A BACK-PROJECTION EPISCOPE

NEWNES

PRACTICAL MECHANICS

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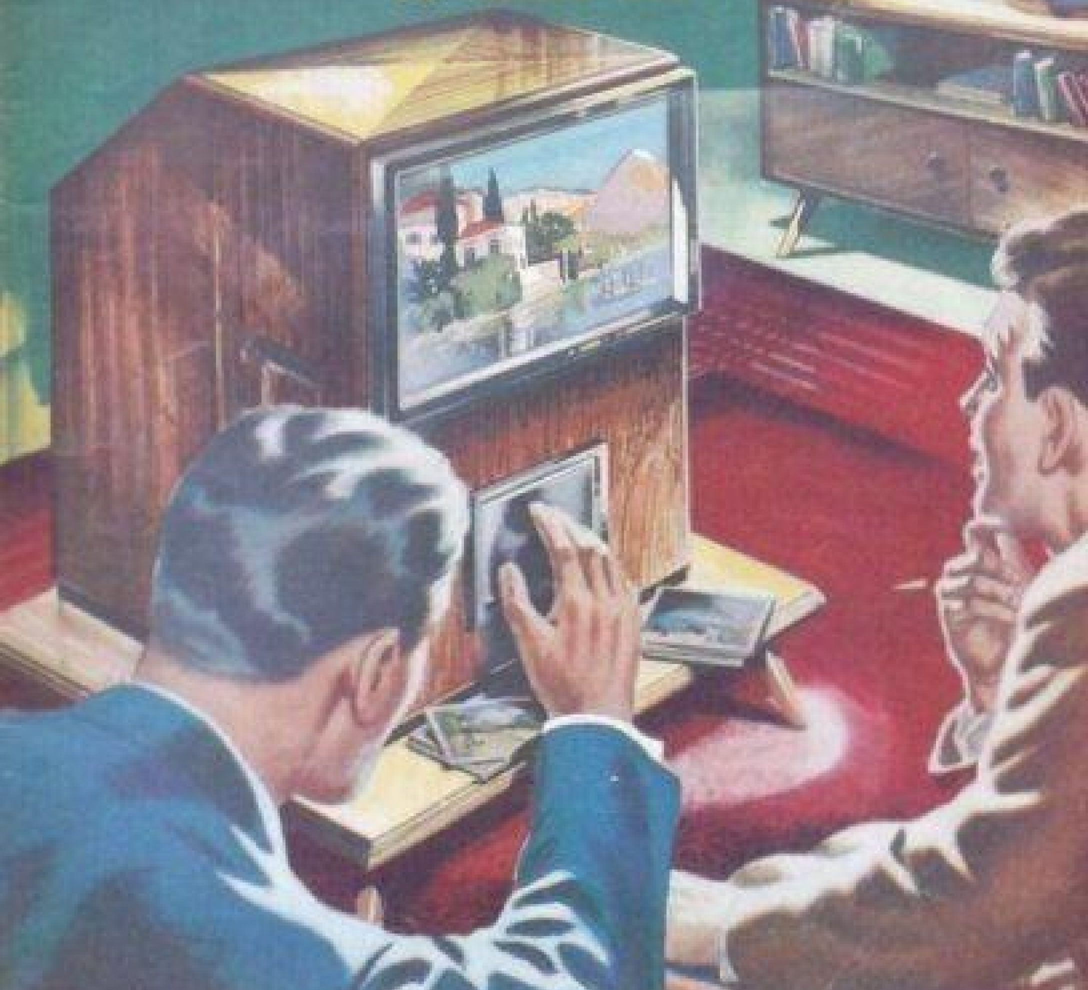
EDITOR : F. J. CAMM

SEPTEMBER 1953



SEPTEMBER, 1953
VOL. XX
No. 237

PRACTICAL MECHANICS

EDITOR
F. J. CAMM

The "Cyclist," "Practical Motorist," and "Home Movies" are temporarily incorporated.

By The Editor

Fair Comment

ATOMIC POWER IN INDUSTRY

ATOMIC energy provides a new kind of fuel for the thermal generation of power. Power units of the type now in use, such as turbines, generators and transmission lines, will remain essentially the same in the future and the new goal is towards cheaper fuel for generating electricity. The result of the use of atomic energy in industry will be heat-to-steam-to-electricity, probably on a large scale. It would seem that atomic energy would replace only the fire-box boilers and therefore it cannot have a revolutionary effect on our industrial economy. This is contrary to the popular belief that a secret process is in course of development which will perform a miracle by making electric power free to the consumer.

Of the total cost of delivering power, about 20 per cent. is accounted for by the cost of operating the thermal facilities; hence atomic power will make no startling changes in cost. Reactors which use atomic fuels must have great thermal and electrical capacity in order to compete with low-cost fuels. Units to produce 100,000 to 200,000 kilowatts of electricity are being considered, though most manufacturing plants could not use units of this capacity for electricity or process steam.

In regard to a reactor for an automobile, it has been suggested that the reactor would consist of a critical mass of plutonium, possibly 1ft. or 2ft. in diameter, surrounded by a concrete shield at least 6ft. thick. Such a device, therefore, would hardly fit into the space occupied by the conventional gas tank.

MODEL AIRCRAFT CONTESTS—BRITAIN LOSES

THE United States team won all four trophies in the International Model Aircraft Flying Contests, at the Royal Aeronautical College, Cranfield. These contests included the famous Wakefield Challenge Cup. Great Britain pioneered the scientific hobby of model aeroplaning, and long before Blériot had crossed the Channel in 1909 there were hundreds of model aircraft clubs in this country with large memberships holding regular model flying and driving contests. The movement received support from high quarters and it was not long before a national association was born to control it. This was the Kite and Model Aeroplane Association and it was recognised by the Royal Aero Club as the only body to control model flying, to frame rules and to homologate records.

Valuable trophies were presented by famous people, including Sir Charles (later Lord) Wakefield, whose gold Challenge Cup was presented for a competition which has become the Blue Riband of the model aircraft movement.

The hobby provided the personnel for the aircraft industry in this country, for every aircraft designer of any note was a model flyer. Most of the competitions were held at Hendon, and the Wakefield competition was the most keenly contested of all. It was a national contest in its early days and it did not take on an international aspect until some years later.

The 1914-18 war caused the K.M.A.A. to suspend activities and an abortive effort was made after it to revive them. The movement languished for a few years until I made the suggestion that a Society of Model Aeronautical Engineers be formed to take over the work of the K.M.A.A. This was done and R.Ae.C. recognition obtained. The society has done excellent work and introduced an international flavour into the sporting side of model flying. The early models were little more than flying sticks bearing little resemblance to full-sized aircraft. They mostly were of the pusher type, tractor models being shunned in those days when little was known about basic principles. The S.M.A.E. introduced rules which insisted that models be made to resemble their prototypes and fuselage models gradually ousted the flying stick freaks. It was found that durations and distances could be obtained in excess of those obtainable from the simpler flying sticks.

It is worth recording that the very first Wakefield Contest was held on July 5th, 1911. It was for models weighing over 4oz., rising from the ground under their own power. Most models of that period were not fitted with undercarriages and were hand launched. 40 marks were awarded for the shortest run before rise, 40 for duration of flight and 20 for stability. Three flights were allowed each competitor. The first competition was won by our esteemed contributor Mr. E. W. Twining, who flew a model of his own design and was awarded 86 marks. It may seem curious to model flyers of the present day that his model did not make the shortest run, nor the longest flight; nor did it obtain the highest marks for stability. His model gave the best average performance under the conditions of the contest, for which there were 13 entries.

To-day the contest interests thousands of model flyers all over the world, and eliminating trials are necessary to select the competing teams.

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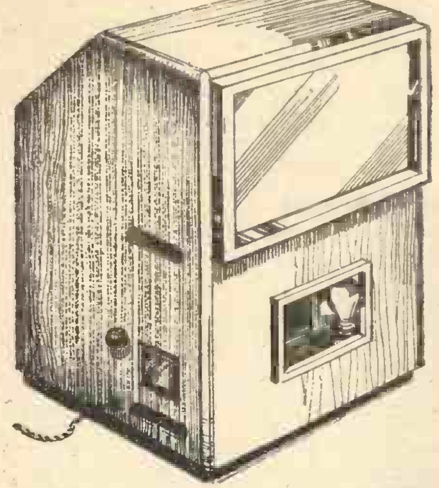
Inland - - - -	14s. per annum.
Abroad - - - -	14s. per annum.
Canada - - - -	13s. per annum.

Editorial and Advertisement Office: "Practical Mechanics," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2
'Phone: Temple Bar 4363
Telegrams: Newnes, Rand, London.
Registered at the G.P.O. for transmission by Canadian Magazine Post.

"P.W." COMES OF AGE

OUR companion journal *Practical Wireless* attains its twenty-first birthday with publication of its October issue—a 96-page souvenir issue containing a free full-size blueprint of a highly efficient and cheaply-built four-valve receiver. The issue is packed with special features, including a further instalment of the new series "A Beginner's Guide to Radio."

This reminds me that PRACTICAL MECHANICS celebrates its twenty-first birthday in October next year and we shall commemorate its coming-of-age in a similar way.—F. J. C.



A Back-Projection EPISCOPE

Constructional Details of a Novel Self-contained Projector for Home Use

By S. T. COLLINS

THE apparatus to be described will perform all the usual functions of an ordinary episcope. That is, it will project an enlarged image of any printed page, photograph, drawing or painting. It has, in addition, several advantages not possessed by the customary type of episcope requiring an external screen.

As can be seen from the diagrams, the complete apparatus is housed in a cabinet about the size of an average television set. In this form it can have a permanent position in any room and is always ready for immediate use. The screen, which is 17½in. by 11½in., is quite large enough for home use and gives a clear picture even without a completely darkened room. It is simple to operate and the picture to be projected is merely held against the opening just below the screen. This arrangement allows considerable flexibility of use. Besides pictures and reading matter any flat article may be projected if desired; in fact, a tolerable reproduction can even be obtained of an object with an irregular surface, though the image is bound to be out of focus in places.

To illustrate its possibilities it may be mentioned that the writer's children soon found new uses, such as the performance of puppet plays, using small toys, and even the presentation of their own faces on the screen to make announcements.

The Cabinet

The shape of the cabinet will be readily seen from the diagrams, Figs. 1, 2 and 3. The main dimensions are shown and should be followed as closely as possible, but a good deal of detail can be left to individual taste. It is important to note that the sloping top, near the back, must be at exactly 45 deg. to the back.

The outside is made of good quality plywood, the edges being mitred and joined with glue and panel pins to a framework of 1in. by 1in. timber, as indicated in the enlarged detail in Fig. 4. For simplicity, some of this framework has been omitted from the diagrams, but its position along all joined edges will be obvious. The various openings required should be cut in the plywood before assembling.

The lamps are separated from the mirrors by two pieces of plywood, one directly below

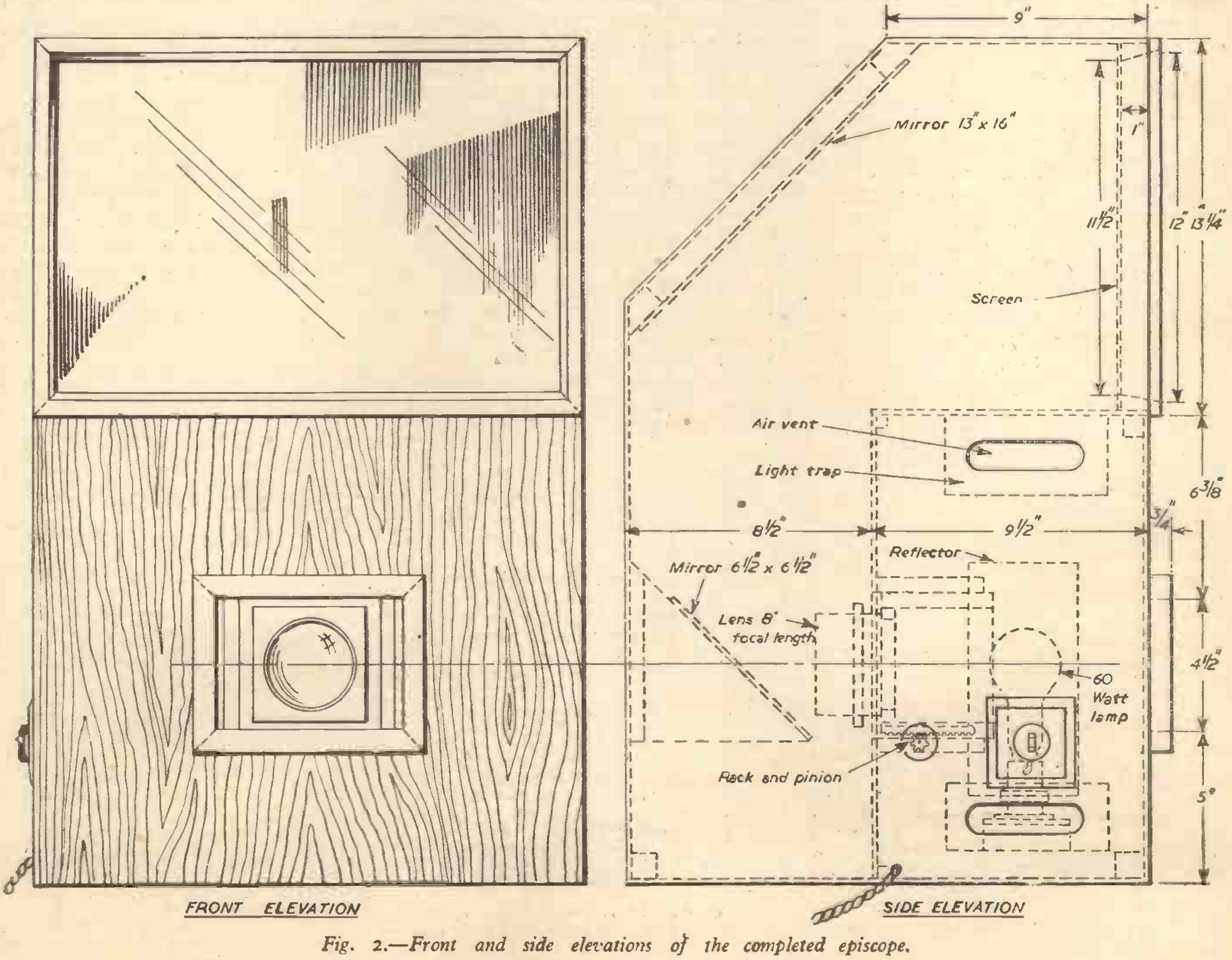


Fig. 2.—Front and side elevations of the completed episcope.

the screen and the other parallel to the back of the cabinet and serving to support the lens mount (Fig. 2). This latter piece should not be fastened permanently at this stage. The bottom of the cabinet can be made from a piece of plywood, but it should be attached to the framework with brass screws for easy removal. Surrounding the opening to which the objects are held is a small frame, best made of a wood contrasting in colour with the plywood.

Sandpapering and finishing off should be left until the whole apparatus is otherwise complete.

Mounting the Lens

The lens used needs to have a focal length of 8ins., and the well-known f2.9 Dallmeyer Pentac was chosen. Any means of mounting which allows horizontal adjustment can be employed. The arrangement shown in Fig. 2 is the simplest possible method: it consists of one box sliding within another. The boxes must be carefully made of well-seasoned wood and the rubbing surfaces require thorough sandpapering and then polishing with graphite.

Adjustment is accomplished by means of two racks and pinions. The racks are recessed into the two bottom edges of the inside box, which holds the lens. The pinions are mounted on their axle under the stationary outside box and project upwards through slots cut in the bottom so that they engage the teeth of the racks. One end of the axle is extended through the side of the cabinet and a suitable knob is attached.

In normal use the position of the object in relation to the screen is fixed: it is obvious therefore that provision for focusing is not absolutely essential but it will be found advantageous.

Lighting

It can be seen that two 60-watt lamps are used to illuminate the surface to be projected. The lampholders are fitted with semi-circular reflectors made from tin sheet and are fastened to a strip of wood, which is then screwed at each end to the framework. The switch on the outside of the cabinet controls the lamps and is of the flush fitting wall type.

The Mirrors

The mirrors, which are 16in. by 13in. and 6½in. by 6½in., are attached by means of small padded clips to pieces of plywood about 1in. wider than the mirrors. These plywood backs can then be screwed into position and any adjustment can be readily carried out.

The larger mirror is fastened to the framework of the sloping top of the cabinet. The smaller mirror is attached to a wooden bracket holding it at an angle of 45 deg. to the back of the cabinet. The triangular plywood off-cuts from the cabinet sides are useful for the construction of the bracket, the exact position of which is best found by trial when the apparatus is complete.

The Screen

The frame supporting the screen is made from hardwood planed to the correct shape and rebated along one side (Fig. 4). The corners are mitred so that the assembled frame has the rebate on the outside, thus enabling the finished frame to slide neatly into position in the front of the cabinet. The actual material of the screen is Clearite (obtainable from Messrs. Newton and Co., London), but it should not be fastened in place until the woodwork has been painted.

Painting and Finishing

Mirrors, lamps, lens and all removable parts should be unfastened before painting. The inside of the cabinet is painted dull black, with the exception of the compartment containing the lamps. This is painted dull white, but the side facing the lens is preferably left black. Light traps made from bent sheet metal, painted black, are next fastened over the four ventilators, so that the exit of light is obstructed but air can circulate freely. Also painted black is the screen frame.

Stopping should be applied to the holes on the outside of the cabinet made on sinking the heads of the panel pins. The final treatment should then be thorough sandpapering before staining and polishing to suit one's taste. When the mirrors and other parts have been replaced the episcope is complete.

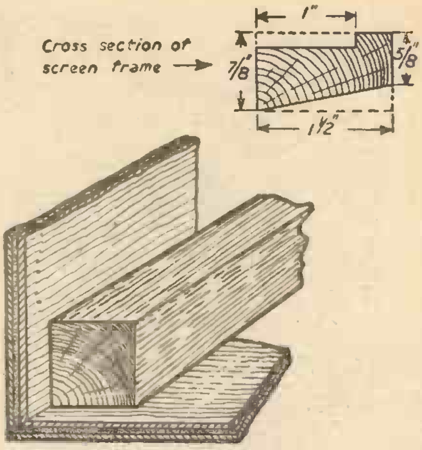


Fig. 4.—Enlarged detail of a corner joint, and section of moulding for screen frame.

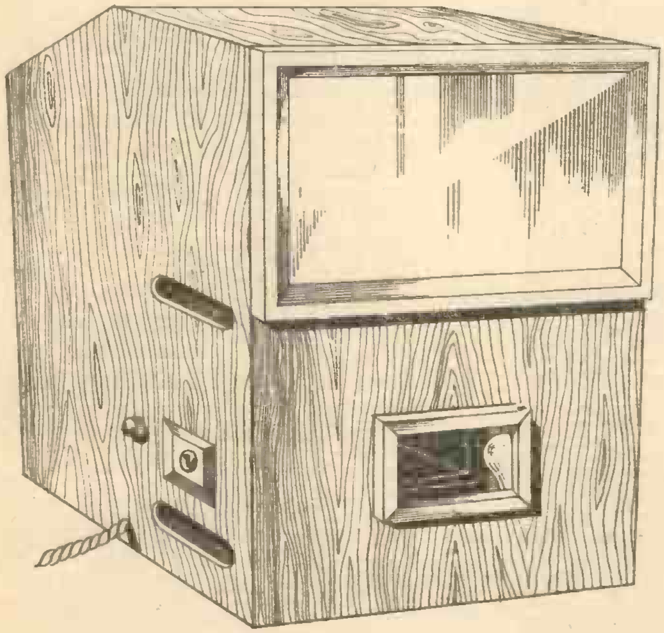


Fig. 1.—Three-quarter front view of the episcope.

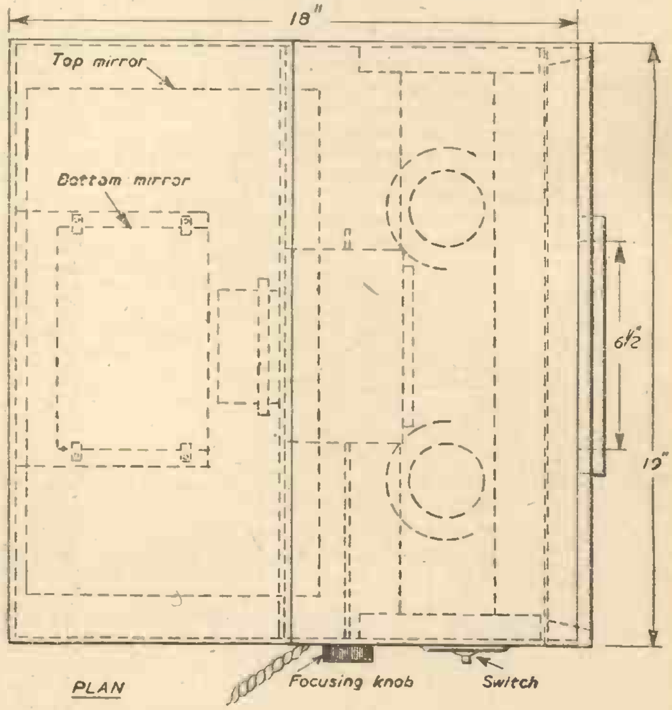


Fig. 3.—Plan view showing position of lamps and mirrors.

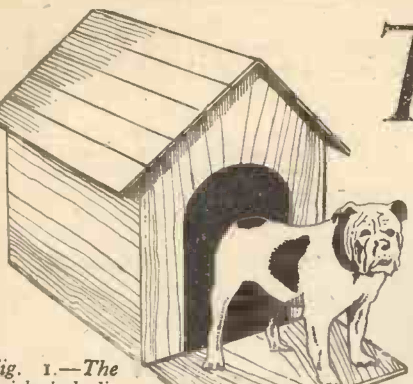


Fig. 1.—The finished obedient watchdog.

The Obedient Dog

A Simple Electrical Novelty Which Will Amuse Your Friends

THIS gadget consists of a little china watch-dog in a small wooden kennel that stands on the table. Directly you call, snap your fingers or whistle he jumps out from his kennel with no readily apparent activating force.

This amusing little toy (see Fig. 1) is quite easy to make, and the action is controlled by the vibration your voice sets up when you shout. Whatever you call out the dog will appear just the same—but nobody need find out about that.

Behind the dog, fixed to the back of the kennel, is a hinged strip of metal which, under the action of a spring, will propel him outside. In the ordinary way this metal strip is held back by a small electro-magnet energised from a pocket lamp battery. The circuit is completed through a "sensitive" contact made by another metal strip suspended outside the kennel in such a way that it rests lightly against a metal stud. The vibrations set up by the voice cause this strip to "dither," thus momentarily upsetting the contact, de-energising the electro-magnet and releasing the propelling strip.

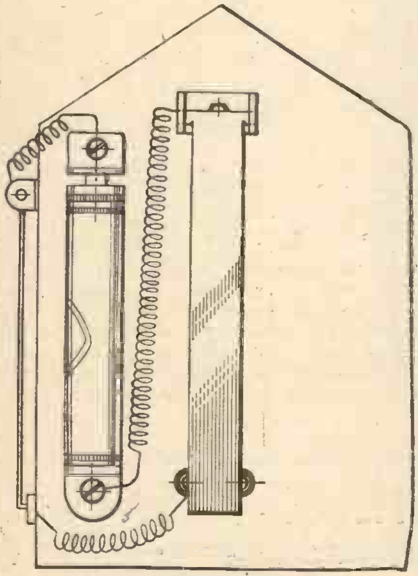


Fig. 2.—The propelling strip.

The Dog

The first thing is to buy the dog, so that the kennel can be made to fit him. A little china dog, a fierce-looking bull terrier for preference, is best; but one of the celluloid variety will do quite well if a small hole is made in it and the body filled with shot to give it the necessary weight. If it is too light or too heavy it will not jump out as enthusiastically as it should.

The Kennel

This can be made any convenient size, but somewhere about 4in. long x 3in. wide x 3½in. high is generally suitable. Cut the sides out of 3-ply, and make an opening in the front sufficiently wide to allow the dog to move in and out easily. A slanting roof overhanging the sides a little looks best. The floor must be made long enough to extend in front for an extra 3in., making a smooth platform.

After preparing the various pieces for the kennel the mechanism must be fitted before they are assembled. First comes the propelling strip. This is made from 26 s.w.g. mild steel, ½in. wide by about 2½in. long. In cutting this strip, two narrow supporting ears must be left at the top, as shown in Fig. 2, or alternatively a 1/16in. pin, arranged to project 3/16in. beyond each side, can afterwards be sweated on the extreme end.

The Mechanism

Obtain a small electro-magnet of the type used in electric bells and mount it centrally on to the back-board of the kennel, so that it will come parallel with the floor and about ¾in. above it. Measure the distance the electro-magnet projects from the board and then bend up a U-shaped piece from thin ½in. strip brass (see Fig. 3), the distance between the arms being ½in. clear and the length of them ¼in. over that of the measurement taken. Drill ⅛in. clearance holes ¼in. from the end of each arm of the "U" and another in the centre of the base. The fitment can then be bolted near the top of the back-board and the ears on the propelling strip sprung into the two holes. The strip should now hang parallel with the board and make a good contact with the face of the electro-magnet, projecting a little beyond it.

A piece of medium-strength clockspring, bent into a "V," is fitted between the board and the propelling strip so that it tends to push the latter away (see Fig. 3) and will send Willie outside at the double. The spring can be fixed in position with a round-headed screw at either edge if you do not feel inclined to try punching a hole through it.

The Contact Strip

This is made from ½in. 26 s.w.g. brass, as shown in Fig. 4, and is mounted in exactly the same way as the propelling strip on one side of the kennel—outside (see Fig. 5). The end of the strip is bent over at right-angles to project about ⅛in., the edge being carefully levelled off with a file. A small contact stud of the type used in radio work is bolted in place, so that when the wooden side is in its proper vertical position the edge of the suspended contact strip rests very lightly against it. The setting of this contact strip must be accurate, and the position of the holes in the "U" piece which carries it must be marked with care.

