The Junior Mechanic—New Monthly Supplement

NEWNES

PRACTICAL MECHANICS

1/3

EDITOR: F. J. CAMM

MAY 1956

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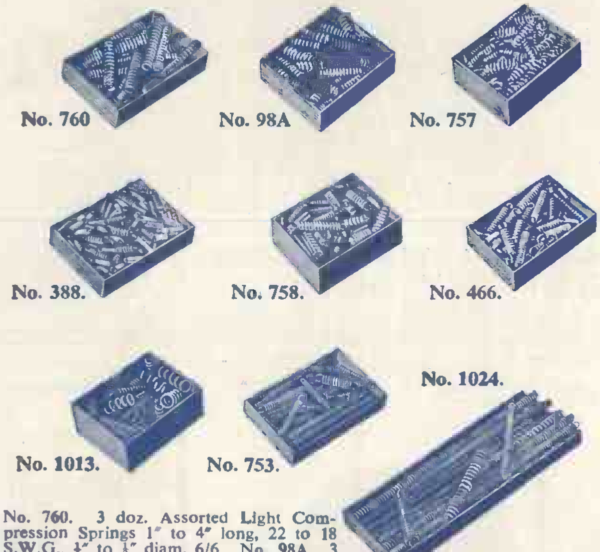
Radio-Controlled Models
A Capacitor Flashgun
Motorising Your Lawn Mower
An All-Purpose Easel and Blackboard



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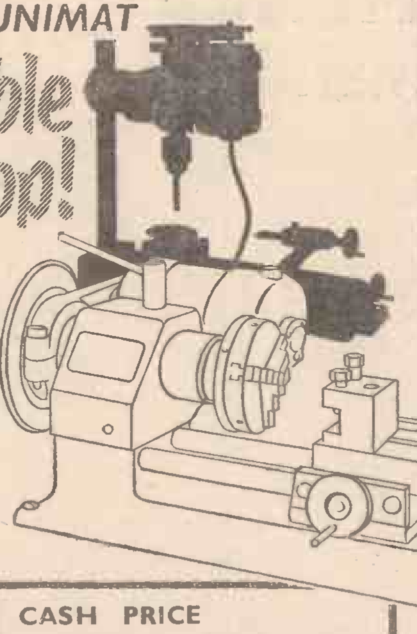

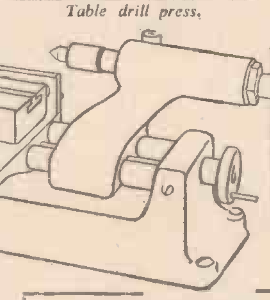

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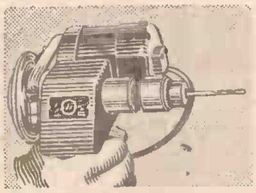
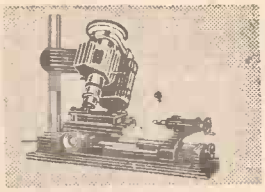


Hand drill.



Milling machine.

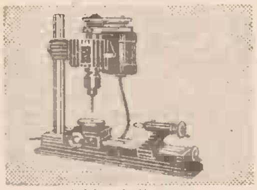
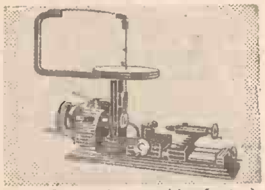
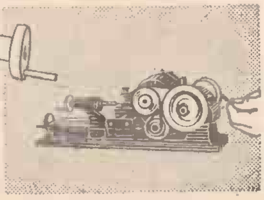


Table drill press.



Jig sawing machine (extra).



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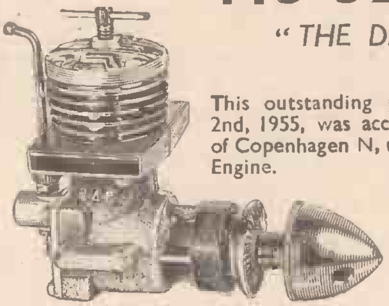

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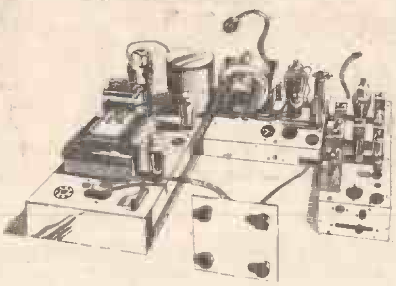

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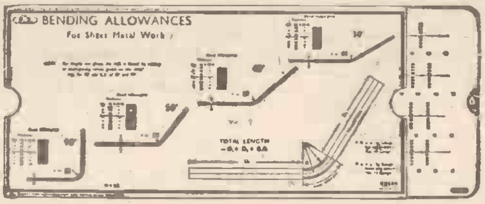

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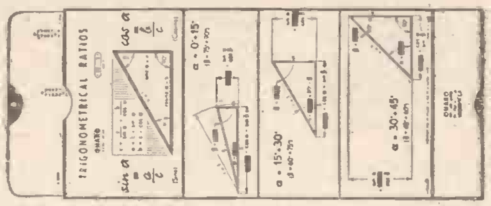
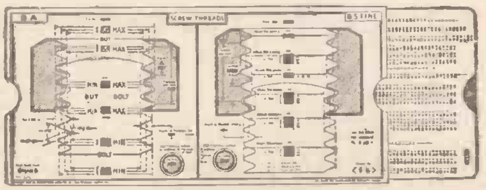


MODEL S.5. Principal Screw Threads



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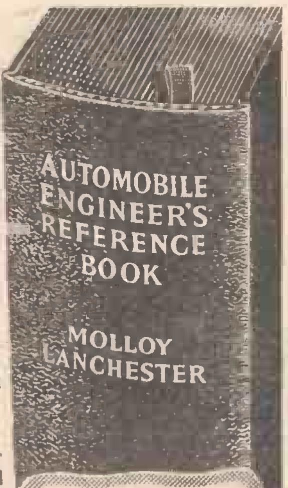

