé of each country should be accepted only for general guidance as applying to an invention already protected in the United Kingdom and requiring a specification of approximately 1,500 words and one sheet of drawings. The fees given, moreover, apply to an application without special circumstances and cover the official fees and normal professional charges of patent agents at home and abroad. In countries where official objections may be raised against an application, additional unpredictable fees are involved. This also applies to oppositions and other special procedures. Closer guidance on the question of costs of applications abroad can be ascertained from patent agents in the United Kingdom.

Australia

Patents are granted in Australia for a term of 16 years from the date of the patent, subject to the payment of annual renewal fees which commence on the expiration of the fourth year of the patent. No renewal fees are payable on patents of addition. An extension of time, not exceeding six months, can be obtained upon payment of a fine for paying renewal fees. For patents granted on applications filed on or after May 1st, 1954, the patent term runs from the date of filing the complete specification.

Australia has special arrangements with Great Britain which enable an application to be filed in Australia within 12 months of a corresponding application in the United Kingdom and to claim priority on the basis thereof.

The Application

A patent application in Australia may be made by the actual inventor or his assignee. An application may also be made by any person in Australia to whom an invention has been communicated by a British inventor.

A patent application in Australia must include an application form containing a statement of address for service and other particulars and the form must be signed by the applicant; in the case of a corporation the signature must be under seal. It is further necessary to file a declaration signed by or on behalf of the applicant stating full particulars of the actual inventor. This declaration may be filed in the Australian Patent Office at any time before acceptance of the application.

The application may be accompanied in the first instance by a provisional specification giving a clear description of the invention. In order to continue the application a complete specification must be lodged in the Patent Office within one year of the provisional filing date. A Convention application, however, must be accompanied by a complete specification in the first instance.

The Specification

A complete specification must be filed in duplicate and be accompanied by an additional copy of the claims. The specification must fully describe the invention, including the best method of performance thereof. In appropriate cases the complete specification must be accompanied by drawings illustrating one or more practical embodiments of the invention.

The complete specification is submitted to examination by an examiner who carries out an investigation through Australian patents to ascertain whether the invention as claimed is novel. The applicant's attention is drawn to any objections and he has the opportunity of amending his specification for reconsideration by the examiner.

The novelty of an invention can be destroyed by prior publication in a printed document published in Australia or by prior public use of the invention in Australia. An invention will not be affected, however, by publication in an Australian patent specification based on an application made more than 50 years prior to the effective date of the application under examination.

At the expiration of six months after the filing date of a complete specification the application is laid open to public inspection and has the effect that claims in an infringement action may date back to the date of such publication.

The complete specification must be accepted within 15 months from the date of the first report of the examiner. There are certain provisions for extending this term.

After acceptance of the complete specification and payment of an appropriate fee the acceptance is advertised in the *Official Journal* to give any interested party an opportunity of opposing the grant of a patent within three months from the date of advertisement. There is provision for obtaining a short extension of time for lodging such opposition.

There are many grounds for opposition, including the following:

1. That the invention claimed was obtained from the opponent.
2. That the invention is claimed in another Australian application bearing an earlier priority date.
3. That prior publication of the invention has otherwise occurred in Australia.
4. That the invention is not a manner of manufacture or is obvious, i.e., non-inventive.

If no opposition is lodged against the application it is necessary to pay a sealing fee within six months from the date of advertisement of acceptance of the complete specification in order to secure sealing of the patent. The sealing period can be extended under special circumstances.

An application may be assigned before grant and providing the assignment is registered in the Patent Office the patent will be issued in the name of the assignee. If the patent is assigned after grant it is necessary for the assignee to apply to the Australian Commissioner of Patents to enter the name of the assignee on the official register as patent proprietor. The application must be accompanied by a certified copy of the assignment. If an assignment is not registered within six months from the date of execution a fine is payable for belated registration.

Compulsory Licence

In order to encourage working of patented inventions in Australia provision is made for any interested person to apply to the Commissioner of Patents for the grant of a compulsory licence under a patent on the ground that the invention is not being worked adequately or to the fullest possible extent in Australia. An application for such a licence will not be entertained, however, until after the expiration of three years from the date of sealing of the Australian patent. The question of whether or not a licence should be granted and, if so, on what terms is decided by the High Court, to whom a petition is presented by the Commissioner.

Although Australian patent law does not make it obligatory to mark patented articles or products with the patent number it is advisable to do so in order to recover damages from an infringer who might otherwise escape damages on the ground that he was not aware and had no reasonable grounds for supposing that a patent existed.

Application fees are from £40 15s. Renewal fees rise from £7 17s. at the fifth year to £16 15s. for the last year of the patent term.

(*To be continued*)

Hints for the Workshop

Handy Containers

FIG. 1 shows a handy method of storing nuts, bolts, woodscrews and other miscellaneous items of small size. As can be seen, the screw tops of the jars are secured to the underside of shelves and thus the glass containers may be detached at will. Saving in space is also achieved, as the area immediately beneath the shelf is seldom utilised.—E. G. Evans.

Fig. 1.—Jars in position.

A Simple Hasp

A SIMPLE method of securing the lid of a box, without the inconvenience of a padlock, is by the use of an ordinary 2in. or 3in. wire nail and two or three large staples as shown in Fig. 2.

A hole is bored in one side of the box near the lid and close to the opening side. This hole should be slightly larger in diameter than the nail so that it can slide in and out easily. Into the inside of the lid and the side of the box are driven two or three staples, so that when the lid is closed they are in line with the hole in the adjacent side and the nail is able to pass through them all, so securing the lid.

When the lid is closed all that is visible of this "lock" on the outside of the box is a nail head. Few children will be able to solve this mystery when trying to open father's tool box.—P. O'Shaughnessy.

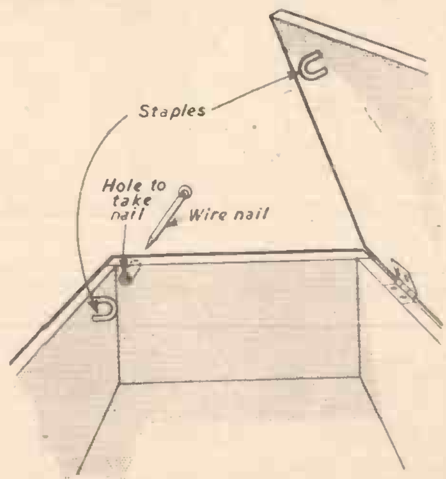
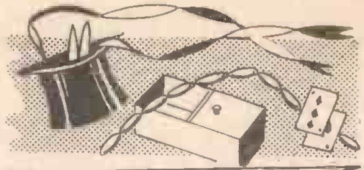


Fig. 2.—Method of securing tool box lid.

CHRISTMAS MAGIC



By H. A. ROBINSON

Some Illusions That Need a Little Mechanical Preparation

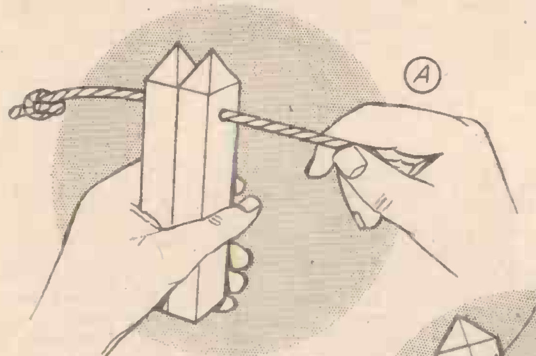
The Pillars of Solomon

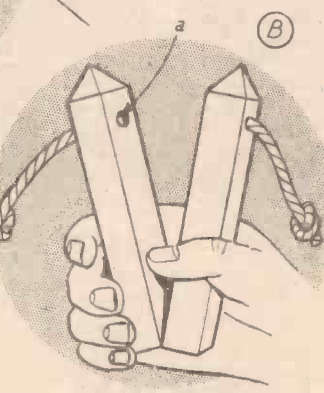
TWO strips of wood are held as (A), Fig. 1, with a piece of cord going (apparently) through two holes from side to side near the top. To show that it is one connected piece, the conjurer pulls at one end and the other retracts inwards. He pulls at that and the other goes in. Having the audience satisfied on this, a knife is asked for and with a cutting action it is passed down between the strips, seemingly severing the cord. Indeed, it is proved by slewing the "pillars" apart as (B), which shows the cord hanging out on both sides, also the hole (a) on the inner faces out of which the cord should protrude—but doesn't.

The strips are put together once more as (A); magic words and a wave of the wand and the pieces of cord once more join up and can be pulled backwards and forwards through the holes.

Diagram (C) shows the secret. The pillars are bored vertically and horizontally and the cord threaded as shown. See to it that when the pieces are slewed apart as (B) a tight hold is kept on the ends.

By building up big pillars a weight can be put inside as (D) and the woods taken *right apart* after the cutting. With a quick action the one cord can be made to disappear in as the other is pulled out, thus giving the idea of a continuous piece. The taking right apart is effective, but in this form the trick takes more preparation and is harder to work.





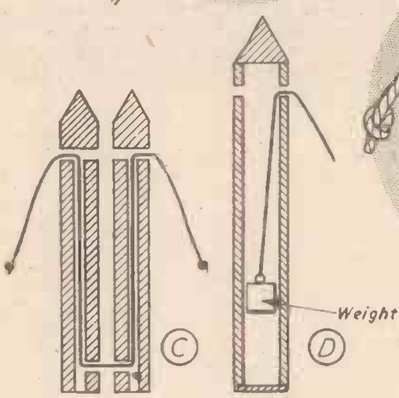


Fig. 1.—Details of the "Pillars of Solomon" trick.

Fig. 3 (Right).—Construction of the mystery tin.

The Obedient Reel

Procure as large a cotton reel as possible and bore the channel (a) in Fig. 2. Thread it on a double length of string of suitable thickness, the one strand going right down the centre hole, but the other passing through the side channel. To get the "obedience," hold the string vertically. When it is held loosely the reel falls freely, but the slightest pull on the string causes it to stop immediately. This seems very mysterious, as it appears to the watcher that both strands go straight through the centre hole.

Get members of your audience to say where they want the reel to stop—halfway down, etc.—and then make it obey their orders.

The Mystery Tin

This item stands ready on your conjurer's table. Have handy a pile of sand on a tray. Take the lid off the tin and deliberately fill it to the brim with sand, making sure that everyone sees it going in. Hold the tin between the hands (like a concertina) and swing the arms about. Replace on the table and take off the lid. To the surprise of all the tin is now full of sweets, which can be handed round to prove that there is "no deception."

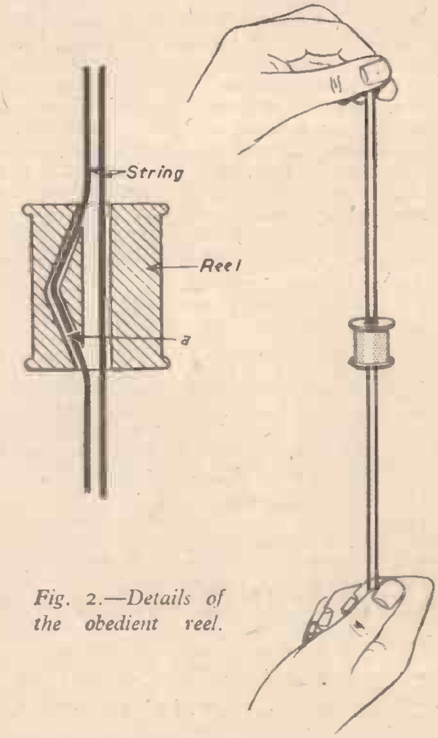
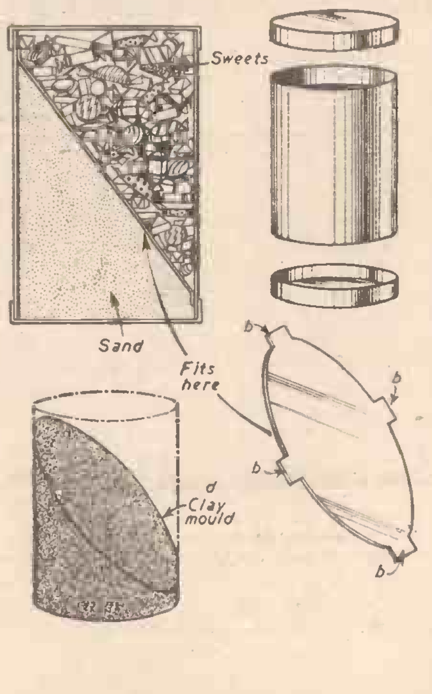


Fig. 2.—Details of the obedient reel.

The secret is shown in Fig. 3. The tin is double-ended with two lids and a partition diagonally across the centre. Thus, there are two separate divisions, the one already full of sweets and the other into which the sand is poured. In the waving about, which is only to confuse the onlookers, the tin is reversed and when set down the end with the sweets is opened.

To make the trick obtain a fairly large tin, or for a small audience a cocoa tin will do. With some care remove the bottom and fit a lid from a second tin. Both this lid and the tin's own lid at the other end should be tight-fitting to prevent accident, as should also the partition. To find the position of this fill the tin with stiff clay. Push this out and slice the clay cylinder so formed diagonally. The surface then exposed gives the shape (d) to which the partition (of thin tinplate) must be cut. While cutting, however, leave on the tabs (b), which are bent up and secured to the tin with a touch of solder on each.



Changing Ink to Water

Cut a piece of black silk as, say, from an old umbrella, shaped as shown in Fig. 4, and of such a size that it will just line a half-pint tumbler. With water in the tumbler the silk can be made to lie tightly against the glass and from a little distance looks like a black

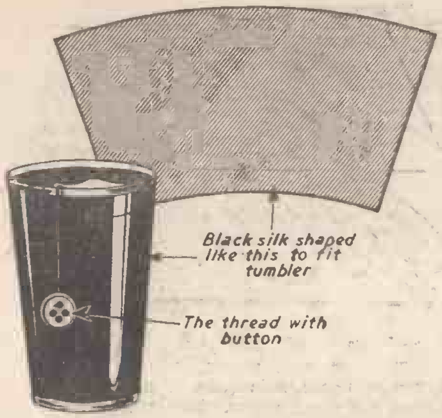


Fig. 4.—Changing ink to water.

liquid, which you tell the audience is ink. Attach a piece of thread to the silk and hang it over the back.

Show the tumbler to the audience and tell them that you are going to change the ink it contains into water. Cover the tumbler with a large handkerchief, say the magic words and whip it away, showing clear water. In the pulling away you, of course, got hold of the thread and so dragged out the black lining. To make no mistake about getting hold of the thread it is good to fasten a small button on the end.

The Balancing Egg

This needs two eggs, the one having to be specially prepared. Volunteers are called for to try to balance the egg you hand them on end. They make valiant efforts, but the egg always falls over. Keep this up till everyone is sure that it just cannot be done. You then apparently take the egg and balance it easily in a vertical position.

The secret is that, under cover of patter or just putting the egg down for a moment on the table behind something, you switch egg number one for egg number two, which has, by vigorous shaking, had its yolk broken. An egg with a broken yolk will always stand upright.

The Changing Card

This trick can be worked in numerous ways. A card is shown and placed on a dinner plate in full view of the audience. You take a large handkerchief, shake it out and show both sides, then, holding it by the tips, lay it over the card. Upon removal the card has changed to another one. Actually there were two cards glued very carefully back to back, and while appearing to spread the handkerchief the dual card is turned over.

Alternatively, the card can be changed by dropping it into a bag (shown to be empty), it being picked out a moment later as another card, the bag still being proved innocent of any other piece of pasteboard. Other ways of using the back-to-back cards can readily be thought out.

Disappearing Matches

This trick can be worked well only when the watchers are fairly near. A matchbox is exhibited and the tray pushed about half way out showing it to be full. Patter, a little waving with the wand and a moving of it about and the tray which had been pushed

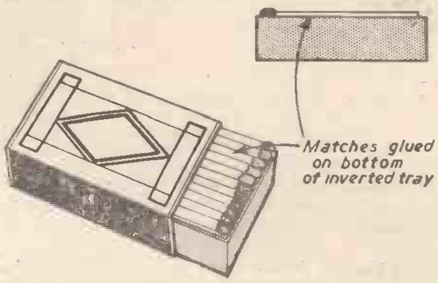


Fig. 5.—How matches are made to disappear.

back can again be brought out, but this time the box is empty.

The solution is that a row of matches (Fig. 5) is glued on the *under side* of the tray, which gives the appearance of a full box. In the hand waving, etc., the box is turned over so that when the tray is again pushed it is obviously empty.

The Disappearing Coin

Make a shallow box as Fig. 6, or use a cigar box, and in one side, level with the bottom, cut a slot just large enough to pass a halfpenny. Ask for a coin, put it in the box and rattle it about so that everyone is sure it is there. Suddenly the noise ceases and the box is shown to be empty. The coin has, of course, been worked down to the slot and slipped through into the hand. Curiously, this simple explanation never seems to occur to the audience. The slot is invisible and in any case it is held away from the audience.

No matter how easy a trick seems to be it should always be practised slowly before a mirror to see how things appear "out in front." Although it spoils things for one of your possible audience it is best if you can get someone to watch you go through the act and tell you of anything that does not look too convincing.

Never keep a trick on too long, no matter how much interest it seems to be attracting, and clear the items of one trick right away before starting another.

The running talk (patter) a conjurer keeps up is not just nonsense, but a genuine help to the illusion. Talk comfortably most of the time and draw the attention in one direction when you want to do something unobserved elsewhere. A quick silence, however, can be very effective at the moment when you show the box to be empty or the card to have gone. The talk is usually made up of telling the audience what you are doing, and as people will invariably look where they are told it can be used as suggested to distract attention at a crucial moment.

Nervousness spoils conjuring so cultivate

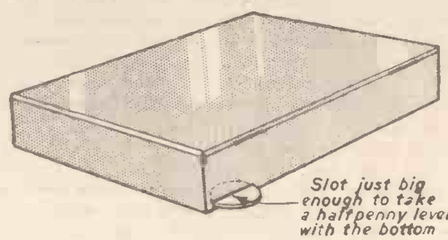


Fig. 6.—The box for making a coin disappear.

a very self-possessed manner and a "master of the situation" atmosphere. This, apart from anything else, puts you in the right frame of mind to deal with and cover up any slips that may take place.

The success of conjuring, however, lies in practice, and again practice, especially if any sleight of hand is required. Nothing looks worse than a fumbled trick.

Making Wall Fixings

A Strong and Simple Method

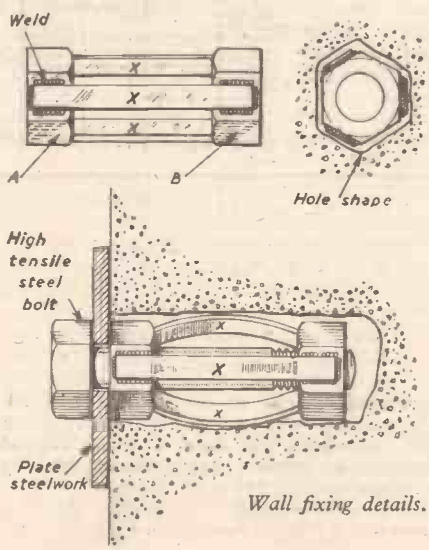
THESE are great time-savers when fixing to brick or concrete walls; for the job can be immediately secured to the fixings without waiting for cement "grouting" to set, as none is necessary.

Each fixing is built up from a mild steel nut, a high-tensile steel nut and bolt of the required size and three mild steel strips.

The mild steel nut A has the thread drilled out to provide clearance for the bolt shank, and both nut A and the high-tensile nut B are connected as shown by strips ⅛in. thick by ⅜in. wide welded on. Overall distance between the end faces of the nuts must be equal to the bolt length under head, less the thickness of the material which is to be fixed (see sketch).

In application, holes roughly triangular in shape deep enough to take the fixings are cut into the wall face and the fixings are inserted. The job is then lifted into position, and bolts entered through the fixing holes into nut B, which is at the farther end (or bottom) of the holes.

The bolts are then tightened, the action of



Wall fixing details.

the fixings being that they are unable to revolve owing to their shape and the shape of the hole; consequently, the strips of mild steel bend outwards as the bolts are tightened and thrust firmly and immovably against the sides of the holes, so securing the work to the wall face.

The fixings shown here are for heavy duty, but the principle may be used on a smaller scale.

Space Visitors

Some Examples of Mysterious and Well-authenticated Unidentified Flying Objects.
We Do Not Necessarily Subscribe to the Author's Conclusions.—Ed.

By "THEORIST"

IN this article it is proposed to consider some outstanding flying saucer incidents and, where possible, to attempt an analysis of them. That many sightings of unidentified objects in the atmosphere may be attributed to meteorological or astronomical activity is not denied; but certain aspects of the following incidents defy any mundane explanation. As the majority of the strange aerial phenomena have occurred in the United States one may be inclined to set these happenings down as experimental activity associated with the trial and testing of new and highly secret types of aircraft, but the following statement issued by the American Air Force completely disillusions us on this point:

"*The Air Force has stated in the past, and reaffirms at the present time, that unexplained aerial phenomena are not a secret weapon, missile or aircraft developed by the United States. None of the three military departments nor any other agency in the Government is conducting experiments, classified or otherwise, with flying objects which could be a basis for the reported phenomena.*

"*By the same token, no authentic physical evidence has been received establishing the existence of spaceships from other planets.*"

From this statement some interesting circumstances may be elicited. First, there is the obvious admission that the U.S. Air Force possesses evidence of strange aerial objects—evidence which, had it the complexion of hoax or pure moonshine, would have been ignored with righteous contempt. On the contrary, however, the Air Force tacitly recognises that peculiar objects *have* been sighted in the atmosphere.