Only a 2-volt battery is needed, so one of the cylindrical pocket-torch variety is the most convenient to use. To make replacement easy it is best to hold the battery in position with two brass angle brackets, one arranged to make contact with the base and the other with the brass cap at the top. It can be mounted outside the kennel on the back-board or tucked away in a corner inside.

The Sides and Floor

These can now be fixed together, but the roof must be left until the wiring has been completed. Connect one end of the electro-magnet winding to its own mounting, so that it makes a contact of the iron core, and run the other to the contact stud on the side-piece. One battery connection runs to the "U" piece holding the contact strip and the other to the "U" piece holding the propelling strip.

Now the roof can be put on and the gadget tried out. The dog is pushed back into the kennel until the propelling strip touches the electro-magnet. If all the connections are in order and the "V" spring is not too strong, the strip will stick there directly it touches. Now give a shout; and Willie should come popping out. If he doesn't, bend the strip a little until the correct position is found.

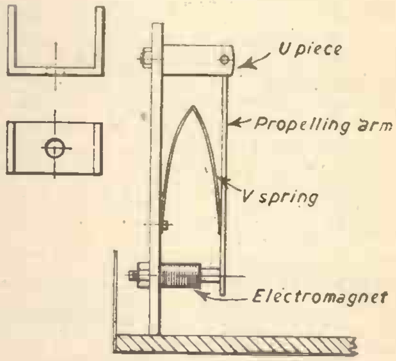


Fig. 3.—Details of the U-piece and how the V-spring is fitted.

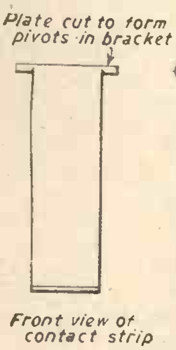


Fig. 4 (left).—The contact strip.

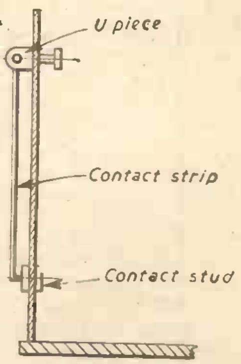


Fig. 5 (right).—The strip in position.

The foot-controlled regulator ready for use.

A Foot-controlled Motor Regulator

Constructional Details of an Inexpensive Unit for Use With Small Fractional Horse-power Motors

By D. LYONS

THE regulator was designed mainly for use with the portable jig-saw, but may be of interest to anyone requiring a means of varying the speed of the smaller type of fractional horse-power motor. With the small series motor the speed has a tendency to drop when a load is applied, with a corresponding increase when the load is removed, and this calls for constant adjustment of the regulator. The use of a foot control leaves both hands free and allows a much greater degree of accuracy when guiding the material on to the saw-blade.

Construction

Make the box from ⅜in. wood, with ⅛in. plywood for the top and bottom, gluing it securely together and screwing the lid in position with small countersunk wood screws. The overall size is 10in. by 4½in. by 1¾in., and though slight modification may be necessary to suit the material available, this is a comfortable size for the foot and will take any resistance likely to be used. Drill two ½in. holes in each of the short sides to provide ventilation, and coat the inside of the box and lid with shellac or line with asbestos paper.

The foot-rest consists of a strip of ⅜in. plywood, 9¾in. by 3¾in., cut across at 4¾in. and hinged, as shown in Fig. 1. This is fitted on the top of the box, the heel piece being screwed down and the other end left loose to act as a pedal. Near the end of the pedal a slotted brass block is fitted and a brass strip pivoted to this projects through a slot in the bottom of the box to the arm of the selector switch. Two short springs keep the pedal up and are fixed over small wood discs, screwed underneath.

Cut the panel for the selector switch from ebonite, or ¼in. hardwood, and drill a small hole 1¼in. from one end. Scribe a circle ¾in. radius round the hole and on this drill four holes for the contact studs. These are No. 3 B.A. brass cheese-headed screws recessed about 1/16in. into the panel, the heads being about 1/16in. apart. Tighten these securely in position and file the heads down until they are flush with the panel. The movable arm is bolted at the centre hole and is long enough to cover the studs and join up with the connecting link from the foot pedal. Duplicate the arm in thin spring brass and fix it under the main arm to keep the pressure constant on the contacts. A double spring washer on the centre bolt keeps the pressure on the arm, which is connected through a short brass strip to a terminal. Connection could be made direct to the centre bolt, but the brass strip prevents the screw from turning and eventually twisting off the wire.

Fit the panel in position and screw it to the bottom and front of the box with wood screws. A long tap screw acts as a strut between the side of the box and the unattached corner of the panel, keeping it secure.

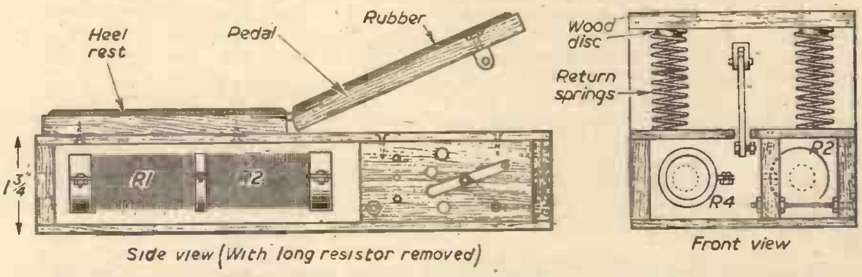
Depressing the foot pedal moves the selector arm across the contact studs and the exact length of the arm is found by trial. After the correct length is found, drill and tap a hole for a small screw and connect up to the foot pedal, locking the screw with a nut to prevent it working loose. Check the pedal action to make sure the arm stops in the selected position; in this case shorting contacts (3) and (4) when pressed right down and returning to contact (1) when released. Fix the resistances in the box by means of wood screws or small bolts, whichever is the most convenient. If bolts are used, recess the heads into the sides of the box and cover with plastic wood. Cover the pedal and heel-rest with sheet rubber cut to shape and fixed with rubber solution.

Electrical Details

The resistances are wire wound and must be large enough to reduce the motor speed to the lowest required and yet carry the full load current without overheating. This would not matter too much in a starter where the resistance is only in circuit for a few seconds, but in a regulator it is more important. It will be quite obvious that the same size resistance cannot be used for every type of motor and some experimenting will be necessary to determine the correct size. If a suitable one can be obtained the connections are straightforward, the required values being tapped and connected to the stud contacts.

Unfortunately, it is not always possible to get what is needed and substitutes have to be adapted to suit the purpose.

In this case the motor is out of a vacuum cleaner and its speed is in the region of 15,000 r.p.m. With the saw running light, a resistance of 300 ohms reduces the revs. enough to drive the blade at a steady idling speed; 200 ohms gives sufficient power for light work and 100 ohms enough for all



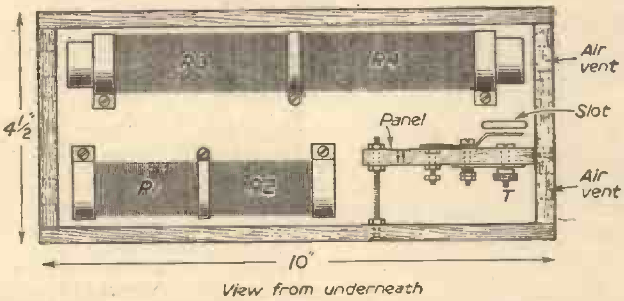


Fig. 1.—Side, front and underneath views showing the layout of the resistors and switch panel.

Note: The electrical wiring and other details are omitted for clearness.

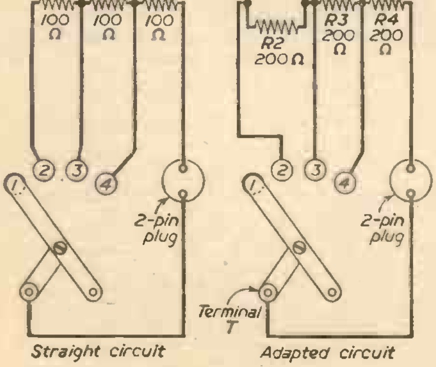


Fig. 2.—Circuit diagrams.

Underneath view, with the bottom of casing removed.

jobs except the very heavy ones.

With this in mind the selector switch was set to utilise the resistances on hand. These consist of two voltage droppers of the type used in radio sets, each having a resistance value of 400 ohms. Both showed signs of heat when the full current was applied for any appreciable length of time, particularly the small one. This was centre tapped and the two halves connected in parallel, giving a total resistance of 100 ohms with twice the current capacity of the original. Connected with half of the large resistance, this gave the required 300 ohms and was connected to contact stud (2), number 1 being used as the "off" position. Moving the selector arm to contact (3) cuts out the small resistance, leaving the 200 ohms of the large resistance in circuit. The last contact, number (4), is connected to the other end of the resistance, and shorting contacts (3) and (4) parallels the two halves, giving a total of 100 ohms, capable of carrying a heavy current. This arrangement is quite suitable for the type of motor in these circumstances, as the last stage of the resistance is kept in circuit, damping out the tendency to race, with its inevitable sparking when load is suddenly removed from the motor, and yet it is heavy enough to carry extra current without heating up. Whatever kind of resistance is used a suitable arrangement can usually be found by using the formula:

Resis. in series $R = R_1 + R_2 + R_3$

Resis. in parallel $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

The foot control is connected in circuit by breaking one motor connection through a small 2-pin socket, which is screwed in a suitable position on the saw base. If the local hand control is fitted this must be left in the full "on" position while using the foot control, but can be quickly reconnected by means of a shorting plug when the foot control is not required.

Back to First Principles

8—Moment of a Force

By W. J. WESTON

"MOMENT" is a curious word; why should it be used for an instant during which time stands still? Connected as the word is with the Latin verb *movere*, to move, its logical meaning is seen in "momentum," quantity of motion, that is, — a quantity measured by the mass of a body multiplied by the velocity of that body. "Degree of importance" might be a translation of "momentum" in that sense. The "moment of a force" is the importance as a *turning factor* of that force; and this is measured by the force multiplied by the length of a perpendicular to the line of force through the turning point. Thus, the cyclist when pedalling begins to exert a turning force at A; it reaches its greatest at B; it vanishes at C, when the line of force is through the turning point. Referring to the diagram, Fig. 1, B is where a perpendicular from the line of force is of greatest length: C is a point where the line of force passes through the turning point. "Torque," twisting power, is a name at times used for this moment of force.

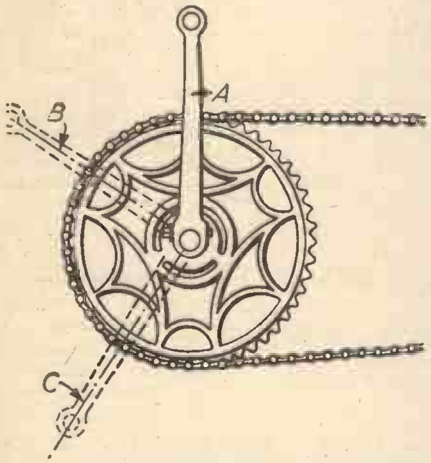


Fig. 1.—Diagram illustrating the "moment of a force."

The Problem: In this steam safety-valve (Fig. 2), A, hinged at C and weighted at B, the distance from the hinge to the centre of the valve is 2in., and to the weight 10in. The effective valve diameter is $1\frac{3}{4}$in. If the valve is just about to lift when the steam-pressure is 240lb. per square inch, what must the weight of the ball be ? (Do not consider, for the purpose of this calculation, the weight of the valve and the arm.)

The Comment: Through the point C two turning forces are acting. There is the upward pressure on the arm transmitted through the valve: this tends to turn the arm in a clockwise (or negative) direction. There is also the downward pressure of the ball: this tends to turn the arm in an anti-clockwise (or positive) direction. When the arm is about to rise, the moments of these two forces are equal. By the effective-diameter is meant the diameter of that area of the valve against which the steam exerts pressure.

The Answer:

Upward pressure at A is $\pi r^2 \times 240$lb.

Moment of this force about C is ∴

$\frac{22}{7} \times \frac{7}{8} \times \frac{7}{8} \times 240 \times 2$lb. or 1155lb.

Moment of force at B about C is W × 10.

W × 10 = 1155lb.

∴ W = 115.5lb.

The Problem: The diagram (Fig. 3) represents a trapdoor AB supported by a hinge at A and a bolt CDE that passes through rings at C, D attached to AB and a ring E attached to the fixed floor FG. The trap door weighs 120lb., and its centre of gravity is 10.5in. from A; AC = 12in., CD = 6in., DE = 3in. Find the forces that the bolt exerts on each ring. (Leave out of consideration the weight of the bolt).

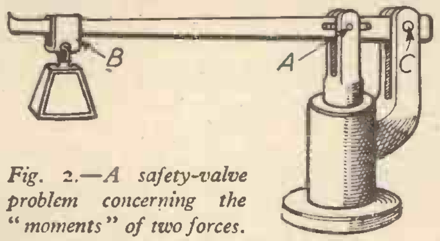


Fig. 2.—A safety-valve problem concerning the "moments" of two forces.

The Comment: The weight of the door, exerted at 10.5in. from A, tends to produce a clockwise movement: this tendency is counteracted by the upward pressure of the bolt upon the fixed floor, the upward pressure being exerted at 21in. from A.

The weight of the door is supported on the two rings C and D, and therefore if C supports x lb. then D supports $(120 - x)$ lb.

The upward pressure at E, exerted at 9in. from C, tends to produce an anti-clockwise rotation of the bolt: this tendency is counteracted by the downward pressure at D, exerted at 6in. from C, which tends to produce a clockwise rotation.

The Answer: Taking moments about A in door:

120lb. × $10\frac{1}{2}$ = Force at F × 21.

∴ Force at F = 60lb.

Taking moments about C in bolt:

60 × 9 = Force at D × 6.

∴ Force at D = 90lb.

And, since Force at C = (120 − Force at D) lb., then

Force at C = 30lb.

The Problem: A light horizontal rod, 20ft. long (Fig. 4), is loaded with three 10lb. weights at points respectively of 3ft., 7ft., and 15ft. from one end, and it is subject to an upward thrust equal to 5lb. weight at the mid-point. Find the resultant of these parallel forces acting on the rod, and if the rod is supported at its ends deduce the pressures on the supports.

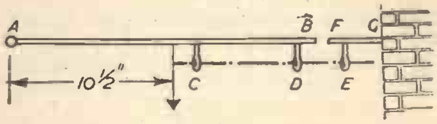


Fig. 3.—A trapdoor problem.

The Comment: Draw your guiding diagram, as shown in Fig. 4. Since 30lb. act downwards and 5lb. act upwards, the resultant upward force is 25lb: the supports at the ends, therefore, bear a combined pressure of 25lb. If x is the pressure at the end from which measurements are taken, then $(25 - x)$ lb. is the pressure at the other end. We distribute the amounts by taking moments.

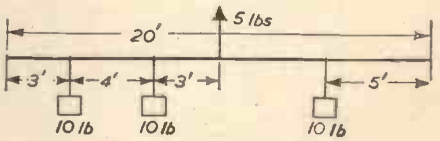


Fig. 4.—Diagram of parallel forces.

The Answer: Taking moments about the end from which measurements are taken:

$3 \times 10 + 7 \times 10 + 15 \times 10 = 5 \times 10 + (25 - x) 20$

That is: $250 = 50 + 500 - 20x$

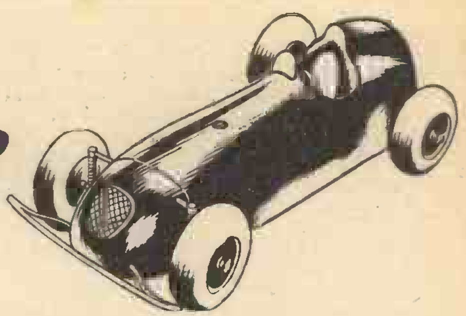
∴ $20x = 550 - 250 = 300$

∴ $x = 15$.

The pressures at the ends ∴ are 15 and 10lb. weight.

The point at which the resultant acts is ∴ 20 feet × $\frac{15}{25}$, i.e. 12 feet from the end where the presssure downwards is 10lb. weight.

A MODEL of a RACING CAR



Constructional Details of a Realistic Model Powered by a Spring-driven Unit

By P. F. HAMM

(Concluded from page 452, August issue)

Steering Gear

STEERING control is obtained by means of an 0 B.A. screw and nut (Fig. 7) via a three-to-one step-up to a vertical rod on the track rod. The vertical member is designed to flex slightly under strain, protecting the linkage. This method of control was adopted as it prevents reverse action between the road and steering wheels, avoiding the need for a steering clamp. The steering wheel is soldered and the rim bound with fine twine. Cut the push rod to a length such that it allows an equal left- and right-hand lock. One track-rod link is threaded to allow accurate alignment of the front wheels. Adjust and lightly rivet the joints.

Alternative types of steering are shown in Fig. 5 (August issue).

Bodywork

This is freely based on Maserati 4 CLT styling and it will be seen to consist of three parts:

1. The front section, which is built up from layers of ½in. deal glued together and carved to shape as in the general views and cross sections (Fig 8) and screwed to the chassis plate with wood screws.

2. The centre section which is of thin aluminium sheet.

The writer would like to assure anyone doubtful of accomplishing the aluminium work that it can be easily done, using the fingers alone, with the exception of the cockpit flair, which is gently beaten to shape with a hide-faced hammer over a rounded block of wood. It may be found necessary to anneal the metal once or twice during this process to avoid splitting the edges. Allow a margin of metal oversize, and trim when complete, as it has a strange habit of "shrinking" in the process. Fix to the chassis with self-tapping screws at the front, and nuts on the cross-tie at the rear.

3. The rear section is fabricated from balsa wood in a similar manner to the front. Press against the centre section occasionally while carving to ensure a neat fit. The rear hub fairings are carved separately and glued to the main section. Fit an aluminium plate to the underside with woodscrews and Bostik. It is then a simple matter to attach it to the chassis plate with self-tapping screws.

Seat

This is shown flat in Fig. 9, and should be carefully bent to shape. Polish before bending, and secure to the chassis-plate with self-tapping screws.

Radiator Grille

Mark out desired radiator shape, or as in Fig. 9, and remove all wood within this line to a depth of 1/16in. Cut a piece of wire gauze to fit this recess and glue in place. A length of 1/16in. dia. copper wire bent to fit snugly round the inside edge and glued in place completes the illusion.

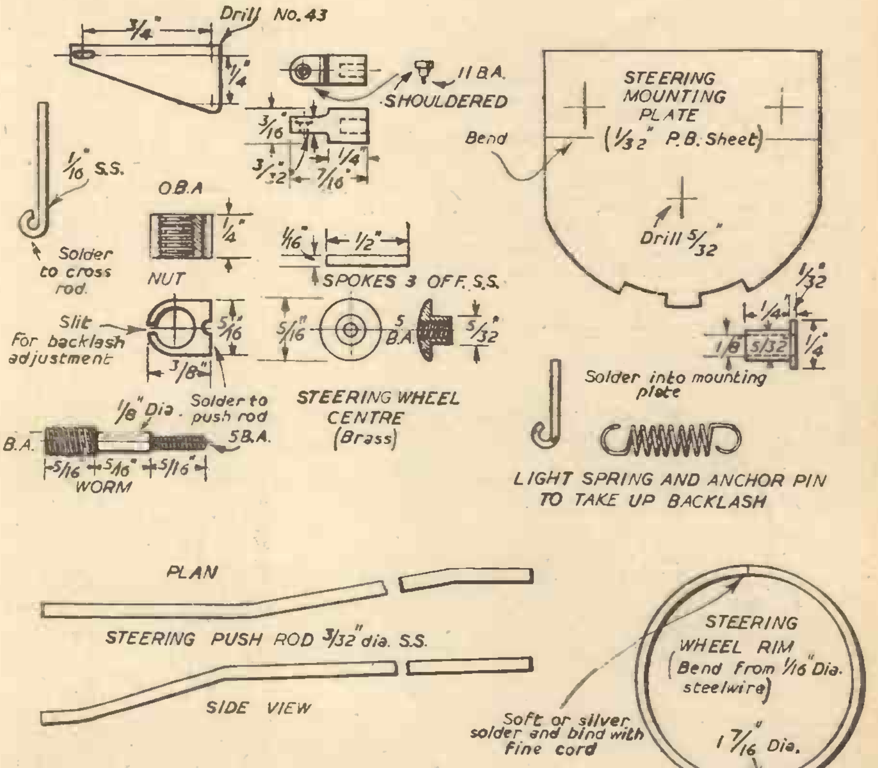


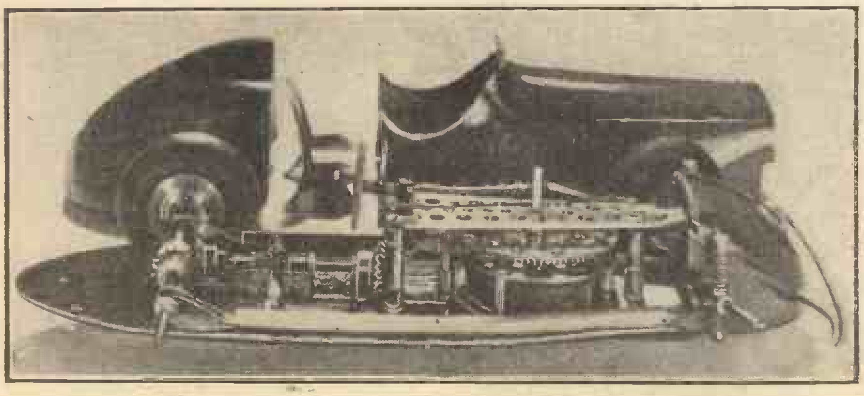
Fig. 7.—Details of the steering gear.

Windscreen

File to the shape indicated in Fig. 9 from Perspex and polish with metal polish. Screw to body with 10 B.A. screws.

Bumper

A certain measure of protection is afforded by the vertical member previously mentioned. However, the addition of a bumper was con-



The completed chassis with bodywork and wheels removed.

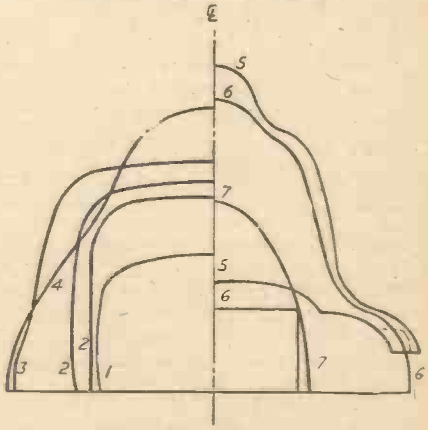


Fig. 8.—Cross-sections of the bodywork.

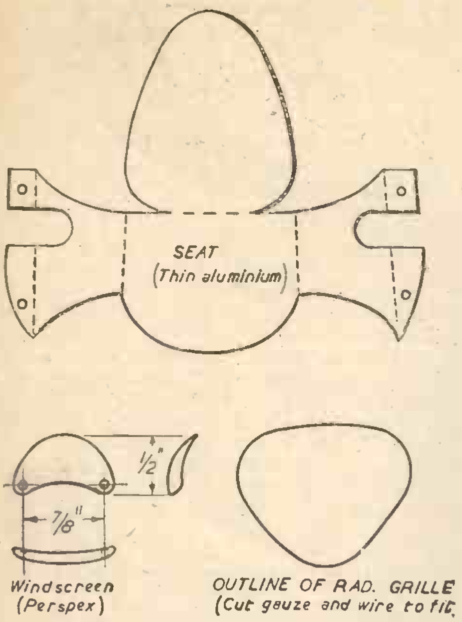
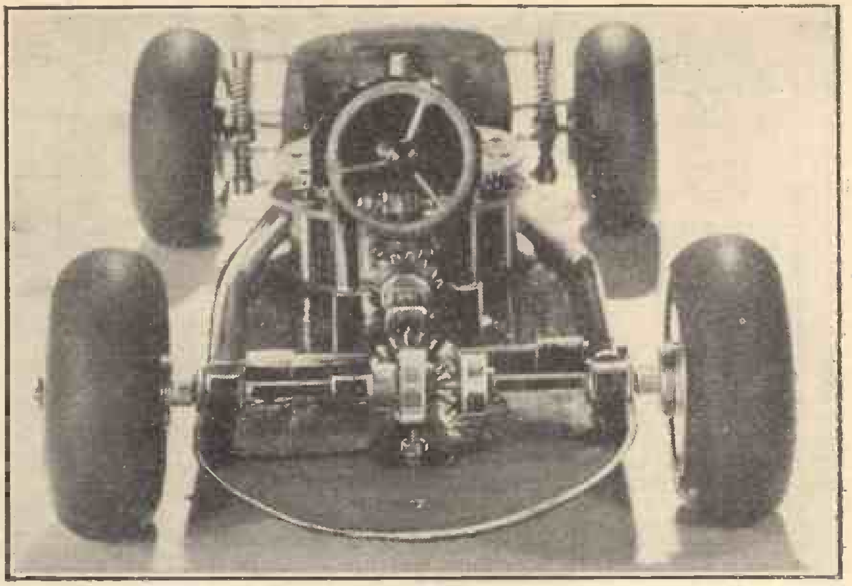


Fig. 9.—Details of seat, windscreen and radiator grille.



End view of the chassis showing the bevel-gear drive.

sidered a wise precaution although it detracts slightly from the "classic" look. The bumper support is fitted by drilling the wood transversely and forcing the $\frac{1}{8}$in. dia. rod through. Bend to shape and solder the bumper to it.