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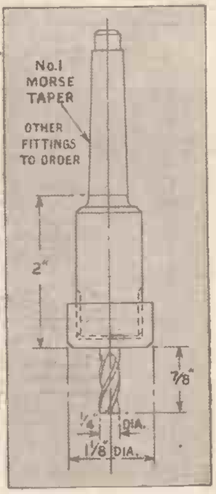

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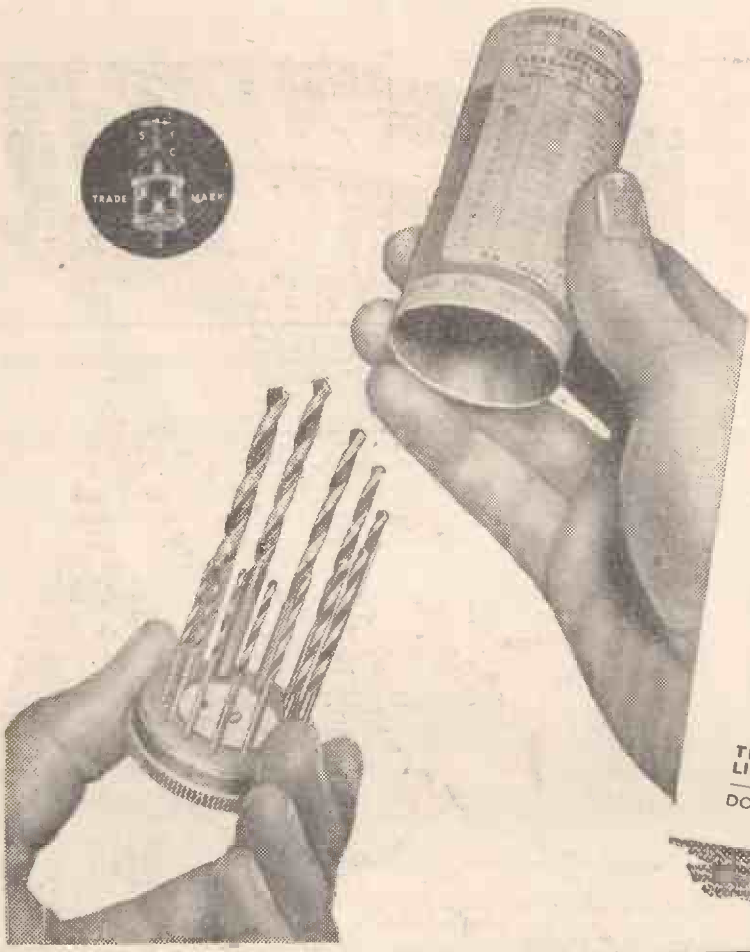

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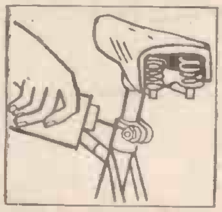

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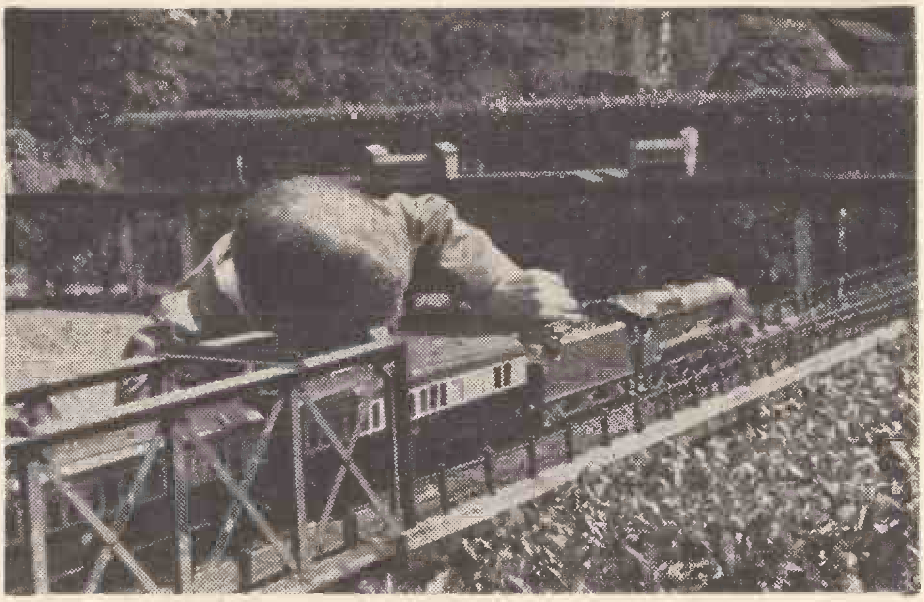

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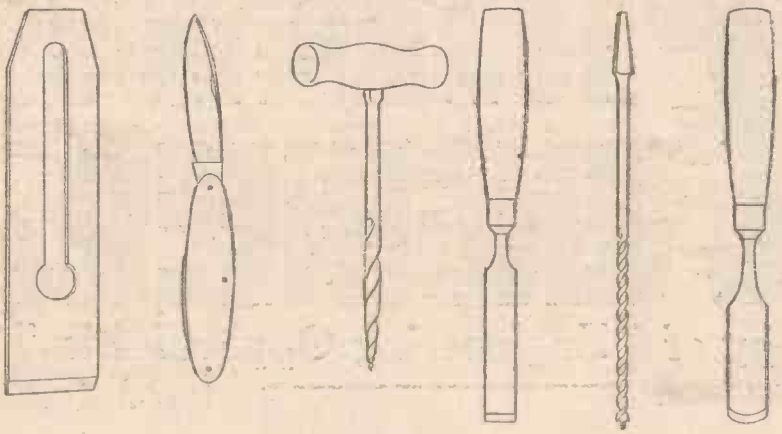