Secondly, the adamant denial that the U.S. Government is in the slightest degree responsible for such strange aerial activity immediately accentuates these mysteries. It compels some reluctantly or otherwise, to entertain the logical, even though startling, explanation that these phenomena are of extra-terrestrial origin.

Thirdly, the U.S. Air Force statement, declaring that it does not possess evidence establishing the existence of spaceships from other planets, is negative in the extreme. By what particular criterion must we accept or refuse the available evidence which suggests that the earth is visited from time to time by beings from other planets? In judging such evidence the U.S. Air Force, or any other air force, is no better equipped than the most ardent earthbound layman. It is also advisable to bear in mind the vast difference which may exist between the detached and sceptical decision of an administrative body and the convictions which individual air force or air-line pilots entertain as a result of personal experience.

The Mantell Tragedy

This incident developed with dramatic suddenness on a day in 1948 and ended in tragedy.

In the vicinity of Fort Knox, Kentucky, U.S.A., on January 7th many people reported the sighting of a large bright object which apparently was heading towards Godman Base airfield. It was travelling at great speed. The control tower at the airfield was alerted. Shortly afterwards the commanding officer, Colonel Hix, located the approaching object with the aid of his binoculars. It appeared to be of an immense size and emitted tremendous blasts of orange-red flame.

Meanwhile three interceptor planes had taken off to examine the intruder. Patches of cloud soon hid the trio, but shortly afterwards Captain Mantell, the officer in command of the flight, came through to control with the information that he had the object or machine clearly in view (it may be inferred that the entity must by that time have halted its headlong flight and was hovering over the air base). In this report Mantell also intimated that the object was of huge proportions and appeared to be of a metallic nature.

Fig. 1.—A Boeing Stratocruiser of the same type as the "Centaurus" which figured in the Labrador incident. (Photograph by courtesy of B.O.A.C.).

After an interval, control received information that the machine (for machine it must have been without any doubt) was climbing, but more *slowly* than the pursuit planes.

A few minutes elapsed before the radio receiver crackled into life again. This time the message stated that the vast machine was increasing its rate of climb. Mantell's colleagues both reported seeing the object, but they eventually lost sight of it and Captain Mantell as pursued and pursuer vanished through higher layers of cloud. After a further interval Mantell once again passed a message to control saying that he would continue to *try to close with the machine* although the ceiling height for his aircraft would naturally set the limit of his pursuit. This was the last time Captain Mantell's voice was heard. The wreckage of his machine was found scattered over a wide area.

If this gallant officer had lost control of his aircraft through lack of oxygen or through some slight structural failure of the aircraft, it is probable that the wreckage would have been found within a restricted area. The fact that the machine was almost completely disintegrated and that the fragments were located over a widespread area of ground infers sudden disaster due to a too near approach to the vast and powerful stranger. A climbing approach to such a large machine in the act of ascending would involve the pursuer in the intense downward stream of that machine's lifting component. The result of such an approach would invariably be catastrophic.

The Globe of Light

On the night of October 1st, 1948, a fantastic duel was waged over the North Dakota town of Fargo. The participants were a highly skilled officer pilot of the National Air Guard, Lieutenant Gorman, and a small globe of light.

Gorman, flying singly, had received the all clear from control at the local airfield, to come in and land. Suddenly, a mysterious light of global form appeared between Gorman's plane and the ground. Having ascertained that no other aircraft was in the act of landing, Lieutenant Gorman boldly swooped upon the light. Quickly it moved aside, but as he flashed by Gorman could not discern any body or form attached to the light phenomenon. By this time observers in the control tower had located the peculiar blob of light circling and dodging the aircraft. For minutes this strange duel continued, but Gorman could not make actual contact with the light. It became obvious to him, however, that the globe was under some form of remote control, as the evasive tactics it displayed were precisely timed and carried out with such sudden change of direction and velocity that it ruled out the possibility of the light globe being manned by any living creature. Eventually, after remaining in the company of this weird object or light to a height approaching 20,000 feet, it shot rapidly away from Lieutenant Gorman's plane into the dark sky above.

If this light was reflected from the ground, it is difficult to imagine how it could appear to Gorman as a detached globe circling first below and then above him. It is even more difficult to visualise such a reflection remaining intact as he climbed closely after it, for he would then be placed between the reflection and the light source. The studied movements of the light suggest an elaborate experiment controlled at long range, and from a direction corresponding to the globe's line of retreat—that is, from above.

Further Strange Incidents

On February 1st, 1950, at dusk, the people of Tucson, Arizona, were astonished to witness an object swiftly approaching the city at about 30,000 feet. It was emitting flames and leaving behind it a smoke trail. The general description of the phenomenon certainly indicates that the object was a meteorite, but the disconcerting factor is that the thing suddenly came to a halt above the town, then moved off at high speed. Any alternative to the meteorite explanation of this occurrence, which is in itself weak, is difficult to conceive unless some strange and intelligently controlled flying machine is postulated.

On March 22nd, 1950, whilst flying an airliner over Arkansas, Captain Adams and First Officer Anderson sighted a large disc which swept round their aircraft with effortless ease. It emitted a strong blue light—a characteristic frequently mentioned in flying saucer reports—and a row of illuminated portholes was discerned. After a brief survey the large disc banked steeply, then streaked away into the distance.

At night on April 28th, 1950, Captain Adickes of Trans-World Airlines, his airliner crew and nearly twenty passengers all witnessed a large unidentified aerial object which flew alongside for a number of minutes. Captain Adickes altered the aircraft's course to take it nearer to the stranger, but immediately the latter veered away and increased its speed. Quickly it slid into the darkness, leaving behind a group of very puzzled people.

The simplicity and completeness of these last two incidents, which are typical of many others, must give even the greatest sceptic food for thought. They make a direct inference that machines far excelling any type of normal aeroplane have been observed in the earth's atmosphere.

The Labrador Mystery

We move forward in time now to a strange phenomenon witnessed by Captain Howard of British Overseas Airways Corporation, his crew and a number of passengers as they flew over Labrador in the Boeing Stratocruiser "Centaurus" (see Fig. 1).

Just after 9 p.m. on June 24th, 1954, the "Centaurus" was heading towards Goose Bay airfield. The cruising height was about 19,000 feet and the sky around was extremely clear. To the left of the airliner the sun was setting. Presently, Captain Howard and his First Officer became aware of a large form located in the general direction of the sun It was dark in colour and approximately resembled the shape of an inverted pear. Stranger still, it was accompanied by at least half a dozen much smaller forms which arranged themselves fore and aft of the main body. The whole formation was moving in a line parallel to the track of the airliner. The smaller forms, however, showed independent motion by moving into and out of the larger form as though it provided hangar space for them. The main body appeared to change shape from time to time.

This strange cavalcade kept station with the "Centaurus" for nearly twenty minutes, during which time a distance of about eighty miles was covered. Meanwhile, Captain Howard had reported the circumstances to control at Goose Bay, and inquired whether any other aircraft were in the vicinity. The answer was in the negative. Goose Bay sent a fighter up to investigate the unidentified objects or machines.

When the pilot of the quickly approaching fighter contacted Howard to ask if the objects were still present it coincided almost exactly with the return of the small bodies into the parent form and the rapid retreat of the latter. In a matter of seconds it had dwindled to a mere speck and soon became invisible.

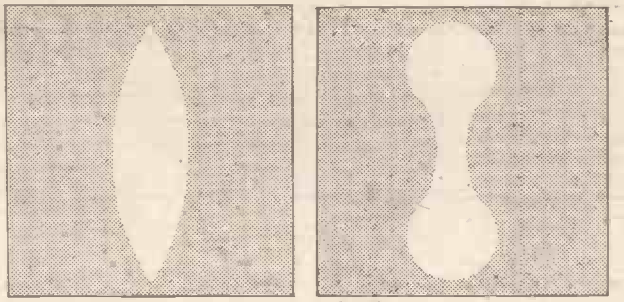


Fig. 2 (Left).—The shape first observed by F/O. Bullivant. (Right). —The second shape of the object before it finally vanished.

Are we to deny the reality of these objects witnessed by the crew and passengers of the "Centaurus"? Must we doubt the judgment of Captain Howard with hundreds of Atlantic crossings to his credit? To do so would be absurd. He stated that the mysterious objects *kept station* with the airliner for twenty minutes. Clouds or mirages do not keep a steady cruising speed of 240 miles per hour.

If these objects were machines manned by sentient beings, the explanation becomes simple and logical. If we refuse to accept this hypothesis, then any other explanation will be highly unconvincing. In fact, there scarcely seems to be an alternative available. The objects were situated in clear air, thousands of feet above the cloud roof. The sun may play some peculiar tricks, but casting a shadow towards itself is not one of them. Even if such an optical miracle is possible in clear air, it would seem more than strange that the sun decided to call the whole thing off at the critical moment of contact between the airliner and the fighter plane.

The rapid recession of the parent body at the approach of the investigating plane suggests a very high velocity. But as the retreat was apparently carried out in level flight it does not give rise to any great difficulty. The apparently changing shape of the parent object or machine can be readily understood. It was to a good extent a silhouette against the setting sun. The image it presented to the observers in the airliner could easily change as it manœuvred amidst its escort and kept station with the "Centaurus." A significant feature of this incident is that the smaller forms at no time positioned themselves *beneath* the parent body. Possibly they were fully aware of the danger inherent in such behaviour, as echoed by the Mantell tragedy.

One final point in this examination of the Labrador mystery. When the parent form fell into headlong retreat she did so only after recalling her family. One is entitled to ask whether this behaviour is common amongst groups of inanimate objects or whether it indicates the presence of reasoning beings in control of superbly efficient flying machines.

Flying Saucer Over Britain

Our final episode is of more recent occurrence than the Labrador incident. Furthermore, it possesses the added interest of taking place within the United Kingdom. It was witnessed by a considerable number of keen and experienced observers. Once more the centre of attraction for the suspected external investigator was an airfield—in fact *two* airfields; the R.A.F. station at St. Athan and Rhoose Aerodrome, which serves Cardiff as a civilian air transport base.

On August 6th, 1954, in the early evening, members of the R.A.F. Gliding School were completing a series of flying operations from St. Athan airfield. The commanding officer, several instructors and a number of air cadets were present, all of whom bore witness to the entity that appeared at altitude above the Bristol Channel.

At 18.15 hours Flying Officer Peter Bullivant, an instructor, and his pupil, Cadet Jennings, seated themselves in a glider and were winch-launched. After casting off into a westerly wind of some 10 or 15 knots, F/O. Bullivant brought the craft round on the southern and second leg of the small circuit. By this time the glider was steady at just over 1,000 ft.; the sky was exceptionally blue and clear of cloud apart from one or two small patches of fracto-cumulus. With the intent and analytical vision of long experience, Bullivant examined the sky around him—and, let us not forget, correct identification of cloud forms and other aerial phenomena is imperative to the glider pilot when airborne. Suddenly, dead ahead, but at a greater altitude than the glider, he spotted the "thing." Let us continue with F/O. Bullivant's own words: "The form I observed was that of a large double-convex lens viewed in vertical profile. It was not possible to estimate its true size or the distance at which it was stationed; but on the southern and eastward legs of the first circuit which Cadet Jennings and I flew, the object was perfectly clear against the blue sky and very sharply defined. I do not think, therefore, that it could have been positioned at any great distance from us. It was of a brilliant silver colour and conveyed the impression of strong light reflecting on a chromium or silver-plated body. Another thing which impressed me was its immobility; it remained quite stationary and seemingly unaffected by wind or air currents.

"Landing after the first circuit, I found that our commanding officer and personnel present were viewing the object and speculating on its origin. Taking off for the second time Jennings and I flew a second circuit similar to the first. During the course of the flight we perceived that the object, whilst still in the same position relative to us, had now altered its shape to that of a silvery dumb-bell. As there was no apparent approach or recession or lateral movement of the form over the critical period of six to seven minutes of observation (after which it vanished quite suddenly), I discarded the idea that it could be light reflected from a conventional aircraft. The two shapes are shown in Fig. 2.

"This immobility of the object equally discouraged the idea that it was a free meteorological balloon. Ultimate inquiry established the fact that no balloon had been released in the area at that time, also that no captive balloon was flying in the vicinity.

"I have in the past been very sceptical about suggestions that 'flying saucers' do really frequent the earth's atmosphere; but on August 6th, 1954, my scepticism received a severe jolt. I am strongly inclined to believe that the object which I saw was a solid body. Whether it was manned or remote controlled I know not; but it was decidedly different from any natural phenomenon or man-made aircraft I have hitherto seen."

With this intriguing experience described by Flying Officer Bullivant, it only remains to be said that this particular flying saucer was sighted by control at Rhoose Aerodrome, also by many citizens of Cardiff, including the mayor, as they sailed homewards from Ilfracombe in a pleasure steamer.

In view of the remarkable circumstances attending the foregoing incidents, I contend that there is a strong case for the existence of super-performance flying machines and consciously directed aerial objects. If the governments of the earth are genuinely innocent of producing such machines and instigating such occurrences, the postulation of sentient extra-terrestrial activity is inevitable.

(To be concluded)

Making your own WALKING STICK

How to Cut and Shape It from the Branch of a Hedge or Tree

THE first necessity is a sharp knife, with which the knots are carefully trimmed (see Fig. 1). Sandpaper is then employed, first a coarse and then a fine grade as shown in Fig. 1, until all the roughness has been removed. If the stick has a natural knob on the end, this is smoothed off and used as it is; in the case of blackthorn and beech an artistically trimmed knob is preferable to a handle. This type of stick, however, is hard to find. A knob invariably forms a part of the root and to find if a stick has such a root, it must be grubbed out of the ground.

After the sticks have been trimmed and sandpapered, they are stored away to allow the sap to evaporate and for the wood to become hard. Blackthorn, beech and chestnut are, as a rule, peeled, and this is done, simultaneously, with the trimming. When all the bark has been removed, the whole stick is lightly sandpapered.

Bending the Handles

Occasionally, a stick is found with a natural straight or circular handle, but this is rare.

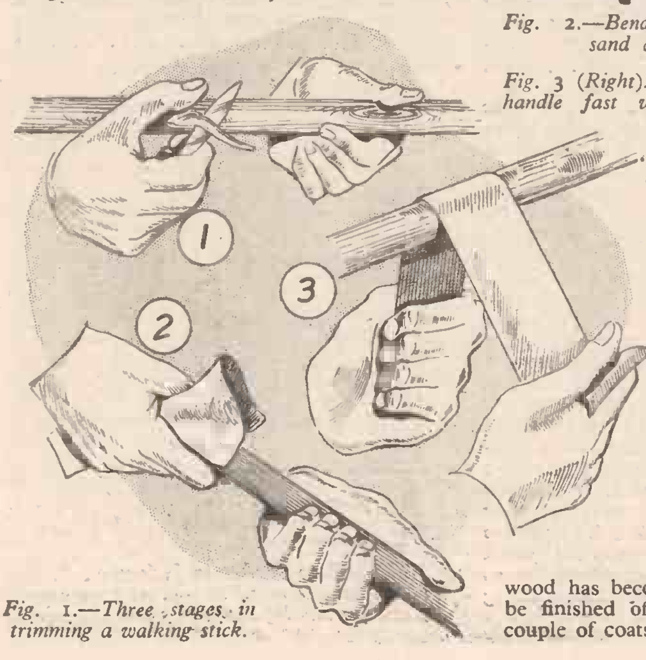


Fig. 1.—Three stages in trimming a walking stick.

Handles have nearly always to be made and there are two methods. One is to grow them and the other is to bend them. In the latter case, a bucket or some other suitable vessel is filled with sand and water and heated on a fire in the garden until the temperature reaches boiling point. The butt ends of the sticks are then pushed into the sand in an upright position until each touches the bottom of the bucket (see Fig. 2). They are then left for about an hour, the contents of the bucket being kept at boiling point. On being removed it will be found that the portion of the sticks that has been in the sand is pliable and can be bent easily. The handles are then made fast with strong string (see Fig. 3). If this is not done, as the sticks cool they will go back almost to their original position.

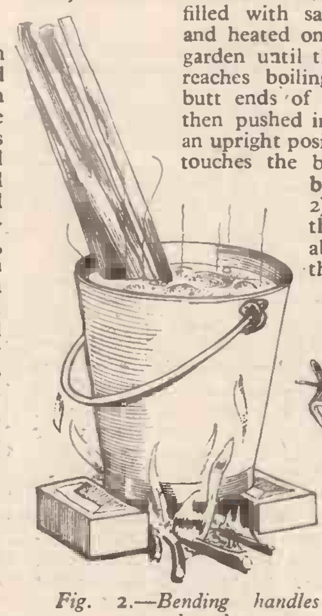


Fig. 2.—Bending handles with sand and water.

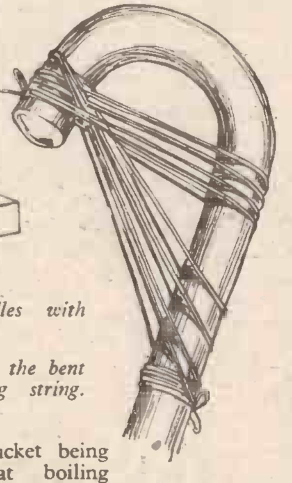


Fig. 3 (Right).—Making the bent handle fast with strong string.

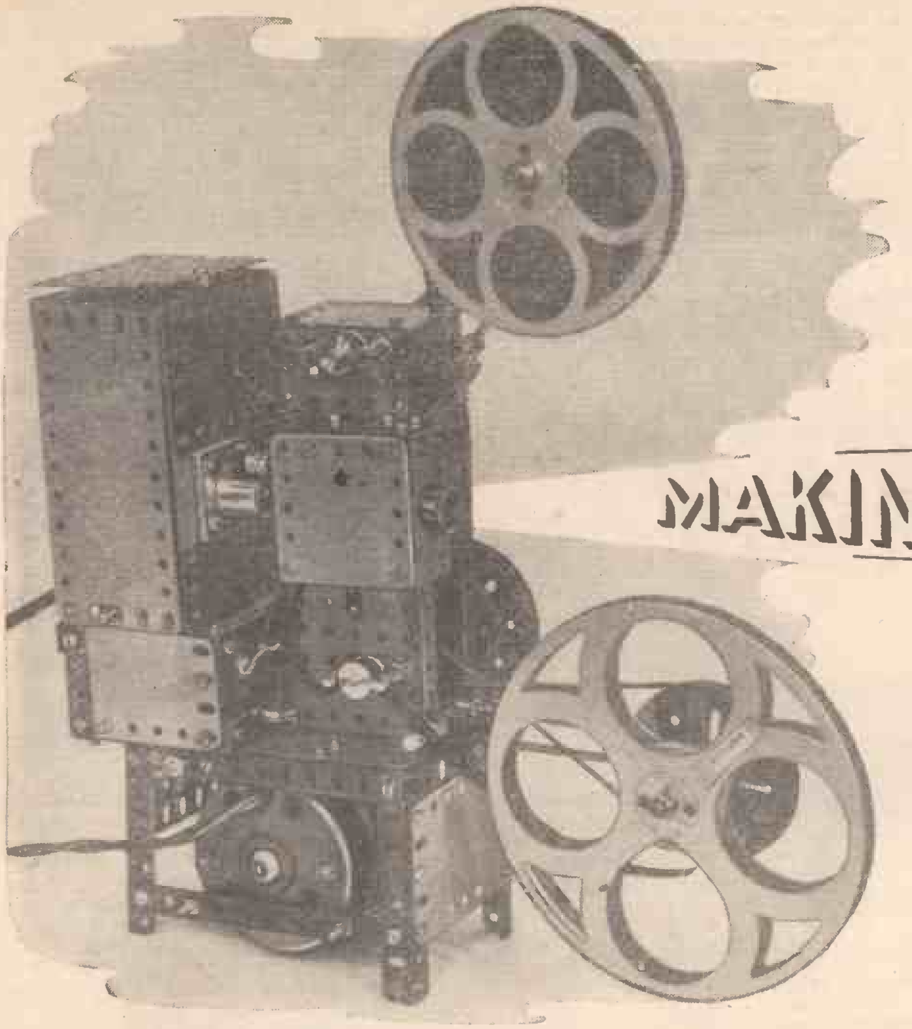
They are now put on the rack and left for a few weeks. By the end of this time the handles are permanently set, the wood has become hard and the sticks can be finished off. Nearly all are given a couple of coats of varnish whether peeled or not. The sticks are then shortened to whatever length is preferred, ferrules are fitted, and sometimes silver or gold bands. Ferrules are cheap, and a silver band engraved with initials is not too expensive. Blackthorn, beech and chestnut are rather heavy, and it is for this reason that they are peeled. If, when found, the sticks are not absolutely straight, they can be straightened by being placed across the top of the bucket of hot sand, and by the sand being packed round them at the points where adjustment is required. The sticks are left for 20 minutes or so, and then made quite straight by being put in a vice and pressure being applied to left or right as necessary. Such a stick should then be tied tightly to one that is absolutely straight before being put away to set and harden. If this is not done it may revert to its original state.