Paintwork

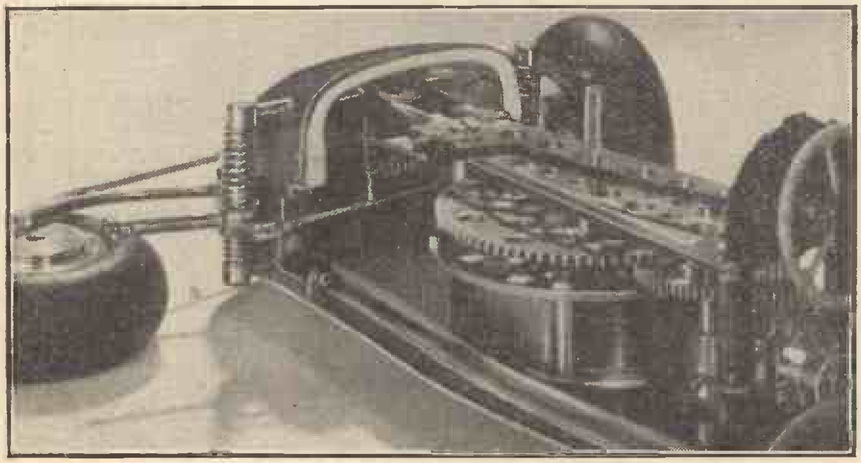
Assuming that all the wooden parts have been well glass-papered the painting can be done. Fill with plastic wood where necessary. The balsa wood tail will be found very absorbent and a coat of banana oil should be applied as a stopper. Mask the parts not requiring painting with brown paper or adhesive tape. Cellulose paint is recommended. Whether using a spray gun or brush, the surface should be rubbed down between applications with "wet and dry" until a smooth surface is obtained. When satisfied finish to a high gloss with metal polish.

For anyone unfamiliar with spray gun technique the following may prove helpful. A gun for use with a vacuum cleaner is entirely adequate for model work. Add thinners (about 50:50) until the paint emerges from the gun in the form which neither "blobs" nor runs. Do not apply more than four or five coats in a day and use plenty of water when rubbing down.

The original model was painted red, Italy's racing colour.

The radiator is black with yellow number. To be correct a rather larger number is needed either side of and just before the cockpit.

Most of the materials required for the model can be obtained from surplus shops and junk yards. Old sewing machines and gramophone motors will provide bevels. Silver steel and "wet and dry" are stocked in good ironmongers' shops. Should difficulty be experienced in getting the brass, phosphor-bronze and aluminium, Messrs. Stantons, Shoe Lane, London, E.C.4, will probably be able to help.

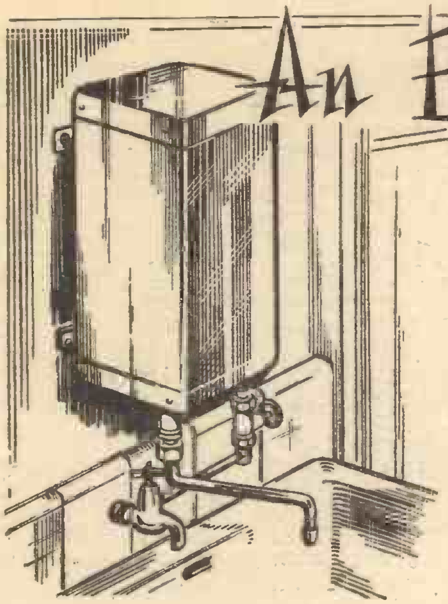


Close-up view of spring motor and independent front suspension.

A Four-seater Motor-boat

THE motor-boat shown in the accompanying illustration, which was built by Mr. J. Sharp, of Oxford, is powered by an 8 h.p. outboard motor. The boat has a semi-V bottom design, which gives it greater speed, is 13ft. 6in. in length, with a beam of 4ft. 6in. and weighs 220lb. It is built almost entirely of resin-bonded mahogany ply-wood and the esimated cost of materials is £80, plus the cost of the engine, a Coventry Victor four-stroke horizontal twin. It is estimated that the boat will be capable of a speed of 15 to 20 knots.

An Electric Water Heater



Constructional Details of a 1½-gallon Unit

By C. MONDAY

THE purchase tax on small electric water heaters is still high, and as it is not difficult to make one of the free outlet type a considerable saving is possible.

A suitable size for a small domestic heater used for hot water to a sink or wash basin is 1½ gallon, while the 3-gallon type is also popular. The heating elements for these sizes are usually 500 to 1,000 watts.

Fig. 1 shows a sectional view of a 1½ gallon heater from which it will be seen that it comprises inner and outer metal tanks separated by an insulating material. The heating element and controlling thermostat are fitted to the bottom of the inner tank while provision is also made for the water inlet and outlet connections. A rectangular form has been adopted for ease of construction, and if finished carefully the appearance is quite pleasing. A cylindrical shape would also be suitable but the forming of the end caps would be more difficult.

If the water is to be used for drinking or cooking it is desirable that the inner tank is made from tinned copper sheet of about 16 s.w.g. For washing up or workshop use it is satisfactory to use galvanised sheet steel in which case 18 s.w.g. would be sufficient. Both materials can be soldered easily, and this type of joint is adequate for the conditions of service. It is not necessary for the tank to be able to withstand high pressures, the only working pressure being due to the effective head of water inside it. Most commercial heaters are designed to take about 15lb. per sq. in. and a tank similar to that described should pass such a test with ease.

Since a cubic foot of water contains 6.25 gallons a tank with a capacity of 1½ gallons will occupy $\frac{1.5}{6.25} \times 1{,}728$ or 415 cubic inches approximately. It must be high enough to admit the heater element and thermostat selected, and a suitable size would be 7in. wide by 5in. deep by 13in. high giving 445 cu. in. The extra capacity allows a little free space above the water surface. These dimensions may, of course, be varied to suit individual requirements.

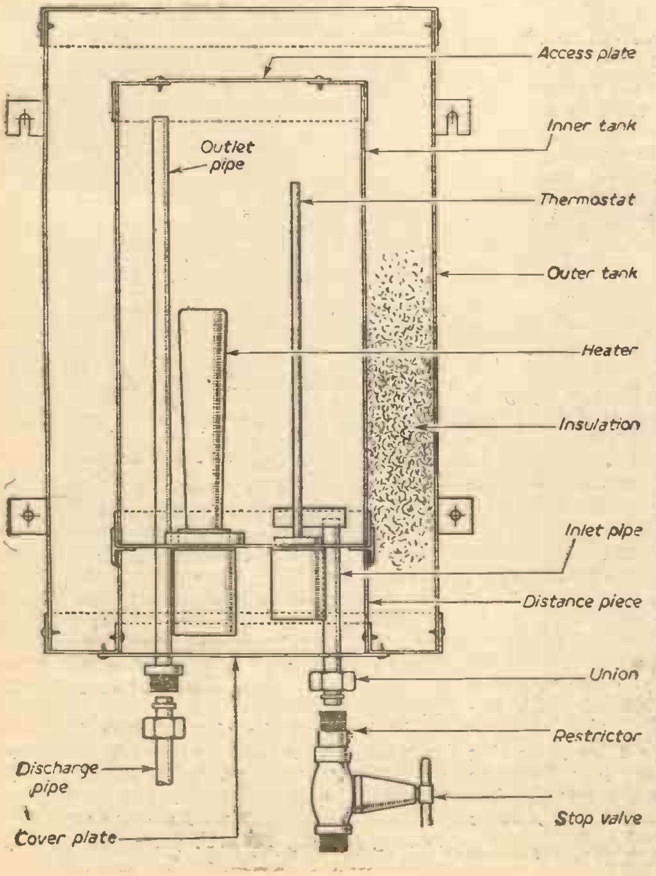


Fig. 1.—(Left) Sectional view of a 1½-gallon electric water heater, showing layout of components.

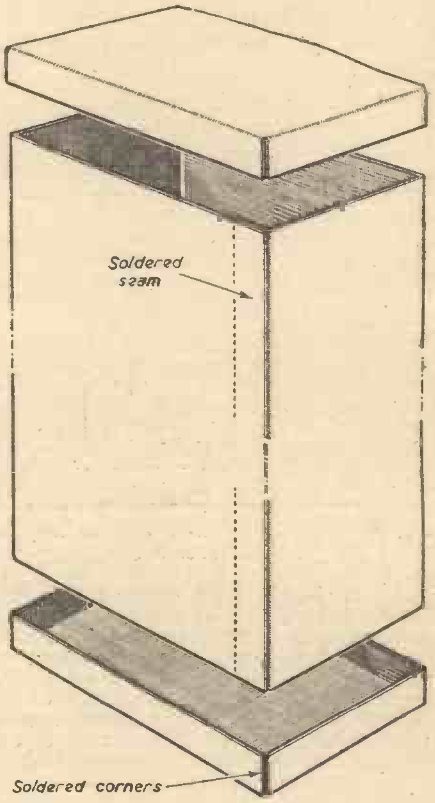


Fig. 2.—(Right) Elevation of the inner tank showing constructional details.

Tank Construction

The construction of the inner tank shown in Fig. 2 comprises the body with top and bottom lids. A rectangular hole about 4in. by 3in. is cut in the top lid and subsequently covered by a detachable plate, allowing access for cleaning and the removal of fur when necessary. The lower lid contains the holes for heater, thermostat, and water pipe connections. The arrangement shown is suitable for G.E.C. type heaters of 500-watt capacity with the associated thermostat, but if other types are used some modification may be required. Some thermostats are not intended for direct contact with the water, and in such cases a tube must be soldered into the tank and closed at the top to take this unit. The makers instructions will give information on this point.

The body of the tank is soldered down the seam, the lids being assembled after the piping is installed.

The outer tank is made up in a similar fashion so that it is about 2in. larger all round to allow for insulation. Plain steel sheet is suitable, and if properly prepared gives a good surface for finishing. 18 s.w.g. should be the minimum thickness to avoid buckling.

Two lids are constructed similar to those for the inner tank, the corners being brazed and ground off flush for the sake of appearance. A hole 7in. by 5in. with a ½in. internal flange is provided on the lower one. The latter may be brazed in place on the tank body or attached with Parker-Kalon self-tapping screws in the same way as the top one. Two straps are brazed or riveted to the back for attachment to the wall.

A sheet steel distance piece shown in Fig. 1 is made up with a flanged top and side plates to support and locate the inner tank when it is assembled. The depth of this part should be sufficient to give clearance for the heater element and thermostat heads.

Pipe Fittings

This completes the sheet metal work and the pipe fittings can be installed next as shown in Fig. 3. The water outlet pipe is made of ½in. dia. hard copper pipe which projects into the tank 12in. and is soldered where it passes through the lid. A galvanised or preferably turned brass nipple threaded ½in. B.S.P. externally is soldered on the bottom, and projects below the bottom of the outer tank.

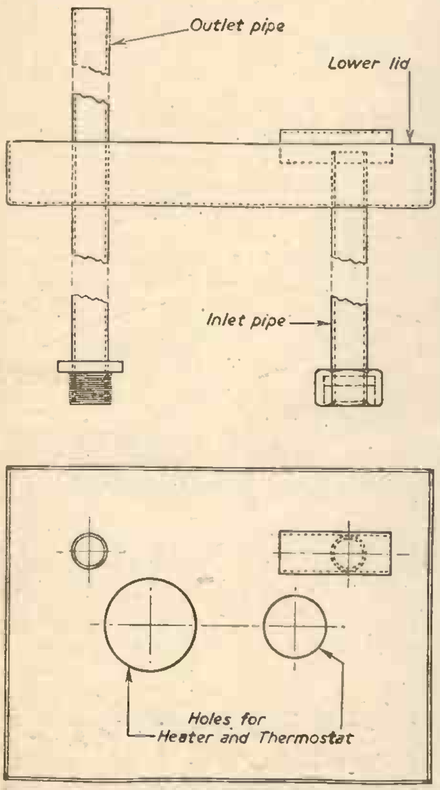


Fig. 3.—Assembly of inlet and outlet pipes in the lower lid.

A short length of ½in. copper pipe is used for the inlet, projecting about 1in. into the tank, the top being covered by a curved copper plate to allow the water to enter sideways. This prevents the incoming cold stream shooting up to the top of the tank. A standard brass tail fitting with union nut is soldered to this pipe on the outside of the lid and projects clear of the outer tank.

The heater element and thermostat normally have B.S.P. threads at the base of the head and these are passed through the holes in the lid, brass back nuts being screwed on the inside. If the latter are soldered in place subsequent removal of the units for inspection or replacement will be easier. They should, in any case, be taken out again while the assembly is completed.

The inner tank can now be assembled, the two lids being soldered in place. A cover plate for the top access hole is cut out about 1in. larger each way, and is fixed on with self-tapping screws, a Hallite washer with jointing compound being interposed to make a watertight joint. The heater and thermostat are screwed in place by hand, Hallite washers also being fitted to these.

Assembly of the outer tank is straightforward, the distance piece being attached by self-tapping screws as shown. The assembled body and lower lid are then ready for the inner tank which is lowered in from the top.

Insulating Material

At this stage the insulation is packed in. Granulated cork is probably the best although other materials such as fibreglass may be used. It should be packed firmly but not tightly into the space between the two tanks and over the top of the inner one up to the outer rim. The insulation should be sufficient to hold the inner tank in position but clamp straps may be used if required. The upper lid is fitted into place and secured with self-tapping screws.

The outer tank may be finished by any normal brush or spray painting procedure, the final appearance being dependent upon the amount of care that is taken.

The completed unit may now be fastened to the wall by Rawlplugs and screws.

An outlet bend to suit the position where water is to be discharged can be made up from copper pipe, a tail with union nut being soldered to the top to connect with the screwed nipple.

Restrictor

On the inlet side a standard ½ in. brass or chromium plated stop valve is fitted but a restrictor is required between the valve and the inlet pipe to balance the inlet and outlet flows. Fig. 4 shows the construction of a simple restrictor. A ½in. brass nipple is fitted with a brass plug soldered in place, a 3/16in. dia, hole being drilled through it. A 3/16in. dia. hole is tapped in one side through to the centre hole and a short screwed adjuster fitted into it. The latter should be short enough to be fully recessed into the hole, a screwdriver slot being cut in the head. To make the nipple watertight a flat is filed where the tapped hole emerges, the latter being closed by a screw and fibre washer.

The restrictor is screwed into the outlet side of the stop cock, the upper end fitting into the union nut of the inlet pipe using a fibre washer to make the joint watertight.

Water connections are taken direct from the mains supply, copper or galvanised piping being used as desired.

Electrical Connections

The electrical connections are simple and assuming an A.C. supply the live wire is taken to one side of the thermostat, the other side of the later being connected to the heater element. The second terminal of the heater is connected to neutral. In the interests of safety it is also desirable to earth the apparatus.

Overlapping plates with slots cut out for the two water pipes and the electric cable are used to finish off the base of the outer tank, being attached by self-tapping scews. It is not really necessary to insulate the small compartment so formed as the losses are slight but it may be packed with fibreglass if desired.

The tank should be filled with water before the heating element is switched on. As the water heats up it expands and a certain amount will dribble from the outlet pipe. This effect is not noticeable in use after the main body of the water is hot.

The thermostat will have a range of about 70-190 deg. F. and the setting selected represents the temperature at which the current is switched off. As the operating differential is usually about 8-16 deg. F. the water will be colder than the setting by this amount before the heater is switched on again. In areas where the water supply is hard, furring will be minimised if the setting is kept below 150-160 deg. F.

The restrictor should be adjusted so that with the tap turned on the flow from the outlet becomes intermittent. It is then screwed out gradually until a full flow is just maintained.

Running Costs

To enable an estimate of running costs to be made a few calculations are included below.

A gallon of water weighs 10 lbs., consequently, a 1½ gall. heater holds 15lb. of water. To raise 1lb. of water through 1 deg. F. requires 1 British Thermal Unit, and therefore to raise 15lb. to 160 deg. F. assuming incoming main water at 60 deg. will require 15 x (160-60) B. Th. U.= 1,500 B. Th. U.

To find the heat produced by an electrical heater the formula B.Th.U. per minute= $\frac{\text{Watts}}{17.58}$ can be used. Assuming a 500-watt unit this will give out heat equivalent to $\frac{500}{17.58}$ = 28.5 B.Th.U. per min. In order to supply the 1,500 B.Th.U. necessary to raise 15lb. through 100 deg. F. it will therefore take $\frac{1{,}500}{28.5}$ = 52½ mins. approx., or allowing for general losses of 10 per cent., about 58 mins.

A 750-watt unit would take $\frac{17.58}{750}$ x 1,500 or about 38 mins. after allowing for losses.

Once the temperature set on the thermostat has been reached the heat lost to the external air though the tank walls and insulation must be balanced by the input of the heating element.

The thermal conductivity of granulated cork is about 0.3 B.Th.U. per hour for each deg. F. temperature difference through one square foot of surface. This is for a thickness of 1in. and as the tank insulation is 2in. the heat transfer will be half of this amount. The tank walls have little insulating value and may be ignored.

In the constructional details a tank of 7in. by 5in. by 13in. has been assumed and by adding 2in. all round for the insulation an overall size of 11in. by 9in. by 17in. will be obtained. The area of the outside surface will then be given by the sum of

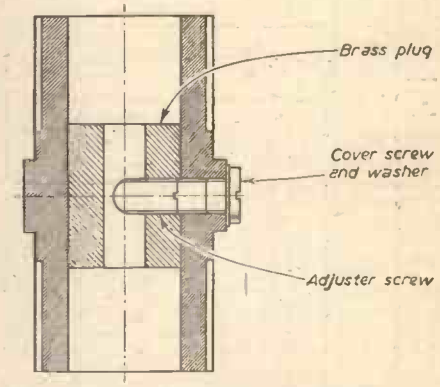


Fig. 4.—Section of the restrictor.

(2 x 9 x 17) + (2 x 11 x 17) + (2 x 9 x 11) =878 sq. inches or 6.1 sq. ft.

The temperature to be used in the formula is the difference between the water inside the tank and the external air, or ambient, temperature. The latter will vary according to the position in which the water heater is installed, and according to the time of the year. An average of about 60 deg. F. can be taken for the ambient temperature, giving a temperature difference of 100 deg. F.

By inserting the above figures into the formula we obtain: ½ x 0.3 x temp. difference of 100 deg. x 6.1 sq. ft.=0.3 x 50 x 6.1=91.5 B.Th.U. per hour loss through the insulation. As a 500-watt element gives 28.5 B.Th.U. per minute it will need to operate for $\frac{91.5}{28.5}$ or approximately 3.2 mins. in every hour to balance the heat loss.

To sum up the above it can be seen that to heat 1½ gallons of water from 60 deg. to the working temperature of 160 deg. requires the element to operate for about 58 mins. and thereafter the thermostat will cut in and out to give an average operating period of about 3½ mins. in every hour to maintain this temperature.

The operating time to heat incoming water which displaces that used will, of course, vary according to the amount used and can be calculated from the above formula if the quantity can be estimated.

The total cost of running the heater can then be deduced quite accurately as a 500 watt element takes ½ kilowatt of electricity per hour and a 750-watt one ¾ k.w. hr.

The method outlined above can be applied to a water heater of any size and with any form of insulation if the factor "k" (thermal conductivity) is known for the latter. The effect of different thicknesses of insulation on operating time, and of different sized elements on the rate of heating can also be derived.

A Blowpipe for Brazing

A Useful Addition to the Home Workshop

By P. SCREATON

BLOWPIPES for professional brazing normally use a fairly high pressure air supply, but for one here described a vacuum cleaner and a domestic gas supply are all that is required. The writer has used one for some time, and has derived a good deal of pleasure and satisfaction from it; all the parts were obtained from a scrap yard!

The only variation from the standard pattern is the air pipe which is of large diameter so as not to restrict the air flow.

The Hearth

In brazing or silver-soldering a hearth is necessary to conserve the heat. A small one was made in a large flat tin 12in. square and 3in. deep, filled level with small coke. (Clean cinders would do instead.) For small work firebricks are arranged round two sides, and the work piece placed in the angle. For awkwardly-shaped items which will not go into the hearth extra firebricks are built up around the joint which is to be brazed.

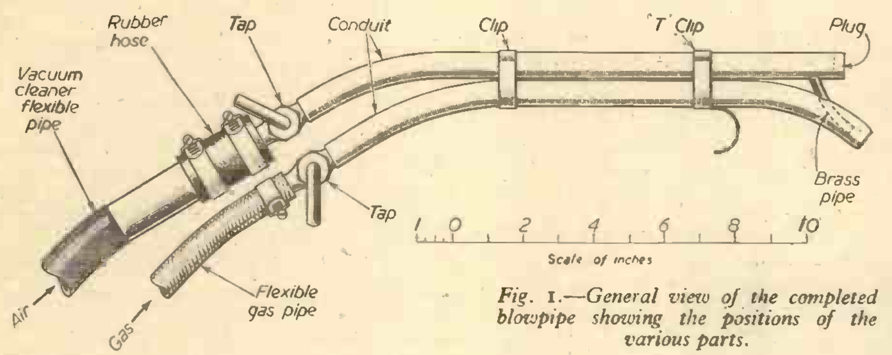


Fig. 1.—General view of the completed blowpipe showing the positions of the various parts.

Construction

Two pieces of electric conduit, ¾in. outside diameter and 15½in. long were bent as shown in Fig. 1, and drilled to take the small pipe which carries the air into the gas jet. This was of brass 7/32in. inside diameter, and 5/16in. outside. A disc of mild steel was used to plug up the end of the air conduit, and light gauge sheet steel was used for the clips which held the conduits together. The front clip was made from a "T" shaped piece, the upright of the "T" being bent round to form a hook. This is useful for parking the pipe when not in use.

Two taps were fitted to control the flame, and they were bored out to 9/32in. to avoid restriction. The air tap was then built up with suitable tube for connecting up to the flexible pipe from the outlet side of the vacuum cleaner. The joint was made with motor-car, water-hose and worm-drive clips. The gas tap was also adapted to connect up with the flexible gas pipe.

Silver-soldered Joints

The parts were silver-soldered together and a blowlamp was used to supply the heat for this operation. The first effort in assembly was to get the small air pipe accurately positioned in the middle of the gas jet. To get this right it had to be a tight fit in the holes drilled for it so that it remained located while the silver soldering was done. The end of the air pipe was made to come ¼in. inside the gas jet. The rest of the assembly was quite straightforward.

An Airbleed

The blowpipe does not take the full air output of the cleaner, which tends to over-rev. in consequence. While this does not matter for occasional short runs the motor could be damaged if used this way for long periods. Particularly on the cylinder type of cleaner, since on these the air which is being used passes through the motor and acts as a coolant. Cutting down the flow therefore not only over-revs. the motor but also reduces the amount of cooling air.

In order to safeguard the motor a bleed was interposed between the motor and the flexible pipe. This is a piece of tube about 7in. long with a slot 1¼in. by 5/16in. (Fig. 2) and with this full open there is still ample air supply to the blowpipe, at a pressure of 10½in. of water. A sleeve was made to cover the slot if greater pressure is required for a short time.

Anyone interested in blower performance may like to know that when the bleed is closed the increase in revs. more than doubles the output pressure, although the total airflow is actually reduced.

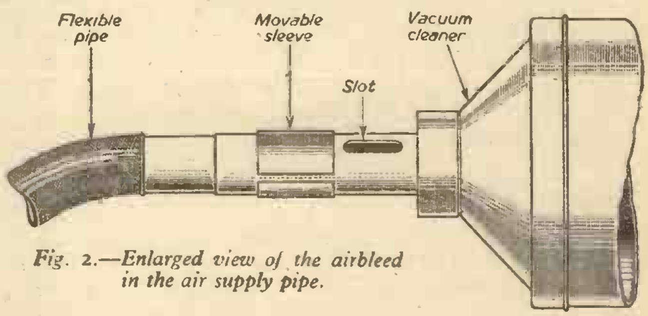


Fig. 2.—Enlarged view of the airbleed in the air supply pipe.

Brazing Technique

Any reader who has not done brazing before may find these notes useful Clean the parts to be brazed with a file or scraper, do not use emery cloth. Assemble the joint and place in position on the hearth. Heat up with the flame, do not hold the blowpipe too close; you will see that there is a blue cone of inner flame and a purplish outer flame. Only play the outer flame on the joint or excessive oxydisation will result. When the job is a bright red, heat up the end of the brazing rod and dip it into the flux; some will stick to the hot rod and can be applied to the joint where it will melt and run in. Hold the rod to the joint and in a few seconds the metal will start to melt and follow the flux.

There is a capillary action by which the metal easily runs right into the joint.

When the job has cooled just sufficient for the metal to solidify, plunge it into cold water. This causes most of the scale to come off, leaving a much cleaner job.

Silver-soldering

The technique is the same for silver-soldering and also for sifbronzing; less heat is required, and patent fluxes are usually employed. Silver-soldering is, of course, particularly useful for work in brass; using the lower heat, avoids melting the whole job.

Unfortunately these metals and their fluxes are rather expensive, while "hard" brazing rod and ordinary borax for a flux are quite cheap and make an extremely strong joint.

One final point, if yours is one of the upright type of cleaners don't forget to remove the belt which drives the brush before you switch on.

LIGHT AND HUMAN VISION

2—An Orbital Cosmos

Modern Observations on the Stellar World

By WILLIAM ELLWOOD

OUR Stellar World, of which the whole Solar System is but a minute fragment, is so-called *spiral nebula* of some 100,000 light-years in diameter. At one time, these similar but distant nebulæ were thought to be of gaseous nature, but they are now known to be of stellar formation—island universes like our own. There are, roughly speaking, 100,000,000 such nebulæ within telescopic range, and this represents only the tiniest fraction of the whole. These complete worlds (Fig. 1), at estimated distances of 500,000 to 500,000,000 light-years away from us, are lens-shaped, and disposed at various angles to the line of sight when photographed or observed through a powerful telescope. Observation shows that the majority of these nebulæ are apparently flying away from us at relative speeds ranging from hundreds to thousands of miles per second. The manner in which these calculations are made will be outlined shortly.

The natural inference is that the Cosmos or ultimate universe is expanding outwards from the original centre (Fig. 2). As the evidence *appears* so convincing at first sight, the majority of people resign themselves to such a universe. There are, however, certain serious objections to it, believing more and more as we do that matter and radiation are fundamentally similar, also that matter perforce creates its own space. However, we shall leave that aspect of the problem alone and present a different sort of argument against a directly expanding Cosmos. This questions the validity of certain velocities and real movements of spiral nebulæ.