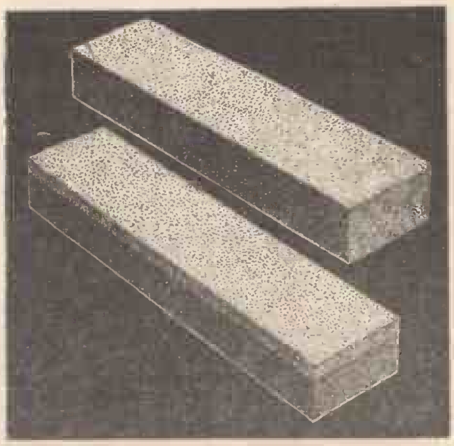

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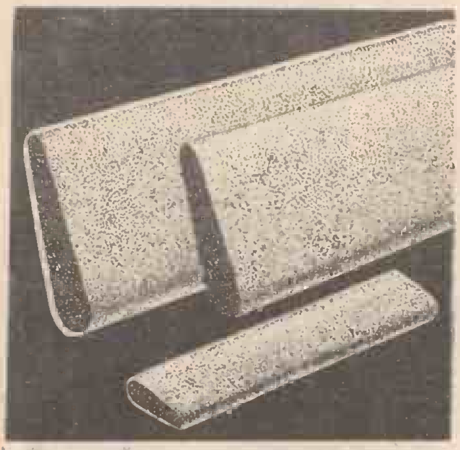

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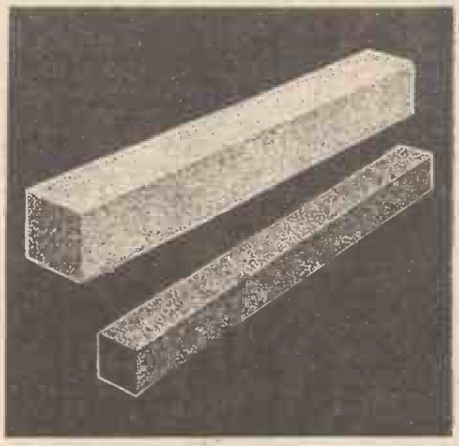

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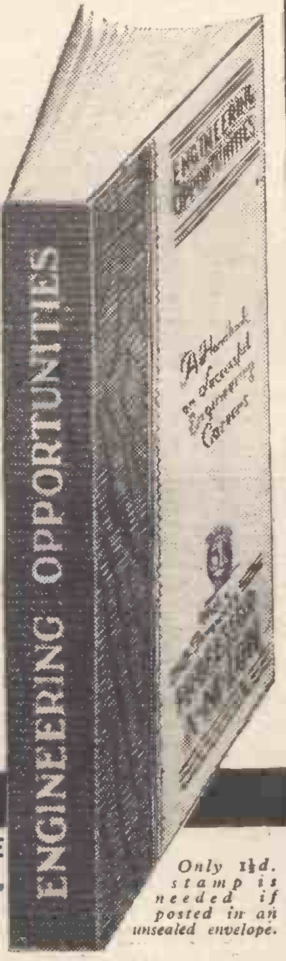

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VOL. XXIII. No. 267

MAY, 1956

Editor: F. J. CAMM

FAIR COMMENT

By

The Editor

Automation

DURING the Industrial Revolution of 150 years ago workmen were apprehensive of the new mechanical methods then being introduced to replace hand labour. Whereas hand labour could not produce large quantities of a given product all of the parts of which were interchangeable, mechanical methods could turn out much larger quantities of the same product every part of which was interchangeable with the next. Whilst one can admire handcraft as it relates to a particular piece, handwork can never match in accuracy or in general appearance the product of the machine.

The introduction of machines, therefore, was looked upon with apprehension by the workers of the period and as soon as machine looms were installed by Arkwright the hand knitters walked into the factories and smashed them.

Yet a second industrial revolution is taking place and by the inevitability of gradualness is being accepted as the new order of things. The public is more enlightened to-day and realises that labour-saving machines do not necessarily create unemployment, that their wages and standard of living are still maintained and they have greater leisure in which to enjoy their particular hobbies and pastimes.

Mechanical Brains

A new word has sneaked into our vocabulary to describe the new style of factory which is being created all over the country—the word automation, a term used to describe the automatic or robot factory which runs itself with a minimum amount of labour. Mechanical brains now perform most abstruse calculations, which formerly took a large staff to solve. A new machine in the short space of 40 minutes can analyse a set of figures, calculate percentages, add and subtract and bring up the answers to 7,000 wage packet problems. This work in the ordinary way would keep 12 people busy for a whole week. This new industrial revolution is here to spread and to stay, and nothing can stop it. It cannot be denied that all routine jobs whether in office or factory can be performed not only cheaper, but quicker and better by means of mechanical and electronic robots. Scientists will produce a machine to perform practically any job without labour, except that which is required to press a switch. To-day there are mechanical and electronic devices which can type letters, answer the telephone and record the message, sort cheques and cash, and count, work out income tax, translate documents from one language to another, assemble complicated mechanisms, automatically gauge parts produced on automatic machines, and even stop the machines when they produce parts which are not according to the drawing. Obviously these methods must in the ultimate replace a large amount of manual labour and reduce individual manual skills to a minimum. Of course, those engaged on making the machines would be more fully employed than before. In mass production everything depends on the tool and gauge maker, but it is obvious that within 50 years a much higher standard of technical and scientific education will be demanded of workmen of that period. In one American factory robots have replaced nearly 2,500 employees, and output has gone up 100 per cent. An electronic brain in another office threw 50 clerks out of work and it is considered that 80 per cent. of all typists and clerks in big offices will be redundant within 10 years. Mr. Hugh Gaitskell in a recent speech prophesied that there will be an enormous drop in the amount of labour required in the near future. It is possible that there will be unemployment in some trades, and particularly in the less skilled, repetition type of work. There will, however, be increased opportunities for those who have learned how to make, operate and maintain these new robots.