Handles Can be Grown

A straight sapling is planted in an odd corner of the garden and the earth is pressed smoothly and tightly round it. A portion, say from 6 to 10in. is bent until it lies flat along the ground and is kept in this position with a couple of pegs (Fig. 4) or if a circular handle is desired, a portion is bent into a circle and made fast to the ground with four pegs. The rest of the sapling is then tied in an absolutely upright position to a stake.

The portion pegged to the ground soon throws out small roots, and as the pegs rot, these hold the handle as desired. The quickness of growth depends on the variety of stick being grown. The sticks are taken out of the ground in the autumn after the fall of the leaf, are trimmed, allowed to season for a time, and then fitted with ferrules. They are varnished if not of ash; it is usual merely to trim ash walking sticks.

Fig. 4.—Growing a handle.



The author's completed projector.

MAKING A 9·5mm.

THE film projector was constructed for experimental purposes to project films at 16 and 24 frames per second. The general arrangement of the machine is shown at Fig. 1.

The projector is of conventional design, with an intermittent frame shift by a claw shuttle and a continuous film feed by sprockets. A similar frame shift mechanism may be designed for 8 mm. or 16 mm. film from the film dimensions set out in British Standards Specification 677 : 1942.

The illumination is by a Class A1-4 12v. 100w. projection lamp, supplied from the mains via a transformer; the condenser and objective lenses are sub-standard projection types—*f*1.5 and *f*1, respectively. In operation, the machine projects a well-illuminated steady picture 2ft. 6in. wide.

The spool arms are fitted to sockets mounted to the main frame, and are detachable to enable the machine to be transported conveniently. The projector is driven by a mains supply induction motor, but may be hand cranked if desired. Components of a well-known constructional outfit have been used extensively in the building of the machine. For convenience in identifying these parts, the constructional outfit components are referred to as standard items in the following text and drawings.

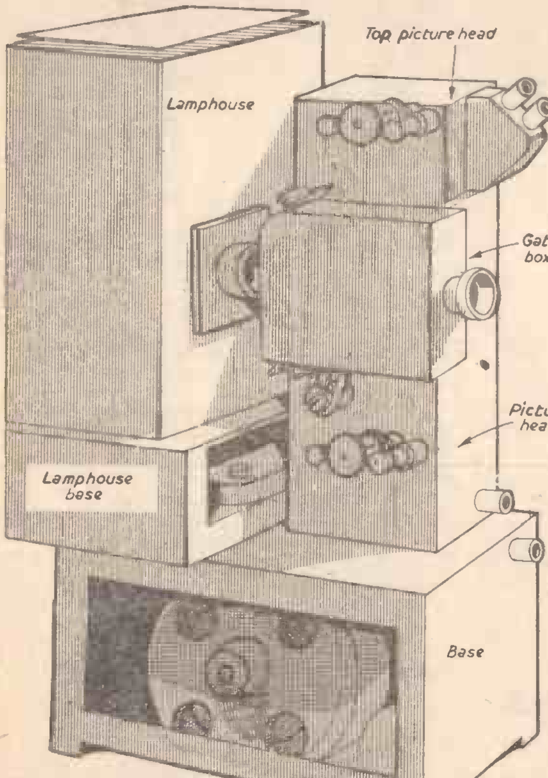


Fig. 1.—General arrangement of the machine.

The slight differences occurring between the description and the corresponding photographs on some aspects of the machine are due to recent minor modifications carried out since the photographs were taken.

The Base and Picture Head

The base of the machine was constructed to accommodate a mains supply motor in the area beneath the baseplate.

Four legs support the baseplate, enabling the 400ft. capacity Cyldon take-up spool to clear by approximately ½in. any level surface on which the machine may be placed.

As it was desired to tilt the projector a few degrees the front legs were made ½in. longer than the rear legs. This arrangement gives the base a fixed longitudinal surface angle of approximately 7 deg., which for normal use is found to be quite satisfactory. The arrangement could be improved by making the four base legs of equal length and fitting screw feet to the front legs, thus permitting variation of the tilt angle.

Two 5½in. x 2½in. flanged plates were connected to each other in three places with 2in. long members to form the main frame of the picture head. At this stage no bolts were finally tightened and, prior to assembling the two plates, one plate was slotted in three places, as shown at Fig. 4, by elongating the relevant holes of the perforated plate into each other.

The constructor should take care not to bruise the plate when cutting the slots, as any distortion in it may lead to misalignment of the gate bracket which later is bolted to the plate at the slots.

The head was lightly bolted to the baseplate in the position shown at Fig. 4 and, as the head was to be rigidly mounted to the plate, it was braced from beneath the baseplate. A portion of the base and flanged plates of the head is cut away in the perspective view to show the two angle strips bolted through the flanges of the headplate, the corresponding holes in the baseplate and the side members of the baseplate.

Two drifts, .001in. less than the diameter of the plate perforations, were inserted into correspondingly opposite holes of the plates to bring the plates into alignment. All bolts were finally tightened and the drift rods removed.

Fig. 2.— ciné film S.W.G. (Bottom

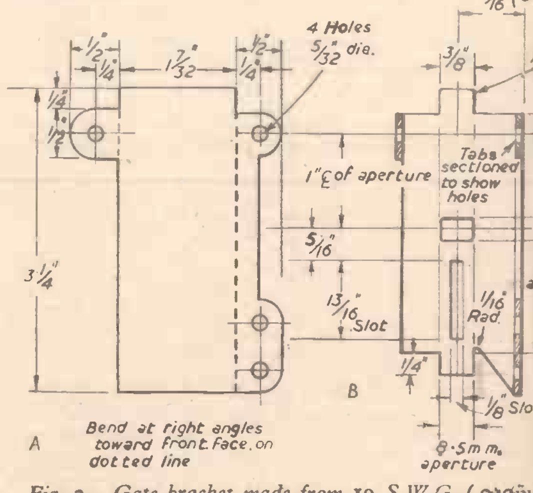


Fig. 3.—Gate bracket made from 19 S.W.G. (.040in. before bending tabs. B.—Front view after bending ta Elevation showing centre tabs bent to 45 deg. D.—Back

The Guide and Gate

The function of the cinematograph guide is smoothly and steadily to guide the transported film between condenser and objective lenses, where the individual frames of the film are scanned in rapid sequence.

The guide is usually in the form of a shallow channel, the width of which prevents lateral movement of the film. The gateplate keeps the film surfaces flat, under slight pressure, to prevent buckling and flutter of the film as it is transported through the guide.

The guide and gate originally used on the machine described were brass pressings, and were, presumably, part of a discarded projector. The conventional swing-open hinged gate was not fitted to the assembly, but, with a little modification, a spring-loaded back-

centreline and height of the gate aperture and the horizontal claw slot positions; drill the tab holes and cut out the gate bracket to the dimensions shown at A in Fig. 3. The 11/16in. dimension from the mounting face of the long tab to the vertical centreline of the bracket shown at B in Fig. 3 is important, as the aperture, the slot below the aperture and the claw assembly, when fitted, must align correctly on this vertical centreline. To avoid dimensional discrepancies occurring in the bending of the long tab the tab could first be bent, then the vertical centreline aperture width of the bracket marked off from the mounting face.

Fig. 2 shows the principal dimensions of 9.5 mm. film. The film is perforated down the centre and it will suit the purpose to

with small toolmaker's clamps and, with a short length of film, i.e., 4in., set the strips .004in. to .005in. wider than the film, ensuring that the strips are parallel with the scribed lines and at equal distance from the vertical centreline of the gate bracket.

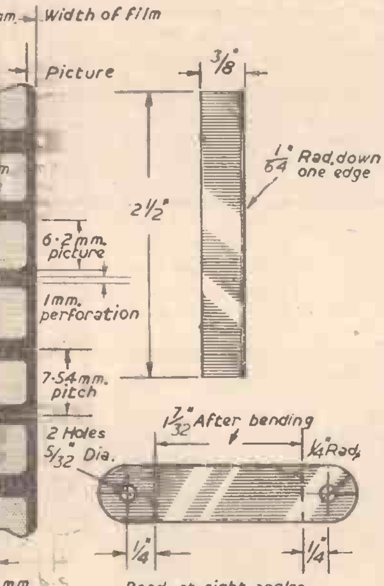
A clearance of .004in. to .005in. should accommodate any slightly offset joints that may be in the film as it is transported through the guide; this clearance should not be exceeded, however, as lateral swaying of the film may occur in operation.

Tighten the clamps, drill and rivet the assembly with the rivet heads positioned at the front face of the bracket, and file the rivets flush to the strips.

Sweat the top member, shown in Fig. 2,

CINE PROJECTOR

Full Constructional Details for Making Apparatus for the Projection of 9.5 mm. Silent Films



—Principal dimensions of 9.5 mm. printed ... (Top right)—Guide strip made from 19 ... (.040in. thick) brass plate—two off. ... right)—Top member made from 19 S.W.G. brass plate.

plate was found to be a satisfactory substitute. Although the modified guide is not so accessible as the swing-open type, the film is quite easily inserted and the guide and gate aperture cleaned by parting the backplate from the front bracket. As only a single assembly is required press work need not be employed. It can readily be made from 19 S.W.G. brass plate as outlined below.

Guide and Gate Construction

Mark off the horizontal

regard the vertical picture edges as equidistant from the centre of the film and perforations. Mark off the position of the bracket centre tabs, continuing the scribed lines across the full length of the back face (as a reference for positioning the guide strips to be fitted later) and bring the bracket to the final shape shown at B in Fig. 3. Drill a 7/32in. hole at the intersection of the aperture centrelines and bring the aperture to its final shape and size with needle files. Care should be taken to ensure that the aperture does not become oversized in this latter operation and that the relevant aperture edges are square and parallel to one another.

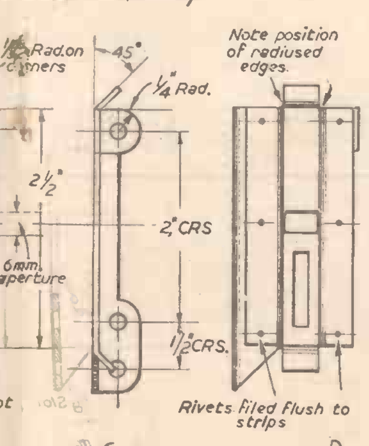
The aperture, when projected, is considerably enlarged and forms the boundary of the illuminated area of the screen. The enlarged aperture will appear tilted if it is positioned incorrectly to the mounting face of the long tab and any irregularity in the shape of the aperture will be considerably magnified in the projected replica. Bend the short tab as indicated and the two centre tabs squarely to 45 deg. in the direction shown.

The guide strips shown at Fig. 2 should be set to the reference lines previously scribed on the back face of the bracket with the radiused edges adjacent to the vertical gate edges (see D in Fig. 3).

Clamp the strips lightly in this position

into position, ensuring that the tab holes are in line with the bracket tab holes. The purpose of this member is to strengthen the bracket between the tabs.

The function of the gate pads, shown in



...thick) brass plate. A.—Front view ...abs and cutting to final shape. C.— ...k view showing guide strips in position.

Item	Description	Quantity
	TOP PICTURE HEAD	
9E	Angle strip, 2in. length ...	3
11	Double bracket	2
37	Nut and bolt ...	As required
51	Flanged plate, 2½in. by 1½in.	2
126	Trunnion	2
179	Rod socket	2
	PICTURE HEAD	
9E	Angle strip, 2in. length ...	3
12	Angle bracket	4
37	Nut and bolt ...	As required
52	Flanged plate, 5½in. by 2½in.	2
	Gate bracket	1
	BASE	
2	Perforated strip (5½in.) ...	2
9B	Angle strip, 3½in. length ...	6
9	Angle strip, 5½in. length ...	2
9A	Angle strip (reduced to 4in. length)	2
9E	Angle strip, 2in. length ...	1
37	Nut and bolt ...	As required
103D	Flat strip, 3½in. length ...	2
52A	Flat plate, 5½in. by 3½in. ...	1
	Lamp base strap	2

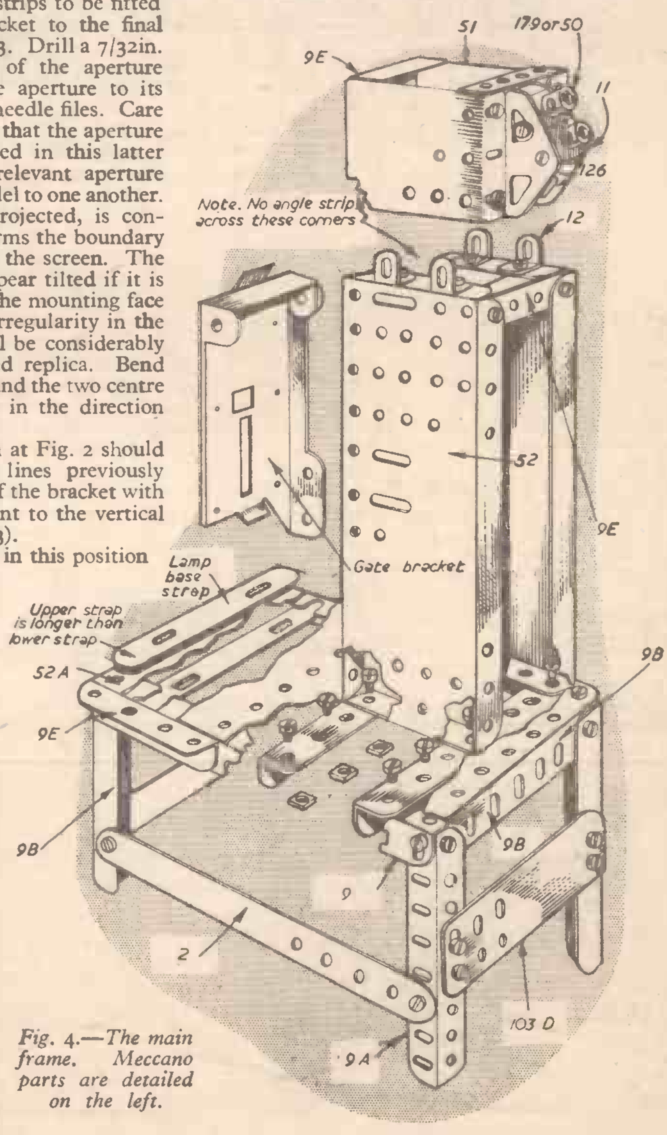


Fig. 4.—The main frame. Meccano parts are detailed on the left.

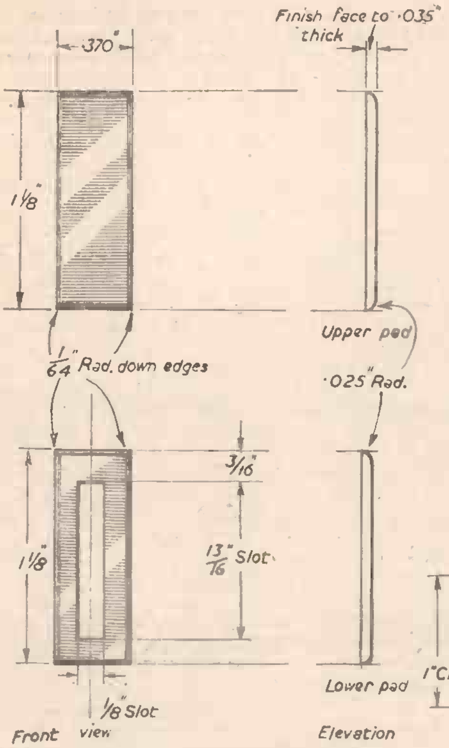


Fig. 5.—Gate pads (one off each). Make from 20 S.W.G. (.036in. thick) brass plate.

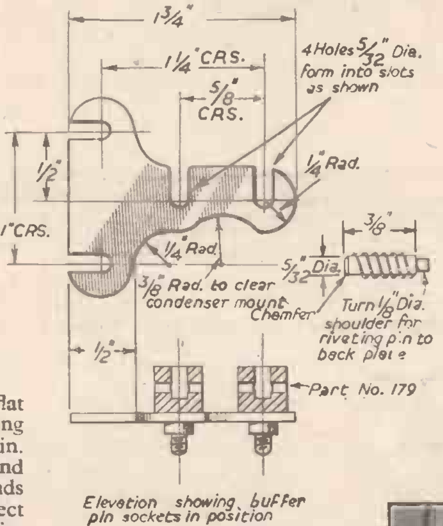
Fig. 5, is to hold the transported film flat under slight pressure imparted by the spring buffer mounted to the backplate. The .005in. difference in thickness between the pads and guide strips restricts the pressure of the pads on the film; thus, the springs would be subject to only .001in. linear deflection, using .006in. thick film stock.

Cut out and drill the buffer bracket and fit the sockets as shown in Fig. 6.

Mark off, drill and cut out the backplate, A in Fig. 7, extending the scribed centre tab lines across the length of the face as a reference for positioning the gate pads. The backplate aperture should be cut approximately .02in. larger all round than the actual bracket aperture. It is important that both apertures are in correct alignment when the respective components are assembled.

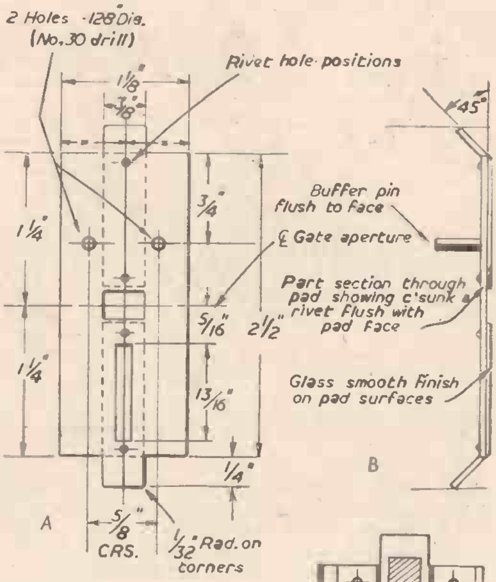
Clamp the pads lightly in their positions (A Fig. 7), ensuring that the radiused sides are uppermost and that the pads are not offset to each other. Drill the rivet holes through the pads and plate, countersink and rivet the assembly, as indicated at B in Fig. 7, with the rivet heads positioned on the back face of the backplate. Bend the centre tabs squarely to an angle of 45 deg. and rivet the buffer pins in position as indicated.

To prevent the emulsion-coated surface of the film bearing on the full width of the guide the shaded portion of the guide shown at C in Fig. 7 should be relieved by .004in. to .006in. below the surface of the guide face with a fine cut square file and the edges of the resultant shallow channel rounded off with very fine abrasive paper. Any sharp edges, pits or scratches that may remain in the guide or on the pad surfaces should be removed and the guide brought to a very smooth finish.



As the continuous passage of the film eventually wears down the guide surfaces, it would be advantageous to hard chromium plate all surfaces that come into contact with the film. To maintain the .005in. clearance between pads and guide face, the pad thickness should be reduced to allow for the plating deposit. Fig. 8 is a photograph of the completed gate bracket and backplate and in Fig. 9 the assembly is seen in position.

(*To be continued.*)



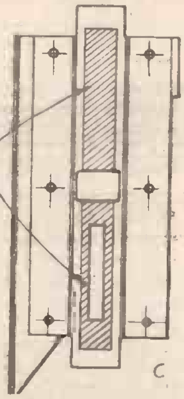


Fig. 7. — A. Backplate (one off), made from 19 S.W.G. brass plate. B.—Elevation of backplate. C.—Back view of gate bracket.

Fig. 6.—(Left) Buffer bracket (one off). Make from 14 S.W.G. (.080in. thick) brass plate. Buffer pin and spring (fit to backplate as in Fig. 7).

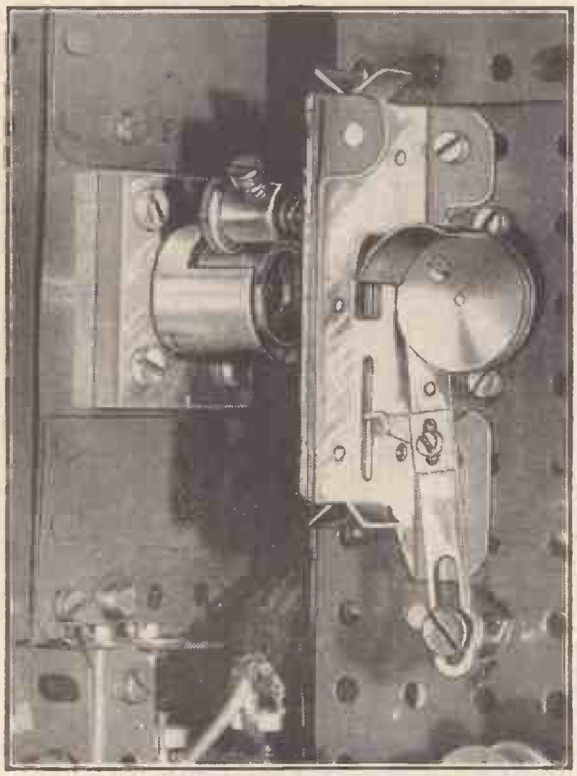


Fig. 9.—Gate bracket and pull down movement in position on picture head.