It has long been known that the ages of innumerable stars are stated in millions of millions of years, and with them, of course, the Cosmos; yet, if the calculated speeds of distant nebulæ, relative to our nebula, are true and their directions are in accordance with direct expansion, those same spiral nebulæ would have been in *close proximity* to the Solar System a paltry few thousands of millions of years ago! This suggests that either our estimate of star ages is incorrect (which is ridiculous), or that the directions and true relative speeds of the nebulæ are incorrect, which is possible. A way out of the dilemma is to be found in an orbital Cosmos, but first let us glance at the method by which distances and speeds are judged. It is known as the Doppler principle, the effect being due to the relative motion between the source of light and the observer. For simplicity, we have previously referred to light "rays," which is quite in order when talking of rectilinear propagation, etc., but we must remember that in reality it has a "wave" motion. Now, since the velocity of wave transmission is

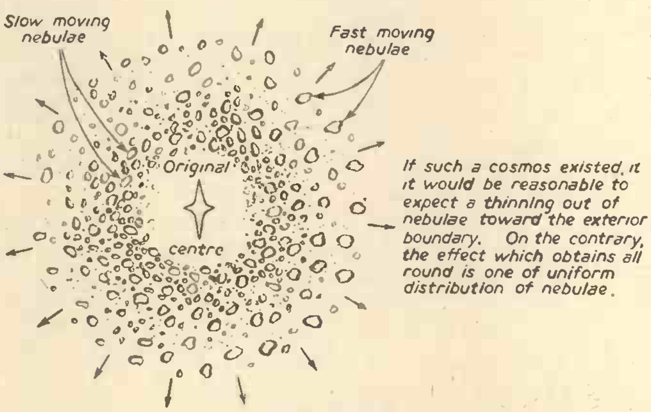


Fig. 2.—A Cosmos expanding directly from the original centre.

Fig. 1.—Two impressions of spiral nebulæ. One is inclined at about 45 deg., the other is seen in profile. These "nebulæ" were at one time thought to be of gaseous nature, but it is now known that they are of stellar formation. Our own world is considered to be a typical spiral nebula.

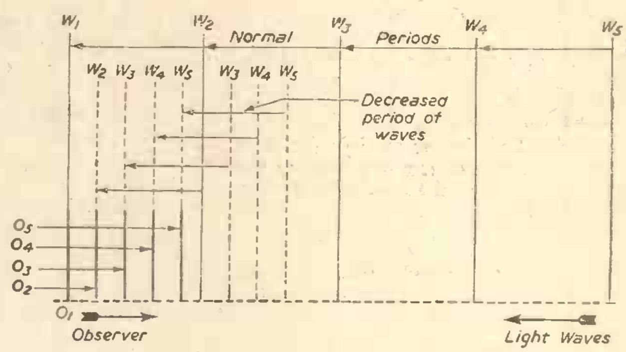


Fig. 3.—Apparent shortening of wave period when observer moves in a direction opposite to that of light waves.

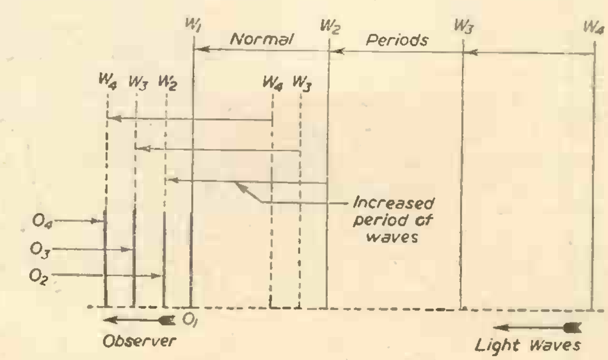


Fig. 4.—Apparent lengthening of wave period when observer moves in the same direction as light waves.

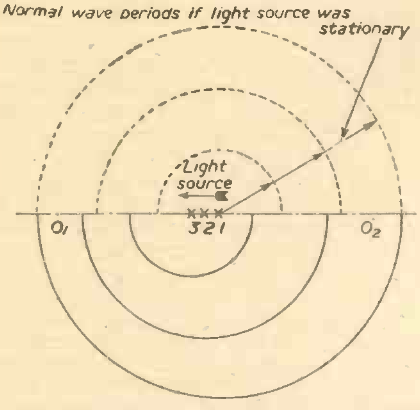


Fig. 5.—Different wave periods experienced by two observers stationary to a moving light source.

constant in all directions, it follows that the period of the waves is proportional to the wavelength. The apparent period of the wave decreases if an observer is moving in the opposite direction to that of the waves (Fig. 3). It increases if he is moving in the same direction as the waves (Fig. 4). In Fig. 5 is shown the varying wave period for two observers stationary to a moving light-source.

Applying the above principle to nebular motion, it is found by examination of the spectrum that if a body is approaching our own universe, the wavelength of its light is shortened and certain spectral lines are displaced toward the violet end of the spectrum. On the other hand, a body moving away from us increases the wavelength of its light reaching us and causes the spectral lines to be displaced towards the red end.

The result of such investigation is that apparently about 80 per cent. of the spiral nebulæ are receding from us, whilst a minority of nearer nebulæ may be approaching us. How the direct expansionist theory takes care of the latter stubborn minority is not known. If we consider that the bodies representing the outer limits of an expanding universe are moving faster than those bodies nearer the centre, nebulæ speeds must vary in proportion to their distances from that original centre. This demands that no matter in which nebula an observer is situated, all the remaining nebulæ *must* appear to be receding from him. Once more theory and observation contradict each other. If we consider an orbital Cosmos as suggested in Fig. 6, we shall see that star ages, nebulæ directions and speeds, may be reconciled.

It has, in common with natural entities both large and small, a circling or revolving motion. Atoms, planet systems and nebulæ: all, in greater or lesser degree, exhibit orbital characteristics.

The whole structure displays a noticeable eccentricity. Densely-packed spiral nebulæ forming the nucleus, impose an aphelion and perihelion condition on the outer bands of circling nebulæ, where nucleus and outer nebulæ represent sun and planets respectively. The nucleus, for ever pouring forth and withdrawing matter into and from the circling nebulæ, will never be seen by an observer in our world; so truly astronomical is the intervening distance. We are capable, however, of observing the effect orbital motion has on us and our "neighbours."

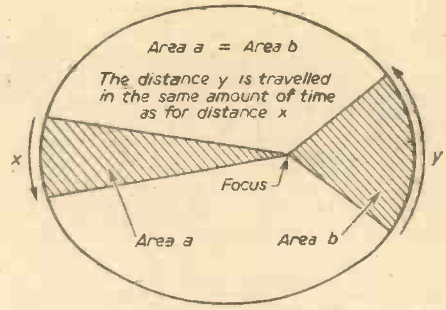


Fig. 7.—Kepler's second law. A body in orbit encloses equal areas of the orbital plane in equal times.

We must also bear in mind the fact that light from certain nebulæ takes millions of years to reach us, the nebulæ concerned occupying an entirely new position in space at the time of light reception. This, however, cannot materially affect our present discussion.

Fig. 7 shows that a body in orbit encloses equal areas of the orbital plane in equal times. Thus, at aphelion it moves slowly, but at perihelion it reaches maximum speed We shall extract such an orbital plane from our cosmic universe (Fig. 8), and mark out the accelerating and decelerating portions of the orbit, in, shall we say, units of velocity; then remove the encircled portion to be examined in Fig. 9.

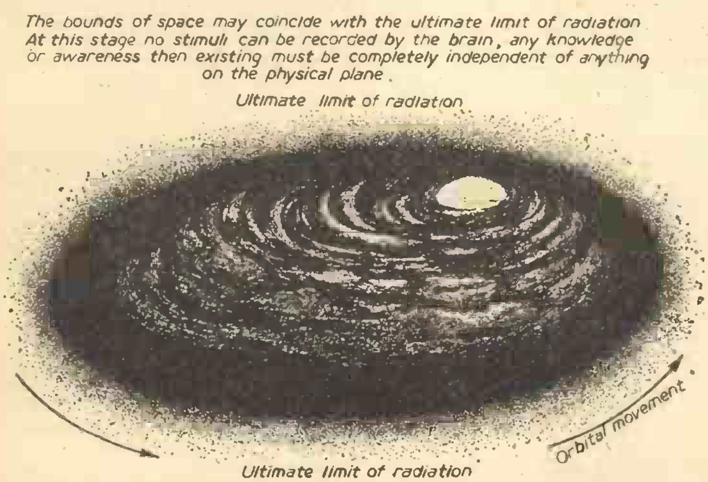


Fig. 6.—An orbital Cosmos. Spiral universes revolving round a nucleus of great density.

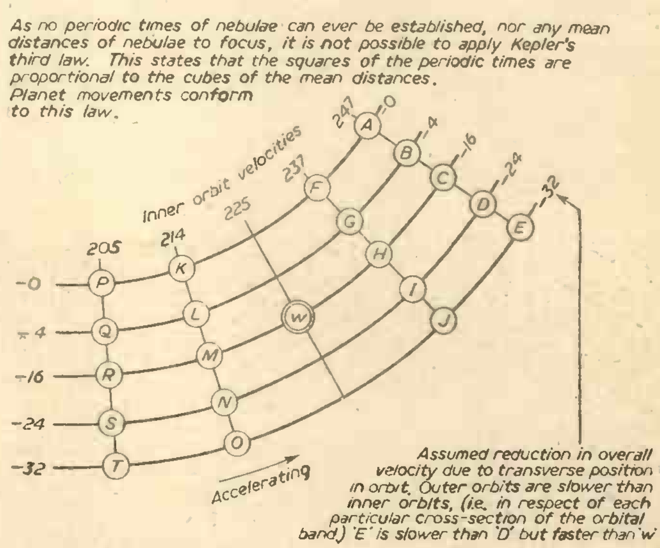


Fig. 9.—The phenomenon of expansion in an orbital Cosmos.

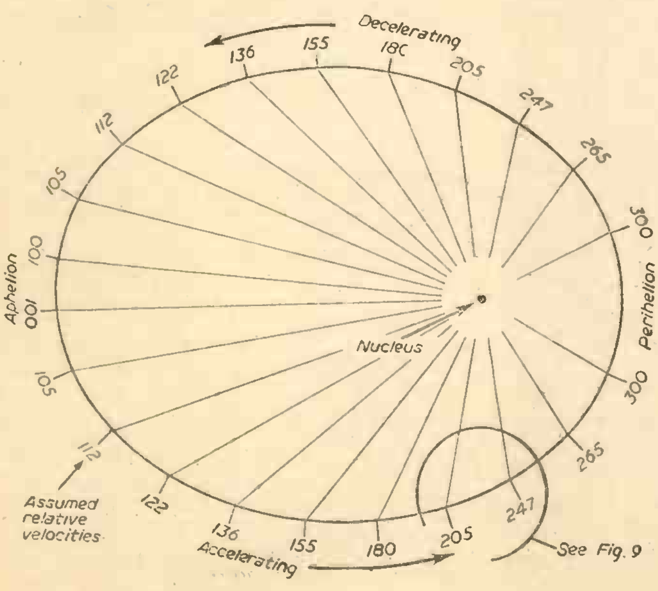


Fig. 8 (left).—As nebulæ approach perihelion, their velocities increase to a maximum.

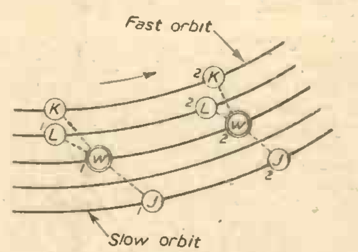


Fig. 10.—Temporary contracting effect in an otherwise apparently expanding Cosmos.

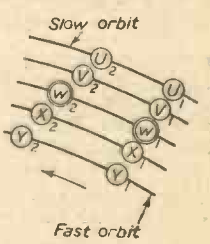


Fig. 11.—Limited expanding effect in an otherwise apparently contracting Cosmos.

Assume that our Stellar World is represented at W. If, from W, we compare positions and relevant speeds of acceleration of other nebulæ, we shall be convinced that the majority are flying away from us. In reality, nebulæ "A" to "I" *are* accelerating away from us. *We* are accelerating away from nebulæ "M" to "T." The resulting conviction is one of expansion. This fanning out effect still prevails in varying degrees, no matter in which direction we look. The further nebulæ are towards perihelion, the greater will their velocity be relative to ours. Our acceleration away from the distant, and slower, rearward nebulæ, will give them an apparent velocity greater than those which are nearer to us. The phenomenon of "further away, the faster they go" is in accord with recorded observations. It will be seen that the calculated relative speeds of "forward" nebulæ must be increased and those of "rearward" nebulæ decreased, in order to realise *true* relative speeds. This, naturally, is due to the angle at which the bodies are observed.

There are, however, regions where nebulæ could appear to be approaching us (Fig. 10), and in these cases the intervening distances do decrease. It is due to the transverse positioning of nebulæ in the orbit. Nebulæ "K" and "L" are at present slightly rearward of W, but as they occupy inner orbits, it is logical to suppose that they are gradually gaining on W. In turn, W may be gaining slightly on nebulæ "J" occupying an outer orbit. The result in both cases is a shortening of the distance between those nebulæ and our world W. Nebulæ bearing such a relationship to us, are in the minority, as such a change is only noticeable when the overall speeds of acceleration of observer and observed are similar. It is, in short, a secondary or hinging motion. The contracting effect caused by it, is of definitely limited duration, calculated in millions of years; and is eventually superseded by the expanding effect. This minority, just explained, could very well account for the "stubborn" fraternity previously mentioned.

When perihelion is passed and the nebulæ start to decelerate, the "stubborn" minority will then offer the only example of *expansion* (Fig. 11) in an otherwise contracting universe! This overall contracting effect will continue until aphelion is reached. The cycle will then commence all over again. Naturally, this type of Cosmos offers no contradictions in regard to star ages; in fact, it tends to confirm those ages.

Other characteristics such as "curved light" and the idea of a "space-time cycle," take on an added significance when considered in relation to an orbital cosmic universe, but these things are beyond discussion here. The purpose of this article has been to state, as clearly as possible, that such a universe contains within it, the phenomena experienced from our ever-changing position in space. It infers, that the Stellar World is at present accelerating along a super orbit towards the point of maximum velocity. The complete journey round the orbit will take untold millions of years, only to repeat itself—for ever.

A Novel Clothes-prop Head

By C. E. STARR

THIS gadget is intended to give complete clothes line control and to make sure that the line stays supported by the prop at all times. My wife has used it with complete success for the past three years, even in very high and gusty winds.

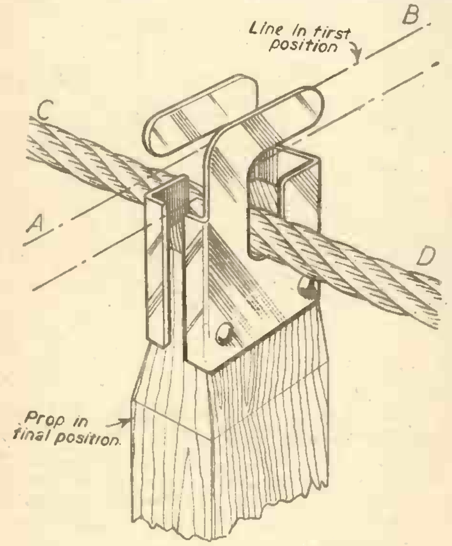


Fig. 1.—The novel clothes-prop head.

The device is attached to the prop by two rivets after the end of the prop has been shaped to a section 1in. x 7/16in. x ⅝in. The wood that projects into the slot is then filed to the same shape as the slot radius, this giving solid support to the line right through the head.

It should be cut from 17 s.w.g. mild steel sheet, to the dimensions given in Fig. 2, and then bent on the dotted lines to 90° to form box section. Four ⅛in. diameter holes to take the rivets are drilled before the bending is done.

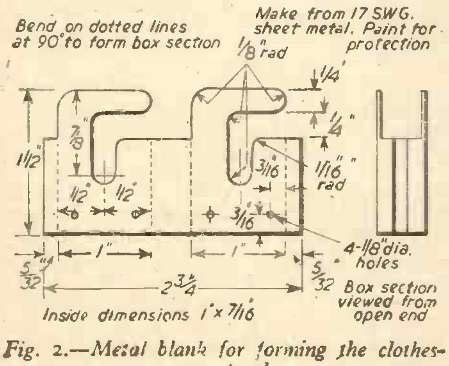


Fig. 2.—Metal blank for forming the clothes-prop head.

Using the Head

The method of using the device is shown in Fig. 1. Place the prop under line (AB) until line is lying as far down as possible between the two tongues. Then turn in a right-hand direction, when the line will take up position CD in the bottom of the slot: it will be lying along the slot already cut in the top of the wooden part of the prop.

Ash-pan Improvement

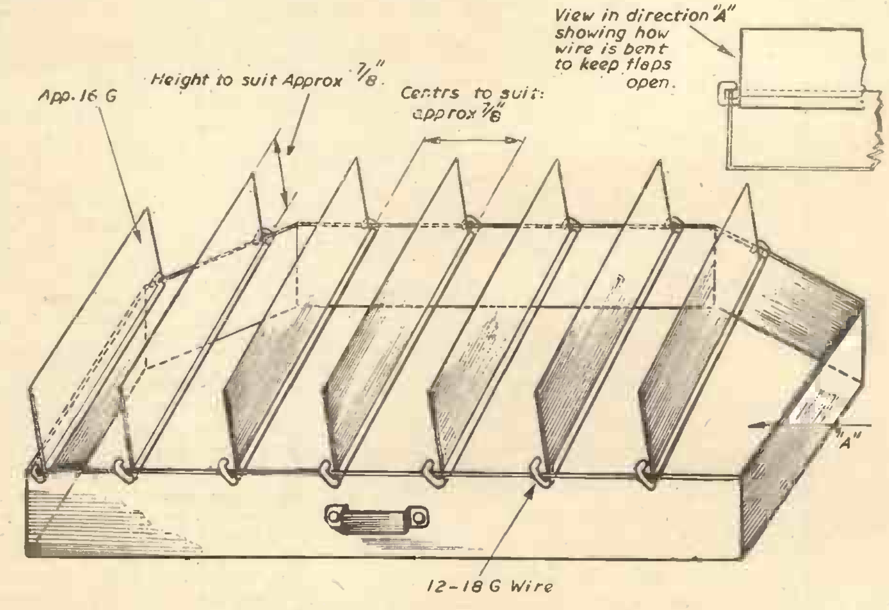
By C. WILLIAMS

THE type of ash-pan for which this improvement is intended is the all-night-burning type, and its purpose is to facilitate emptying and eliminate the danger and annoyance of the wind blowing the ashes about.

The device consists merely of the addition of flaps to the existing ash pan. These are of approximately 16 G. metal and are of a width and height to suit the pan. The height of the flaps and the distance between centres must, of course, be the same.

As shown in the illustration, the flaps are folded to envelop pins which are bent to rest on the edge of the pan. This keeps the flaps in nearly vertical position; they lay back slightly and so cannot fall shut.

Before removing the pan, a poker is passed along, closing all the flaps into a horizontal position. Their size and shape should be such that they just touch each other, thus enclosing completely the ash in the pan. In this position the ash can be carried in complete safety. Any handy man can make this small conversion, the scrap materials used costing about 1s.



General arrangement for an improved ash-pan.

A Simple Microprojector

A Device for Projecting Botanical and Biological Specimens on to a Screen

MUCH of the eyestrain involved in viewing and drawing microscopic botanical or biological specimens can be eliminated by the construction of a microprojector. The specimen must first be mounted on a slide in the customary manner for use with a microscope, and a much magnified image is then projected on to a screen in a darkened room.

An easy and perfectly satisfactory layout is shown in Fig. 3. The slide is held by elastic bands or strip springs against the side of a wooden box containing a 60-watt lamp, a hole being cut in the side of the box to illuminate the slide. If available, a low power objective should be taken from a microscope and mounted on a wooden stand as shown in the illustration and the relative positions of lens and screen adjusted until a bright image is focused on the screen. The actual positions will depend on the objective employed. If an objective is not available, a substitute can be devised from two short-focus convex lenses placed close together and preferably mounted as in Fig. 2, when light only passes through the centre of the lens system. A focal length of 1in. is the most satisfactory. The wooden stand not only holds the lens system but also acts as a baffle, shielding the screen from stray light.

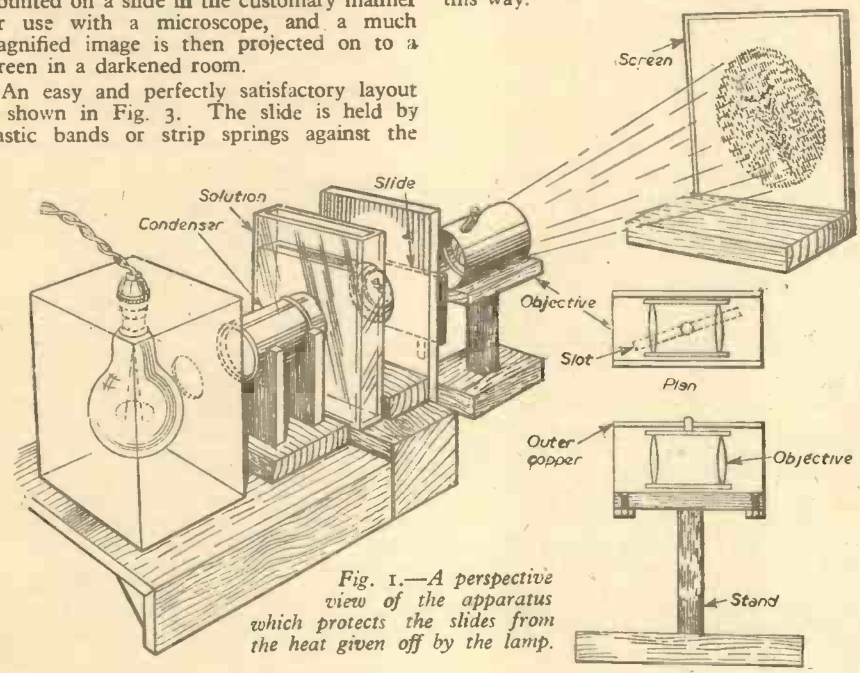


Fig. 1.—A perspective view of the apparatus which protects the slides from the heat given off by the lamp.

Translucent Screen

The maximum convenience in viewing, a translucent screen should be made by stretching a piece of greaseproof paper upon a wooden framework of dimensions roughly 12in. x 12in., and the screen is then observed from the remote side. With this scheme a magnification of 30 to 40 diameters can be used for successively demonstrating the specimen to an audience in a darkened corner of the room.

It is fascinating to make photographic records of minute specimens, and with a microprojector this is fairly easy. If the screen is replaced by a photographic film, an exposure of an hour is necessary but if, instead, gaslight paper replaces the screen, an exposure of three minutes is sufficient. The light and shade in the resulting print are reversed, but this is not really important since the specimen is usually stained to show up its structure and so in any case the natural colour contrasts could not be obtained. What is important is that an accurate record of the cell structure is clearly shown in black and white. The microphotographs of botanical specimens reproduced on the following page were all obtained in this way.

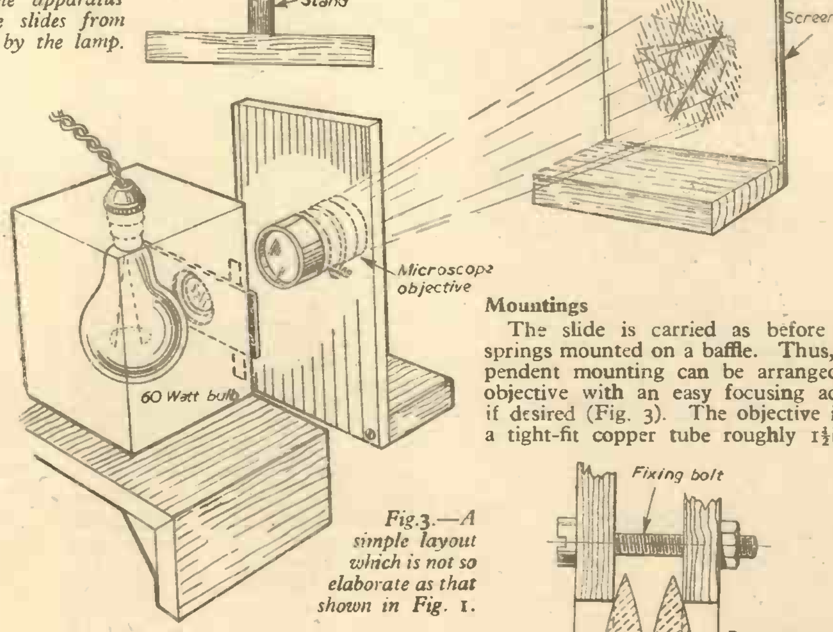


Fig. 3.—A simple layout which is not so elaborate as that shown in Fig. 1.

If a piece of red Cellophane or other transparent red paper is held between the lens and the gaslight paper, the image can be focused directly on the gaslight paper. Exposure is effected by removing the Cellophane. The advantage of this method lies in the fact that the slide gets warm owing to its proximity to the lamp; if exposure were made by switching on the lamp, the glass slide would be heated up from cold and the consequent expansion would result in a blurred image. (The expansion of the specimen itself is negligible, it is the increase in thickness of the glass causing the very short distance from lens to specimen to alter that upsets the focus.)

More Elaborate System

As mentioned above, the heating of the slide may cause inconvenience in certain cases, particularly if it is desired to exhibit the slide continuously for a long period, or if the specimen is likely to be damaged by heat. To overcome this the more elaborate system of Fig. 1 may be set up.

In the new scheme, the heat from the lamp is absorbed in passing through a solution of 5 grams of alum in 100 grams of water contained in a rectangular trough. The solution is extremely efficient in transmitting the light rays and absorbing the heat rays, but tap water may be used as a fairly good substitute. For the best effect the light should traverse about 1in. of solution.