Education

Technical and scientific education has now been made available for all, at a very cheap rate indeed. Those who do not therefore avail themselves of these opportunities to bring their knowledge up to date so that they can be employed in this new era of automation must expect either to be unemployed or to be offered only the lowest paid posts. Even the cleaning of factory floors and what may be termed the menial tasks are now performed without manual labour, so they may not be available. It is obvious that to maintain our present standard of living we must be able to compete in world markets against cheap Japanese and other foreign labour. Because of our standard of living our prices are dearer than those of countries where there is an unlimited supply of cheap labour. As it is unthinkable that we should reduce our standard of living to that of these other unenlightened races, other means must be found to reduce the cost of our products and automation is the only answer.

Price Increase

OWING to the continued increases in the cost of production, we are reluctantly compelled as from this issue, to increase the price of this journal to 1s. 3d. We have deferred making this decision until it became absolutely necessary. We were left with the only other alternative of reducing the size of the journal, a course which we felt would be unpopular with all our readers.—F. J. C.

The printing dispute, which has prevented publication of this journal since the issue dated February, 1956, has been settled, and we shall now be able to publish normally.

We greatly regret the inconvenience to our readers which this dispute has caused, but readers, we are certain, will appreciate that this break in publication has been due to circumstances beyond our control.

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MOTORISING YOUR LAWN MOWER

Conversion Details Using an Old Minimotor as a Power Unit

By J. K. EASLEA

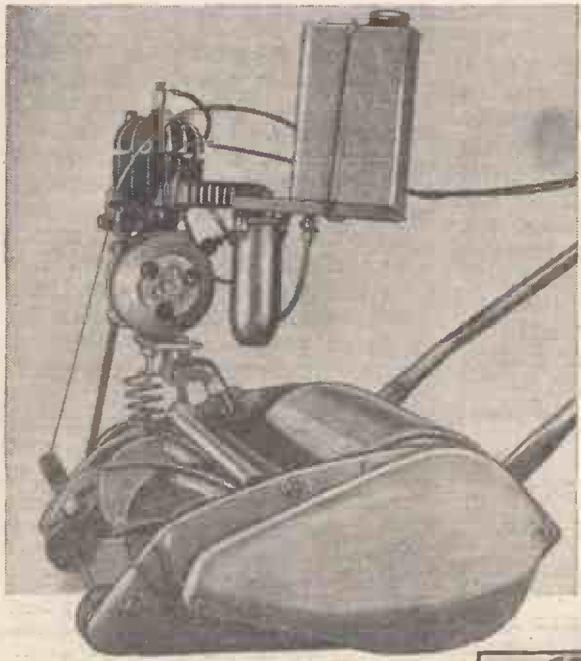


Fig. 1.—The author's motorised lawn mower.

THE modern roller lawn mower is so well made that it can be adapted to take a small petrol motor without extensive alteration. Although any small 2- or 4-stroke motor would be suitable, the writer used a 49 c.c. Minimotor which was not needed for its original purpose. The resulting appearance of the conversion is shown in Fig. 1. Similar second-hand motors may be bought cheaply and are easily overhauled by a competent amateur mechanic. The measurements given in the article are appropriate to my own particular lawn mower and for another type modifications will have to be made. Additional purchases, which may be made at any good tool shop, should not exceed about 10s. if the scrap-box supplies the small pieces of duralumin, etc., which are required.

In order to prevent overheating it is desirable to keep the engine revolutions low. Due to the good low-speed torque of the engine ample power is available, with a speed reduction of 3 : 1, to operate the cutters at a satisfactory speed.

Modifications to Mower

First the machine is dismantled and the cutting cylinder removed so that a 2in. extension piece of mild steel can be welded to the plain end of the shaft The cutting cylinder is then mounted in a lathe and the diameter of the extension piece reduced to ⅝in. A large clearance hole must now be cut in the side plate to permit the passage of the cutting cylinder shaft, after which the mower can be reassembled temporarily.

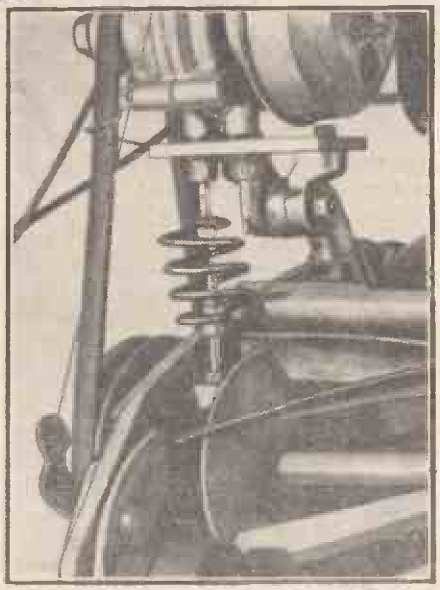


Fig. 2.—The elbow lug and hinge in position.

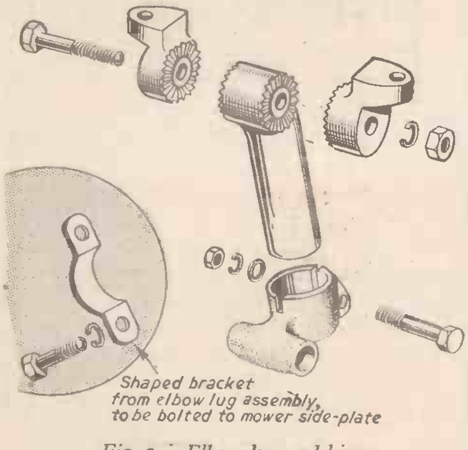


Fig. 3.—Elbow lug and hinge.

Fit 5in. dia. pulley (Picador) carefully in position on the shaft extension and tighten the grub-screw, thus marking the shaft. After removing the pulley a shallow 3/16in. hole is bored in the shaft to take the end of the grub-screw.

The elbow lug and hinge used originally to attach the Minimotor petrol tank to the saddle pillar of the bicycle is used in this conversion to provide a pivoted mounting for the motor, as will be seen in Figs. 2 and 3. The mower tie-bar is reduced in diameter at one end to 5/16in. by filing so that the steel bearing tube can be pressed on to it. The elbow lug is shortened by 1½in. and cut at an angle of 45 deg.; this provides clearance for the roller.