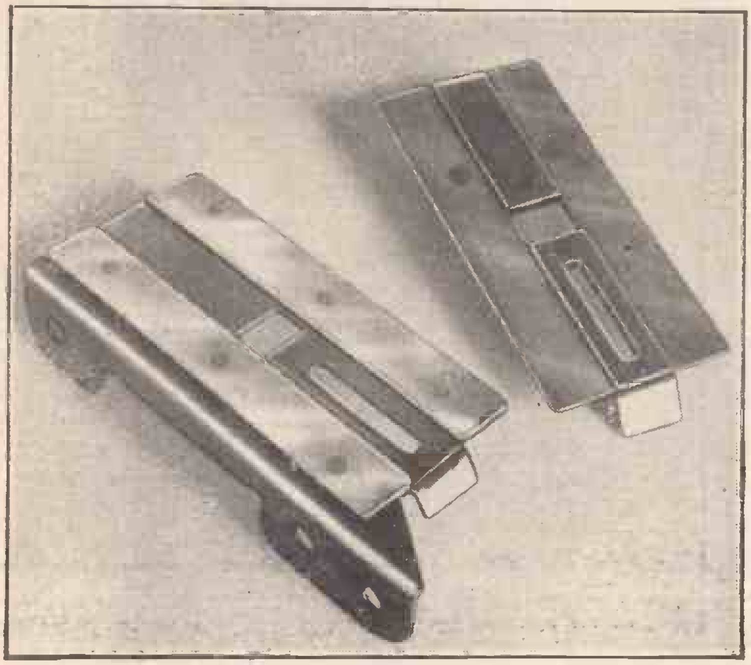


Fig. 8.—(Left) Gate bracket and backplate.

RADIOGRAPHIC TESTS OF METALS

By

"INDUSTRIALIST"

Methods Used and Equipment Required for the Detection of Cracks and Internal Flaws in Metals by Radiographic Tests

THE purpose of radiographic tests of metals is to detect internal flaws, such as blowholes, non-metallic inclusions, internal cracks, etc. X-rays were discovered in 1895 by Professor Röntgen, and the following is a brief explanation of how they work.

Wavelength

An A.C., such as is employed in lighting and heating, is subject to periodic changes of voltage with time. This means that the voltage passes through zero, increases to a positive maximum, falls once more down to zero, increases next to a negative maximum, and finally declines to zero again, after which the succession of changes is repeated. This sequence is shown in Fig. 1, and the distance between A and E on the figure is termed a cycle or wave-length. The number of times this cycle is repeated in one second is termed the frequency of the current. In ordinary lighting current, this frequency is approximately 50 cycles per sec.

Radiant Heat and Light Waves

Radiant heat and light are made up of electrical waves with much smaller wavelengths but of similar type. The difference is essentially one of wavelength, heat waves being longer than light waves and possessing a much higher power of penetration. The colours of the visible spectrum vary according to the differing wavelengths of the varying colours. Thus, red light has a longer wavelength than violet, and orange, yellow, green and indigo come between red and violet.

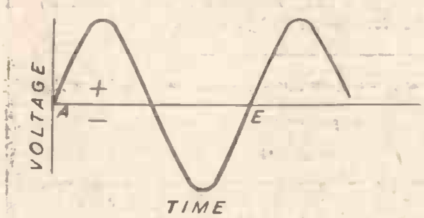


Fig. 1.—Wavelength.

Infra-red Rays

When we go outside the visible spectrum we come to certain invisible rays, one group of which is known as infra-red rays. This includes heat rays.

Radio-transmission includes invisible rays of even longer wavelength, up to as much as several miles, and rays having a wavelength of the same order as these are used in melting steel by the modern high-frequency process or induction furnace.

Diffraction of X-rays

The next group of invisible rays are the X-rays, which extend beyond the violet and ultra-violet rays and have very much shorter wavelengths than even these, namely 10^{-8} cm., i.e. 1/10th of a millionth of a mm. They are electromagnetic in character, and although they cannot be seen they have some of the characteristics of visible light, being capable of reflection, refraction and diffraction.

Diffraction of the X-rays could not be attempted until a suitable diffraction grating was devised, the ordinary grating used in the diffraction of visible light being quite useless for X-rays. In 1912, however, Von Laue invented the crystal diffraction grating.

In this, crystals were used in which the molecules or atoms were spaced out regularly, as Von Laue had decided that the distances between them were approximately of the same order as the wavelengths of X-rays. By passing an X-ray beam through a thin crystal plate and on to a sensitized plate, he was able to develop and fix the picture so obtained, which proved to show a regular and symmetrical arrangement of dots. From these it was possible to calculate the wavelength of the X-ray. Once this was known, it became possible to use X-rays to determine the spacing of molecules or atoms in metals and alloys.

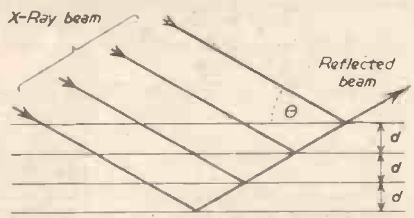


Fig. 2.—Reflection of X-ray beam.

The Work of Bragg

The Von Laue photographs were, however, difficult to interpret, until Sir William Bragg realized that the rays would penetrate the metallic surface, but that below the surface the planes in which the atoms were located would act as internal reflecting planes for the rays, much as ordinary light is reflected back from a plane polished surface, with the difference that a "fuzzy" print is obtained unless the relation $2d \sin \theta = n\lambda$ is fulfilled, where d is the distance between two successive layers of atomic planes, θ is the angle (glancing) made by the X-ray beam with the surface of the metal undergoing examination (see Fig. 2) λ is the wavelength of the X-ray, and n is an integer.

These conditions satisfied, every reflected ray reinforces others, so that a range of sharp bands is obtained on a photographic film placed so as to receive the reflected rays. The bands or lines on the film are then spaced at specific distances, from which it is easy to calculate the distances between the atoms.

The Interior of Metals

Using X-rays of higher penetrating power, internal photographs of metals and alloys may be obtained comparable to the X-ray photographs of the human body. Voids such as blowholes or gas cavities, internal cracks, hot tears, misruns, etc., offer little resistance to the penetration of the rays as compared to the resistance of the metal, and they show up as shadows on the photographic film. The X-ray test is a non-destructive one and has proved particularly valuable in testing welded structures.

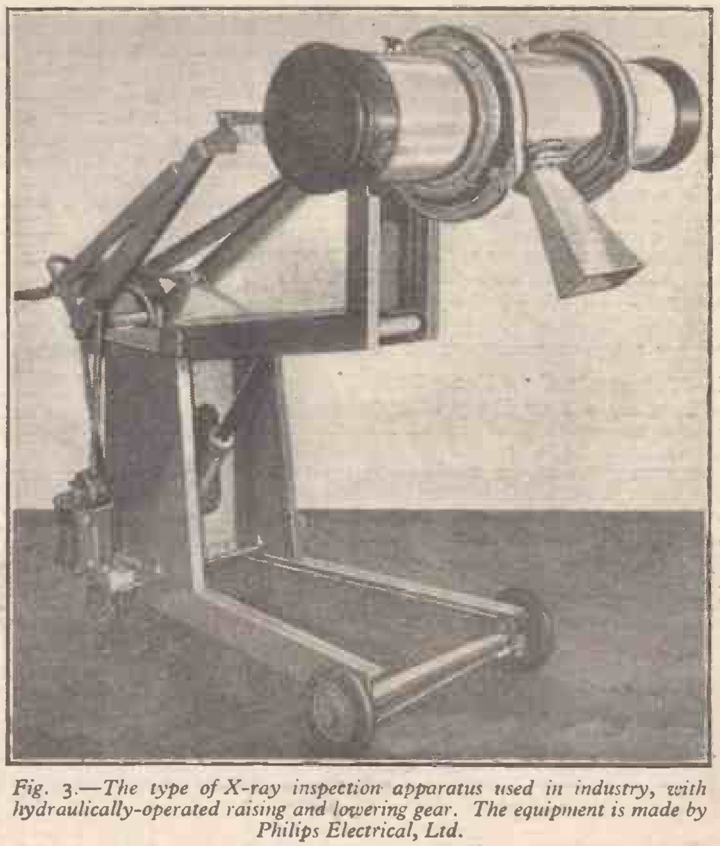


Fig. 3.—The type of X-ray inspection apparatus used in industry, with hydraulically-operated raising and lowering gear. The equipment is made by Philips Electrical, Ltd.

Density

The ability of a meta or alloy to absorb the rays is approximately proportional to the density of the material in the area through which the beam passes. Figs. 4 and 5 give a rough idea of what voids and non-metallic

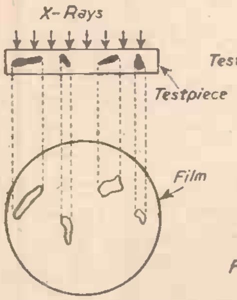


Fig. 4.—Non-metallic inclusions as they appear on the negative.

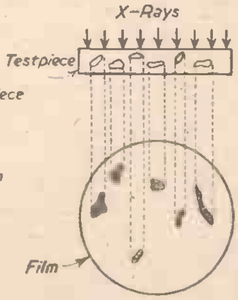


Fig. 5 — Discontinuities as they appear on the negative.

inclusions look like in an X-ray photograph. The non-metallic inclusions absorb more of the rays than the metal, so that fewer reach the film, and in consequence a light spot is obtained. If the intensities of the film are correctly evaluated, the soundness of the material and the position and probable character of the flaws may be determined.

Apparatus Required

Before dealing in detail with the apparatus required, it should be pointed out that this has up to 1 million volts potential and is capable of penetrating 7in. of steel or even 8in. in some instances. Units as large as 10 million volts are said to be under development. Fig. 3 shows an industrial X-ray unit. The thickness of metal that can be penetrated by X-rays is governed by the kind of metal. Heavier metals with high atomic weights are harder to penetrate than lighter metals. Other factors in determining depth of penetration are the voltage across the tube and the period of exposure.

Gamma and Beta Rays

For research purposes, even greater depths of penetration have been achieved, as much as 12in. depth being achieved with a two million volt mobile X-ray unit developed by the General Electric Company of America.

Other types of rays, such as gamma and beta rays, have been used for radiographic testing. Gamma rays are emanations from radium or radio-active salts and penetrate about the same distance as X-rays. Beta rays have a much lower penetration, but have been employed of late as a means of measuring the thickness of thin strip and sheet in rapid motion during manufacture.

Fundamentals of an X-ray Test

To carry out an X-ray test, the fundamental requirements are (a) an X-ray tube, which provides a source of bombarding electrons, aimed at the anode or target, and the anode itself, which is placed in the beam of electrons or cathode rays; (b) a difference in potential between cathode and target, produced by transformers, storage batteries, electrostatic generators or magnetic induction generators. These provide the desired velocity of the electrons as they travel across the intervening space. From the electronic bombardment of the anode arise the X-rays.

What happens is that as a result of the impact of an electronic stream at high velocity upon a metallic anode or target (the positive electrode) X-rays are produced in an evacuated or gas-filled tube. The electrons are driven off from the cathode or negative electrode by the aid of a heated filament. Their velocity is imparted by impressing an exceptionally high potential, of the order of hundreds of kV, across the tube.

The X-ray Tube

There are two forms of X-ray tube, one containing an ionized residual gas, the other being a highly evacuated glass bulb or cylinder containing a pair of tungsten wire filaments and a target, which may be solid or hollow (see Fig. 6). The pressure in the tube of evacuated type may be as little as a few hundredths of a micron (1 micron = 1/1,000 mm. mercury pressure).

The target, of copper, usually contains a small tungsten disc. The negative electrode filament is enclosed in a metallic hood, concave in form, serving to direct the electronic stream upon the target face (see Fig. 7). X-ray tubes are not usually self-rectifying, an auxiliary rectifying device being introduced for A.C. when voltages exceeding 70,000 are used.

Transformers

Industrial plants mostly employ a transformer rather than a storage battery, especially when the voltage required exceeds 45,000 volts. Either a high tension A.C. closed core transformer or an electrostatic

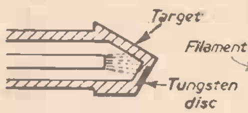


Fig. 6. — Positive electrode of X-ray tube.

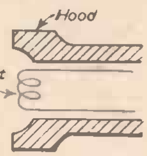


Fig. 7. — Negative electrode of X-ray tube.

generator may be employed for voltages up to half a million, but the former cannot be used for more than this. Where rays of exceptionally high energy (2,000,000 volts to 100,000,000 volts) are required, a magnetic induction accelerator may be used. This comprises an electromagnet and a vacuum tube of annular form. In the one to two million volt units, low frequency resonance transformers are employed for the acceleration of the electrons.

Accessory Equipment

Modern industry employs much transformer type power, and for this reason accessory equipment may be required, including an autotransformer for regulating the current input to the high tension transformer; a method of current rectification, such as a valve tube; a means of controlling tube current; individual and separate transformers to furnish the current for the filaments of the various tubes; extra windings on the H.T. transformer or insulated storage batteries, if a different method of providing filament current is required; voltage measuring instruments, e.g., calibrated primary transformer voltmeters, electrostatic voltmeters, sphere gap or spectrometer.

Filament Current

In most instances the current passing through the filament of the X-ray tube ranges from 3 volts to 6 volts, and the electrode voltages are from 50 kV to upwards of 1,000 kV, as required. The tungsten filament has a temperature ranging from 1,700 deg. C. to 2,400 deg. C. The penetration of the X-rays may be varied by modification of the degree of evacuation of the tube. Rays may be either "hard," giving high penetration, or "soft," giving low penetration, according to the degree of tube evacuation.

Portability

The apparatus employed in making radiographic tests may be either permanent and fixed or portable, according to the type of work to be done. A small self-contained bench unit may be obtained or a more powerful unit in which the X-ray tube is separate from the generator and adjustable in all directions. An apparatus of this type may be employed either for the investigation of the structure of metals or for ordinary radiographic tests.

Requirements of the Test

Having produced the X-ray beam, we have now to concentrate it upon the work, collect up a part of the reflected radiation and record it on a suitably placed photographic film. We must also employ methods of carefully regulating and measuring the angles of the X-ray beams. The rays are detected by photographic films of special character, which consist of a layer of gelatine approximately one thousandth of an inch in thickness, which embodies a silver compound, highly sensitive, and is backed by a transparent film, to which it is applied as a coating. Owing to the high speed and other properties required, this type of film differs greatly from the normal film used in photography. It is also possible to obtain an X-ray paper which is lower in price than the film, but differs in many respects from it and has a more restricted range of use.

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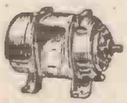

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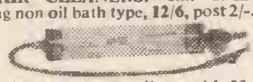

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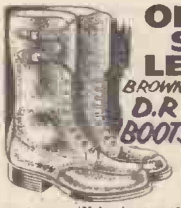

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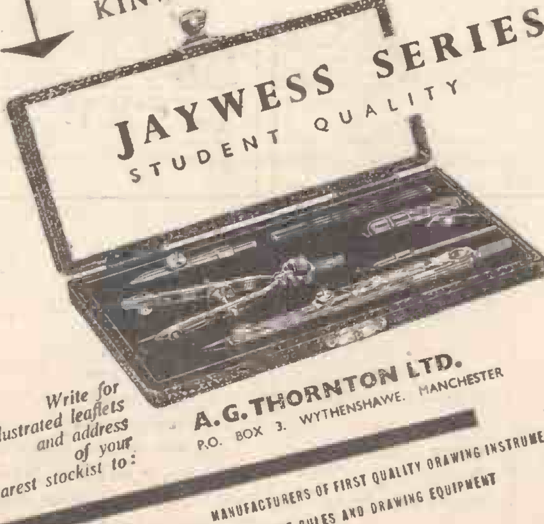

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3,000 **Circular Split Dies** 1" dia. cutting 1/4", 5/16", 3/8", 7/16", 1/8" Whit., B.S.F., also brass thread, 26 thread all sizes and American N.S. 12/- per set of 5 sizes, 2 sets 22/6, 4 sets 42/6. Taps to suit 12/6 per set, either taper or second or plug. 1" dia. stocks 6/- each.

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MAKING STATIC MODELS

LOCOMOTIVES & TRAINS

Details for Making an 1830 Engine and Carriages

MODELS which cannot, by reason of their small size or inconvenience of shape or proportions, be made to work, have a fascination of their own. Figs. 1 and 2 are two photographs of a railway model I made. The prototype model represents a short train on the Liverpool and Manchester Railway in 1830 and is headed by the famous Planet locomotive, which became the first of the normal modern type, with the boiler having an internal and external firebox, flue tubes through the barrel and a smokebox which enclosed the cylinders. Thus at one master stroke Robert Stephenson designed a boiler which became a standard type and is likely to continue as such.

If these early engines are not modelled in static form there is no possibility of making them at all, except in large scales. Their general form is too open for an electromotor to be invisibly enclosed. Steam is, of course, out of the question, so that they cannot be made to work Most engines, even up to the end of the nineteenth century, have to be modelled with some part of the motor projecting into the cab or gearing showing under the boiler barrel. Furthermore, by the addition of a few details, such as the engine crew and passengers, a whole static model can be made to appear far more realistic and is capable of bringing home to the observer a vivid picture of railway travel conditions existing at the period represented.

For modelmakers who are interested in railway history and in making models of old-time trains there is Locomotion No. 1 on the Stockton and Darlington Railway, the Canterbury and Whitstable Railway, the Stanhope and Tyne Railway, the Leicester and Swannington Railway; the North Star on the Great Western Railway, one of Bury's engines and carriages; these last like those in my model, but with the lower panels painted green, on the London and Birmingham Railway of 1838; the Great Western 8ft. broad gauge engines from 1846 to 1888 and so on right to 1890 or 1900. If the societies of model engineers co-operated and organised a scheme, railway history could be represented by a fine collection of models which could be handed down to posterity and would show to future generations what the trains and engines and railway travel were like long after the steam locomotive has passed out of existence. It is likely that the next twenty years will see

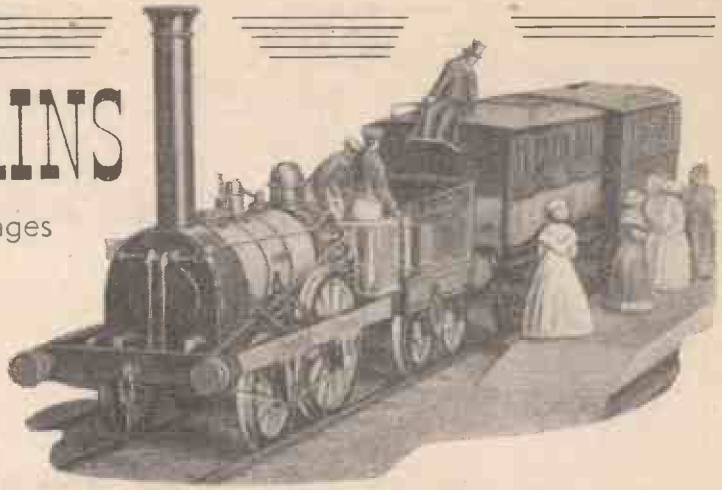

Fig. 1—(Right). The author's model of an 1830 Liverpool and Manchester Railway train.

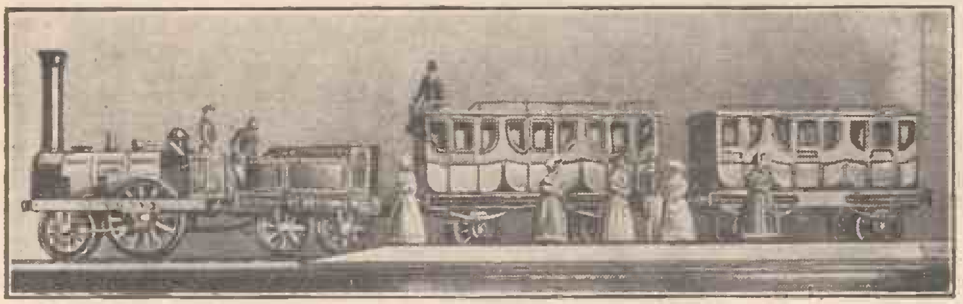

Fig. 2.—(Below) A further photograph of the author's model.