Because of the increased distance of the slide from the lamp, a bigger hole must be cut in the side of the lamphouse and a condenser used to concentrate the light on the slide. The size of the hole depends on the diameter of the condenser lenses, but in the writer's scheme the latter is 1½in. so the hole has a diameter of 1in. As can be seen, the condenser consists of two short-focus convex lenses mounted in a short length of tube so that the position can easily be adjusted.

Mountings

The slide is carried as before by strip springs mounted on a baffle. Thus, an independent mounting can be arranged for the objective with an easy focusing adjustment if desired (Fig. 3). The objective is held in a tight-fit copper tube roughly 1½in. long:

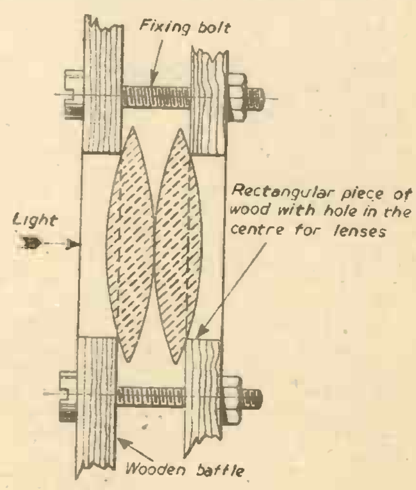
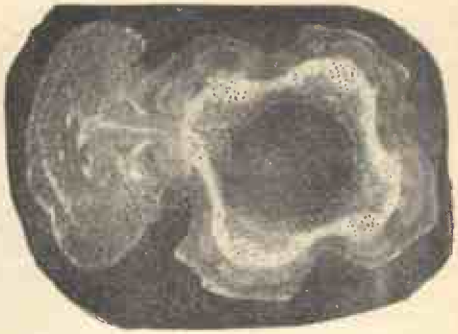


Fig. 2.—A substitute for an objective can be made from two short-focus convex lenses mounted as shown.

Transverse section of a lily seed showing the ovaries.

Typical transverse section of a stem.



Transverse section of host (right) and longitudinal section of parasite (on left).

this copper tube rides in a slightly bigger copper tube which has a diagonal slot cut in its upper surface. A $\frac{1}{8}$in. of brass rod soldered on the inner tube projects through this slot and as the rod is moved along the slot it causes the objective to rotate and thus advance or recede from the slide. With this layout the components may be mounted rigidly on a baseboard.

For exhibiting to large audiences, a higher power lamp must be used in order to get sufficient light to illuminate an image three or four feet in diameter. The lamphouse will now need redesigning for cooling purposes, but the simple box arrangement with a 100-watt lamp has met all the requirements of the writer. Alternatively, a 12-volt car headlamp bulb can be used in the box.

Making a Chiming Clock

A Novel Conversion Utilising the Disused Mechanism of an Alarm Clock

By L. J. PAYNE

THE ordinary domestic alarm clock, once its alarm mechanism ceases to function, is often discarded, yet with some stout plywood and some oddments from the junk-box it can start its life over again, but now in the form of an attractive and novel chiming timepiece.

The first thing to do is to take the alarm clock, remove it from its case, clean it with some petrol and check the actual time mechanism. The alarm mechanism is best out of the way and can be removed with a little patience and careful use of pliers, which can be used for slackening the nuts on the clockframe corners. The timepiece, now cleaned and inspected, is best put in a paper bag and placed on one side.

Construction

The clock case takes the form of a model church. The clock face and front of the church is a piece of seven-ply. Cut this to size, sandpaper, and locate and drill a $\frac{1}{4}$in. diameter hole for the clock hand spindles to protrude. Placing the clock mechanism in the position it will eventually take up at the back of the piece of plywood you will find that there are two gear wheels on the front of the "works" which prevent the hand spindles from protruding through the hole made for them. A recess must be made in which these two gear wheels can work, so mark around them and carefully cut out the desired space with a sharp knife. It will be wise to work layer by layer, counting the layers as you go until only one is left. Now try the timepiece in position and make sure that, using vacated holes in the clockframe, it can, when the time comes, be wood-screwed into position.

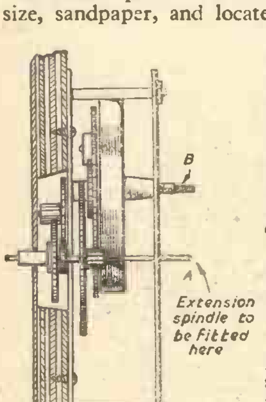


Fig. 1.—Side view of the clockwork mechanism.

Front and side view of the clock case.

Also, ensure that the mechanism is not obstructed by splinters and that the hand spindles stick out for at least a $\frac{1}{4}$in. from the clock face (Fig. 1).

Clock Case

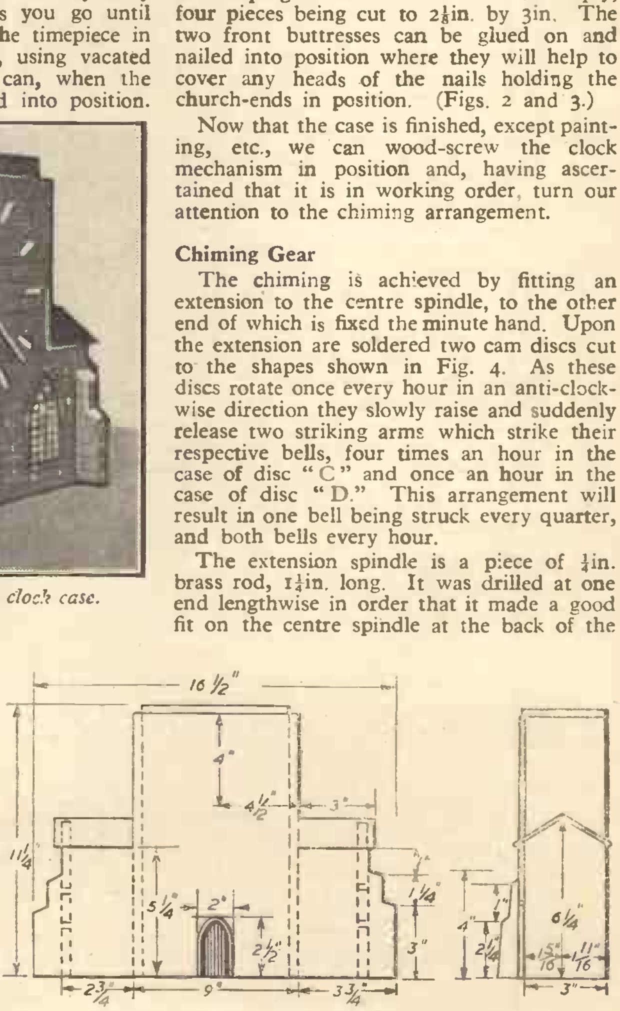
We can now proceed with the clock case. The tower sides and church end-pieces can be cut from some 3in. by 1in. or 3in. by $\frac{1}{2}$in. timber. So, too, can the buttresses, which will prevent any tendency of the clock to fall over on its face. When cut, the tower sides and the church-ends can be glued and nailed into place. The roofs, too, can be fixed with strong glue and panel pins. The church end sloping roofs are made from three-ply, four pieces being cut to $2\frac{1}{8}$in. by 3in. The two front buttresses can be glued on and nailed into position where they will help to cover any heads of the nails holding the church-ends in position. (Figs. 2 and 3.)

Now that the case is finished, except painting, etc., we can wood-screw the clock mechanism in position and, having ascertained that it is in working order, turn our attention to the chiming arrangement.

Chiming Gear

The chiming is achieved by fitting an extension to the centre spindle, to the other end of which is fixed the minute hand. Upon the extension are soldered two cam discs cut to the shapes shown in Fig. 4. As these discs rotate once every hour in an anti-clockwise direction they slowly raise and suddenly release two striking arms which strike their respective bells, four times an hour in the case of disc "C" and once an hour in the case of disc "D." This arrangement will result in one bell being struck every quarter, and both bells every hour.

The extension spindle is a piece of $\frac{1}{4}$in. brass rod, $1\frac{1}{4}$in. long. It was drilled at one end lengthwise in order that it made a good fit on the centre spindle at the back of the



Figs. 2. and 3.—Front and side view of the clock case.

timepiece. Cross drill this spindle and then tap 4 BA, so that the extension can now be firmly fixed to the spindle and yet can be loosened and adjusted if necessary. The two cam discs C and D can be improvised from old clock-gear wheels. or if a neater job is preferred they can be cut from scrap metal.

Cutting the disc for the quarter-hour bell can be a most exacting task if the accuracy of the bell-ringing is to be ensured, so perhaps the improvisation of some wheel or disc which is already marked or cut out in some way will give a better result.

When the cam discs are ready for fixing, solder them on to the extension spindle about 3/16in. apart, making sure that they are facing the same way, as shown in Fig. 6, when viewed from the back of the clock.

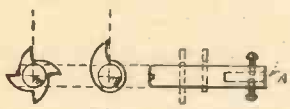


Fig. 4.—Cam discs and extension spindle.

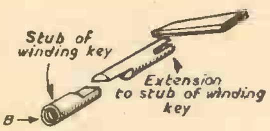


Fig. 5.—Detail of winding key extension.

The Striking Arms

The holes left in the clock frame by the removal of the alarm mechanism will now be useful for the pivoting of the striking arms. As the winding shaft protrudes from the back of the clock frame on the right-hand side and needs clearances to allow for winding, it will be necessary to have the striking arms arranged on the left, as in Fig. 6.

The striking arms are best made from some non-ferrous metal in order that the soldering necessary can be easily done. Obtain some brass or copper tubing with an internal diameter of about ⅛in., cut two lengths of approximately ⅜in. each and on to them solder the striking arms. Using any finely threaded bolts which will fit smoothly inside the pieces of tubing, secure the arms to the clock frame and test for smooth action, as any slackness will prevent accurately rung bells. The arms themselves must not be too rigid or they will have a tendency to either "stick" to the bell, having hit it, or fail to hit the bell altogether, when moved slightly away. In fact, the quarter-hour arm will need a fair amount of whip if its cam disc has any inaccuracies. This can be provided by using about 2½in. of clock spring. Clock-spring steel is difficult to work with, but nipped carefully on the edge and bound with copper wire to the arm, followed by soldering, a joint which is strong enough can be obtained. Using this method a brass nut or washer can be fixed to the other end of the piece of spring to act as a striker. Small coiled springs are used to give the striking arms the necessary sharp action at the moment of striking.

Assembling

Assuming that the clock case has been painted a dark grey colour and is otherwise ready for the final stages of assembly, the clock and its chiming mechanism can be firmly fixed into position. The provision of bells should present no serious problem, indeed, bicycle bells and many containers used in the kitchen can produce quite pleasant chimes. When everything functions as it should do attention can be devoted to fixing on the hands and "lining up" the chimes.

First, ensure that the two striking arms will operate within a second or so of each other once an hour—this is the hourly chime, and so, with one hand holding the cam discs in the "just operating" position fix the hour hand on with the other hand, ensuring at the same time that the hour hand takes up a position pointing to

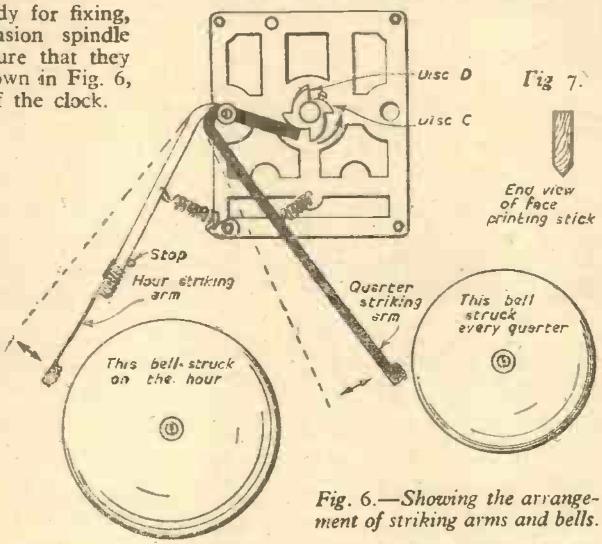


Fig. 6.—Showing the arrangement of striking arms and bells.

12 o'clock. Similarly, we can fix the minute hand so that it lies above the hour hand. At this point it is advisable to consider the hands and the clock face. The original hands can be used, but if a 7in. clock face is desired hands 2½in. and 3½in. long must be made. These can be made of 3/32in. squared brass and soldered to the original brass sleeves, unless it is desired to adjust the time from the front of the clock. If so, the minute hand must be fixed firmly to the minute hand spindle, preferably with the aid of a small grub-screw and a "flat" filed on the spindle in the appropriate place. To make winding easier an extension to the winding key is necessary, as shown in Fig. 5.

Clock-face Digits

The clock-face digits can be put on in white paint using a printing stick with an end cut to the shape shown in Fig. 7. By rotating the hands through the various hours and smearing the stick with white paint on each occasion a neat print can be made for each hour, taking care to keep the printing the same distance from the tip of the hour hand and always pointing towards the centre of the clock face. The outside end of each print must, of course, be level with the tip of the minute hand when that hand passes over it. The 12 o'clock mark can now be made, the minute hand being moved away while this is done.

The door was coated with Indian ink and water-colours and glued in position, while the windows were water-coloured on thin card and also glued in position.

Using a pen and Indian ink a suggestion of stonework can be made on the corners and around the windows. These little touches will help to give the finished clock a more pleasing appearance. The one shown has kept good time and correct chimes for over six months.

Items of Interest

The SA/4 Jet Bomber

THE second prototype of the SA/4 long-range high-level jet bomber, which was recently delivered to the Ministry of Supply, was designed and built at the Belfast works of Short Brothers and Harland, Ltd. This aircraft is to carry out special trials for the development of some of Britain's latest secret equipment. Incorporated in the aircraft are many unique features including those relating to flying controls.

The SA/4 carries a crew of five, has a wing span of 109 ft. and is 102 ft. long. It has a tricycle undercarriage with four-wheel bogies and nose wheel steering. The members of the crew are housed in a pressure cabin to enable them to operate the aircraft at high altitudes.

John Cobb's Car

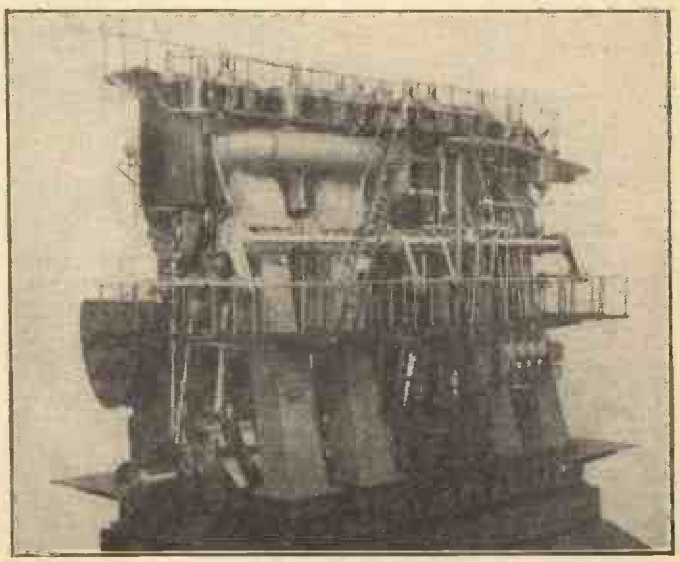
THE car in which John Cobb set up the world's land speed record of 394.1 m.p.h. has been bought by Dunlop for exhibition, first at Fort Dunlop where its tyres were made, and then round Great Britain.

11½-ton Conveyor Belt

A CONVEYOR belt weighing 11½ tons is being shipped to India from Dunlop's general rubber goods factory in Cambridge Street, Manchester. The belt, which will convey hot drenched coke in an iron and steel works, is 397 yds. long.

A Remarkable Model

THE accompanying illustration shows a fine example of model engineering craftsmanship. It is a quadruple expansion marine engine, built to a scale of 1/16th full size, and is the work of the late Mr. S. J. Ward, of Northampton.



The Shape of

Stereoscopes, Panoramics and Stereophonics Briefly Ex

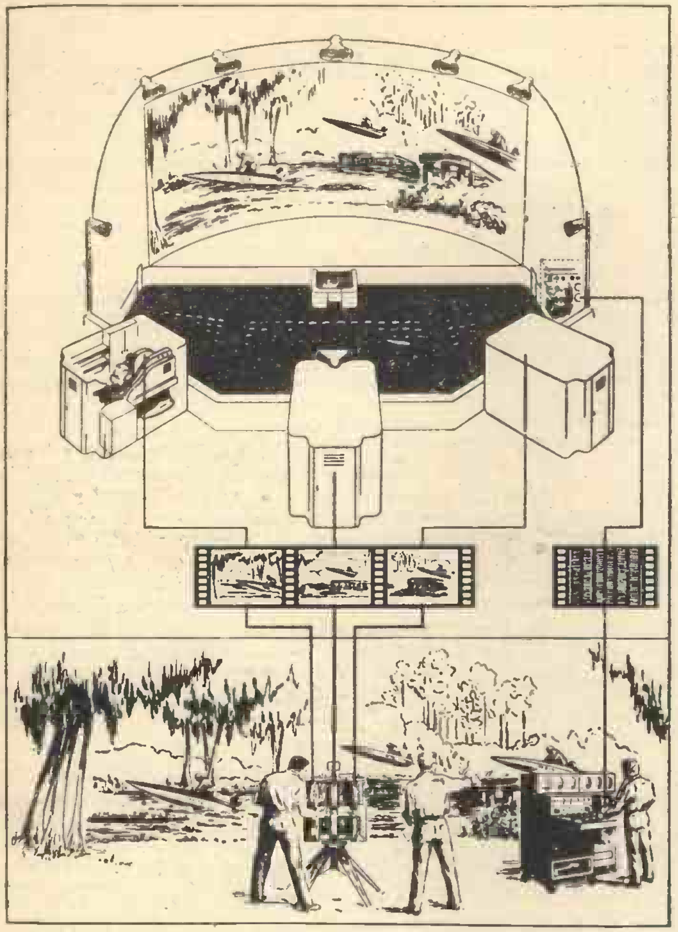


Fig. 1 (Left).—Cinerama. Schematic sketch showing (at bottom of picture) camera taking three separate negatives, prints from which are projected with three projectors on to wide panoramic screen, running synchronously together with multiple sound tracks reproducing on six sets of loudspeakers.

THE name 3-D popularly covers several completely different methods of presenting and projecting films, not all of them of recent origin. Film making has not altered very much since the introduction of talking pictures in 1928, and since that time, apart from an increasing number of colour films, the technical side has remained more or less in the same groove. Improvements there have been in matters of detail—in sound-recording equipment, in the optics of cameras and projectors, in various trick processes in the studios, in the laboratory and in the comfort of the tip-up seats—but fundamentally the technical methods of production and presentation have remained static.

Why should there be a change? Cinema going had become an established habit all over the world. Association of sight and sound in the flexible medium of cinema had created an instrument for conveying information in a manner most easily absorbed by the public. Whether the information was of a trivial "escapist" entertainment type or of a serious educational or propagandist character, the impact was irresistible.

TV Competition

Then came TV. At first, particularly in Britain, the new rival combination of sight and sound communication had little effect upon the cinema box offices. America was slow off the mark with public television services, but America is a land of enthusiasm and crazes, and when the TV craze caught on, it did so in no uncertain manner. Over the past three years, hundreds of thousands—even millions—of TV sets have been sold in the U.S.A. There the television set has already taken its place with the refrigerator, the washing machine and the automobile, as an essential part of the American way of living. The high pressure TV campaign of the last Presidential elections put the final seal upon its success. Television in the U.S.A. is not merely an "it would be nice to have it" product in the home—it has become a "must have it" fitting and fixture.

This tremendous popularity of television in America, with its alternative programmes, highly competitive on a sponsored basis, naturally has had serious effects upon the box office earnings in that country. For the first time in the fabulous history of a fabulous industry, American films were not earning their production costs in their own country. The livelihood of thousands of craftsmen and technicians and an enormous capital investment in plant at studios and theatres was in peril. Smaller theatres, especially those operating on a marginal basis, went to the wall. Something had to be found to tempt the public away from the hated television receivers back to the cinema. What was it to be? Sound saved the cinema from bankruptcy in the late twenties. Was there another magic technical "gimmick" that would do the trick again?

The Transition from Silent to Sound Films

At this point it is necessary to recapitulate briefly what actually did happen in 1927-28, because there is a great deal of similarity, not only in the situation facing the film world to-day, but in the sequence of events. With falling attendances and rising costs films seemed to be losing their hold in the entertainment field. Money was short; 1927 was a slump year in the U.S.A. Wide pictures, photographed on film 70 m.m. wide compared with the standard 35 m.m., were tried out by Fox Films, projected upon huge screens, and were received by the public politely but not enthusiastically. Jack, Sam and Harry Warner, heads of a (then) medium-sized film producing company, decided to try a new development of an old idea, the talking picture, as a last gamble to draw the public. Electrical gramophone disc recording had made great advances in the previous two or three years, and the Warner Brothers decided to take up the Vitaphone, a system of running synchronously film and gramophone discs.

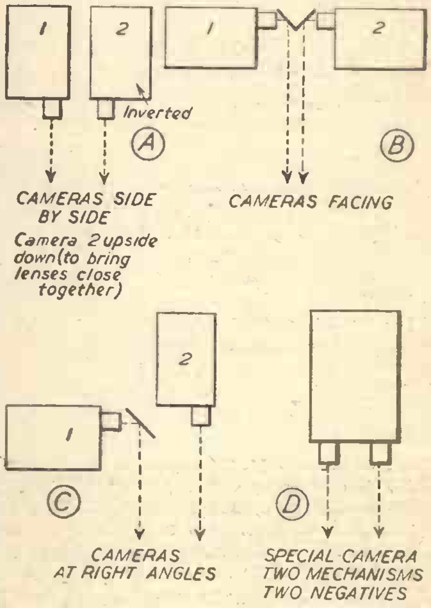


Fig. 2.—Alternative methods of photographing 3-D.

Starting with operatic recordings and "The Jazz Singer," they went on to make "The Singing Fool," with Al Jolson. The association of a dynamic personality with the new technical novelty captured the imagination of the filmgoers, and the initial presentations at New York and other key cities and in London played to capacity audiences. Nevertheless, within a couple of years, the Vitaphone system of making talking pictures was on its way out, the mechanical restrictions inherent in the gramophone recording method

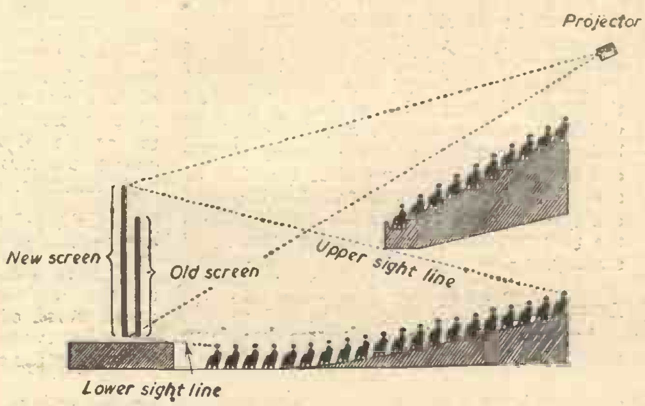


Fig. 2a.—Profile of new wide screen presentation—1 to 1.66, by Paramount.

Films to Come

…lained By BAYNHAM HONRI (*President of the British Kinematograph Society*).

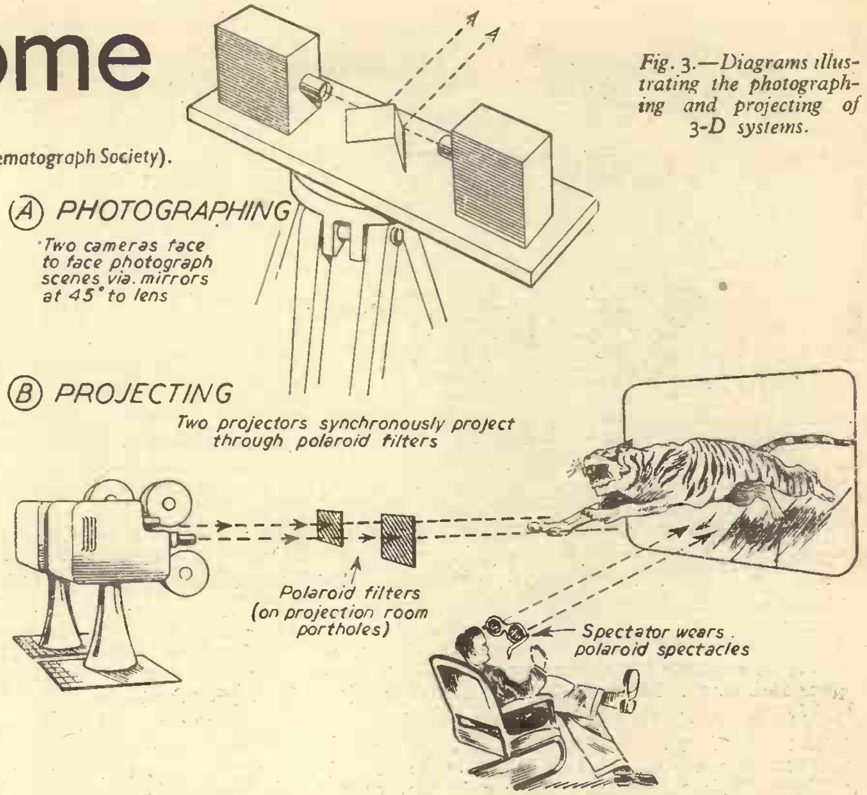
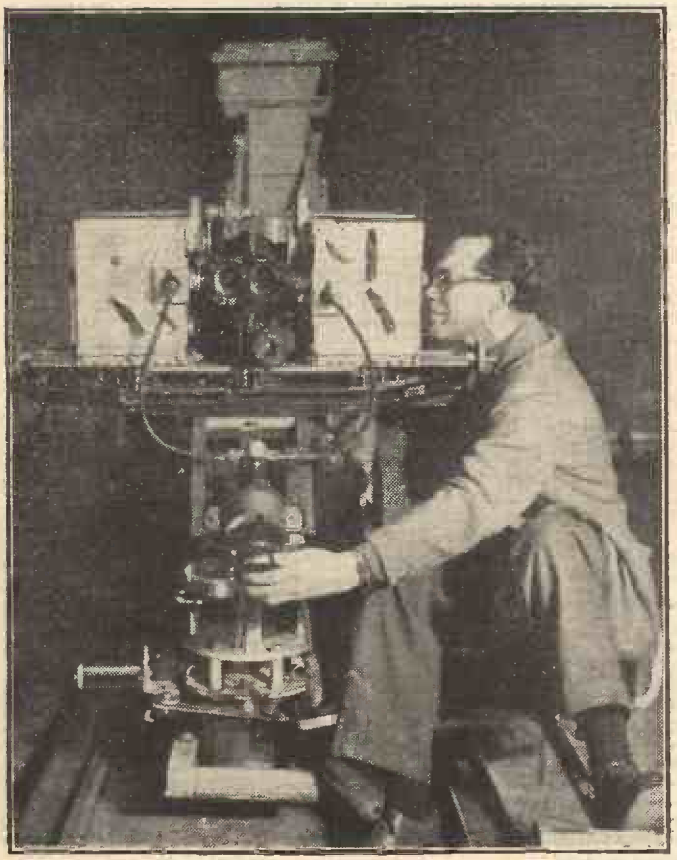


Fig. 3.—Diagrams illustrating the photographing and projecting of 3-D systems.

proving impracticable, except for long scenes, each approximately one reel in length, filmed by several cameras at the same time. Much more flexible were the new sound-on-film systems by Western Electric, R.C.A., British Acoustic and others. The shape of the silent picture was adjusted to allow for the sound track to be printed by its side, on film of the same gauge that ran on the original Edison Kinetoscopes of 1889. And so, with mobility and flexibility restored to the motion picture itself, the industry settled back into an era of prosperity, stability and complacency.