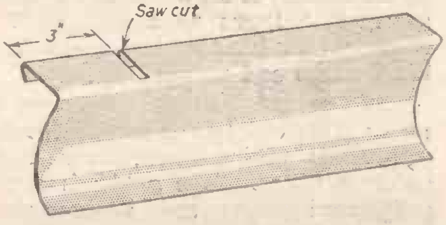


Fig. 4.—The slot in the delivery plate.

The final alteration to the machine merely consists of sawing the top edge of the delivery plate and bending it so as to afford clearance to the elbow lug and hinge assembly (see Fig. 4).

Mounting the Petrol Motor

The crank-case was originally secured to one end of the petrol tank frame by two partly threaded rods fitted with hardened steel rollers. These bolts, after removing the rollers, are secured with nuts and fibre washers to the ¼in. duralumin plate, drilled as shown in Fig. 5. Two clearance holes

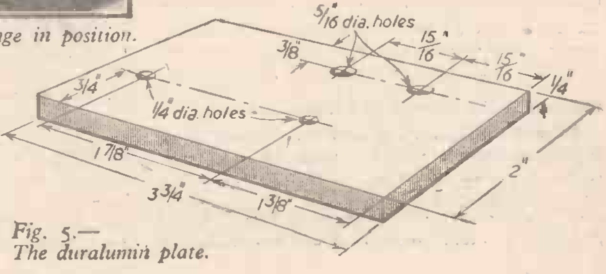


Fig. 5.—The duralumin plate.

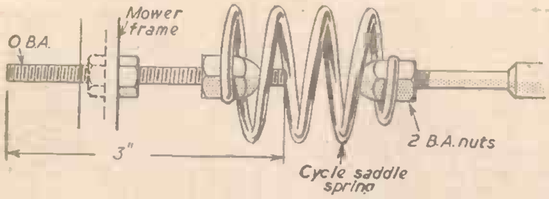


Fig. 6.—Spring and cutting cylinder adjusting screw.

for 3/16in. Whitworth bolts are drilled to secure this plate to the elbow lug assembly.

A cycle saddle spring is used to control the position of the motor, one end being attached by two 2 B.A. nuts to one of the two bolts mentioned above, the other end going to a 3in. long brass rod threaded 0 B.A. which is used to replace the cutting cylinder adjusting screw (see Fig. 6 and also Fig. 1). The driving roller should now be removed from the motor and replaced by a 1¾in. dia. pulley (Picador) threaded ½in. B.S.F. and secured by a Simmonds nut. The pulley may be seen in Fig 10.

Controls

The Bowden cable and control lever for the carburetter may be used without modification. However, the clutch lever has to be altered to give an increased movement of 1in. to provide positive operation of the clutch as shown in Figs. 7 and 8. The nipple at the end of the clutch wire is connected to the shaped alloy bracket originally forming part of the elbow lug assembly. This is shown inset in Fig. 3 and in position

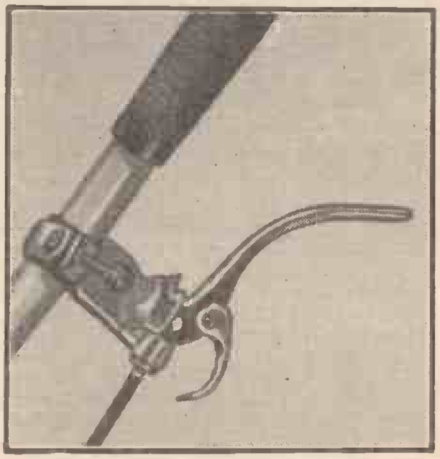


Fig. 8.—The modified clutch lever.

in Fig. 2. An easy way of connecting it is to use a mudguard-stay nut and bolt from a bicycle. The alloy bracket is itself bolted to the mower side-plate by the nut holding the wood-roller bracket. The original clutch adjuster is secured to the cylinder barrel using the bolt normally fixing it to the petrol tank.

The Petrol Tank

The petrol tank is most conveniently attached to the motor by a frame of brass angle made as in Fig. 9 and bolted to the top of the silencer. The dimensions given are suitable for the normal ½-gallon container used by the leading oil companies. A hole can now be drilled in the base and the petrol tap soldered in position. A curtain spring or something similar should be used to steady the tank as shown in Fig. 10.

Operating the Completed Motor Mower

In order to start the motor a leather strap pierced at one end with a large hollow brass rivet is wrapped round the fly-wheel, the rivet engaging with the head of a small self-tapping screw. Starting is not difficult if care is taken not to flood the cylinder

Fig. 9 (right).—Petrol tank supporting framework.

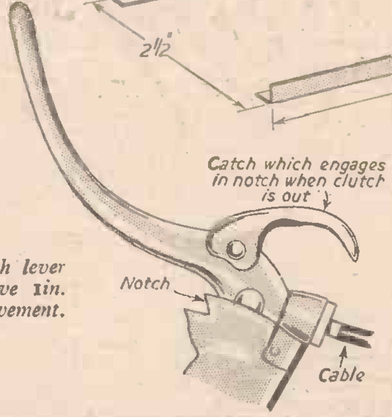


Fig. 7.—Clutch lever modified to give 1in. increased movement.

with too much petroil, thus oiling-up the plug. To provide reliable declutching operation a length of stout wire may be secured to the engine crankcase bolts (see Fig. 9) and adjusted to just clear the 26in.-long V-belt when the clutch is engaged. Fig. 10 shows the motor in the clutched and declutched position.

If the mower is to be used in the smaller garden it will be found to be easier to operate if the chain drive between the roller and cutting cylinders is removed.