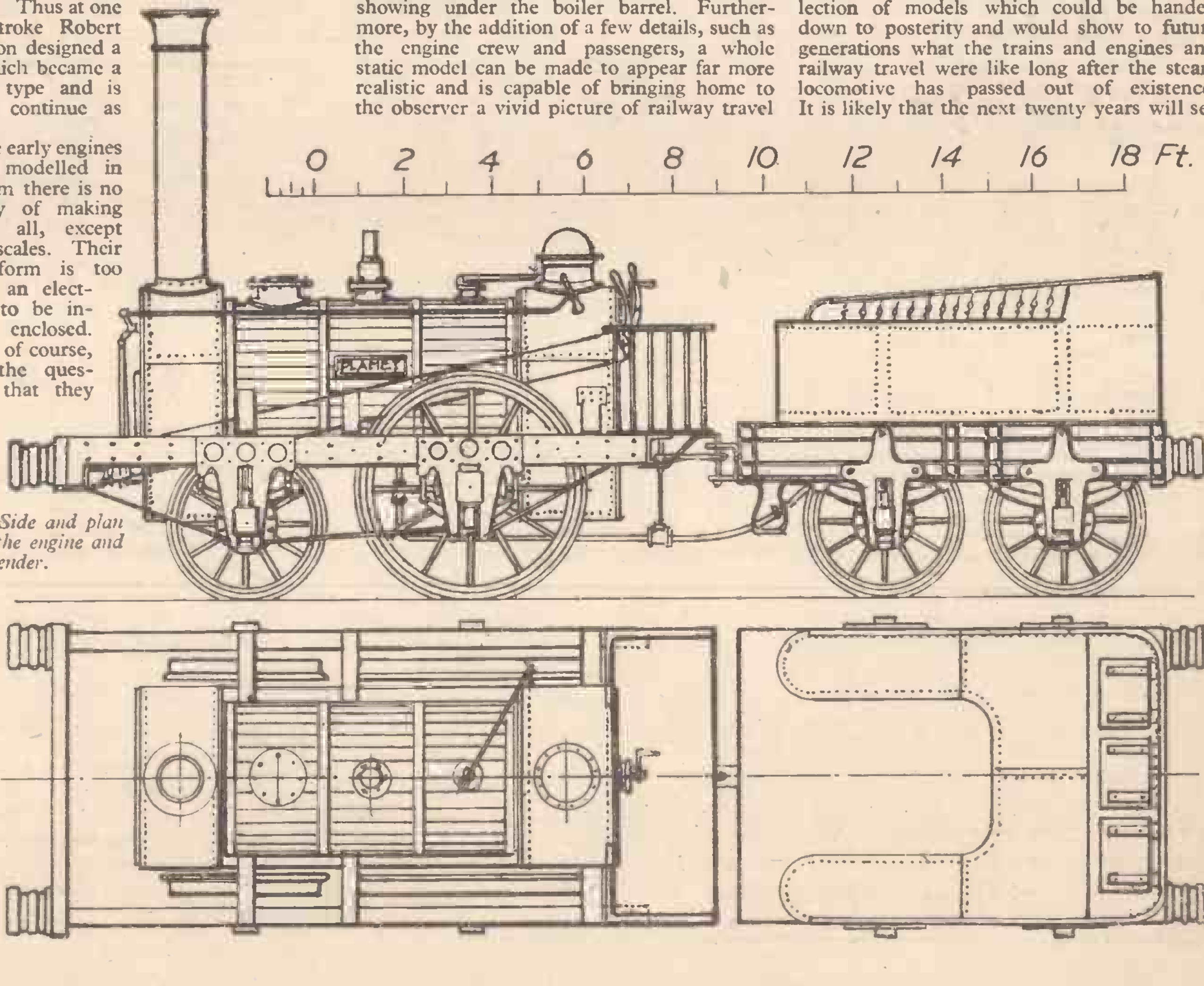

Fig. 3.—Side and plan views of the engine and tender.

the end of steam propulsion on our railways.

The engine of Robert Stephenson of the year 1830 is given here as an example of how such models may be made. The scale is ¼in. to 1ft. In all such models the scale should be a uniform one and from the point of view of the materials to be employed in the construction nothing could be better than ¼in. Although it is possible to make the models of metal, the size is such that there is no need whatever to do so; in fact, the soldering of the parts together cannot make so neat a job as gluing. In my own model there are only three little fittings on the engine in metal, and on the whole train only a few items made from tinned iron wire. Wheels are built up in wood and those on the carriages are of wood with spokes of Bristol-board. This makes a much neater job than if they were of cast metal.

A small lathe will be required on which to turn the circular parts, such as the dome, which is turned from a piece of copper rod, the lock-up safety valve, which is of brass, and the chimney top, which can be turned in boxwood. The boiler is turned in mahogany and the wheel hubs and rims are in boxwood, as are also the leather type buffers on engine and tender and buffer heads and sockets on the carriages. The firebox and smokebox are of mahogany and there are four mahogany strips forming frames. Two of these run from the back of the smokebox to the front corners of the firebox and the other two are longer and extend from the front buffer beam to a point under the footplate. These long frames will have Bristol-board glued on their outside faces. Then there are cross beams at front and back. The front one is the buffer beam, which will have semicircular ends.

The tender has a body made in three pieces, solid, to form the tank and this is glued on to a rectangular frame, the back member of which is the rear buffer beam.

Figs. 3 and 4 are respectively side and end views of the engine and on Fig. 3 is included the tender and a plan of the whole. Bristol-board will be largely used in the construction and of this two thicknesses will be required, namely, "2 sheet" and "4 sheet." The whole of the boiler will be covered with the "2 sheet," i.e., the thinner gauge. That over the barrel will be scored with a knife to represent planks or wooden strip lapping. The smokebox and firebox will also be entirely covered and the pieces must be cut accurately to the edges of the wood. The same applies to the front of the smokebox and back of the firebox; in each case cut to the size of the wood; do not let the cardboard overlap at the edge. Before gluing down, each plate much be carefully marked out for rivets. These rivets, or their heads, will be reproduced by pricking through from the back with a needle or a pin. I suggest that the reader tries out this pricking on an odd bit of Bristol-board and he will then find what is the best kind of point to get the effect. The cardboard should be supported upon a piece of hardwood board or on hard strawboard. Avoid indenting the Bristol-board around the rivet head as much as possible.

There are bolts through the engine frames and the Bristol-board, before it is glued to the outside, must have all the bolt heads embossed like the rivets. Then on the outside and the inside are hornplates. Those four for the outside will have three holes punched out of their top sides and around these holes there are bolts the heads of which must be shown. The springs are cut from tiny bits of hardwood and glued in, as are also the axle box guides.

The brackets for supporting the boiler on the frames,

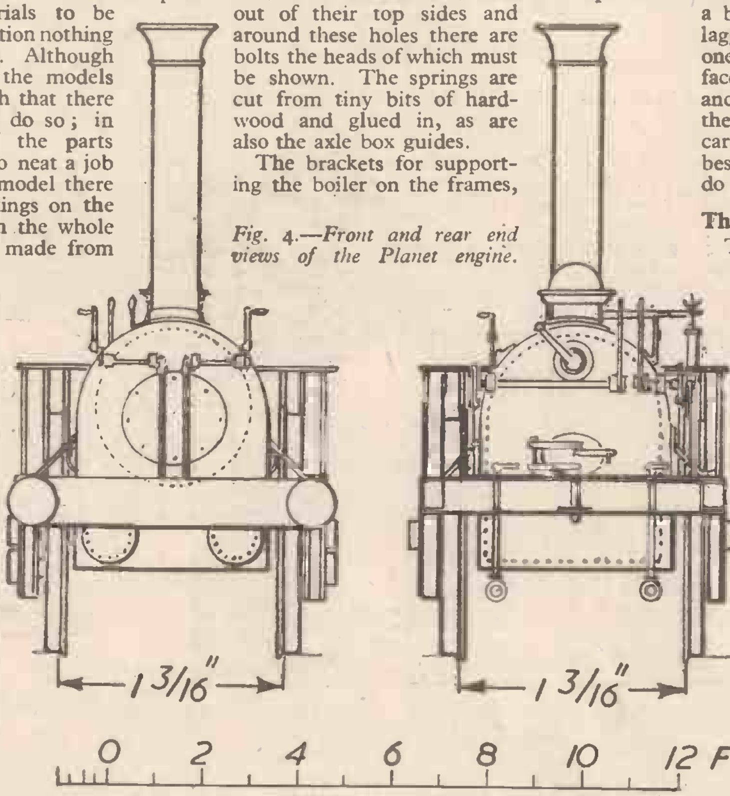

Fig. 4.—Front and rear end views of the Planet engine.

six in number, will be built up in the thicker Bristol-board. The four attached to the boiler barrel are longer than those on the firebox and therefore have cylindrical braces or stiffeners in them; these stiffeners should be made by rolling paper with glue around a circular bit of wood of suitable diameter to form a ring which will fit into the angle of the bracket and the boiler barrel. The gluing on of the brackets should be done after the barrel and the firebox are covered with Bristol-board.

The lagging of the boiler barrel was bound with bands of brass in the Planet and to imitate these take a piece of strong paper, such as a fine quality notepaper, which will be long enough to encircle the barrel; give this a coat of thin glue and stick it down on to tinfoil, the foil having the glossy side outermost. When the adhesive is dry cut it into four strips each a bare ⅛in. wide. Glue these down on the lagging, afterwards giving the tinfoil surface one or two coats of yellow lacquer. The faces of axle boxes in engine and tender and the nameplate on the boiler are done in the same way. The name Planet calls for careful drawing of the letters and I found it best to stick the tinfoil on to thick card and do the lettering before cutting out the plates.

The Chimney

This is made from a length of 5/16in. diameter brass tubing. It should be glued into a hole to a depth of ⅛in. in the smokebox and a ring of Bristol-board passed down and glued to the box; this will form the bottom flange of an angle. Then complete this angle by a vertical band of board glued around the chimney.

The chimney top, which on the original Planet was of black iron, will be turned with a spigot extending downward inside of the chimney; this spigot should make a good push in fit and be glued, but before taking it out of the lathe bore or otherwise turn the inside bell mouth of the top.

The Valve Gear

This consists mostly of tinned iron wire, which must be made perfectly straight. The best way in which to straighten it will be to stretch about 1ft. of it at a time, then cut off the required lengths and finally roll these between two flat surfaces of either hardwood or glass. The forked ends of the rods will be made by gluing two tiny pieces of Bristol-board on to each side of the ends of the rods and on to the lever ends to which they have to be attached. The whole gear is shown in perspective in Fig. 5. From this it will be seen that there were two eccentrics only, E and E1, one for each valve. These eccentrics were not keyed or otherwise fastened to the crank axle A, but were free to revolve through half a revolution and were therefore able to take up positions in accordance with the revolution of the cranks. The eccentric rods ER were brought through to the front of the smokebox and there they had deep notches in them which rested upon and drove pins in levers attached to the valve shifting rods VSR and

(*Continued on page 153*)

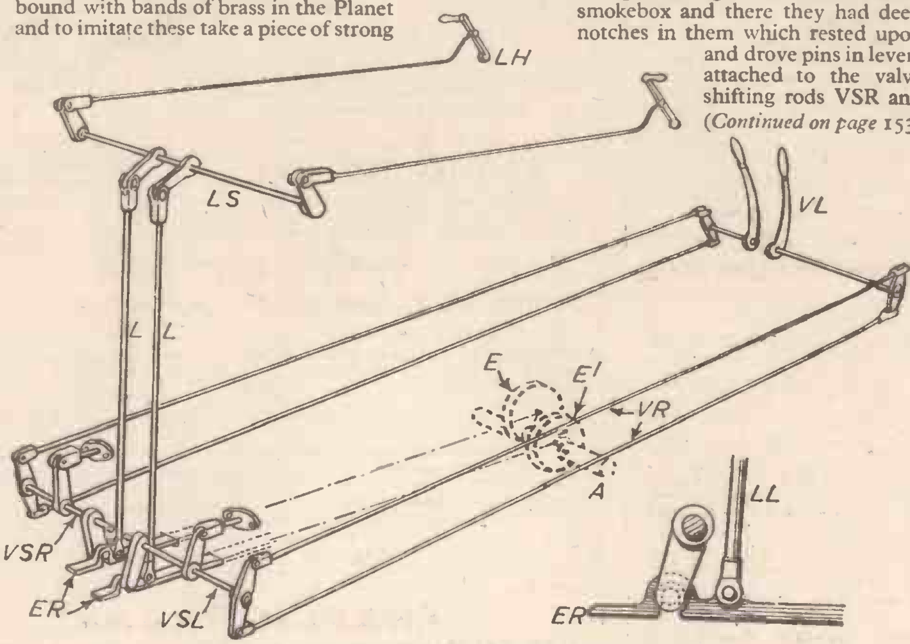

Fig. 5.—A perspective view of the complete valve gear.

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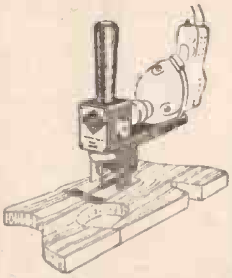

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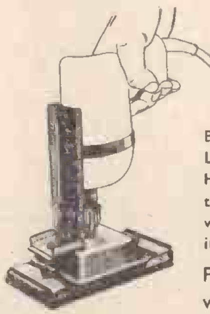

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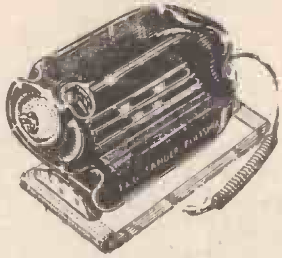

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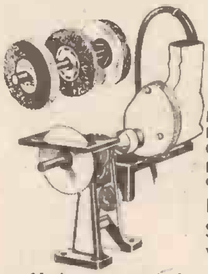

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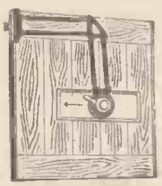

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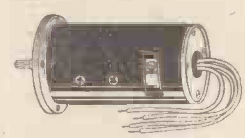

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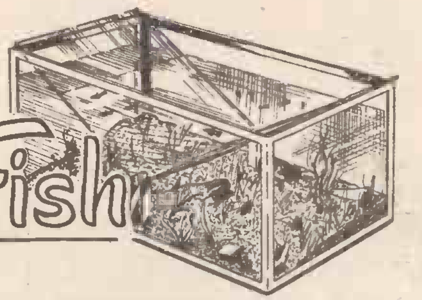
VSL. At the outer ends of these, cross crank arms had valve rods VR attached, and these extended back to the handles VL, which were valve operating levers. Beside these there were means whereby the eccentric rods could be disconnected from the shafts VSR and VSL. These consisted of two lifting links L and L, a shaft LS and two rods leading back to driver's handles LH, which operated the disconnection of the eccentrics from the valves. Now if the engine always ran in the same direction none of this gear would be needed, but as direction is sometimes required to be reversed the eccentrics cannot be always at the same angle with the cranks; they must always be in advance of the cranks. If the eccentrics were fixed on the axle they would be in advance for one direction only; therefore they are not fixed, but are free to revolve through half of a revolution of the cranks and then engage with stops or driving pins on the axle. Suppose that the driver wishes to reverse his engine in order to run backwards and will then have to run forward again: each time he reverses he has first to lift the eccentric rods by means of one of the handles LH. He then has to operate the valves by hand by means of the handles VL. This movement of the valves will cause the wheels to revolve and the engine to travel, but the eccentrics will not revolve until the axle has made a half revolution, when they will be caught by the stops or driving pins. The driver can then lower the eccentric rods on to the pins in the crank arms on VSR and VSL and the engine continues working in the opposite direction. This gear continued in use until 1835, when Hawthornes introduced four eccentrics and an ordinary reversing lever. The inner or valve ends of the four rods then were fitted with various forms of gabs, or forks, which engaged with the valve spindle, which was then brought backward towards the crank axle. In this gear the valves were not moved by hand.

It was a simple matter to connect the ends of the eccentric rods by means of a slotted link and yet another five gears had to elapse before this was done by Howe and Williams, both of them on Stephenson's staff, thus bringing about the revolutionary gear which enabled steam to be used expansively. At about the same time the Gooch gear was introduced, which did the same thing but in a different way.

(*To be continued*)

Breeding Tropical Fish



Some Hints for the Beginner

By I. W. BRASSINGTON

THE requirements for the breeding of tropical fish vary tremendously between one type and another. For instance, the Guppy breeds without any help, while the Neon tetra demands special tanks and equipment, great attention to detail and an infinite patience.

Types of Fish

From the breeder's point of view fish may be divided into two types—the egg-laying varieties and the live-bearers. The eggs of these fish hatch inside the mother and at birth the young are immediately free-swimming. Partly because of this the live-bearers are generally the easier to breed.

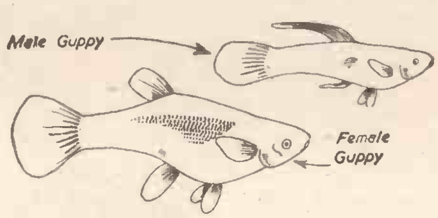


Fig. 1.—The difference between the male and female guppy.

Sexing

Live-bearers in some cases are so easy to sex that it would be impossible to mistake male for female, but egg-layers are generally very difficult to sex—so much so in fact that experts are often unsure. In the illustration of the male and female Guppy (Fig. 1) you will see that the difference is very marked indeed, the female always being much larger and more drab in colour. The male Swordtail (another live-bearer) is easy to spot, as the female has no sword.

In the case of egg-layers, though, one needs experience to determine the sex. When fish are in mating condition the male will sometimes show small white spots on the gills, but often the best way of sexing is to go by the general body shape, the female usually being more plump and rounder in the belly. I have tried to show the amount of difference one might expect in Fig. 2.

Mating

If you have a male and a female Guppy in a normal, healthy tank they will be almost certain to breed, no matter what other types of community fish are with them, without your doing anything to help. Unfortunately, it is not so easy with other varieties. Neon tetras, for instance, need to be very carefully selected and the usual way is to put several of them in a tank, feed them well for a few days and wait to see if any of them show signs of pairing. If you spot a pair, then they can be moved to their breeding quarters, where they must be given plenty of room to themselves so that one either needs a spare tank or, alternatively, a shallow tray. It is essential to get to know the breeding habits and requirements of the particular variety in which you are interested.

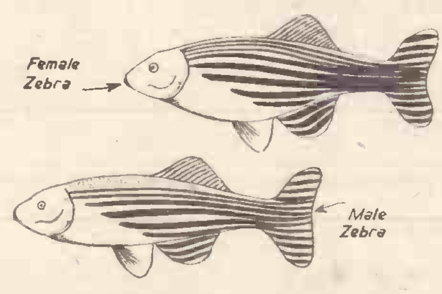


Fig. 2.—Slight difference between male and female zebras.

Care of the Fry

It is quite common for a female to eat the young fish she has just brought into the world, so that some provision must be made for separating them. With the egg-layers it is often possible to arrange for the spawning to coincide with one's leisure hours, in which case the adult fish can be immediately removed to another tank, but this cannot be so conveniently arranged with live-bearers. The Guppy, for example, may be carrying a second batch of embryos before the first is born (both from a single fertilisation) and one is very lucky to be on the spot at the right time.

There are several ways to overcome this difficulty. A very heavy planting of fine-leaved plants will help the fry to remain hidden, or the plants may be just laid on the bottom and weighted down with pieces of glass. A layer of glass marbles on the base of the tank will allow the fry to drop between and prevent the adult fish from getting at them. Then there are breeding traps which work on the same principle of allowing the fry to pass through, but preventing the adults from following them (see Fig. 3).

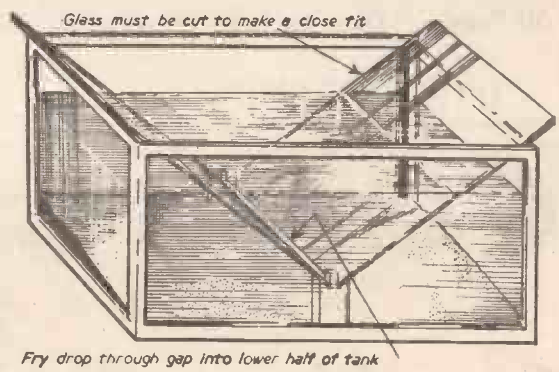


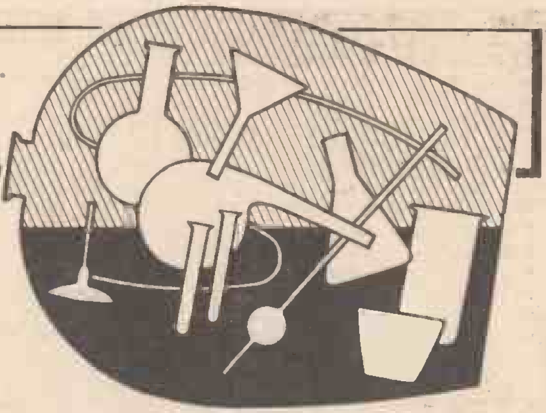
Fig. 3.—A simple breeding trap.

Feeding

The young of live-bearers present little difficulty as they are big enough to eat the very fine grade of the normal dried foods and very soon tackle micro-worms. The young of the egg-layers, however, need special attention. For about a week after hatching out they feed on the yolk-sac which is attached to them, but afterwards most varieties will need to be fed on infusoria.

Infusorians are a class of minute, mostly microscopic animals which can be very easily reared in all kinds of organic infusions. Because of their small size they make an ideal food for young fry for about the first three weeks, after which time they are big enough to go on to micro-worms. To obtain infusoria fill a jam jar with aquarium water and put into it some crushed lettuce leaves. Put the jar in a dark, warm place and after about four days you will notice the mixture taking on a slightly milky look which is due to the presence of millions of these minute animals. A little of this liquid should be fed to the fry several times a day.

THE JUNIOR CHEMIST



The First of a Series of Articles Which Will Describe Experiments Suitable for the Home Laboratory

THE most suitable location for the home laboratory would be in an attic or lumber room or garden shed. If a gas and water supply is available in the laboratory it is a great advantage, but if not, other sources of supply must be contrived.