Film History Repeats Itself?

The history of 1927 looked like repeating itself twenty-five years later. For in 1952 there was presented in New York an extraordinary new type of entertainment, "Cinerama," the name of which was evolved by combining the words "cinema" and "panorama," indicating the basic principles of the system. In addition, sound is reproduced from a separate medium, as in the days of Vitaphone. Upon a huge, curved screen, about 60 feet wide and 25 feet high, with a maximum depth of about 15 feet, are thrown three pictures side by side from three projectors. The pictures are interlocked and synchronised so that the three separate motion pictures join together to form one complete composite of such an immense field as to fill the whole of the wide angle of vision of the human eye, about 65 deg. horizontal and 60 deg. vertical. Cinerama's range from the majority of seating positions is about 146 deg. and 55 deg. respectively, thus enabling the eye of the viewer to take in a field which approximates to what he normally sees directly in front of him and to the left and right. The whole field of vision, including what is called "peripheral vision," is thus filled by the composite images put upon the screen. The system is not stereoscopic, since the viewer's right and left eyes are not fed with separate picture information, filtered by polarised spectacles or other means of optical isolation. Yet the effect is said to give a very startling illusion of the third dimensional, assisted, no doubt, by stereophonic sound. Six separate sound tracks, recorded magnetically on one film, are fed to five sets of loud-speakers equally spaced behind the screen, together with additional speakers in the auditorium. As the picture, for example, of a motor-boat passes across the screen from right to left, so does the appropriate sound come from the appropriate loud-speaker. (See Fig. 1.)



Stereo-techniques 3-D Cameras

Two Newman-Sinclair cameras are mounted on an adjustable baseplate. The latest stereo-techniques camera, now under construction, combines two camera movements and lenses in one camera.

Most of the long-standing technical standards of film making and projection have been ignored by the promoters of Cinerama. The size of each frame of picture is one-half higher than normal and occupies the full width of the film, between the perforations. The film travels 50 per cent. faster through the projectors, which pull down six perforations for each frame as against the normal four. Sound is on a separate film altogether, which carries a magnetic coating and six sound tracks. Discrepancies in the joining up of the three composite images is cleverly concealed to a large extent by means of a wobbling vignetting device which softens the joining edges. The Cinerama camera is a complicated affair shooting three negatives simultaneously with three 27 m.m. focal length lenses set at 48 deg. angles to cover, in composite form, the complete field required by the Cinerama screen.

The inventor of Cinerama, Frederick Waller, was a "Special Effects" (i.e., trick photography, etc.) specialist for Paramount for some years, and during the war perfected a gunnery trainer. In this a composite picture from three projection machines was projected inside a sphere, simulating conditions likely to be met in aerial combat. From this gunnery trainer was developed an improved system to which was added stereophonic sound, resulting in Cinerama. Cinerama is playing to capacity in New York, Los Angeles and elsewhere. It provokes enthusiasm—it is said to be a "new experience"—and the programmes, so far, have been designed to exploit what is called "audience-participation." Is Cinerama, then, the "gimmick" that the film industry requires?

There is no doubt at all that Cinerama is a colossal success. But it is expensive to install; quite beyond the pocket of most cinema proprietors. Furthermore, it necessi-

(*A*) *The image on a standard 35 m.m. film is compressed horizontally* (*but not vertically*) *by a supplementary Hypergonar lens on the camera lens.* (*B*) *A compensating Hypergonar lens on the projector lens restores the picture to normal, but widens it to an aspect ratio of* 2.66 : 1 *on a wide curved panoramic screen. The scene is from "The Robe"* (20*th Century Fox*), *the first full-length production to be shot with the CinemaScope process.*

tates the sacrifice of large numbers of seats, the screen can only be installed in wide auditoria, it is a medium suitable only for specialised subjects, and the personnel to operate the equipment is at least five times as many as for the normal cinema.

Alternatives

The cinema moguls, therefore, looked around for alternative methods of presentation which might give the same "audience-participation" effect as Cinerama: the same sense of stereoscopy. Not unnaturally, they rediscovered genuine stereoscopic films, to which their attention had been drawn by a number of stereoscopic short films shown at the Festival of Britain's Telekinema. A feature film "B'wana Devil" was made with a system known as Natural Vision, which, like the Telekinema's "Stereo-Techniques" process, used polar screens for sorting out what the left eye and the right eye should see. Two negatives are photographed simultaneously on cameras coupled together and lens systems which are very approximately 3in. apart, but capable of being varied from about 2½in. to 7in. separation, according to the depth of the shot being photographed. For long shots or for exaggerated three-dimensional effects, a wide inter-ocular separation is used. In practice, the two cameras face one another and adjustments for parallax and convergence are made by precision control of mirrors and by toeing-in one of the cameras. (See Fig. 2 and 3A.)

Prints from the resultant twin negatives are projected in the cinema on two projectors which are mechanically or electrically interlocked, and the "left" and "right" eye images are projected through polaroid filters mounted on the projection room port-holes, the polarisation of the two filters being set at 90 deg. to one another. Viewers wear spectacles fitted with polaroid filters adjusted in the same manner, and these filters ensure that the left-hand image is allowed to reach the left eye only, while the right-hand image is similarly filtered through to the right eye (Fig. 3B). The novelty effect of "B'wana Devil" caught the imagination of the American public and it did enormous business. Soon there were many three-dimensional systems (by now known as "3-D") offered to producers—Paravision, Stereo Cine, Dunning, Producers Service and Tri-Opticon (the American version of the British Stereo-Techniques system). All of these systems worked more or less on the same lines as "Natural Vision" and required the spectator to wear polaroid spectacles. M.G.M. revived their "Metroscopix" system which required the viewer to wear spectacles having red and green glasses to sort out what the left eye and right eye should see.

Wide Screen

Meanwhile, 20th Century-Fox acquired the French invention which they now call CinemaScope. This is not a 3-D system, but is more on the lines of Cinerama, inasmuch as the object is to project a picture upon a very wide concave screen, but from one projector only, instead of Cinerama's three. To do this, scenes are photographed with a cylindrical lens of special design fitted in front of the normal camera lens which has the effect of compressing the scene horizontally. The projector is fitted with a similar lens, which expands the scene again to its original aspect—of 2.66 to 1 compared with the normal 1.33 to 1 (see Fig. 4).

CinemaScope is sometimes referred to as the "Poor Man's Cinerama"; the screen proportions are actually a little wider, 2.66 to 1 compared with Cinerama's 2.4 to 1, and both utilise stereophonic sound to heighten the three-dimensional illusion. One film, "Prince Valiant" is now being made in England on the CinemaScope system, but it is significant that a second camera is

Fig. 4.—A comparison of the CinemaScope and standard screens.

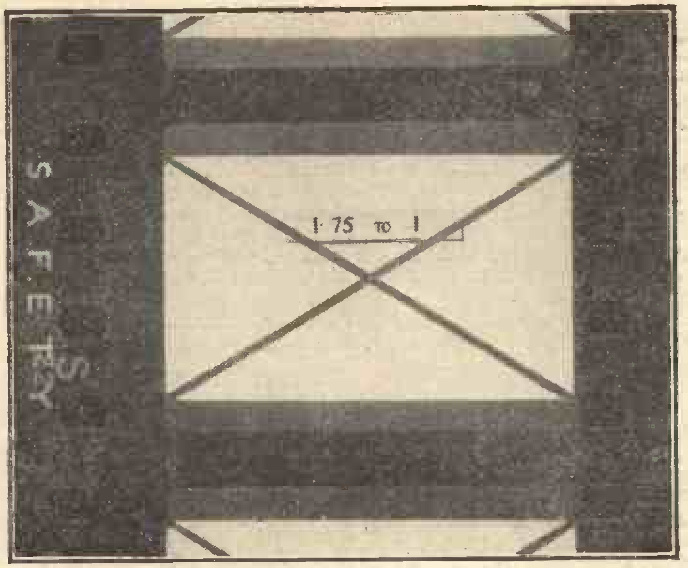


Fig. 5.—Wide screen proportions can be obtained by using a shorter focus lens on the projector and cutting off a section of the top and bottom of each film frame. This illustration shows the old normal frame and the section which would be utilised within it for a screen aspect of 1.75 : 1. The projector is fitted with an aperture plate in its gate of this ratio.

simultaneously shooting a negative for more normal type of projection.

Other American companies have been making pictures on normal equipment, which are intended for projection on large or wide screens, by cutting off sections of the top and bottom of the picture and using projection lenses which have a short focal length (see Fig 5). Various aspects of from 2 to 1, 1.86 to 1, 1.75 to 1 and 1.66 to 1 are being tried by different companies, but the more moderate ratio of 1.66 to 1 seems to be gaining favour (Fig 6). The fact is, few cinemas, especially British cinemas, are structurally suitable for extremely wide screens. Nevertheless, larger screens have become popular and the improved technical standards necessitated by such large screens may well give audiences something of that sense of participation in the scene being viewed that gave Cinerama such a success.

Exciting days are ahead for cinemagoers. The film people are determined to change the shape of pictures to come so that they are unlike the "hated" television. It will be recalled that the shape of the picture in British television at one time had a proportion of 5 to 4, but that this was changed a couple of years ago to a standard of 4 to 3, which is the same as the old normal cinema screen. H. J. Barton-Chapple in *Practical Television* revealed recently that this standard, equivalent to a screen proportion of 1.33 to 1, has not been very strictly adhered to by set manufacturers. Similarly, the cinema proprietors seem to hold differing views about the changing shape of the new big screen, which, it must be added, will have a metallic or beaded surface to increase reflection, apart from requiring a more powerful light source. (See Fig. 2a).

Ultimately, the cinema may give us wide screened, coloured three-dimensional films, but in the meantime we will be served up with one or the other of these developments separately. Stereo films are extremely popular with audiences, notwithstanding the necessity of wearing polaroid spectacles, judging by the London success of "The House of Wax." No less than twenty-five 3-D films of similar type are now being made in Hollywood, most of them of the "horrific" type, exploiting the special characteristics of this medium. It is a curious fact that no major British production is being made on true-3-D at the moment, especially as the British Stereo-Techniques system was first in the field and probably still leads in the intricate technique of this type of photography.

It is not beyond the realms of possibility that cinema owners may vary the method of presentation from week to week—3-D one week, wide panoramic screen the following week and a reversion to the old normal screen on a third week, according to the type of subject being presented. This will depend upon a simplification and agreement within the industry of the standards to be used, a move which is being carried out by the British Kinematograph Society in conjunction with the Society of Motion Picture and Television Engineers of America. I think such a variation of presentation would appeal to cinemagoers if it could be achieved.

Approximate proportions with relation to existing 4x3 Standard	Proportion of height as to width of screen
4 x 3 Existing Standard	1·33 to 1
5 x 3	1·66 to 1
5¼ x 3	1·75 to 1
5½ x 3	1·86 to 1
6 x 3	2 to 1
8 x 3	2·6 to 1 Cinemascope

Fig. 6.—Normal wide screen and panoramic screen aspect ratios.

Whatever happens, exciting days, or rather evenings, lie ahead for cinemagoers, who will be the first to benefit from the intense competition now developing between the cinema and television.

BOOKS Received

Pass Your Driving Test. By A. Kilgour. Published by C. Arthur Pearson, Limited, Tower House, Southampton Street, Strand, W.C.2. 80 pages. 3s. 6d. net. (Fourth edition.)

As its title suggests, the aim of this book is to assist prospective licence holders to pass their driving test. It is divided into four sections, the first of which deals with the details of the actual driving test and lists the practical points which the examiner watches. Section 2 is titled "Driving Test Hints" and, with the aid of many photographs and line drawings, the various manoeuvres through which the applicant has to take his vehicle are dealt with in detail. Questions and answers on the highway code form the book's third section, and here are listed all the possible questions which may be put in the oral section of the test. Section 4 deals with traffic signals and signs: those made by the driver, by the police on point duty and the permanent roadside signs. The appendix contains a table of vehicle groups; a table showing where to apply for a driving test and a table giving stopping distances at different speeds. Each section is simply explained and carefully illustrated with photographs and diagrams and all this information is concisely packed into a pocket-size book which can be carried and studied anywhere.

Model Maker's Workshop. By E. W. Hobbs, revised by Norman G. Taylor. Model Motor Boats, by Norman G. Taylor. Published by Cassell and Co., Ltd., 37/38, St. Andrew's Hill, London, E.C.4. 65 pages. 4s. 6d. net each.

These two books are included in Cassell's new Model Maker series. "Model Maker's Workshop" deals, in addition to workshop layout for general model making, with model making in the home and the tools and equipment required for various hobbies. There are special chapters on woodworking tools, metal-working tools, materials, the lathe and items of workshop equipment which are easy to make and useful to the model maker. The book is illustrated with numerous line drawings.

The first chapter of "Model Motor Boats" deals with the subject from a general point of view, types of model, simple workshop equipment, etc. Following this is a chapter which goes into the question of motive power and includes hints and advice on the installation and operation of power plants, including steam diesel, glow plug, spark ignition and miniature jet motors. Practical construction is given a chapter to itself and all the general principles of hull and superstructure construction are dealt with. Four designs are contained at the end of the book and there is a chapter dealing with each of these. Line drawings are used throughout to supplement the information given.

Car Battery Charging Control—2

Control Units and Regulators

(Concluded from page 465, August issue)

By F. J. FULFORD

THE method by which voltage control is secured was broadly described last month. The control units may vary in shape but the principle of operation is the same. There are two main types; the first is that in which the voltage controller looks much the same as the cut-out, though the cut-out may be identified by the presence of a stop on top of the armature to limit its movement. The Lucas RF91 control box is typical of this type. Of the second type, the C.A.V. "barrel type" is often found on British cars.

The Lucas RF91 Type Control Unit

This type of unit consists of a cut-out and regulator mounted side by side on a moulded base, which carries the terminals. The cut-out is of the type described last month. The regulator is shown diagrammatically in Fig. 6. It consists of a moving part, A, on which one contact is mounted. A is fixed to the frame, B, by a flat piece of spring steel, and is thus allowed to vibrate. On the core D is wound the coil. The spring normally holds the armature A away from the core so that the two contacts are closed. The dynamo output is connected to the frame of the unit, as is one end of the coil. The other end of the coil is taken to earth, in this case, the car chassis. The current flowing from the dynamo through the coil magnetises the core and tries to pull the contacts open. It is arranged that this will not happen whilst the dynamo is rotating at a low speed, but as the dynamo speed increases, so will its voltage. When the voltage reaches a high enough level the force of the spring will be overcome and the contacts will be opened. This action places the resistance in the field circuit, which reduces the current through the field and reduces the dynamo voltage. With the reduction of voltage, the magnetism of the core becomes insufficient to overcome the spring, so that the contacts close again. The resistance is now shorted out of the field circuit, allowing the dynamo voltage to increase again, which once again opens the contacts. This cycle of operations is continually repeated, and the armature assumes the vibratory action of a door bell. As the speed of the dynamo rises its voltage, when the resistance is switched out, will also rise, which makes the vibratory action faster.

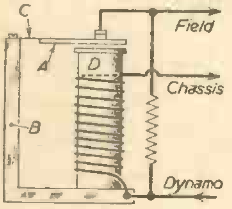


Fig. 6.—*Simple voltage regulator.*

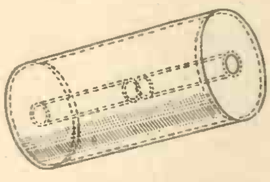


Fig. 8.—The form of the barrel.

A diagrammatic sketch of the regulator as used, with its associated circuit is shown in Fig. 7. Some extra features are also introduced. It will be seen that an extra coil is wound on the core, and this coil is tapped in the middle. To one end is brought the dynamo output from the cut-out. The tapping point is taken to the battery circuit and the other end to the consuming units, with the exception of the starter motor. All the current from the dynamo flows through this winding, and adds to the magnetic effect of the core. A high current increases the degree of control and protects the dynamo against overload.

The adjusting screw E, by which the regulator is set, is also shown. This screw bears against a strip of bi-metallic material which distorts with a change of temperature. By this means, the setting of the regulator is altered as it warms up, enabling the battery to be given a rapid boost charge after the car is first started from cold.

The Barrel-type Regulator

The principal of this type of regulator is the same as that previously described but the mechanical arrangement is different. It consists of a hollow cylinder containing a further hollow cylinder of smaller size, as shown in Fig. 8. The inner cylinder is in two pieces, having an air gap in the middle. The controlling coils are mounted on the inner cylinder, and inside this again is the armature. The armature is supported on two diaphragm-like springs, one at either end of the barrel. The armature of this unit, however, vibrates in a floating manner. It also has two coils, one being the voltage controlling coil and the other for current compensation. The main contacts are at the left-hand side of the regulator as shown, and are denoted C1 in Fig. 9. These, contacts are normally kept closed by the spring D. When the magnetic field due to the dynamo voltage becomes strong enough, the armature is pulled to the right, opening the contacts. This switches in the field resistance, which lowers the dynamo voltage, the magnetic pull on the armature is reduced, allowing the spring to regain control and the contacts close again. The vibratory action is thus set up, just as it was in the case previously described. Inside the controlling spring D, a second pair of contacts, C2, will be noted. At the top end of the dynamo speed range the armature movement becomes great enough to close these contacts, which short-circuits the field. In this way a greater degree of control is effected at higher dynamo speeds.

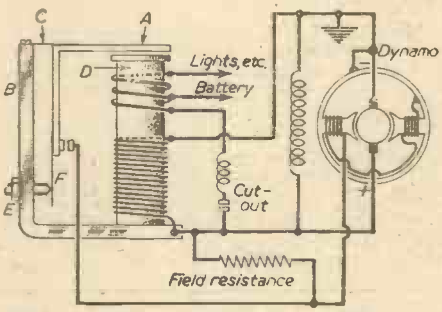


Fig. 7.—Regulator circuit of Lucas RF91 type.

The regulator has three adjustments, A1, A2 and A3. A1 and A3 take the form of plugs which may be screwed in or out of the barrel. The plug A1 controls the position of the main contacts and should not be touched after the regulator has been in service, since the contacts become bedded in by hammering. Turning the plug turns one contact. Sparking is then likely to develop, which might lead to the welding together of the contacts. The plug A3 controls the spring pressure on the armature and controls the regulated voltage. The adjusting screw for the second pair of contacts is mounted inside the plug A3, so that after altering A3 it is necessary to alter A2 if it is to be kept in the same position as before. It is A2 which controls the regulated voltage at high dynamo speeds. Special tools are needed to make adjustments and to unlock the locking rings.

The Adjustment of Regulators

It is perhaps natural that the owner of a failing battery should attempt to prolong its life by altering the regulator. This course is unwise. If the battery plates have shed the active material, the capacity of the battery will be much reduced, and it will become charged to the limit of its capabilities in a short time. The charging rate will then be satisfactory at the beginning of a run, but will soon fall. In a case such as this, it is better to have the battery checked with a high discharge cell tester than to interfere with the regulator.

Every other possible cause of trouble should also be checked before alteration of the regulator is considered. The fan belt should be tight enough to avoid slip. All connections should be clean and tight.

If, after this check, the regulator still appears to require attention a quick check on its operation can be made by connecting a voltmeter across the battery, with the engine running. Note the battery voltage when the cut-out is open, and then gradually increase the engine speed. There should be a rise in the voltage when the cut-out closes, and then a steady rise up to the point where regulation commences. After this there should be no substantial rise. If a load is now switched on, in the form of the head-lights, a momentary drop in voltage may occur, but the reading should quickly recover. Similarly, when the load is switched off, a slight rise may be noticed, but here again it should quickly correct itself. If everything appears to be in order, the charging rate may now be adjusted. To do this, a voltmeter is connected across the dynamo output and the circuit opened by carefully inserting a piece of paper between the cut-out contacts. The true regulated voltage will now be read. For this test the engine should be running at a moderate speed, since the secondary current controlling coil is not in operation; damage may occur if the engine is over-revved. The regulator is normally set to maintain a stated voltage, usually somewhere between $7\frac{1}{4}$ and $8\frac{1}{2}$ volts for 6-volt equipment.

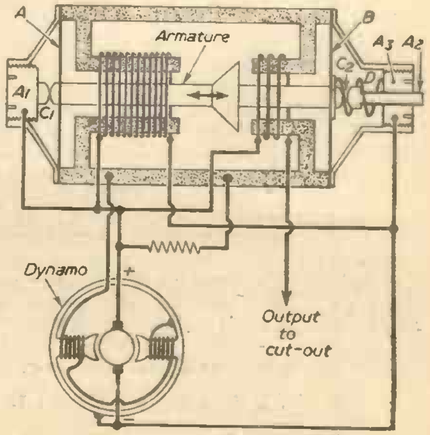


Fig. 9.—Barrel-type regulator and circuit.

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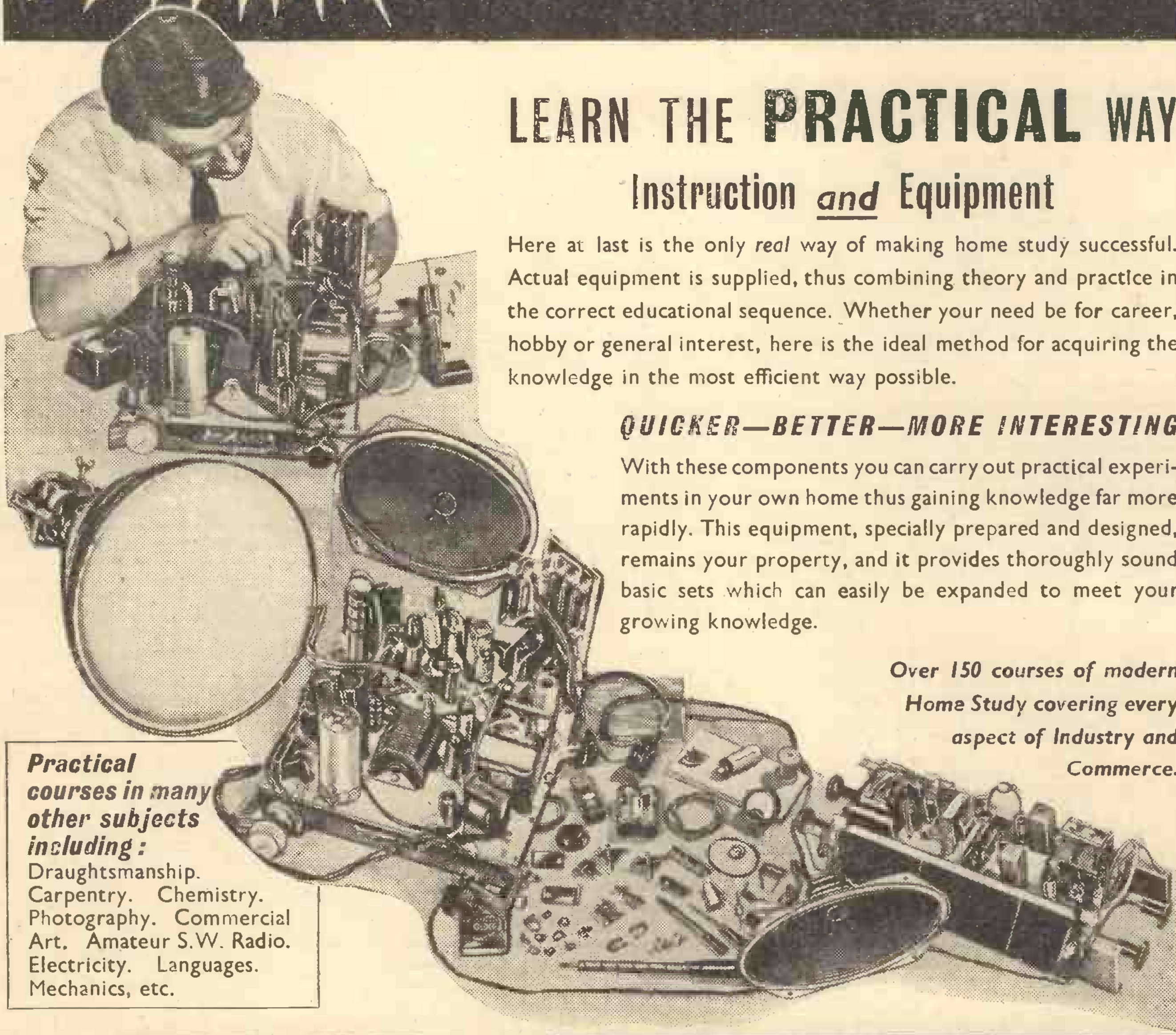

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HARNESSING THE SUN

Modern Ideas on an Age-old Problem

By "PHYSICIST"

THE earth's climate is not likely to alter appreciably within the next 100 million years, but the naturally occurring terrestrial sources of energy will be exhausted long before that. It is not surprising, therefore, that increasing interest is being shown in the direct exploitation of solar energy.