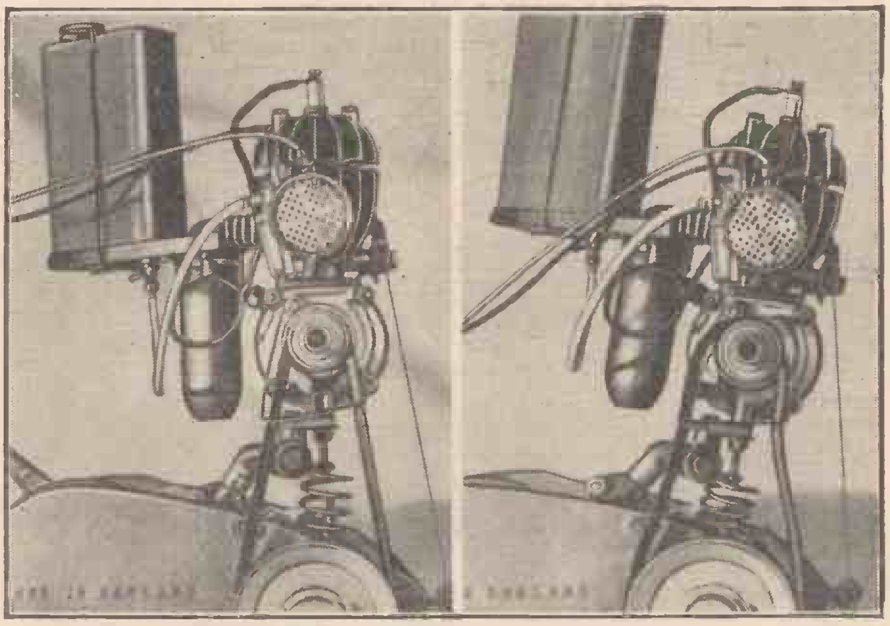


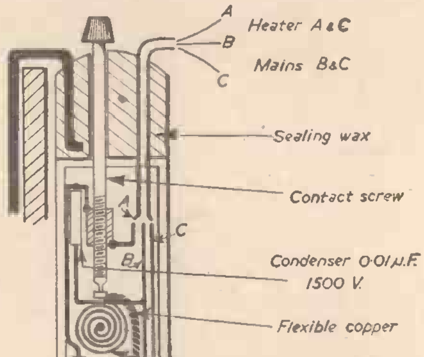
Fig. 10.—The motor in clutched and declutched positions.

An Aquarium Thermostat

This Design was Received from B. Eiben in Answer to a Request in "Information Sought"

A BIMETAL spiral (thin soldered iron-brass sheet perhaps) has on its end a platinum bolt as a contact. The other contact is a brass screw for adjusting the temperature. Between A-B is a condenser of 0.01μF. or more for suppressing arcing. A copper flexible is also soldered to the spiral and connected with B to prevent trembling of the spiral and unnecessary sparking. A small neon tube with a series resistance for 220v. this would be 2MΩ) indicates if the contacts are closed and the heater is in action. These parts are mounted on an insulating sheet and put into a test-tube. The top is sealed with sealing-wax or similar material to prevent water entering. The brass screw is fed through a tube for adjustment purposes. A handle for hanging the glass into the aquarium is also fitted in the wax.

This type will control heaters up to 300w./220v. When working on D.C. mains you will have to change the terminals B-C every week.



Mr. Eiben's thermostat.

A BULB FREQUENCY METER *for model control*

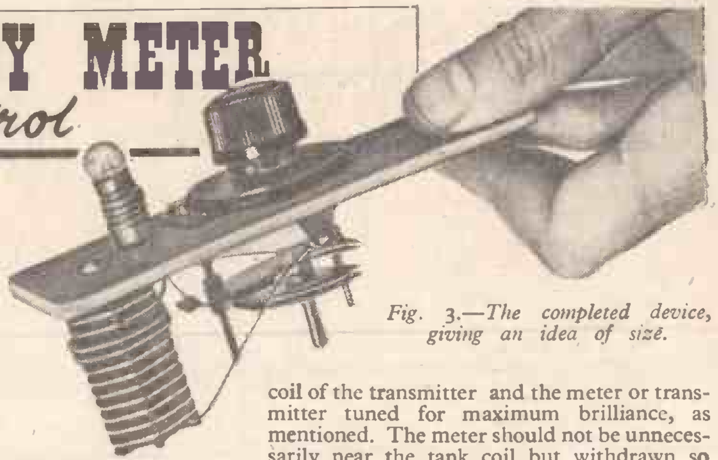


Fig. 3.—The completed device, giving an idea of size.

A Handy Test Unit

By F. G. RAYER

MANY frequency meters used for checking the operation of a model control transmitter employ a moving-coil meter for measuring or indicating purposes. This is a good method, but such meters are relatively expensive and require to be treated with care. It is, however, possible to replace the moving-coil meter by means of a small bulb, thereby reducing cost and producing a smaller and more robust instrument. Frequency and output of the transmitter may be tested with it in the usual way.

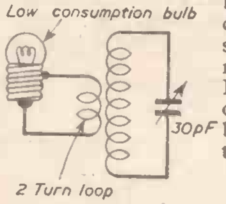


Fig. 1.—Circuit of bulb frequency meter.

The tuned circuit shown in Fig. 1 is brought to resonance by the 30 pF variable condenser. R.F. energy is then developed across it and transferred to the bulb by means of the coupling loop. To ascertain whether a transmitter is within the permitted band, the frequency meter is tuned for maximum brilliance and the dial reading noted. To set a transmitter within the band the meter dial is set to the correct reading and the transmitter then tuned for maximum brilliance of the meter bulb.

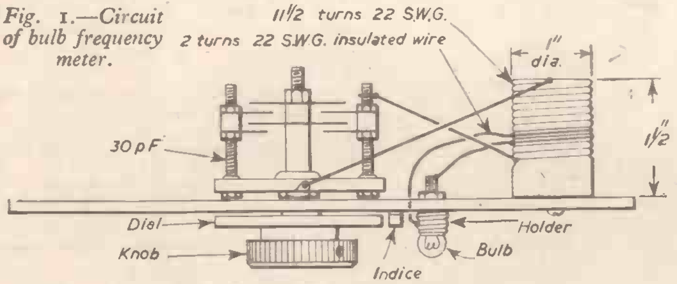


Fig. 2.—Wiring plan and coil.