For the laboratory bench an old chest of drawers may be adapted as shown in Fig. 1; the drawers will be found useful for storing chemicals and apparatus. Fig. 1 also shows how a water supply may be obtained from a bucket, siphon tube and pinch cock. Alternatively a bench may be made, the only essential points about the design being that it should be firm and robust. Whether an old chest of drawers or a specially made bench is used the shelves shown in Fig. 1 should be incorporated and a sink fitted. The sink should be lead lined and fitted as shown in Fig. 2. A rectangular hole of suitable size is cut from the bench top with a fretsaw and a wooden box about 4in. in depth made to fit this opening. The box is screwed into position and then lined by cutting a piece of sheet lead to the shape shown in Fig. 2, tacking this to the inside of the box, and fusing the seams together with a blowlamp and tallow flux. A piece of lead pipe is required to carry away the waste. A hole of the same diameter as the pipe is drilled in the sink bottom and the pipe inserted and jointed in the same manner as the seams. All waste is conveyed by this pipe to an enamelled iron bucket situated underneath the bench. The use of enamelled iron is advisable, for, like the lead lining, it resists the attack of acids and other corrosive substances. The shelving at the back of the bench is used for housing the common reagent bottles.

Fig 1.—The laboratory bench.

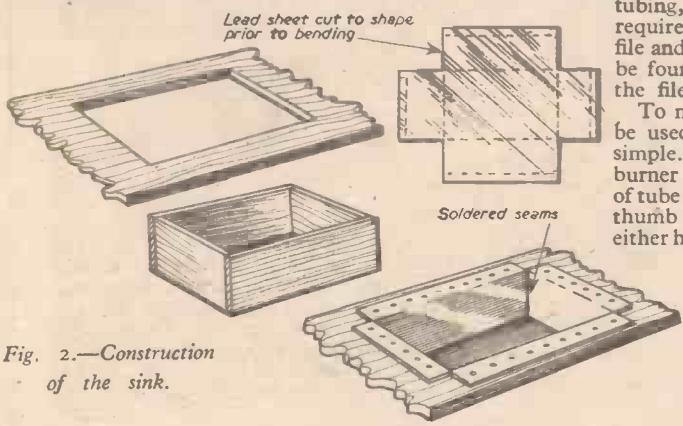


Fig. 2.—Construction of the sink.

Apparatus

The following may be obtained from a chemist or laboratory furnisher and will suffice for the time being: A bunsen burner (if a gas jet is not in close proximity a spirit lamp must be substituted); an iron tripod; a pipeclay triangle; a wire gauze; three watch glasses; a set of cork borers; an assortment of corks; a dozen test tubes and a brush for cleaning them; one or two lengths of narrow glass tubing; two small evaporating basins; a nest of beakers (three); odd bottles, both narrow and wide necked for the storage of chemicals.

Test tubes are most conveniently kept in a suitable stand such as is shown in Fig. 3. Anyone with access to a few carpentry tools can make one.

Manipulation of Glass Tubing

Skill in modelling glass tubing to various shapes enables the experimenter to fit up his apparatus neatly and soundly. To cut glass tubing, nick it at the point required with a three-cornered file and then break it. It will be found to fracture neatly at the file mark.

To make fine jets heat must be used, but the procedure is simple. Light the bunsen burner and take a short length of tube (about 6in.) between the thumb and the first finger of either hand. Hold the tubing in the flame so that its central portion is immediately above the blue cone which is the zone of greatest heat (see Fig. 4). During the heating process the glass must be constantly revolved; this is very important as success in this and all glass-blowing operations depends on uniform heating.

When the glass is red hot (the flame takes on an intense yellow colour at this point) remove it from the burner, and with a steady, straight pull draw the two ends apart. If a friend holds one end of the tube it will be found possible to draw it out to a length of 6ft. or more. Although of very narrow bore the silk-like strand of glass will be found to have remained tubing. To make a small jet the tube must be drawn until 3in. or 4in. of additional length is obtained. Then when cold the central portion may be nicked and snapped, resulting in two tapering glass tubes (see Fig. 5.)

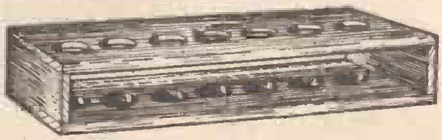


Fig. 3.—A test tube rack.

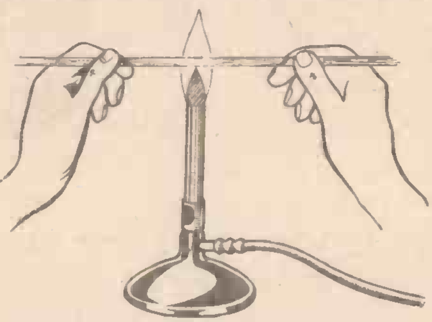


Fig. 4.—Heating glass tubing.

Bending Glass Tubing

For this operation a fishtail gas burner is essential as a considerable length of the tubing must be softened to effect a good bend. Hold the tubing in the flame and in line with it to heat the largest area. Keep it constantly revolving and when it is sufficiently hot remove it from the flame and gently bend it to the required angle. Some practice is necessary before good results can be attained.

Fig. 5.—Drawing tube into jets.

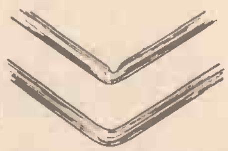


Fig. 6.—Correctly and incorrectly formed bends.

(Continued on page 157)

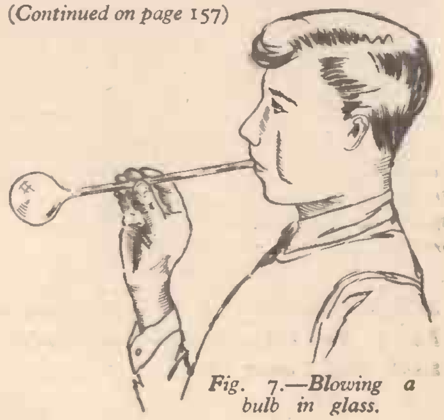


Fig. 7.—Blowing a bulb in glass.

S.24.

RUSTED FITTINGS?

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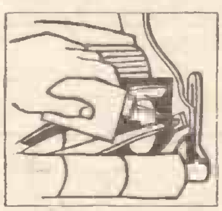

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The beginner's effort is usually kinked, as shown in Fig. 6 at the top, due to the inadequate length of tubing being heated; between 2in. and 3in. must be in the flame. A properly bent tube is shown at the bottom of Fig. 6.

Glass Bulbs and Bubbles

Hold the end of a length of glass tubing in the bunsen flame, revolving it constantly until it fuses into a solid mass. At this point withdraw from the source of heat and blow strongly down the open end of the tube (see Fig. 7). The air pressure blows the softened glass outwards, forming a bulb at the hot extremity. It is in this way that thermometer tubes are made. Now, by repeated heating and blowing, the bulb may be blown into a large glass bubble.

THE SPEAKING HEAD

Try This Illusion at Your End-of-term or Scout Troop Party

HERE is an excellent Christmas illusion to work when it is possible to be just a little way back from your audience; say, in a fairly long private room or in a Scout or other clubroom. The writer has used it successfully in a variety show given in a medium-sized hall.

What the Audience Sees

The curtain rises disclosing a small table and a chair. In a house the guests would be ushered into a room with these items already "on stage." Professor Diddlem enters carefully carrying a box labelled "HEAD WITH CARE." This he sets down on the chair.

In a humorous way and with a slightly "foreign" accent he explains that while digging in the buried town of Boz he came upon a head which though centuries old has still the power of speech.

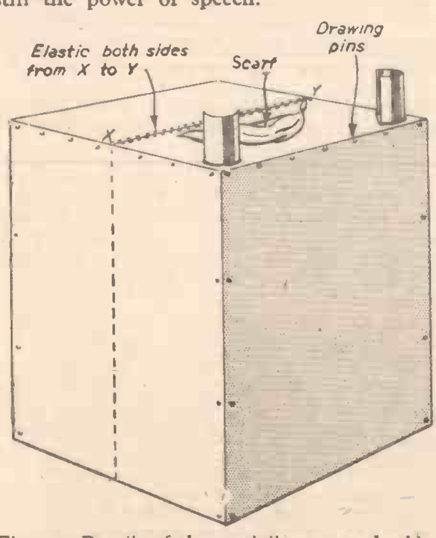


Fig. 4.—Details of the specially prepared table.

"I have brought this with me," he says, tapping the box, "and with your kind permission I will demonstrate the strange powers of my discovery."

He lifts the box and sets it on the table, at the same time lighting two corner candles or lamps fastened at each side of the front of the table top. He now asks for the room light to be lowered. Giving the watchers a

Fig. 1 (Left).—The magician enters carrying the box.

Fig. 2.—His assistant pokes his head through prepared table top into box.

moment or so to get their eyes used to the dimmer illumination, he then makes a show of undoing clips and eventually gingerly raises the box revealing a grotesque head with eyes closed apparently lying there.

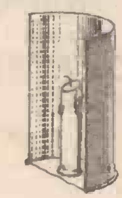
This he proceeds to wake up and there follows a spirited cross-talk, the head speaking in a hollow, "far away" voice. To finish the turn the head declares that it is tired and closes its eyes. The professor makes several attempts to keep it talking without success and tells the audience it is no use going on. He replaces the box over the head, apparently refastens the clips and lifts it from the table, showing an empty surface. Carefully holding the box, as if of great value, he bows and walks off amid applause.

How it is all done is clear from the three sketches, Figs. 1, 2 and 3. Simple as the trick is, the illusion of a head lying on the table is very complete.

The accessories necessary are the table (Fig. 4), prepared top and lamp-holders (Fig. 5), the box for the head, two cloths to go right round the table, some elastic and a silk scarf.

The Table

A ready-made table with its top removed would do for the main item, but it is quite easy to make the framework as shown in Fig. 6 for the purpose. The uprights (A) are about 2ft. 6in. long with a section of 2in. × 1½in. Four side pieces (B) are 2ft. 3in. × 3½in. × ½in., while the eight strengtheners (C) are strips of three-ply cut to lie as indicated.



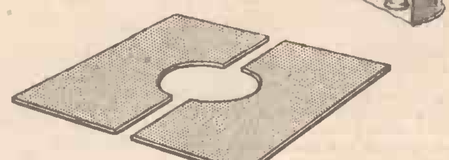


Fig. 5.—Prepared top and lamp holders.

Pieces (B) are let into the uprights at the corners and secured by screws, but the final strength is given by the strips (C), which are held to the outside of the legs and inside of the sides (B) by a single screw at each point of contact. While putting on the strengtheners, see that the legs all touch the floor firmly and that there is no wobbling.

Fig. 3.—The box is removed revealing head lying on table.

The top of the table is two stiff sheets of card (or three-ply) with two semicircles cut out which when together will comfortably allow the head of the helper under the table to pass. Fit the sheets to the top edges of the table frame with a series of fine nails or short screws.

Two lengths of cloth (old curtains will do) are now required. They should be of sufficient size to cover everything down to floor level as in Fig. 4. The join of the pieces is shown by the dotted line and into the two top edges is sewn, between x and y, lengths of elastic so that the edges here can be drawn apart. The cloths are kept in the right position by drawing pins pushed in at various suitable points.

Other Accessories

The top is furnished with the two lamp-holders shown in Fig. 5; these are cut by halving a cocoa tin and can be fitted with candles or low-powered bulbs. Candles, with the bright tin behind, give a quite good illumination, sufficient for most rooms. The scarf is laid in the position shown.

For the box in which the head is supposed to come, this has to be open at the bottom and a good sized hat box, inverted, is ideal. It is finished with the label " HEAD WITH CARE " and the professor must make sure that, having no under side, the box is always carried slightly tilted from the audience. The label for a good effect must be printed in very large and clear letters.

The assistant who becomes the head is inside the table before the curtain goes up or the guests are ushered in. He should be comfortably seated on something that just brings his chin on the surface of the table when he sits upright.

When the professor puts the box on the table he gives a signal, say, a kick with his foot or a tap on the box, to show that all is ready and the person inside parts the elastics and pushes his head up into the empty container. While this is being done the professor keeps a hand firmly on the top of the box to prevent movement and talks to the onlookers to hold their attention.

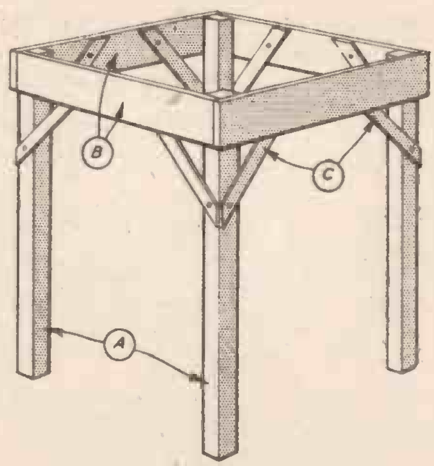


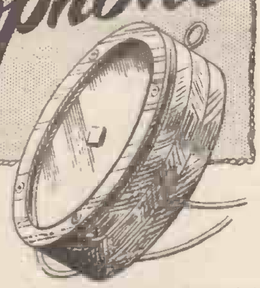
Fig. 6.—Table construction.

When he is ready the assistant gives a sign in his turn and the professor lifts the box, raising the back first so that it is tilted again towards the audience. It is then completely removed, revealing the head, the professor immediately arranging the scarf (lying in front) around the neck and under the chin of his " exhibit." This apparently to give support but really to camouflage the break in the cloth, etc.

Disappearing at the end of the turn is just the reverse set of actions. The box is placed over the head and the assistant within draws back into the table and pulls the elastic together. The professor keeps on talking and seemingly fastening clasps till he gets another pre-agreed signal, when he lifts the box, shows an empty table top, and makes his exit.

Our JUNIOR SECTION

Making a Microphone



Talk to Your Friends By Means of This Easily Made Device

To make the microphone shown in Figs. 1 and 2, cut with a fretsaw, three circles of wood 2¼in. in diameter and ¼in. thick. In the centres of two of the discs, cut holes ⅞in. in diameter, glue them together and then glue the combination on to the other disc. From a carbon rod ¾in. in diameter, cut two pieces ⅛in. and ¼in. thick. With a ¾in. flat-headed wood screw fix the thinner piece of carbon in the hole formed by the three discs of wood. The end of the screw will project a little through the wood and should be filed off neat and flat. Cut a washer from thick cardboard 2¼in. outside diameter and 1⅜in. inside diameter, and cut also a similar washer from 3/16in. plywood.

The Diaphragm

The diaphragm of the instrument is cut from a cocoa tin, and is 2¼in. in diameter. It is essential that the diaphragm should be as flat as possible and free from all kinks. Drill four holes in the diaphragm, ¼in. from the edge, to take ½in. wood screws, and drill a ⅛in. hole exactly in its centre. Drill the ¼in. carbon block to take a ⅜in. by ⅛in. countersunk machine bolt, and fix the block on the diaphragm. Screw the nut on to the bolt as tightly as possible, but do not exert too much pressure or else the carbon will split.

Fill the hole in the microphone case with granulated carbon or carbon granules, to a depth of a bare ⅛in. (see Fig. 2), and place the cardboard washer and diaphragm in position. Over the diaphragm place the plywood washer and secure it with four round-headed screws. The carbon granules must be obtained from some good electrical company.

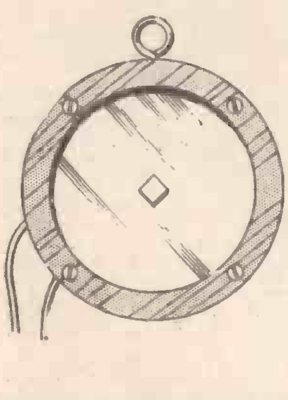


Fig. 1.—A front view of the microphone.

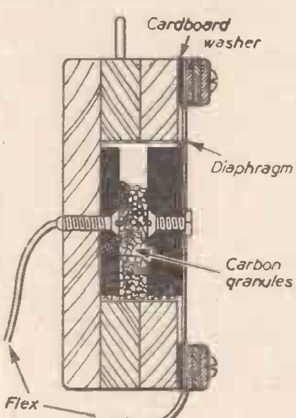


Fig. 2.—A sectional view showing details of construction.

Connections

To one of the screws securing the diaphragm attach one end of a length of double flex. This is most conveniently done by placing the wire under the diaphragm and round the screw before the screw is finally driven home. The corresponding end of the flex is soldered on to the ¾in. wood screw which projects through the back of the case. To complete the construction a screw eye should be fixed into the case and the whole stained a dark brown.

To test the instrument, connect it in series with a dry cell and a pair of wireless headphones (see Fig. 3). Shake the microphone and blow into it—a loud roaring noise should be heard in the 'phones. Now speak and a voice should be heard. If the voice is too faint or distorted beyond recognition, alter the amount of carbon in the transmitter until the correct result is obtained.

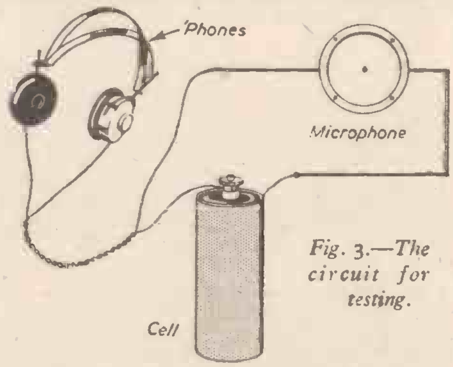


Fig. 3.—The circuit for testing.

Books Reviewed

MODEL ENGINEERING PRACTICE. By F. J. Camm. 236 pages. 272 illustrations. Crown octavo. 17s. 6d. net, or 18/- by post. Published by George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

MOST readers are acquainted with the beautiful models made by Mr. F. J. Camm, the editor of PRACTICAL MECHANICS. Some of them have won international competitions and they range from model aeroplanes and locomotives to model bicycles, motor cycles, motor-cars, marine engines, power boats, architectural models, and models of original design. Mr. Camm has a world-wide reputation and those who have seen his models have admired the detail and finish of his work. This book does not tell you how to make models but the methods used in making them, and he has set down from his ripe and lengthy experience model making methods which must be suitable for the amateur with limited equipment and experience. It deals with: the model maker's workshop; files and filing; miscellaneous tools; trammels, squares and calipers; the protractor vernier and the micrometer; micrometer adjustment; drills and drilling; taps and dies; marking out for machining; soft soldering; silver soldering and brazing; lathe work; centring the work; tool types; face-plates and mandrels; boring-bars; screw-cutting in the lathe; scroll chuck and fixtures; riveting; painting models; prototype models; showcases for models; hollow- or slush-casting; casting in soft metals; making small foundry patterns; making wheels for models.

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MAKING YOUR OWN? Telescopes, Enlargers, Projectors or, in fact, anything using lenses. Then get our booklets "How to Use Ex-Gov. Lenses & Prisms," price 2/6 ea. Comprehensive lists of optical, radio and scientific equipment free for s.a.e. H. W. English, Rayleigh Rd., Hutton, Brentwood, Essex.

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POLYESTER HANDBOOK.—This textbook for the glass fibre/polyester resin industry is now ready, and is the complete manual for the amateur and professional alike. Price 5/6, post free.

We can supply any quantities of materials for moulding and fabricating.

In addition we have a Field Kit available, F.P. Field Kit No. 5, for car repairs, etc., or just plain experiment. Price 17/6, post free. Fibrin Plastics Limited, Dobcross, Oldham, Lancs.

STEAM CARS.—1956 Claydon Steam Car is described in "Light Steam Power." Your copy and lists of engineering drawings, castings, books, for 3/6. "Light Steam Power," Kirk Michael, Isle-of-Man, U.K.

PRACTICAL MECHANICS (unbound), June, 1945, to December, 1955, complete. What offers! Harman, 46A, King's Road, Chelsea, S.W.3.

(Continued on next page)

(Continued from previous page)

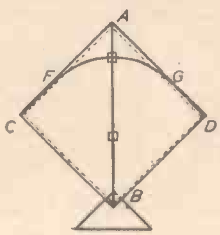
Letters to the Editor

The Editor Does not Necessarily Agree with the Views of his Correspondents

Indian Kites

SIR,—I have spent many years in India, and in my youth was really fascinated by kites, flying many home-made ones.

In your June issue you described the construction of a kite which will easily be torn around the periphery. This can be overcome by tying a piece of cotton on to the ends of the bamboos, i.e., at the points A, B, C and D. The square of tissue paper should be slightly larger than the size required so that the surplus ¼in. or so can be turned over the cotton and stuck down with glue. The surplus paper should also envelop part of the curved bamboo between F and C, G and D. Sellotape can be used for strengthening purposes as in your article. I also noticed that the bottom string of the bridle is too near the tail. It should be about 5in. (not 2in.) from the tail for good control and performance. Sellotape ought to be used where the bridle is tied to the backbone to prevent the hole in the tissue from tearing.



Mr. B. J. Hiley's kite modifications.

With this new position of the bridle, no spinning should occur. If it does, it can be prevented by altering the length of either string in the bridle. The correct length can be found by trial and error, bearing in mind that spinning usually results from one string being too long. It is quite unnecessary to have a tail at right angles to the plane of the kite to prevent spinning.—B. J. HILEY (Christchurch).

Thermosetting Resin

SIR,—The recent spate of inquiries involving opportunities for thermosetting resin leads us to write to you.