At first sight, the idea that the sun's rays can supply our fuel needs appears absurd, yet the earth receives approximately 100 billion British Thermal Units of energy from the sun every second, which is the amount of energy available in six million tons of coal. Even in Britain, where the sun is obscured by clouds for long intervals, sufficient solar energy is received to more than supply all our needs.

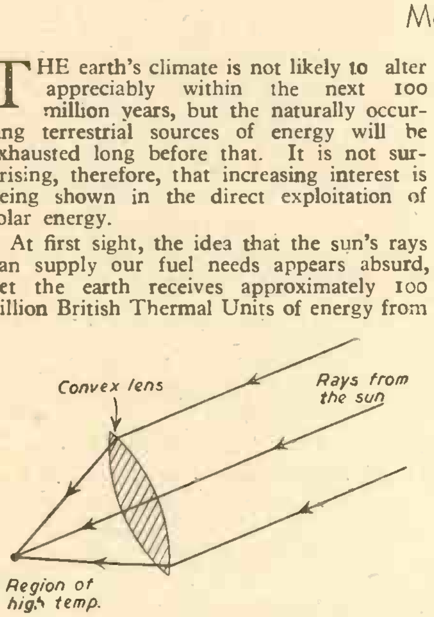


Fig. 1.—Simple burning glass in which the sun's rays are concentrated into a small area.

But although we are innundated with this bountiful supply of energy, it has proved exceedingly difficult to harness. It is true that in the past determined attempts to make use of it have been few and far between, but there is no doubt that within the next 100 years the world's rapidly dwindling naturally occurring fuel reserves will make it imperative that satisfactory methods for its utilisation be worked out.

The effectiveness with which solar energy can be harnessed will to a large extent depend upon geographical position; no doubt, the tropics and the arid regions of the world, where there are long periods of brilliant sunshine will provide the most advantageous sites from which to develop the use of this energy.

Solar Furnaces

In our youth we were all familiar with the use of the magnifying glass (convex lens), or even the crude lens formed by the thickened bottom of a glass jar, which could focus the sun's rays into an intense spot of light. The heat developed in this small area was sufficient to char paper and at times cause it to burst into flames (Fig. 1). This application of solar energy dates back to the Ancient Greeks, and as long ago as 1774 the burning glass had been used to melt iron.

Because of the difficulty in making and the resulting high cost of large glass lenses, recent solar furnaces have used spherical mirrors to focus the sun's rays (Figs. 2 and 3). A 10ft. diameter aluminium mirror furnace, in which the sun's rays were concentrated by a concave mirror (Fig. 3), reached a temperature of 3,000 deg. C. in a few seconds and has been used to study the behaviour of metals and refractory materials at high temperatures. The largest solar furnace built so far was erected last year in the French Pyrenees, and has a 40ft. diameter mirror which can produce 75 kilowatts of energy in the form of heat.

Attempts have been made to use the heat, which is produced by solar furnaces, to produce mechanical power, and sufficient steam has been generated to drive low horsepower steam engines, but because of the large size which a full scale power plant would have and the consequent high cost, it has not been pursued farther.

There are reports, however, that a solar power plant is supplying the industrial fuel needs of factories, and the National Physical Laboratory in India is investigating the use of solar energy to drive low-power engines and also for domestic cooking.

Evaporation Units

Drought and lack of pure drinking water is one of the main obstacles to the development of the arid regions of the world and a menace to shipwrecked sailors. Hence, it is only natural that the methods of overcoming this lack of fresh water should have been actively investigated. A solar still, developed during the war by investigators at the Massachusetts Institute of Technology, has proved of inestimable value on life rafts and in the tropics for purifying sea or brackish water by evaporation.

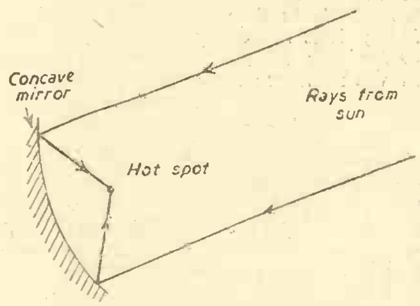


Fig. 2.—Single mirror solar furnace.

Solar energy has also been used in the production of salt from brine, particularly in Palestine and Australia. In this particular application, it has been found that the addition of certain dyes to the brine can increase the uptake of solar energy by as much as 35 per cent.

The Transformation of Solar Energy into Electricity

This phase in the development of solar energy has been very actively pursued, with a view to employing light and heat sensitive devices.

When two different metals are joined together and one junction is heated, an electric potential is set up and a current flows around the circuit as long as this temperature difference is maintained. The effect, which is referred to as the "thermo-electrical effect," is not the same for all metals.

It has been suggested as a means of transforming solar energy, but the results to date are not particularly encouraging, for the overall efficiency of the process has never exceeded 5 per cent., even when lenses and reflectors were used to concentrate the sun's rays on to the converter.

Consideration has also been given to the use of photo-electric cells of the barrier type (such as are used in exposure meters), but here also, the overall efficiency of energy conversion is low, being considerably less than 1 per cent.

Some progress has been made in the use of photo-galvanic cells. These are cells containing chemicals in solution, in which an electric potential is generated between cells on which the sunlight falls and similar cells kept in the dark.

The use of phosphorescent materials, which continue to emit light after the incident light has been cut off, has been suggested as a means of storing and utilising solar energy. It is thought that they may prove of value when low intensity of illumination is required, as for example, to light side streets in towns and cities after dark.

Water Heating for Buildings

This application of solar energy has received much attention in America, as a means of heating dwellings and business premises. A heat absorbing fluid, such as water, is circulated through pipes which are exposed to sunlight. The fluid is circulated through a large reservoir and from thence throughout the building, see Fig. 4.

In California, sufficient hot water for an average-sized house can be obtained from a collector of about 7 or 8 square yards in area.

If the reservoir is large enough, the heat can be stored for use when the sun is obscured. The problem of heat storage has received much attention.

Certain chemical compounds undergo physical changes, such as melting or crystallisation, within the temperature range 30 deg. F to 100 deg. F and these changes are invariably accompanied by the evolution or absorption of heat. The most important chemical in this respect, has proved to be

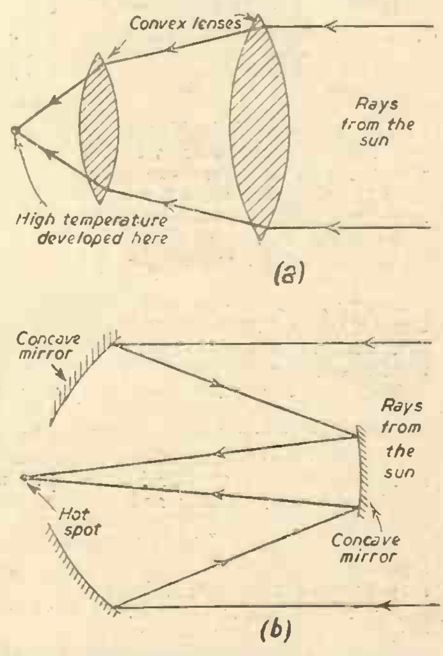


Fig. 3.—More elaborate forms of solar furnaces.
(a) Using two convex lenses.
(b) Using two concave mirrors.
These enable more energy to be collected without increasing the size of the apparatus.

Glauber's salt crystals which lose their water of crystallisation on heating through 90 deg. F and in so doing take up a quantity of heat. On cooling, through the same temperature range, this heat is re-emitted. The quantity of heat which can thus be stored is quite appreciable. It has been calculated that Glauber's salt is able to store eight times more heat than the same volume of water over the temperature range of 80 deg. to 100 deg. F.

Other methods of heat storage, such as the circulation of the fluid through big containers filled with pebbles, have been suggested.

Various estimates of the efficiency of this method of using solar energy have been made, and 25 to 30 per cent. seems to have been achieved.

Undoubtedly, this method of using solar energy is one which will find increasing

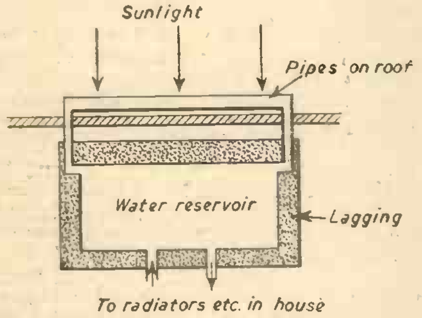


Fig. 4.—Diagram of a system for house heating by solar energy, allowing heat to be stored for use when there is no sunlight.

application, for, although the initial capital outlay may be high, the subsequent running costs are negligible. Unfortunately, it is only likely to be of real value in those parts of the world which receive plenty of sunshine all the year round.

Photosynthesis by Sunlight

By the term photosynthesis is meant the use of sunlight to promote biological growth, more particularly in plants. We are all familiar with the manner in which growing vegetation can store the sun's energy. Plants use sunlight to synthesise carbohydrates from carbon dioxide and water, using chlorophyll (the green pigment present in most plants) as a catalyst. (Fig. 5.)

Actually, our fuel supplies—wood, coal and oil—have all originated from plants and trees and, therefore, represent solar energy which fell on the earth as long as one million years ago.

The amount of solar radiation which becomes fixed by photosynthesis in normal plants and trees is disappointingly small and never exceeds 0.5 per cent. of the incident radiation. Wide investigations have been made to devise a means of increasing the rate of fixation of this energy, in the hope that it may also lead to improved food production. A minute, single, green-celled plant organism, known as algæ, has been discovered which multiplies rapidly and can transform solar energy with a higher efficiency than normal plants. At present, the strains of algæ which are used can transform about 2 per cent. of the light falling on them and it is hoped that new strains will be bred which will increase this figure considerably.

Algæ looks like proving a satisfactory food; it is not distasteful and, in addition to having a high protein content, it is rich in vitamins. It is of easy cultivation and the rate of production is high, reaching 40 tons per acre, per annum.

The usual method of cultivation is to circulate the algæ, suspended in water, through transparent pipes which are exposed to sunlight. Food for the algæ can be most organic fertilizers and carbon dioxide, which is dissolved in the feed solution under pressure.

In addition to its use in food production, algæ might find use as a fuel provided its cost were low enough. Present cost of production is, however, too high to allow successful exploitation for this purpose.

Investigators in the field of photosynthesis have not confined their investigations to mass algæ culture. Realising that solar radiation is not wholly in the form of heat energy and that processes which only make use of the heat energy are wasteful, they have explored all the possible processes in which the light energy of solar radiation is utilised. Chemical reactions, such as the oxidation of water to hydrogen peroxide at metal oxide surfaces exposed to sunlight, have been explored and a process has been reported in which sunlight falling on a solution liberates oxygen and hydrogen from water and the solar energy thus absorbed is later recovered when these gases are burnt together.

Energy From the Winds and the Sea

About 2 per cent. of the sun's energy which falls on the earth is taken up by the gases of the atmosphere in producing winds and by the sea in producing waves. This represents an enormous amount of energy, but it has proved very difficult to harness. Small wind-driven generators have been developed and experimental plants, giving between 100 and 1,000 kilowatts, are being constructed.

Consideration has also been given to the extraction of the energy of motion of sea waves, but the enormous size of the converting machinery has prevented its exploitation.

There is little doubt that solar energy will ultimately be harnessed to meet our fuel needs and, although the investigations undertaken to date do not appear to have solved the problems standing in the way of large scale power production from solar energy, they do represent a notable step forward.

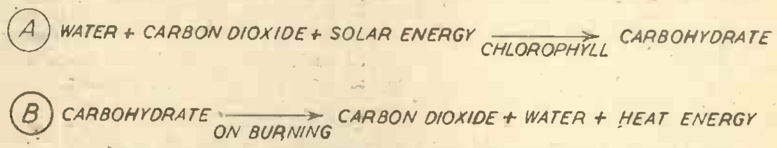


Fig. 5.—Diagrammatic representations of (A) Photosynthesis. (B) Release of solar energy during combustion.

Venner S.O.S. Life-saving Transmitter

THE operation of the Venner S.O.S. Life-saving Transmitter is simplicity itself, and the necessary drill can be carried out by any man, woman, or even child. As soon as the lifeboat gets clear of the sinking ship all that has to be done is to take the thin steel rod (secured by the beckets holding the oars), unscrew the small cover at the end of the box—sticking out 3in. from the side of the thwart—insert the rod in the hole and keep turning the small handle underneath.

Within a second or two a light appears in one of the small windows on the end of the box, indicating that the handle is being turned fast enough. At the end of approximately 30 seconds another light appears in the second small window and indicates that the S.O.S. is being continuously transmitted; this second light is in parallel with the aerial and registers the signal each time the apparatus transmits.

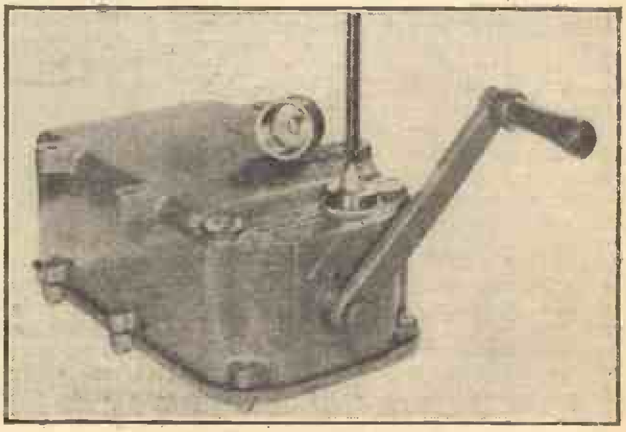
The tuning of the apparatus is fixed and needs no attention over long periods. Neither are there batteries nor accumulators to run down. It will thus be appreciated that the Venner S.O.S. Transmitter is always ready for instant service and requires no skill whatsoever to operate it.

The small case in which the unit is housed is made of light alloy in a one-piece casting. There is a close fitting base with an efficient water-tight gasket, lugs for attachment and water-tight glands for the entry of the turning handle, and the two water-tight caps. One of the latter seals the point of attachment of the aerial rod, and the other, situated underneath, covers the tuning device—whereby the transmitter can be tuned externally; this is purely for the wireless operator to check occasionally that the aerial is properly tuned. The transmitter consists of a crystal-controlled oscillating valve followed by a power amplifier valve.

Modulation of the continuous wave is achieved by toning. Power is generated by a geared D.C. dynamo, with L.T. and H.T. windings and separate commutators. The brush gear of these commutators is the only part of the whole equipment subject to any form of wear.

The shaft end of the generator is extended to form the drive of the signal code disc, which is in turn geared down to provide the signal keying sequence. The code disc is formed in such a way as to send out a continuous alarm interspersed with S.O.S. signals.

Further particulars can be obtained from Venner Electronics Ltd., Kingston By-pass, New Malden, Surrey.



The Venner S.O.S. Transmitter.

Why Not Invent?

Notes on What to Avoid, Some Profitable Fields and Correct Timing

By PROFESSOR A. M. LOW (President of the Institute of Patentees)

I OFTEN hear someone say, "I've got an idea for something that would sell in thousands." The number of people who begin to invent something is probably greater than the number who hope to write a novel. I have found one of the best conversational openings with a stranger at dinner is to say, "And how's the invention?" because everyone has either invented something, is inventing or is thinking of inventing it!

The war has shown how extremely inventive is the ordinary man and woman in Britain. A thousand inventions and ideas a month poured into the Ministries and the factory organisations. Many hundreds of them were adopted. A very much greater number proved impractical for one reason or another. And my experience in talking and writing to hundreds of "amateur" inventors suggests that the majority are doomed to disappointment and may, indeed, lose a great deal of money rather than make the fortune that is popularly supposed to come the way of the successful inventor.

The reasons why their inventions are doomed to disappointment are numerous, but they fall generally under a number of heads. The commonest is that they have ingenuity rather than utility. It is not sufficient for an invention to be ingenious—it must be useful in the broad sense that it accomplishes something more cheaply, quickly or easily than before. But it is always the ingenuity of their inventions that fascinates amateur inventors rather than the utility.

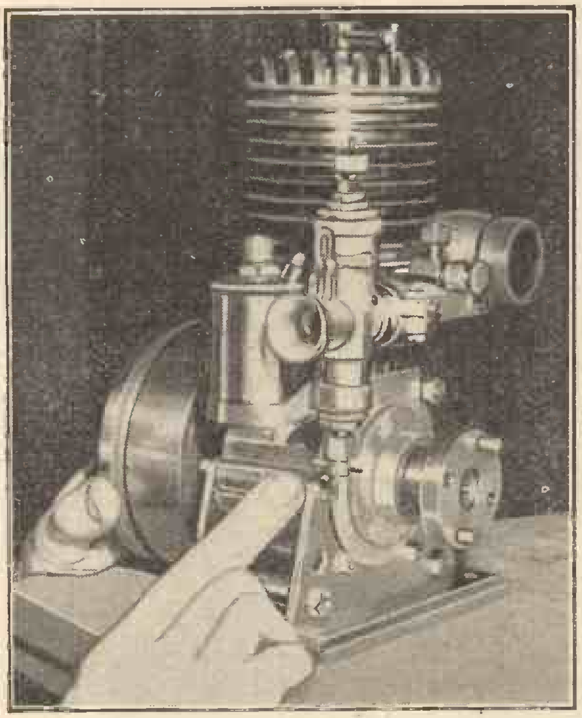
I remember having a new mouse-trap demonstrated to me that was certainly the most ingenious I had ever seen. The details are forgotten, but at least six forms of sudden death awaited the mouse and as many lures were ready to get him within range. The proud inventor asked me what I thought and I had to tell him, "It is very ingenious, but don't patent it, because a cat would be cheaper." Not only did the very complicated mechanism cost a great deal to make—setting the trap would have taken perhaps five or ten minutes.

The Time Factor

The time factor, incidentally, is one frequently overlooked by amateurs in their favourite field of invention—labour-saving. It is little use saving "labour" if you waste time. I remember a washing-up machine that was certainly labour-saving in the sense that all you had to do was place the dirty crockery in certain positions. But I estimated that it would take ten minutes to do this—almost as long as the ordinary housewife would have taken to wash them by soap and water methods costing one-tenth as much.

Another mistake is to invent some new way of doing something which is already done very well. I remember a lady who invented a new burglar alarm and was so pleased with it she spent considerable sums on patents and models. The alarm consisted essentially of wires so placed that when a door or window was entered, a gramophone was automatically switched on to play a record of dogs barking! When I asked her, "Wouldn't it be easier to keep a watchdog with all the advantage that he could bite as well as bark?" she was definitely hurt, and nothing I could say would persuade her that her invention was not epoch-making. It is fairly obvious that the usual alarm bell ringing inside or outside the house or in the nearest police station would be a great deal cheaper and at least equally as effective.

Most of the thirty thousand patents taken out each year in England are mechanical, and it is important that inventors should keep to the class of work of which they have some knowledge. It needs long experience to improve some vital detail of, say, a motor car, but any ordinary user might think of a useful accessory to make repairs easier.



Made by Mr. P. S. Stanwell, of Wanstead, this crude oil engine of 98 c.c. which develops 3 b.h.p. was shows recently in London at the preview of the Inventors' Club. It is claimed that the engine will run on any type of fuel oil.

Profitable Fields

Remember that simple things for cooking, the house, knitting, woodwork are all among the most profitable fields of patents and everyone is an expert in something! Another important point is that when an article is very widely used any improvement must be considerable if it is to make worth while the changing of all the tools and stocks which exist. To improve a lampholder would be a very difficult task from the commercial point of view because so many millions are in use.

All this may sound very discouraging, but in fact it is not so. Every year, what may be called "amateurs" produce first-class ideas that in some way increase the wealth, health or comfort of their fellow citizens. To know what to avoid and to be able to examine your invention objectively is to avoid much disappointment and probable loss of money.

People sometimes ask me "What should I invent?" It is rather like asking for an idea for a short story or a novel! In my experience at least fifty per cent. of the art of invention is seeing something that is needed. Satisfying that need to the man or woman of imagination and moderate mechanical ability is rarely difficult once the need has been perceived. The man who made a fortune out of crinkling hairpins to prevent them falling out had virtually solved his problems once he noticed that hairpins fell out, caused women inconvenience, and could be made to stay in quite simply.

I can, however, give you one or two hints. Notice that inventions are not completely "new" things, but a combination of two or more old ideas. The most obvious example is the fountain pen—neither pen nor ink was original, the "invention" consisted of bringing them conveniently together. So it is with every invention. The inventor carries someone else's ideas further, combining perhaps the principles of two others in ingenious fashion.

Timing

Timing is important with inventions. You can be too soon both technically and psychologically. I demonstrated television before the 1914-18 war and the wireless-controlled 'plane during that war. Both were too many years before their time. If you have what you believe to be a really first-class idea at the moment I advise you to keep it. While present economic conditions last, it is obvious that manufacturers will be more concerned in turning out quantities of what they are equipped to produce, rather than looking for new goods. When controls of labour and materials are lifted and trade becomes competitive, it will be another matter. For certain things you must also catch the customer's "mood." The best example I can think of is the game of Monopoly, which swept America like wildfire during the economic blizzard years. Deliberately or accidentally it exactly provided the entertainment needed at that time.

Very little has been done to help inventors, yet they are really important to any country, for they pave the way to new industry. In England we have the Institute of Patentees, which is an organisation entirely devoted to helping inventors. The Institute organises exhibitions, gives reports upon inventions, free legal advice as to agreements or royalties, and generally helps its members to find the right manufacturer for their idea. Patentees who find their ideas being pirated can go to the Institute for advice.

Above all, remember that it is the amateur who has excelled in the art of invention. It was not official bureaux which were responsible for the steam engines, spinning machines, the telegraph, radio or X-rays. Originality is a country's most vital asset. It cannot be regimented by hidebound committee men.

The Changing World

A final word—do not forget that the world is changing. In ten years' time half the marvels of to-day will be out of date. Science is still ignorant. May it not be you who can foresee more of these changes and thus contribute to health, happiness or the contents of your own pocket?

LETTERS TO THE EDITOR

The Editor does not necessarily agree with the views of his correspondents.

Stencil Cutting

SIR,—With reference to the letter in the July issue of PRACTICAL MECHANICS from M. G. Lees, Gloucester, on the subject of Duplicating Machine Stencil Cutting by the use of printers' type and blocks. It is quite a straight-forward process, the mechanical action of which is exactly the same as when the typist strikes the key of the typewriter and reproduces the desired characters on the stencil for multicopy reproduction on the Gestetner duplicator, the only difference being that the printing machine cuts the whole subject matter in one impression, whereas the typist does it letter after letter. There is no question of the stencil being printed before waxing. I have witnessed the process being accomplished, and if there are any tricks in processing I can only think it is the usual trade knowledge of a manufacturing process.

I possess a Gestetner machine and print a variety of business letter headings and forms, but Gestetner's people prepare all my specially printed headings and forms where type-setting and artist work is required, some of which are quite complicated, especially the illustrated descriptive subjects, but I do not require to buy a ream (480); I get one stencil which they call the Gesteprint or, if I wish to add my own typing matter, I get the Duroprint stencil, and as my typing matter varies from week to week I usually buy these in the minimum lots of two dozen.

I also have Gestetner's photographic stencil making outfit and find this to be a most economical method of reproducing customers' existing printed copy. I would not, however, think of oiling a copy if it lacked reasonable transparency; I would reflex it and make a positive, then contact-print it on the stencil. I believe Gestener has now produced a process which reflexes any subject matter direct on to the stencil without needing to make a negative and then a positive.

What I cannot understand is why Mr. Lees wishes to print stencils when he seems to have a printing machine as well as a Gestetner, and presumably the necessary type founts. If I was so well equipped I would naturally print my work direct on the printing machine, and let the Gestetner do what it is primarily intended for, such as duplicating of letters, forms and illustrated matter where expensive blocks would otherwise be required. —A. HOOD (Broughty Ferry).

SIR,—The following information may me of use to Mr. M. G. Lees (Gloucester), who is enquiring about commercial stencil cutting in the July issue of PRACTICAL MECHANICS.

The principle upon which the Gestetner and Roneo process is carried out is as follows: A sheet of very fine cloth material covered with a thin coating of wax on one side is supplied by the makers, attached to a stiff paper backing, with the waxed surface uppermost. When the stencil is being cut a sheet of carbon paper is placed between the waxed cloth and the stiff paper, and on this latter is recorded a copy of what has been stencilled.

A special steel pen, like a scriber, but with a small rounded point, is then used to make the stencil; or the stencil is put in a typewriter by means of which the printing is cut.

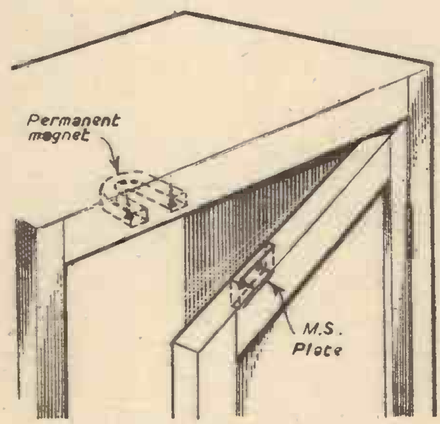
In both cases the process is to just remove the wax, leaving the fine cloth bare, it being porous to the ink in the duplicator drum. When using the pen for the cutting operation, the pressure on the waxed cloth must be adjusted in order not to break right through the very thin cloth base. The stencil is then wound round the duplicator drum and the requisite number of copies run off.