A simple practical layout for the parts is shown in Fig. 2, the "panel" projection to the left serving as an extension by which the meter can be held. The exact maximum capacity of the tuning condenser is not important, except that very small values will limit the waverange covered, whereas large values will make tuning difficult. A maximum capacity of 15 pF to 50 pF is feasible, with around 25 pF maximum being most suitable. A degree dial or pointer is locked securely to the condenser.

As movement of the coil turns would upset calibration, a notched, ribbed former is used. A solid former may be substituted, but a few turns may then require removing from the winding to compensate for stray capacity. The ends of the winding are tightly secured by passing through small holes, and the connections taken directly to the tuning condenser. A trace of varnish would hold secure the turns upon a smooth former.

The lamp loop is of insulated wire, wound on top of the tuned section in the same notches. Its ends are similarly secured and taken to the bulb holder. So that the meter may be retained for continuous use it is essential that condenser and dial be firm, and that turns on the coil be immovable. The bulb requires to be a low-consumption type, that used being of 2 volts .04 amp rating, intended as a dial lamp in battery-operated radio sets. If this cannot easily be obtained, the 6 volts .04 or .06 amp type used as a rear light with most cycle-dynamo sets will do.

When making checks, the tuning coil of the frequency meter is brought near the tank coil of the transmitter and the meter or transmitter tuned for maximum brilliance, as mentioned. The meter should not be unnecessarily near the tank coil but withdrawn so that the bulb is extinguished when tuning is slightly off resonance. With a small one-valve transmitter this will be at about 2in. from the tank coil. With larger transmitters, care is necessary to avoid blowing the bulb. Initial calibration of the meter is obtained by tuning it to a transmitter known to be on frequency and noting the dial or pointer reading. If the tank coil cannot be reached, the transmitter aerial may be connected by means of a lead with a one- or two-turn loop in it, and the meter brought near this loop. If the meter is to be carried out-of-doors a box round coil and condenser is necessary. This should be fixed in position before calibrating the meter dial. The completed device is shown in Fig. 3, 4 and 5.

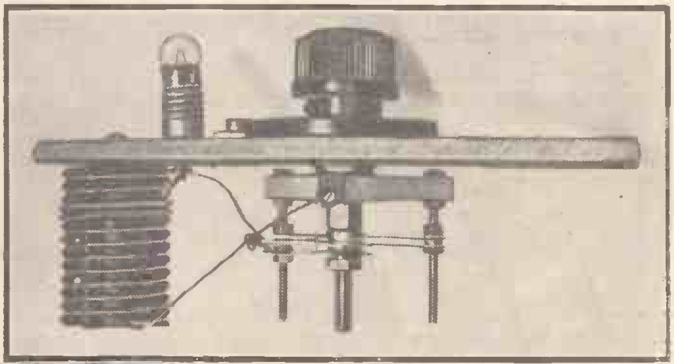


Fig. 5.—A side view showing the coil.

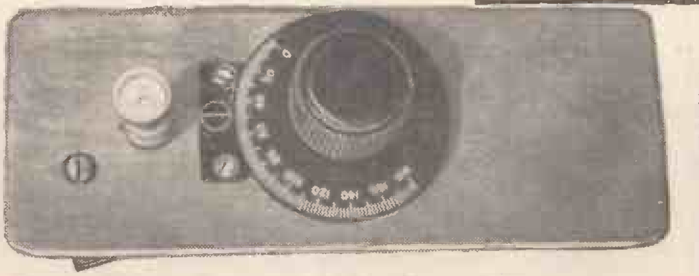


Fig. 4.—A top view of the completed meter.

The photograph shows the U.S. Army's new convertiplane, which is seen in flight over St. Louis, Missouri. Built by the McDonnell Aircraft Corp. of St. Louis, it can take off or hover like a conventional helicopter or can fly straight ahead with the speed and range of a conventional winged aircraft. This is the first of its type to be built.

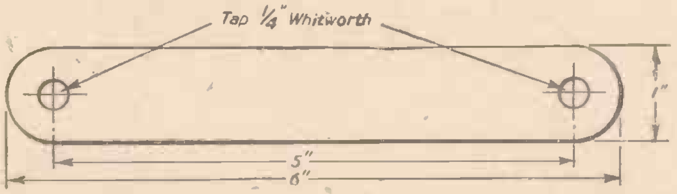
A CAPACITOR FLASH GUN

Compact! Cheap to Construct! Economical in Use!

By M. KATERS

Fig. 3.—The folded flashgun.

THE flashgun is capable of folding into a reasonably small space as can be seen from Fig. 3. The direction of the flash is obtained by swinging the reflector which is clipped to the barrel. The flash unit is attached to the camera by means of a metal bar (Fig. 1a). If, however, you wish to use the camera shoe, then the bar can be removed and a shoe adapter fitted (Fig. 1b).



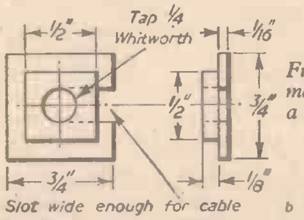


Fig. 1. — The metal bar fitting and shoe adapter.

The gun is capable of firing flash bulbs of the A.S.C.C. cap type manufactured either by Philips or Mazda, also the new capless type if an adapter is used.

The advantage of the battery capacitor system over the battery one is that ordinary batteries deteriorate during their life. Therefore, to ensure that the bulbs will fire every time when in use, fresh or almost fresh batteries are required. In the capacitor system a positive flash is obtained every time even though the battery is deteriorating. Such a battery will last as long as a year.

Fig. 2.—Two views of the completed flashgun.

The Circuit

The electrical circuit for the flashgun is shown in Fig. 4, while Fig. 6 shows how the actual components are linked up in the flashgun barrel; an earth return through the camera being assumed.