We would mention first of all our liquid porcelain epoxy resin paint, based on epikote resins supplied by Shell Chemicals. The material sets to a porcelain-hard finish upon the addition of a catalysing agent, and may be applied by brush or spray. The resin dries at room temperature in four hours after application and develops to full hardness and chemical resistance in eight days. The material is advertised regularly in your journal and is available in black, white, cream, red, sky blue, aluminium and clear. Other colours are available for industrial use. We would certainly recommend this material to R. Colebourne for waterproofing cardboard cylinders, R. Crocker for waterproofing an elm bowl ("Your Queries Answered," October issue) and to E. J. Allen ("Information Sought," October) for a hard finish on wood carvings. R. E. Mathews ("Your Queries Answered") would find the aluminium epoxy finish suitable for producing an abrasion-resistant finish equal to stoved enamels.

For the benefit of R. Bamber ("Your Queries Answered") we would mention that our R111 casting polyester would be quite satisfactory for the process outlined and may at the moment be coloured to 31 different colours.—(Silver Dee Plastics, Hartington, Staveley, Chesterfield).

Cutting Perspex Discs

SIR,—*Re* "Information Sought," September, 1956, issue.

I would suggest that Mr. Scott buys one or a set of "Picador" hole saws, the range of these being from ⅜in. to 2in. They can be used with a ¼in. twist drill and a brace or breast drill.

As an alternative he could use a tank and washer cutter to a certain depth and trepan to finish.—N. V. SILCOCKS (Glam).

SIR,—*Re* "Information Sought" (cutting Perspex discs), September issue of PRACTICAL MECHANICS. Your reader should obtain a "Lufbra" hole-cutter made for the job of cutting material like Perspex and also metal.

It is adjustable from ¾in. to 3½in. and costs 7s., carriage extra, from Southern Radio Supply, Ltd., 11, Little Newport Street, London, W.C.2. It is available also from other radio shops.—A. CURTIS (London, S.W.15).

The Fairfax Telescope

SIR,—In your "Information Sought" column of PRACTICAL MECHANICS, October, 1956, W. May asks for the order of assembling the miscellaneous parts of a Fairfax 18x telescope. He also requires the principle governing the magnification factor.

The parts he lists are as follow:

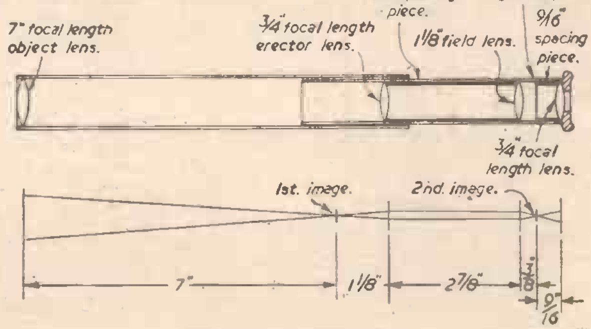
Object glass, 7in. focal length.
Two lenses, ¾in. focal length.
One lens, 1⅛in. focal length.
One light stop aperture, 5/16in.
One hollow fibre spacing-piece, 9/16in. long.
One hollow fibre spacing-piece, 2⅞in. long.
Length extended, 11¾in.
Telescopic magnification 18x.

Before going into details of assembly, some understanding of the requirements and principles of such an optical system should prove not only interesting but of some assistance.

In the simple form of an astronomical telescope consisting of two lenses, one is of long focus (the object glass) and the other of short focus (the eyepiece). The magnification is easily found by dividing the focal length of the eyepiece into the focal length of the object glass, i.e., 7in. focal length object glass with 1in. focal length eyepiece = 7x magnification. However, a combination of lenses gives better results for various requirements.

An astronomical telescope, for instance, shows an inverted image, so an extra lens is used called an erector lens to revert the image back to its normal position. It will be appreciated that in astronomy this is unnecessary, as it does not matter which way up we see the stars or moon.

This lens can be made to effect the magnification considerably according to the position it is placed between the object glass and eyepiece.



Fairfax telescope assembly.

It has been found that a combination of lenses in an eyepiece improves various aspects of its resolving power, and there are any number of types. However, we will discuss the Huygenian eyepiece which seems to be the one concerned in the above list of parts.

It consists of two plano-convex lenses with their curved surfaces facing the objective. The focal length of the field lens is two to three times that of the eye lens. This type of eyepiece has the focal plane of the image viewed between the two lenses, and it is usual to have a stop fitted in the eyepiece exactly coinciding with this image plane. The distance between the lenses is the sum of their focal lengths divided by two.

The combined focus is found by dividing the product of the focal lengths of each by the sum of the focal lengths, minus the distance they are apart.

In the telescope in question, if parallel rays of light from any object pass through an object glass of 7in. focal length, an image will be formed 7in. away. If a ¾in. focal length erector lens were placed 1⅛in. from this image plane, that is 8⅛in. from the object lens, it will, in turn, cast an image twice the size 2¼in. farther back or 10⅜in. from the object glass.

If a Huygenian eyepiece is built from the remaining lenses using the 1⅛in. focal length lens as the field lens and the ¾in. as eyepiece, they will be 15/16in. apart with a stop fitted between them about 9/16in. from the eyepiece.

The focal length of this eyepiece would be about ¾in.; dividing this into the focal length of the object lens we get 8x, and as the erector lens is doubling the magnification we get 16x. As the fibre stop in the above list is 2⅞in. long, rather than 2½in., this indicates a slight increase in the magnification of the erector lens which would no doubt give 18x. What is more, the total length of such a combination would result in length when extended of about 11¾in., as specified.

The diameter of a lens has no effect on its magnification, but affects the amount of light collected, therefore the clarity of vision.

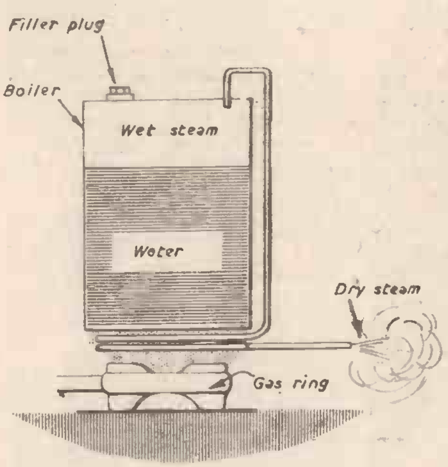
Should any doubt remain, the sketch should simplify matters.—E. M. SUTER (S. Rhodesia).

Producing Dry Steam

SIR,—In reply to J. Murphy, "Information Sought," October issue, regarding the production of dry steam for glazing gum confectionery, although I am not conversant with the process described, surely the best way to produce dry steam is as sketch below.

If the steam is too dry and hot, decrease the number of coils in contact with the gas flame.

A safety valve would probably be required. —J. K. BROWN (Southport).



Suggested method of producing dry steam.

Drilling Up to ½in. with a ¼in. Electric Drill

SIR,—Your correspondent in the September issue, Mr. D. F. C. Vosper (Drilling up to ½in. with a ¼in. Electric Drill) has, I suggest, a too elaborate solution to his problem. It would be both cheaper and easier to have the drill shanks ground down to ¼in. diameter. Any competent toolmaker will do the grinding for a small charge.

I agree with your comment, in general, about the duty of the motor, but larger holes may be satisfactorily drilled by using several drills, modified as above, in steps of increasing diameter, until the required hole size is reached.—E. L. BRADFORD (Essex.)

Horizontal Enlarger Improvements

SIR,—I have made the horizontal enlarger, as described in the July, 1956, issue, and have worked out some improvements which, I think, would help other readers.

It was found that the 100-watt lamp as described was not bright enough, so I purchased a 150-watt pearl enlarger lamp costing just over 3s., and this is much whiter than the ordinary pearl lamp.

The negative carrier as described by the writer is rather crude, for when the glass is placed in it there is a tendency for it to be a little loose, which might result in the negative slipping down each time it is placed in.

Also there is no allowance made for moving the negative from side to side in order to get it square on the screen. I suggest the following improvements.

The carrier can be made the same as before except that it is made ¼in. wider than the glass which is to fit in it.

This means that the glass can be moved sideways in order to get it in line with the opening in the camera, also to tilt the negative more squarely as it may be slightly out when fixed between the g'ass.

Having got this freedom at the sides it is essential to pad the inside of the carrier so that the glass with the negative inside it will move smoothly and it will be gripped with a little pressure to hold it firmly in place. This can be done by padding the inside of the carrier with green felt.

This, I think, gives more freedom for adjusting the negative when it is in the carrier, also it ensures that the negative will not slip once it is in.

It is suggested that most cameras will not need to be fastened down as they will sit quite firmly on the sledge. This cannot be true, because if a folding camera is used and has to be turned upside down because of the hinged back, then it cannot stay upright on its own and will have to be fastened by its tripod screw or any other means that are possible.

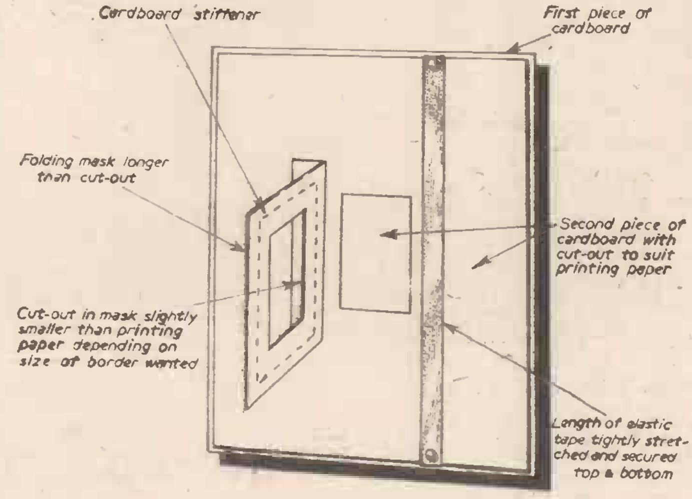
It will be found that the lamphouse is much more secure if about three screws are driven through it to the base on which it stands, as well as fixing it with strips of tinplate or brass strips.

If the lamphouse and the camera are fixed too low down on the cradles, when a large picture is wanted, the picture which is projected will have its bottom edge missing.

With regard to the screen the following method is suggested. Take a large piece of cardboard about the same size as the plywood screen and on top of this glue a piece of card similar to that which is used as leaves in a photo album, but in this one a cut-out is made to suit exactly the size of printing paper used, whether it be oblong or square. It will be found to be almost the same thickness as the printing paper. Next take a piece of the same card and make it bigger than the cut-out; on this, too, cut out a space slightly smaller than the printing paper, depending on what size of border is wanted.

This is then secured to one side of the cut-out and bent back a few times to make it fold. It is then made a little stiffer so that it will lie flat each time it is folded back on to the printing paper; the method of doing this is shown in the diagram.

This method of marking will ensure a clean and even border on the finished print. The method of keeping the mask flat whilst exposing is by means of an elastic band strung from top to bottom. Having secured the print holder, including the mask, to the plywood screen, making sure it is central with the projected picture, an old print is placed face down in the cut-out, the mask is folded over and secured under the elastic tape.



Modified enlarger screen.

The enlarger is switched on and the image is focused on to the back of the old print. The projector is then switched off and an unexposed piece of printing paper is placed in; the mask is then tucked under the elastic band as before. Illumination is, of course, by means of a yellow or orange safe-light.—A. J. THORLEY (Manchester).

Magnetic Board

SIR,—We note that there is an inquiry in the November PRACTICAL MECHANICS from Mr. J. K. Swells, of Bridgwater, for details of a magnetic board for instructional purposes. May we assist you in this matter by recommending that your reader uses a piece of "Flexo" plywood, which can be obtained through Flexo Plywood Industries, Ltd., and "Eclipse" button magnets. The method of using these is illustrated on page 9 of a booklet, "Small Magnets Are So Versatile," available from us.—JAMES NEILL & Co. (SHEFFIELD), LTD. (Napier Street, Sheffield, 11).

TRADE NOTES

Pocket Handwarmer

FROM K. F. Meyer, Ltd., 74, Borough High Street, London, S.E.1, who are the sole importers, comes news of a handwarmer. Chromium plated and contained in a velvet bag, it employs lighter fuel and will burn for six to 12 hours on one measure of fuel. It is suitable for almost anyone who spends much time out of doors in winter

Pocket handwarmer and case.

weather, and retails at 10s. 6d. It can be bought from the sports departments of the large London stores—Gamages, Selfridges and Army and Navy Stores.

A Woodscrew Chuck

THE Coronet Tool Co., 8, Mansfield Road, Derby, have recently sent us details of one of their new patent woodscrew chucks. As will be seen from the accompanying illustration, the chuck is of simple design, incorporating an ordinary woodscrew, interchangeable for size and having facilities for adjusting the length of the screw protruding through the faceplate by means of an adjusting plug. It is self contained and the work can be taken off and replaced at will without the slightest difficulty. For turning larger work (such as a 12in. fruit bowl) a chuck of larger diameter is available, and this chuck is provided with facilities for further support of the work by means of a larger face area and two extra independent screws for securing the material to the faceplate. These chucks are designed for use with any popular make of lathe. Any further details can be obtained from the above address.

The Coronet woodscrew chuck.

Work Baskets

MADE from glass fibre reinforced plastic material by Universal Metal Products, Ltd., Langley Road, Salford, 6, Lancs, these 17in. × 13in. × 7in. deep work baskets are being used by a number of firms for handling work in progress. They are tough, durable and light, can be easily stacked and have radiused corners. All inquiries should be sent to the above address.

New Romac Rubber Solution Containers

THE idea of using gelatin capsules for the rubber solution provided with their bicycle tyre puncture repair outfits has been introduced by the firm of Romac.

A quantity of capsules in a transparent envelope is to be included in each of their Cure-C-Cure puncture outfits. There will be one capsule for each patch. The capsules, which are easily pierced with the nail or a pin are small, no more than ⅝in. long, and are coloured a bright yellow, so as to be seen easily in the dark. The rubber solution remains perfectly fresh in these containers and does not dry out.

New Lucas Rear Lamp and Reflector

THIS new design is a streamlined model designed for mudguard fixing. It has a fast colour diakon body, firmly secured against theft and cushioned against shock in strong rubber-moulded base, which forms a seal and prevents the entry of dust and water.

A conical-shaped rear-lamp lens gives extra wide angle of visibility, and the moulded-in reflector is a constant protection against possible bulb failure. It will operate from the dynamo with single cable connection, fed through a hole in the rubber base. The price is 5s. 11d. complete with bulb.

Lucas rear lamp and reflector.

The Relyon Time Switch

THIS unit is made by Smiths English Clock Systems, Ltd., 179-185, Great Portland Street, London, W.1, and may be used in any electric circuit where a switching

(Right)—The Relyon time switch

operation is required. Apart from its obvious commercial uses for public lighting and neon signs, illuminated clocks, shop window lighting, etc., there are several domestic applications. It can be used for controlling immersion heaters, porch and hall lights, garage heaters, etc.

The retail selling price is £5 8s. for the single circuit model (£6 18s. double circuit) and is available through electrical contractors, etc.

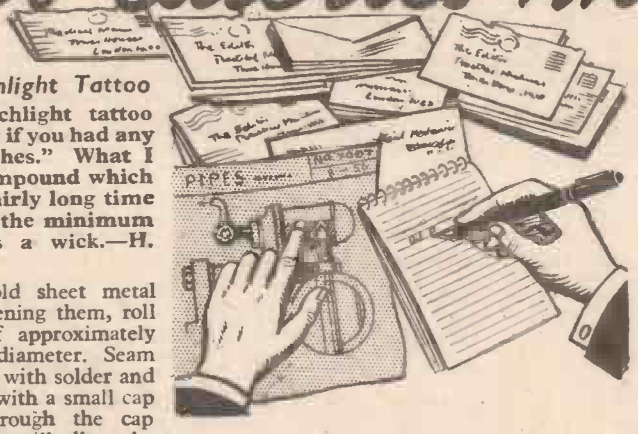
Bondafiller

BASED on polyester resin and employing a variant on the now widely used glass fibre and resin technique for repair work, Bondafiller can be used in many car repairs and in a wide range of other uses in workshop and home. Its high adhesion to metal makes it suitable for repairs to water or oil tanks, pipes, furniture, etc. Bondafiller sets in 30 minutes and does not peel or crack. It may be obtained at motor accessory shops and garages or direct from Bondaglass, Ltd., 40a, Parsons Mead, West Croydon, Surrey. The Handy Pack size costs 6s. 6d. and there is a larger size available for 25s.

"Selecta" Home Workshop

B. ELLIOTT & CO. LTD., manufacturers of machine tools and engineering equipment, of Victoria Works, Willesden, London, N.W.10, are now in full production with their new "Selecta" Home Workshop, an all-in-one unit which replaces manual work or the necessity of having different kits for different jobs. It is capable of rip sawing, mitring, grooving, dovetailing, tool sharpening, scarfing, fly cutting, cross sawing, cutting large sheets, sanding, grinding, drilling, polishing and routing.

Your Queries Answered



"Torches" for a Torchlight Tattoo

WE are holding a torchlight tattoo and I was wondering if you had any suggestions for the "torches." What I had in mind was some compound which would burn in tins for a fairly long time and which would produce the minimum of smoke, using rags as a wick.—H. Vickers (London).

CUT up a number of old sheet metal "tins" and, after flattening them, roll up from them cylinders of approximately 10in. length and 2in. or 3in. diameter. Seam each cylinder along its length with solder and cover its lower end similarly with a small cap of the same material. Through the cap must be drilled a hole which will allow the insertion of a long wooden pole or holder. By proceeding in this manner you will have the necessary containers for the torches which you require. Each container should have poured into it a quantity of molten wax and then a length of hempen rag to act as a wick. The wax can be of the crudest description, but it should not contain any oil since this will make the burning difficult and uncontrollable. When the wax has solidified within the improvised cylinder the torch will be ready for use. It is used merely by igniting the projecting hempen wick and it is equally as readily put out merely by snuffing the wick. These torches take a little trouble to make, but they are really efficient and burn for a considerable time with the minimum of "mess."

Casting Material : Plating Non-metallic Casting

WHAT is the best medium (metals and stone excepted) for making statuettes about 6in. in height ?

I have heard that some sort of material (plaster or terra cotta ?) can, after preparation, be copper plated and finally silver or chromium plated. Can you give details ?—A. G. Cousins (Oxford).

A GOOD casting mixture for your purpose will be a 50 : 50 mixture of Portland cement and whiting, the latter being coloured (if required) by admixture of some mineral colouring matter. This is slaked either with plain water or with water containing 5 per cent. of dissolved gelatine or glue. Such a mixture sets to a smooth surface and, unlike plaster, is not brittle. It is a very cheap mixture.

Another mixture consists of a 50 : 50 mixture of whiting and calcined magnesite, slaked to mortar consistency with a solution of 40 parts of magnesium chloride in 60 parts of water. It sets slowly (about 30 hours) but expands very slightly in setting, so that it gives very sharply-defined casts.

A third alternative is to use "Catacast," which is a cold-setting synthetic plastic liquid manufactured by Catalin, Ltd., Waltham Abbey, Essex. This is mixed with a small quantity of an "acid accelerator" and poured into a mould in which it sets overnight to a transparent mass.

In order to electroplate a non-metallic casting the latter is brushed over with fine plumbago (blacklead) until it is black all over. The surface has now been made conducting, so that the casting can be copper-plated in an ordinary copper plating bath. Only a very thin layer of deposited copper is required. This is then silver-plated or, alternatively, it is plated with nickel and then with chromium.

Better than plumbago or graphite for the above purpose, you can use an aqueous dispersion of semi-colloidal graphite manufactured specially for this purpose by Messrs. E. G. Acheson, Ltd., 9, Gayfere Street, London, S.W.1.

QUERY SERVICE
RULES

A stamped, addressed envelope, a sixpenny, crossed postal order, and the query coupon from the current issue, which appears on the inside of back cover, must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the reader. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Antique Finish on Copper

I HAVE made some copper ornamental hinge plates for fitting to a piece of reproduction furniture. These are too bright and gaudy and I should like to know how, in a simple way, to give the metal a dull, pitted and antique finish ?—F. Southworth (Lancs.).

IN order to obtain the pittings these should be hammered into the metal, using as the pitting tool either a nail point or a nail head. Do not use for the purpose a fine steel punch since this gives too "accurate" a pitting mark.

In order to colour the copper hinges see, first of all, that they are degreased on their surfaces. Then dissolve about one-eighth of an ounce of sodium sulphide in about one pint of cold water and immerse the articles in this solution for a few minutes. The copper will rapidly tarnish through gold, red and brown colours to a deep bronze-black. By using the solution more dilute than the above the tarnishing will be proportionately slower and the article can be removed at any stage. The colorations are due to a film of copper sulphide which is rapidly formed on the copper.

If the final result is too dark merely polish off the high spots and you will obtain exactly the antique finish which you want.

Sodium sulphide has a rather bad smell. Hence, all these operations should be done out of doors. After tarnishing, the article is dried and rubbed with a soft rag. Finally, it should be lacquered lightly.

Truing a Lathe Chuck

PLEASE tell me the method of truing up the chuck on my lathe which is running eccentrically.—J. Grey (Herne Hill).

FROM your letter we gather that you are not very experienced in lathe work ; therefore, before attempting to true the jaws, we suggest you undertake the following simple checks.