If a mistake is made in the cutting of the stencil, that portion of the stencil is painted over with a special liquid containing a type of wax dissolved in amyl-acetate, which latter, when evaporated off, leaves a new layer of wax which can again be cut as desired.—E. D. LUCAS (Rugby).

Magnetic Door Catch

SIR,—I recently made a magnetic cupboard-door catch which may be of interest to other readers.

The magnet used is an old loudspeaker horse-shoe magnet, about 2¼in. across the poles, and having two vertical holes which proved convenient for fixing. It is screwed to the underside of the top part of the cupboard with the poles facing outwards, and a strip of mild steel is screwed with countersunk screws to the inside of the door, in such a position that when the door is closed the steel plate acts as a keeper to the magnet, thus preserving the magnetism as well as just keeping the door closed. The plate should be recessed in the door, as shown in the sketch. All that is seen on the outside of the door when closed, is the knob with which it is pulled open.—A READER (Horbury).



A magnetic cupboard-door catch.

Perpetual Motion

SIR,—With regard to your comments on perpetual motion in the August issue of PRACTICAL MECHANICS. Of course in a way you are right. But don't you think it might be a good idea if some person came out with a plain, definite statement of *what perpetual motion is?*

It is a very easy thing to say that perpetual motion is impossible, but that is only because *impossible* perpetual motion is the thing chosen.

I have seen a clock that the maker told me had been going for ten years without any kind of attention. And there seemed no reason why it should not go for another ten years. Or at any rate until the mechanical side wanted seeing to. It wouldn't be fair to attempt to make a perpetual clock that never wanted cleaning.

Niagara has been flowing for millions of years. Well, surely that is perpetual motion? To me a tremendous amount of cross thought has been written on the subject. Have you ever seen a clearly defined description of perpetual motion? I never have, although I have been interested in it for very many years. Therefore, may I suggest this.

Perpetual motion is a motion that is constant, such as the tides, a flowing river of sufficient size *not* to dry up.

A perpetual-motion machine is one that will work of itself, or receives its power or impulse from one of the *natural* perpetual motions, such as temperature which varies a great deal, but always comes back to the start, whatever that start may be. The clock I mentioned went by changes of temperature. But if the pendulum had fallen off, would that have been the fault of the motion, or what?

I think inventors should always be encouraged to invent, and their way made easy, but as far as perpetual motion is concerned everyone seems to hide behind nomenclature that doesn't really apply, or matter.—C. V. THOMPSON (West Kensington, London, W.).

Time Lag in the Cinema

SIR,—"Derbian" (June 1953, p. 386), is in error in his second paragraph. The error does not affect his argument, but misinforms.

The distance between the centre of the picture and the corresponding sound is 20 frames, not eight, on 35 mm. sound motion-picture film, with ± ½ frame tolerance on the print. For 16 mm. film the distance is 26 frames. This difference is, to put it mildly, a nuisance. Also these standards are sometimes not observed.

But never is the lead so small as eight frames, for this would scarcely reach the sound head, let alone form a loop as well.

References: American standards, Z22.2—1946; Z22.3—1946; Z22.40—1950; Z22.15—1946; Z22.16—1946.—R. A. FAIRTHORNE (Farnborough).

SIR,—May I suggest that your correspondent, "Derbian" reads my previous letter more closely, as he seems to have missed the point completely; in fact, it is not so easily answered—as the manager and engineer found—and has nothing to do with normal speed of light and sound.

Of all the theatres I have visited, only in this particular one does the fluctuating time-lag occur. As far as the sound track is concerned, for a 35 mm. film, the sound is printed 20 frames ahead, and 16 mm. 26 frames ahead. However, I hope "Derbian" will read my letter again, and meanwhile I hold to my original theory.—R. H. BARHAM (Reigate).

Microscope Slides

SIR,—I was interested to read the query from S. B. Carter (Maida Vale, W.9), *re* microscope slides. I had the same problem but discovered that a firm of manufacturing opticians, Butterworths (Edinburgh), Ltd., 14, Thistle St., Edinburgh, produce a wide variety of microscope slides with steps and depressions and I feel sure they will be able to assist your correspondent.—E. J. NISBET (Edinburgh).

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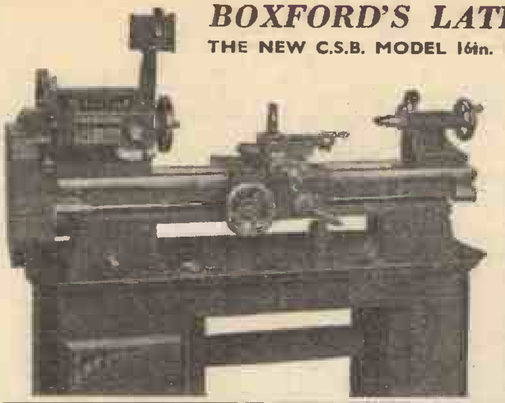

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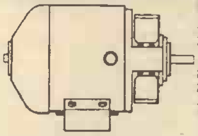

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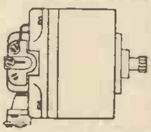

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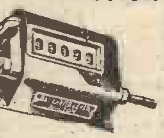

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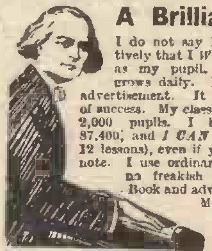

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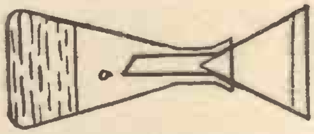

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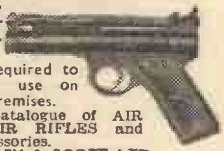

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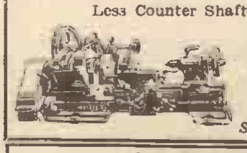

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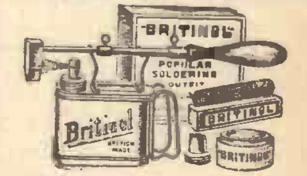

Britinol Soldering Outfits Solve All Soldering Problems !
(As reviewed in PRACTICAL MECHANICS May, 1953)
The "Popular" Outfit, as illustrated, Britinol Spirit Blow-lamp, Telescopic Soldering Iron, Paste and Cored Wire Solder, 16/3. The "Junior," as above, but without Soldering Iron, 9/6. All items sold separately. From Model Shops and Tool-Dealers.
BI-METALS (BRITINOL) LTD., St. Mary's Works, Bridge Road, London, N.9. S.A.E. for illustrated list.

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Trade Notes

New "Morrisflex" Disc Driver Machine

B. O. MORRIS, LTD., Coventry, have recently developed a disc driver machine to provide ample power and correct speed for the new fabric reinforced abrasive discs which have been so startingly successful, but up to now have been unable to be run under optimum conditions.

The disc driver machine is powered by a constant speed 2 h.p. motor which maintains speed, thus providing the best working conditions for the new fabric reinforced discs. The machine is available in floor, bench and overhead mountings. The machine finds its most successful application in cutting away and smoothing welds, and in deburring and smoothing rough edges and surfaces.

"Morrisflex" disc driver machine.

This new model has been enthusiastically received, and the manufacturers, Messrs. B. O. Morris, Ltd., are only too anxious to demonstrate its remarkable performance and time- and money-saving capabilities.

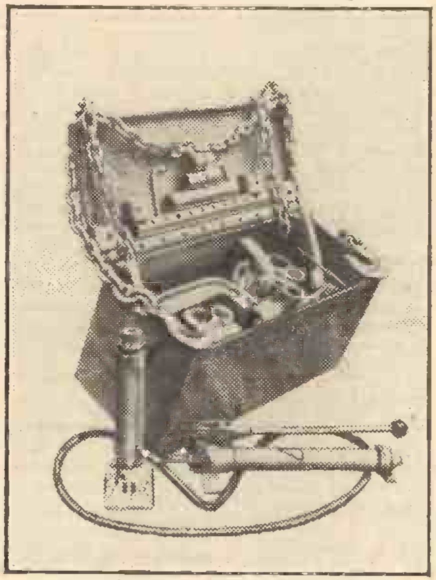
Magnetic Conveyor

A NEW magnetic conveyor for use in assembling or packaging metal objects of all sizes, with no exposed movable parts near the work benches, has recently been patented. The parts are carried from point to point along the surface of a stainless steel platform which can be placed at any height.

The actual movement of the materials along the conveyor is controlled by a hidden magnetic lock. Advantages claimed for the system are extreme safety and cleanliness combined with flexibility of layout.

"Staffa" Industrial Service Kit

MESSRS. Chamberlain Industries, Ltd., of Staffa Road, Leyton, London, E.10, have introduced a light, handy, portable, hand-operated hydraulic tool for general works use, and of special interest to engineers and maintenance fitters engaged in machine shops, shipbuilding, railway yards, mills, mines, structural steel and construction work.



The "Staffa" industrial service kit.

The base unit consists of a small, hand-operated pump coupled to a five-ton hydraulic ram by a flexible high-pressure hose, 7ft. long. By means of specially designed tools for attachment to the ram, functions such as pushing, pulling, pressing, lifting, bending, clamping or spreading can be performed, but with 200 times more thrust than with the human hands.

Work can also be carried out in complete safety as the operator can work the hand pump in a position well clear of the operation. There are five various kits available each with its own particular selection of attachments to deal specifically with the task, all contained in a very neat strong metal tool chest which is fitted with two lifting handles and provided with hasp and staple, padlock and two keys.

B.S.A., Sunbeam and New Hudson Bicycle Replacement Parts Catalogue

THIS weighty and comprehensive catalogue is designed for the convenience of the cycle dealer and repairer, and every item, from the frame down to the smallest nut and bolt, on B.S.A., Sunbeam and New Hudson cycles is listed, numbered and priced. There are three indexes: a model No. index, a numerical index and one of the thumb type. Almost half of the book consists of illustrations, an additional aid which enables the user to find the item required with the minimum of delay. The price of this catalogue is 2/6, and it may be obtained from B.S.A. Cycles, Ltd., Birmingham, 11.

A. T. Sallis Government Surplus List

WE have received from A. T. Sallis his latest list of Government surplus equipment. It contains descriptions and prices of over four hundred items, ranging from Type 46 Power Units at £5/10/- to sponge rubber blocks at 1/-. Also included are transformers, blower and heater units, compasses, rotary blower units, resistance boxes, Type 83 scanners, small transmitters, geared motors, and so many other items that it is impossible to list them all. Postage rates are given in every case. This list may be obtained from A. T. Sallis, 93, North Road, Brighton.

National Handicrafts and Hobbies Exhibition

THE second annual National Handicrafts and Hobbies Exhibition will be held at the Central Hall, Westminster, from September 17th to 30th. A wide and varied range of interests is catered for by 125 exhibitors covering:

Marquetry, modelling, artificial jewellery, weaving and spinning, woodwork and carpentry, basketry, book-binding, leather-work, toy-making, embroidery, knitting, home-decorating, wireless, television, stamp-collecting, gardening, preserve-making, sweet-making, pottery-throwing, glass-blowing, model railways and model ships. Visitors will see a number of unusual and practical demonstrations each day by experts. These include wrought-iron work, beaten silverware, marquetry, woodwork, yarn-dyeing, embroidery-work, a model forge, a working model railway and a puppet theatre. All the 125 exhibits on view are presented as "live demonstrations" with trained staff in attendance. Of special interest to children will be Angora rabbit-keeping, bee-keeping, aquaria, doll-making. A number of interesting competitions of national appeal have been organised in connection with household gadgets, marquetry, models and books. In each case there are cash prizes and other awards. Admission price is one shilling.

Boffin says: "The only trouble with my F.I.D.O. mixture is that it disperses the aircraft as well!"

QUERIES and ENQUIRIES

A stamped, addressed envelope, three penny stamps, 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.

Electro-plating Queries

PLEASE answer the following queries regarding your article, "Electro-plating at Home," as published in the May issue.

(1) What strength chromic acid is recommended? I used 25 per cent., with no success.

(2) Should the 16-gauge copper wire be insulated?

(3) My ammeter will only register 1 amp., with the bath in operation, irrespective of the size of cathode. Could you suggest the likely trouble? The resistance, as recommended in your article, has no effect whatsoever on the ammeter reading. I have soldered the wire to the crocodile clips: would this have an adverse effect on the ammeter readings?

(4) What size should the respective anodes be, using the quantities of solutions stated in the article?—K. Winter (Wednesbury).

WITHOUT knowing exactly how you have set up the apparatus, it is difficult to be specific about the cause of the troubles you mention. It is hoped, however, that the following comments will be of some help.

(1) The chromic acid used in the formula is anhydrous chromic acid, sold as a red flake under the name of chromium trioxide. If you have been using 25 per cent. solution of chromic acid to make up the formula, then the chromium content of your bath has been much too low, *with a consequent increase in resistance*. This error alone might be the cause of all your troubles.

(2) The 16-gauge copper wire need not be insulated, provided that the wires are arranged so that they do not touch.

(3) The fact that your ammeter reads only one amp. suggests that the trouble lies in your batteries (providing that the ammeter is not faulty). The ordinary dry battery is not capable of delivering more than a certain value of current without affecting the voltage. If you apply a voltmeter across such a battery with a nominal voltage of six volts, when it is delivering a heavy current, you will find that the actual voltage is considerably less; sometimes as little as two volts. This condition can be overcome by either joining additional six-volt batteries in parallel, or by increasing the applied voltage by using additional cells in series. Of the two methods the former is to be preferred. The fact that the recommended resistance has no effect on the current suggests either that the ammeter is sticking or that the concentration of the solution is incorrect; for, with a six-volt battery and an ammeter alone in circuit, it is possible to reduce the current to a very low value using this resistance. (The resistance solution should be compounded with *pure* copper sulphate, and sulphuric acid should *not* be added.

Soldering the wires to the clips should have no adverse effect on the ammeter reading.

(4) The anodes for electroplating are not dependent in size on the quantity of solution being used but on the area being plated. For chromium plating it is recommended that the anode area should equal three times the area being plated. With other types of plating solution the anode size is not so critical, roughly equal areas producing satisfactory results.

If no success is obtained with chromium plating when these faults have been rectified, try increasing the current above the calculated value for a short time until bubbles of gas appear freely from the cathode.

Magnetic Drawing-pin Substitute

I PROPOSE to magnetise an ordinary drawing board (inclined) so as to enable small metal counters to be attached and moved freely thereon, as an alternative to the more usual coloured drawing-pins.

The problem is, I think, fundamentally simple, involving the use of a large number of very small permanent or electro-magnets to ensure an evenly distributed field. An extremely strong field is required to enable the board to be revolved to a steep incline, approaching the vertical.

Perhaps you might also advise me as to the names of British manufacturers who specialise in the type of magnet most readily applicable to this type of problem.—D. J. Maguire, B.Arch., M.T.P.I. (Cork).

IN order to obtain maximum magnetic pull the thickness of the board would have to be reduced to a minimum value. In order to avoid heating at the back of the board and to reduce the weight of the board we think that permanent magnets would offer the best chance of success. We suggest the fitting of bar magnets with adjacent poles of opposite magnetic polarity at the rear surface of the board. The other ends of the bar magnets should be mounted on a sheet of soft iron or mild steel to complete the magnetic circuit as far as possible. The distance between the poles will depend on the size of the iron or steel articles to be held on the board.

You may be able to obtain suitable magnets from one of the following firms:

James Neill & Co., Ltd., Napier Street, Sheffield;

H. S. Greenwood & Sons, Ltd., 47, Princess Street, Rochdale;

Mullard Wireless Services Co., Ltd., Century House, Shaftesbury Ave., W.C.2.

Readers are asked to note that we have discontinued our electrical query service. Replies that appear in these pages from time to time are old ones and are published as being of general interest. Will readers requiring information on other subjects please be as brief as possible with their enquiries.

Removing Developer Stains

COULD you please tell me of a substance which will remove developer stains (Johnson's Universal) from white porcelain; also, where could I obtain material necessary?—C. Whitaker (Stockton-on-Tees).

WE have been in touch with Johnsons of Hendon, Ltd., who advise us that the only method of removing the developer from porcelain is to make up a fairly strong solution of potassium permanganate, paint it on the affected parts, leave for a few minutes and then rinse off. After this an acid fixing solution should be applied immediately.

Messrs. Johnsons informed us that it was unusual for the developer to stain porcelain, although it is quite common with enamel.

Chemical-action Cigarette Lighter

I WOULD like to make a chemical-action cigarette lighter. Can you please tell me the chemicals used and how to make such a lighter? Can a tube of this chemical, possessing the same diameter as an average cigarette, have an effective life?—S. Poll (Brixton, S.W.9)

BY a "chemical-action" cigarette lighter we presume you mean an apparatus working on catalyst principles.

We are of the opinion that an apparatus the size of a cigarette would have a limited life from the point of view of needing to be refilled frequently.

We suggest making a metal tube, capped at either end. At the ignition end, about $\frac{3}{8}$in. from the tube end, insert a piece of fine platinum gauze. This is the catalyst. Pack the remainder of the tube (but keeping the packing out of contact with gauze) loosely with cotton fibres. The chemical with which the packing is kept moistened is *pure* methyl alcohol.

The passage by suction of the methyl alcohol—air mixture across the platinum gauze causes the latter to become incandescent.

Arc Welding Equipment

I WISH to make or acquire a small arc welding set which will operate from the mains supply (240 volt 50 cycle A.C.), and would be grateful if you could give me some details as to what would be required.

(*Continued on page* 530.)

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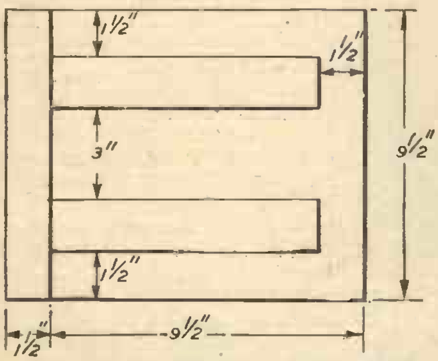
The maximum thickness steel plate encountered in the job is ⅛in., which would have to be butt-welded.

I have a transformer for 240 volts, giving up to 6 volts 60 amps., but am told that this is unsuitable.

Also, what other equipment is necessary, besides the transformer, and do I need a rectifier and choke ?

I would also be grateful if you could recommend any literature on the subject and any suppliers of the parts I require.—William F. Chambers (St. Albans).

PROVIDING that your supply is capable of producing about 28 amps. we suggest that you build a transformer as follows: The core could be constructed of Stalloy stampings approx. 0.014in, thick to the dimensions given below, the stampings being lightly insulated on one side. A bobbin or former, through which the centre limb of the stampings will afterwards be threaded, should be wound with the primary coil, having 120 turns of copper conductor of approx. 0.0125 sq. in. Over the primary should be wound a layer of leatheroid about 0.07in. thick before winding on the secondary coil. The latter coil could have 40 turns of d.c.c. copper conductor, having a cross sectional area of approx. 0.04 sq. in.



Dimensions of stalloy stampings for welding transformer.

A choke coil should be connected between the secondary terminal of the transformer and the electrode. The choke coil could have a three-limbed core of Stalloy stampings built up with the centre limb having a cross-sectional area of approx. 10 sq. in. ; the cross-sectional area of each of the outer limbs should be at least 5 sq. in. The centre limb should be wound with 55 turns of d.c.c. copper conductor of cross-sectional area approx. 0.04 sq. in. An air gap having a total length of about 0.08in. should be left in the magnetic circuit of the choke coil. Tappings should be brought out from the choke coil at 50, 43, 39, 35 and 32 turns for use on the higher welding currents. The air gap can be filled with fibre or wood so that the core can be clamped up solid. Adjustment of the air gap will provide a means of varying the choking effect if required.

A rectifier is not required. The following books provide information on transformer design and construction : "Design of Electrical Apparatus," by J. H. Kuhlmann (Chapman and Hall Ltd.), and "Practical Design of Small Motors and Transformers," by E. Molloy (George Newnes, Ltd.), but we do not know of any literature which deals specifically with welding transformers and chokes. We suggest the following suppliers :

Stampings : Joseph Sankey and Sons Ltd., Bilston, Staffs.

Wire : London Electric Wire Co. and Smiths Ltd., Church Road, Leyton, E.10 ; P. Ormiston and Sons Ltd., 31a, Denmark Road, W. Ealing, London, W.13.

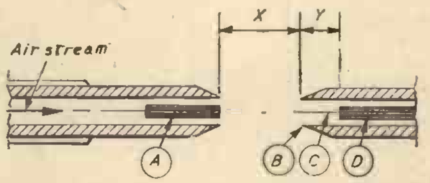
Leatheroid : Mosses and Mitchell Ltd., 60-68, Ironmonger Row, London, E.C.1 ; Attwater and Sons, Hopwood Street Mills, Preston.

Air-pressure Hooters for Car

I INTEND to make a set of air-pressure hooters for my car and should be grateful for your advice.

I intend to use an ex-R.A.F. rotary pump, run off the fan belt, a Ford windscreen wiper reserve tank and a blow-off valve, with four separate valves, each hooter to have one. I should like a rough idea of how to make the hooter parts and a method of getting different notes.—(Bernard J. Engleback.)

THE required effect may be secured by fitting various types of reeds—of the type previously fitted in press-bulb horns. Alternatively, modified Galton whistles should produce the desired effects, especially if both orifice and piston are made adjustable. This is shown in the illustration.



Modified Galton whistles with adjustable orifice and piston.

As will be seen, the Galton whistle consists of two parts. Air from a nozzle is projected on to a circular slit (A) from whence it issues against the circular knife-edge (B). This sets the air in the resonant cavity (C) in vibration. The volume of air in this cavity is changed by means of movable piston (D), and adjustment in the value of (Y) is secured through the agency of a micrometer screw, or similar arrangements. The distance of the gap (X) can also be adjusted to a favourable value by similar means.

Map Mounting Paste

FROM time to time I have maps to mount on a rather open-meshed cloth. Please tell me how to make a suitable paste, keeping in mind the following requirements :

(1) It must be cheap to make.

(2) The ingredients easily obtainable.

(3) Very great adhesive qualities.

(4) Easily made up, as our facilities are limited.

(5) Good keeping qualities.—M. Cutler (Sheffield University).

IT is suggested that you make up two adhesives, one, an ordinary flour paste (using plain flour). Make it of fairly stiff consistency and pass it through a wire strainer in order to break up all lumps. For the second solution, dissolve in warm water a portion of a packet of finely powdered glue or size. The quantity should be such that when the water in which it is dissolved has become cold it should have a consistency equal to that of an ordinary table jelly. Now see that both the paste and the size have approximately equal bulks, say, 1 pint or whatever total quantity may be required. Next warm up to, say, 180 deg. F. both the flour and glue solutions and to each of them add a preservative, which may be oil of cloves, a disinfectant such as Dettol, Lysol or T.C.P., or perhaps a larger quantity of pure alcohol.

Into the paste the oil of cloves may be stirred and one of the disinfectants into the glue. Then pour the glue into the paste and stir the two together, whilst they are still warm, until they are thoroughly intermixed. This adhesive will serve your purpose and keep indefinitely.

Heating Elements for Oven

I AM making a small electric cooker from 18 gauge steel, the oven being 13in. wide by 13in. deep by 13in. high. Please supply the following information :

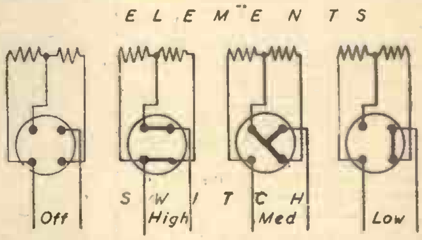
(a) Would it be satisfactory to use two 500-watt fire elements for oven heating?

(b) How would the three-heat switch be connected up to give three heats ?

(c) Would the best position for the oven elements be let into the sides or into the bottom ?

(d) Where could I obtain three-heat switches, an oven thermometer and boiling plates, also oven elements if fire elements are not suitable ?—F. R. Nickerson (Notts).

IF the heating elements are placed at the bottom of the oven, good even heating will result, but this system has the disadvantage that water, grease, etc., tend to drop on to the elements. Side heating units may be adopted but the cook will require to gain experience of cooking with side heat. In some cases bottom and top heating is employed, some form of heat deflection sometimes being placed over the elements to distribute the heat. Our suggestion would be for bottom heating with deflector plates for the protection



Switch used for series-parallel control.

of the elements and the promotion of heat distribution. The two 500-watt elements should be suitable, with independent control for the elements together with series-connected elements for low heat. The sketch shows the connections of a switch used for series-parallel control.

We suggest the following suppliers :

Three-heat switch : Arrow Electric Switches Ltd., Hangar Lane, London, W.5 ; J. A. Crabtree and Co. Ltd., Lincoln Works, Walsall ; General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2.

Boiling plates : Backer Electric Co. Ltd., Fitzwilliam Road, Rotherham, Yorks ; G.E.C. Ltd., Magnet House, Kingsway, London, W.C.2.

Oven thermometers : Thomas Armstrong and Co. Ltd., 80, Deansgate, Manchester, 3 ; Cambridge Instrument Co. Ltd., 13, Grosvenor Place, London, S.W.1.

Information Sought

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

R. Cornford of Knebworth, Herts, writes : "Can any reader supply details of a domestic potato peeler, actuated either by an ex-Government surplus stock geared 24in. motor or by a home-made water wheel drive ?"

A querist from Malta asks : "Can anyone explain how to fill a ball-point pen and give constructional details of the necessary pump or syringe ?"

J. Rae, of Glasgow, writes : "Please tell me how to convert my Morris 4 cyl., side-valve (1926) engine, to paraffin burning. It is already installed in a cabin cruiser and has been running. It is fitted with an S.V. carburetter, the inlet manifold being on the opposite side of the cylinder block to the exhaust manifold. Petrol is gravity fed and the water-pump keeps the water-jacket cool."