First, clean the chuck recess and adaptor plate thoroughly, making absolutely certain no small particles of swarf adhere to the faces. At the same time ascertain that no burrs are present, which may prevent correct seating. Next, check the recess and threaded portion and once again clean away any dirt. Before offering the adaptor with the chuck assembled, measure the recess in the plate carefully with the aid of a Vernier, and gauge the corresponding spigot on the spindle nose with a micrometer. A difference of only .001in. should be sufficient to allow the adaptor to screw on to the machine nose. We are, of course, assuming that your spindle is running true, but if this is suspect then we suggest you check this with a dial indicator.

If you still find the chuck is "out," remove it from the adaptor and check the latter item with the indicator for eccentricity and the face which contacts the chuck. Both the diameter and face must run perfectly concentric to obtain satisfactory results, and if they do not then a new plate is necessary.

Assuming that you have carried out these instructions carefully and are assured that the chuck and not the fittings is responsible for this lack of truth, then again we urge a certain degree of checking. Try each of the jaws for slackness in their slots ; if badly worn, a complete reconditioning is required. However, properly fitting jaws will not operate correctly if smothered with chippings, and once again a thorough clean is advocated.

If after all this cleaning the chuck still runs eccentrically, then grinding the jaws with a tool post grinding machine will correct them. You could true the outer faces with this machine, though this latter discrepancy is usually caused through a faulty backplate. Actual examination of the offending article would have revealed exactly where the difficulty arises, and we believe you should consult a skilled turner before attempting a wholesale overhaul.

Pipeline Filter

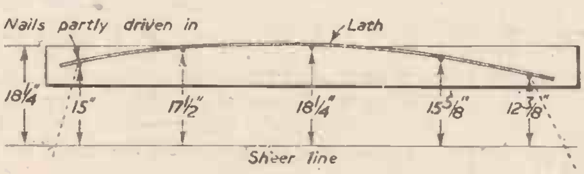
I PURCHASED an ex-R.A.F. rotary vane compressor to use with a paint-spraying plant. This proved highly successful, apart from the fact that a considerable amount of oil was carried out mixed with the air. Can you suggest any way to filter out the oil ?—P. Williamson (Hull).

IT will be necessary to fit a pipeline filter, and these may be purchased to suit your requirements from such firms as :

Newman, Hender and Co., Ltd., Woodchester, Glos ; Vokes, Ltd., Henley Park, Guildford, Surrey ; The Aerograph Co., Ltd., Lower Sydenham, London, S.E.26.

8ft. Sailing Dinghy Queries

WITH reference to your article headed "Building an 8ft. Dinghy," in the August issue, please show me how to set about marking out the building form on which the transom, bow and hog are temporarily fixed. After reading the article and studying Fig. 6 I was still not sure of the procedure. What is the total cost of the dinghy and sails ?—D. Fuller (Southend).



Setting out the keel line.

IT is presumed that the reader wishes to know how to set out the keel line as all the other lines are easily set out on the planks full size f om Fig. 6. Having marked out the position of the points on the keel line as in sketch, partly drive in a nail at each point and then bend a lath around the nails as shown. Then, with a helper holding in place, draw a line along the lath, giving keel line.

The cost of the dinghy alone is £12. The total cost of all the timber used is about £15. The sail, from the firm mentioned in the article, costs £6 and the cost of fittings is about £5. The fully equipped sailing dinghy should cost, therefore, about £26.

Heat-resisting Clear Lacquer

I HAVE recently installed a hot-water system in my house using copper pipes everywhere. I have burnished them with steel wool and wish to preserve the high polish. Can you recommend a transparent lacquer for use on copper pipes and able to withstand heat ?—R. G. Hedges (Bristol).

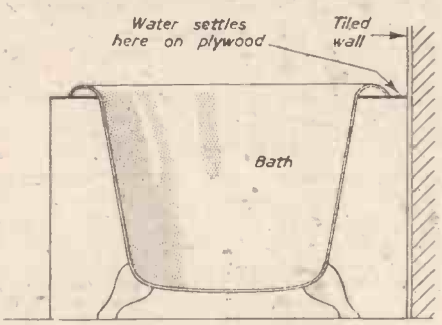
WE recommend you to use an I.C.I. product known as "Bedacryl 122X." This is a xylene solution of a polymethyl acrylic ester resin. It has a high viscosity, and is perfectly clear and transparent. It dries with a glossy film. If too thick for use, it can be thinned out with xylene, turpentine or naphtha. It will resist water and dampness, and it will withstand prolonged exposure to temperatures of about 200 deg. C. (392 deg. F.) without decomposition or discoloration. These are to be regarded as maximum temperatures. Above these temperatures the material volatilises. The lacquer has a good resistance to acids and to alkalies. Hence it will resist soap solutions.

Filling Compound

I HAVE boarded in our open bath, the plywood top being secured under the rim of the bath as in sketch. In wintertime condensation runs down the wall and settles on top of the wood where it has to be wiped off. Also, water often accumulates when the bath has been used.

Although the wood is a good fit, I wish to avoid any possibility of water getting under the bath on to the floor, and setting up rot. I wish to fill in around the rim up to bath level (see sketch).

Can you recommend a preparation for this purpose which would not be too expensive, but which would be waterproof, dry hard and which could be painted ?—H. Lohmann (East Ham).



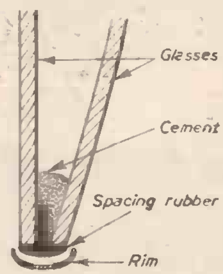
Waterproof filler problem.

THE best compound which you can use is a simple one made by working together equal parts of linseed oil putty and linseed oil white lead paste. Work these together intimately with the fingers and then add to the resulting mixture sufficient dry red lead to colour it pink. Finally, work into the pink mixture a small quantity of hair clippings in order to reinforce it. With a small brush just moisten the sides of the woodwork with raw linseed oil. Then pack the pink mixture well down into the space or gap, giving it about 14 days in which to surface-harden. In time, the mixture will become dead hard throughout. It will resist vibration and it will not crack until every trace of its contained linseed oil has perished. In other words, the material will have an effective life of about 30 years. It can (and should) be painted over, and it will, of course, resist even hot water after it has once become surface hard. If you want to make the compound harden more rapidly, work into it a little raw umber. This will colour it brown, but it can still be painted over.

T.V. Magnifier Adhesive

I HAVE two pieces of glass of 18in. diameter, one flat and the other convex, also a rim to fit around them. I find that by filling them with water and using putty for sealing they give very good results as a television magnifying lens, that is until the water starts to discolour, so now I have decided to use liquid paraffin. Could you tell me what cement to use between the glasses which will be impervious to liquid paraffin ?

The glasses are roughly 3/16in. apart, owing to a filler tube being let in the rim, so I have placed a T-shaped rubber between the glasses to keep them evenly spaced. — F. Kirk (S.E.7).



T.V. magnifier construction.

IF you use distilled water, it will keep clearer for a very much longer time than ordinary tap water. However, if you have decided to use paraffin you will find the following cement of use :

Mix plaster of paris with white of egg and a little vinegar until a paste is obtained. Use this paste as a cement. It will harden in about 24 hours.

For an alternative paraffin-proof cement, mix three parts of powdered resin and one part of caustic soda. Add to the mixture five parts of water. Gently boil this mixture until the resin has dissolved. Then make it into a paste with plaster of paris. This cement will harden in about an hour.

It should be remembered, too, that ordinary glue is quite resistant to paraffin. If you can make a glued joint or seal, this simple means will suffice for your purpose.

Information Sought

Readers are invited to supply the required information to answer the following queries.

Deck Rails for Ship Model

I HAVE constructed a working (sailing) model of a paddle steamer, 31in. long overall, and it has been built to scale. I would like to fit her out with deck rail bulwarks, but the only stanchions, etc., which I can obtain are the flimsy type for showcase models.

Can you suggest any form of railing about 7/16in. in height which would look reasonable yet be fairly robust ?—B. HILL (Reading).

Table Football Game

PLEASE supply constructional details of a table football game of the type where the men are magnetically controlled from under the table surface.

I believe that the contacts on the men and on the magnets are polarised so that each person playing can only move his own players.

Is the metal table of some special material and how are the component parts constructed ?—R. C. CHURCHER (London, W.14).

Boat Steering Wheel

I WISH to make a teak steering wheel for my motor-boat (size 6in. outside radius). Could you please advise me ?—R. F. DYE (Gt. Yarmouth).

Electric "Alarm"

I HAVE an aviary with about 36 budgerigars in my back yard. The aviary is 11ft. × 4ft. and its nearest point to the house wall is about 16ft.

Intruders have been trying, so far without success, to get into the aviary.

Could you give details of some form of electric "alarm" which could be fixed up to give a shock and also ring a bell ? I possess a transformer which will give 500 volts ; could this be used effectively ?—J. MAJOR-DUNKLEY (Salford).

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VENT-AXIA FANS, EXTRACTION OR INTAKE.—Brand New. Silent running. 230/250 volt A.C., 130/-. 12 volt D.C., 90/-. Post 3/-.

CHARTBOARDS.—Complete with pantograph arm, perspex scale, protractor head. Ideal as a drawing board. 17in. square. Brand new, 25/-. Post 3/-.

ROTARY CONVERTERS.—Input 24 v. D.C. Output 230 v. A.C. 50 cycles 100 Watt. 92/6; also available in metal case with switch. 105/-. Cge. 7/6.

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ROOM THERMOSTAT.—Adjustable 45 to 75 deg. Fahr. 250 volts 10 amp. A.C. Ideal for greenhouses, etc., 35/-. post 2/-.

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THERMOSTAT SWITCH.—Bimetal type in sealed glass tube, 2¼in. x 1½in. 30 deg. Cent. Ideal for Aquariums. Wax and Oil Baths, Gluepots, etc. Will control 1 amp. at 240 v., 5/- each, post 1/-.

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CELL TESTING VOLTMETERS.—3-0-3, in leather case with prods., 25/-, post 2/-.

VOLTMETERS for A.C. Mains 50 cy. reading 0 to 300 volts with clear 5in. dial only. 60/-; 2½in. Flush, 25/-; 0/15 volts A.C./D.C. 2½in. Flush, 15/6. Post 1/6.

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THE Cyclist
Editor : F. J. CAMM

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Phone: Temple Bar 4363
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WHAT I THINK By F. J. C.

N.C.U. to Sell Its Offices

RATHER too late, the N.C.U. has framed a suggested agreement with the R.T.T.C. and is desirous of merging with the B.L.R.C.—too late because at an N.C.U. council meeting it was decided to sell the union's offices at 35, Doughty Street, London, in order to provide some ready cash. The Union's balance sheet for 1955 showed an overdraft at the bank of over £6,200 and this at a time when the membership is rapidly declining and, of course, the revenue with it. The position of the Union, therefore, at this time, is parlous. It cannot be denied that its half-a-century-old policy of being the disciple of lost causes has brought it about. Instead of being concerned with "doughty" cycling deeds on the tracks, it has insidiously poked its nose into affairs which are not its concern in an attempt to reinstate itself in the field of road sport which it jettisoned over 50 years ago. The N.C.U. has, in fact, acted more like a militant trade union than as a sporting body. Its title has always been a wrong one. "Union" smacks of a fighting body, strikes and firebrands. The National Cyclists' Association or the National Cyclists' Society would have been far better.

A small handful of people held sway for far too long in the inner control of the N.C.U. Each was fighting for self-aggrandisement, as many have in other cycling bodies.

It has always lacked people of the right temperament and impartial outlook. It has not always acted in concert with other bodies when a united front was desirable. Its policy has been to be *the* body and it was unable to learn the lessons which its policy has brought about. It threw over road sport and thereby saw "dissident" bodies (any group of cyclists dissatisfied with N.C.U. control was labelled as "dissident") such as the R.R.A., the Road Racing Council, the Road Times Trials Council and the B.L.R.C. formed to conduct particular branches of the sport in a manner which the N.C.U. had been unable to do. Instead of encouraging the sport, the N.C.U. has attacked those who had only the good of the sport at heart but found that the sport was being throttled by the jealous stranglehold exercised by this curious body. There can be no wonder, therefore, that clubs and others withdrew their membership and sacrificed confidence in the N.C.U. Its attitude has always been dogmatic and didactic. It has threatened where it should have consulted. It has "proclaimed" (to use one of the favourable pieces of legal claptrap it was so fond of using in an attempt to impress the less enlightened of the cycling community) where it should have encouraged.

It cannot say that it has not been well advised. This journal has for years pointed out its many defects and offered constructive criticism. This well-intended advice has been consistently ignored. It has been content to listen to the sycophantic adulation of some paid advocates of cycling—those who have made a good thing out of it without necessarily believing in the cause they espouse. In our view, the attempt to save the ship by selling the building is tantamount to selling the ship itself. The sale of the premises will no doubt provide some ready money, but as the overdraft must necessarily absorb a fair percentage of the sum so obtained it is doubtful whether the sale of the offices can amount to anything more than a temporary palliative.

The rent of alternative offices will offset any credit balance to some extent, and the Union at once places itself in the hands of landlords who may raise rentals at short notice.

In an effort to stop the ebbing tide the Union now belatedly wants agreements with other bodies. Everyone closely associated with the cycling movement knew this to be desirable years ago, and the Union has been advised by almost everyone to form agreements with the "dissident" bodies. Like most dictatorships, however, it sought to prop up its unbending attitude by threats. It has seen the League in spite of all grow to fame and strength. It has seen the R.T.T.C. year by year become financially stronger. It has done some underhand things in order to get the League suppressed. Little wonder, therefore, that in certain cycling circles Doughty Street became known as Dirty Street.

The Union is now in no strong bargaining position and so far from seeking agreement with the League, we think that the latter should amalgamate with the Road Time Trials Council and jointly offer to take over the N.C.U. In doing so, it is obvious that they would be taking over a liability. The plain fact is that track racing has long since ceased to be a spectacle which would attract a paying gate. There has been one drawback to any amalgamation between the R.T.T.C. and the N.C.U. and that is the N.C.U.'s liability. It is known that the R.T.T.C. has considerable assets and these could have become jeopardised under amalgamation. The sale of the premises will, therefore, clear away that difficulty. The fact that the sport is now in danger because the Government intends to control it is due entirely to the N.C.U. which in the early days of the war went behind the back of the B.L.R.C. to the Minister of Transport and pointed out the "great dangers" of massed starts. The N.C.U. has seen 16 years of the sport on the road and none of its dire predictions have been substantiated. Nevertheless, it has continued to war against this newer body which has been largely responsible for its downfall. At the meeting to which we have referred there were three votes of censure of the Racing Committee which shows that the membership itself is not happy with club management. The members have it within their power at this late stage to call a meeting with the object of investigating the club's affairs, of reconstituting the management of the club and of appointing a new management if the meeting feels that this is necessary.

Tan Hill, Swaledale
A stop by England's highest inn, 1732 ft above the bleak Yorkshire moors

Under Four Hours Again

THE fact that the R.R.A. 100 miles record had for the first time been broken in under four hours shows that the 100 mile distance in that incredible time is not a phenomenon for it has been done several times in the past months. Once again, amateurs and professionals are conjecturing as to what the ultimate figure will be. It is certain that for some years to come the record can only be beaten by a matter of minutes, and so the record breakers of the future will have to be extremely speedy indeed and to choose weather conditions which are absolutely ideal before the attempt is made. It cannot be foreseen that road surfaces will improve much during the next 10 years, nor is any change in bicycle design in the offing which would make the lowering of the record by any considerable margin possible.

Thus physical conditions and climatic conditions must be the two factors for some time to come, and this must mean that the attempts will be less frequent or alternatively that the record where it now stands will be pegged for some years to come. It has happened before in the case of Harry Green's records and in the records of Frank Southall.

Tubeless Tyres

TUBELESS tyres for cycles, as well as for motor cycles, autocycles and mopeds and scooters, were featured for the first time at the Cycle Show, at Earls Court. Thus, the tubeless tyre, first marketed more than half a century ago, is now available to riders of the nimble two wheeler. The Fleuss was before its time!

Tools & Spares For the Cyclist

What to Carry for Short Distance Rides and for Touring

EVERYONE who rides a cycle on almost any type of journey, from the half-mile journey to work to the two-week tour, must recognise the need to carry tools and spares to deal with breakdowns and routine adjustments. The number and type of tools carried will vary according to individual needs, but certain basic requirements are common to all.

The Minimum Tool Kit

For very short journeys the tools and spares may be reduced to two tyre levers, a single multi-size box spanner and a puncture outfit. It is advisable to carry and use properly designed tyre levers ; the various improvisations—spoon handles, screwdrivers, etc., are far more likely to pinch the inner tube, to slip out of place or break at a crucial moment than are the properly designed implements. Box spanners are available in either steel or alloy and are designed to fit any size of nut from the tiny mudguard size to the rear spindle nut size, which is usually the largest on the machine. Various commercial firms manufacture complete puncture outfits, which are equipped with rubber patches, canvas for tyre patching, rubber solution, french chalk, spare valve rubbers, etc. Of these only the rubber solution deteriorates and it is therefore advisable to replace this periodically, whether it is used or not. With this minimum kit, when major repairs are necessary *en route*, the cycle can be wheeled home for repair, but it is always useful to have a spanner. If the back wheel pulls over and jams when a mile or so from home, and you have no spanner, the only solution is to carry the machine.

A General Tool Kit

Riders who put their machines to greater use, i.e., the rider for pleasure and the clubman, will require a more comprehensive tool kit. On the whole, their machines are lighter and have to stand up to far more wear ; adjustments, etc., will therefore be correspondingly increased.

The basic requirements of a puncture outfit and two tyre levers will be unchanged, but a more comprehensive range of spanners should be included. One will be required to suit both front and rear wheel spindle nuts and this type of spanner is available in several types, the open ended, the flat and the ring spanner ; the ring spanner is perhaps the handiest and strongest of all these. Another spanner with the same sizes should be included as it often becomes necessary to hold the nut at one end of the spindle while the other is tightened. This size of spanner will be found to fit many other nuts on the machine, notably those on the saddle and the handlebar extension.

Another size which must be carried is one to fit the cotter pin nuts and this may do double duty if it fits also the retaining nuts on the brake spindle. All the smaller size of nuts can often be adjusted by one multi-size box spanner, these smaller sizes including those on the toe clips, brakes, mudguards, etc. These ubiquitous box spanners, whilst being eminently suited for lighter duties in adjusting nuts of smaller sizes, are often not strong enough to stand up to the great strain imposed in tightening wheel nuts.

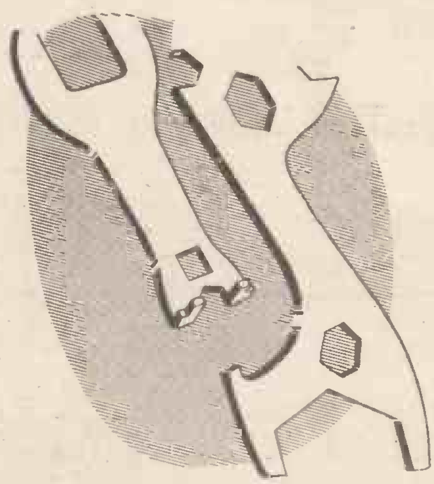

Fig. 2.—Spanners for bottom bracket adjustment.

Care should be exercised in selecting cone spanners. Wheel cones vary in size according to the hubs in use and it is important that the correct size is employed. Make sure too that the blade of the spanner is thin enough to fit between the shoulder of the cone and the face of the locking nut.

If your machine has any awkwardly sized or awkwardly placed nuts, special spanners may be found necessary. These are often available from the makers of the accessory concerned, i.e., spanners for saddle adjustment from Brooks and special spanners from the brake manufacturing firm of G.B.

Fig. 1—A typical cyclist's tool kit.

A screwdriver should always be carried, and although there is a temptation to carry one of the miniature kind for use on a cycle the more robust sort will be found of much greater use.

Pliers are not a necessity, but are often very useful for such jobs as unscrewing a jammed valve locking nut and fitting spring links.

Other optional but very useful items are a link extractor and spoke key. Tool rolls are available to carry the tools as can be seen in Fig. 1, which shows a typical tool kit.

Spares

The question of what spares to carry arises chiefly when a tour is under consideration, particularly a tour abroad, where replacements are not always immediately available.

The numerous small spares, such as nuts and bolts for toe clips, mudguards, chainring, etc., spring links and valve parts, are best carried in a small tin with a lid which can be kept specially for these small odds and ends. A cotter pin, already filed and complete with washer and nut, is a useful emergency replacement and when a " blow out " occurs, every tourist would give thanks for a spare inner tube.

When riding highly tensioned lightweight wheels it is wise to carry spare spokes—a snapped spoke will often put the wheel badly out of truth and being able to replace it immediately prevents aggravation of the trouble.

Tools at Home

For carrying out major repairs at home some heavier tools will be needed and these should be sufficient, if necessary, to dismantle the cycle completely. For removing pedals a long-handled cone spanner is useful. Pedals are often screwed into the cranks very tightly and this is the only tool which will move them. A hammer and punch are necessary to dismantle the bottom bracket and head set and can also be used for removing fixed and free wheels. Special spanners of the shape shown in Fig. 2 are available for unscrewing bottom bracket locking rings and cups. An adjustable spanner will be found useful to adjust some types of headset.

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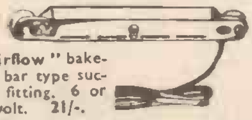

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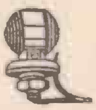

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