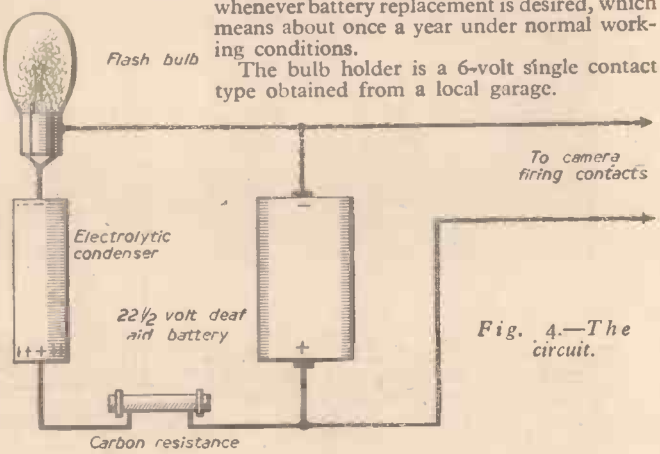


Fig. 4.—The circuit.

The electrical components can be obtained from any radio repair shop. The 25-volt electrolytic condenser can be of any value between 25 and 100 μF. For space reasons the miniature type should be used. The value of the radio carbon limiting resistance is between 2,000 and 6,000Ω.

The components used were a 100 μF electrolytic condenser and a 4,000Ω carbon resistance. I found that with a 4,000Ω resistance the charging rate was about 20 seconds. This means that after the flash bulb is inserted in the gun at least 20 seconds is required before the gun will fire. A lower resistance will give a higher charging rate and a high resistance a lower one. When the condenser is fully charged there is a continuous leakage current of a fraction of a milliamp. This means that a bulb cannot be left indefinitely in the gun without battery deterioration.

The flashgun barrel with non-electrical components is as shown in Fig. 5. It is well known that 1in. copper tubing means the inside diameter while 1in. brass tubing means that the outside diameter is considered. Therefore the outside tube is made of copper with brass tubes a sliding fit for the top and bottom components. The top component is held in positon by 8 B.A. countersunk screws as this component need not be dismantled unless the condenser breaks down, and this is a very rare occurrence with a good quality part. The bottom component is held in position by cheese or round headed screws mainly to act as stops for the reflector clip when it is pushed down while not in use. These screws would have to be removed whenever battery replacement is desired, which means about once a year under normal working conditions.

The bulb holder is a 6-volt single contact type obtained from a local garage.

The reflector size recommended by the makers of flash bulbs should be between 4 and 5in. in diameter. The one shown in Fig. 2 is the minimum size and is an aluminium shallow type pot lid obtained from a chain store. Care must be taken in choosing the lid otherwise your reflector will look so obviously home made; the one used here is of the rounded or beaded-edge type. The barrel

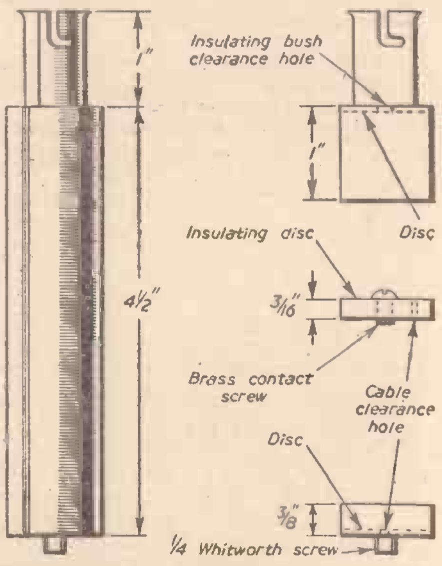


Fig. 5.—Constructional details of the flashgun barrel.

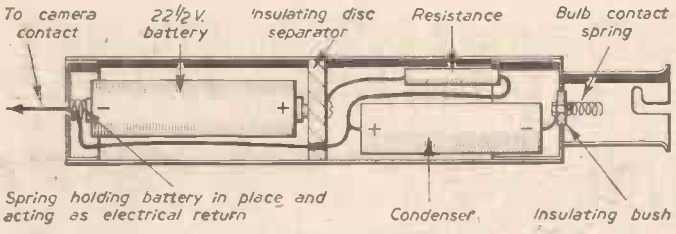


Fig. 6.—How the components are linked up in the flashgun barrel.

clip (Terry) of 1in. diameter was obtained from the same chain store. A piece of strip aluminium of cross section ½in. x ⅛in. joins the centre of the reflector and the clip, both items being riveted into place. The length of the bar—between centres—before bending is 3in. The bar should be bent into the lid shape before riveting as this will give sufficient reflector clearance when it is in the down position on the barrel.

Finish can be as desired. In this case the bar and barrel were black lacquered and the reflector unit polished.

The flashgun can be used for bounce flash in a horizontal direction. This gives a softer, diffused lighting and can be obtained by directing the light at the room walls or card reflectors instead of directly at the subject.

A MODERN Standard Lamp

Make This Useful Item of Unusual Design for Your Home

By T. D. HACKNEY


Fig. 1.—The standard lamp in use.

THE materials required for this lamp, which is shown in Fig. 1, are readily available and the construction so simple that, apart from the finishing, it could be described as a one-evening project.

MATERIALS LIST

1 length ⅜in. dia. mild steel rod, 5ft. 6in. long.
1 length ⅜in. dia. mild steel rod, 2ft. long.
3 plastic balls about 1½in. diameter.
1 piece mild steel about 1½in. x 1in. x ⅛in.
1 strip mild steel about 5in. x ½in. x 1/16in.
1 ¼in. bolt 1in. long with washer and wingnut.
4 steel or brass ring screws.
1 lampholder, together with screwed adapter for same.
1 cord switch.
1 length of plastic-covered flex.

The two lengths of steel rod should first be bent as shown at A, Fig. 2. This operation can be achieved quite easily cold by clamping the rod in the vice and by slipping a 2ft. length of iron pipe over the projecting end. This method will avoid distortion and produce a clean bend.

The plastic feet were made from ready-made balls of this material, which can be obtained drilled and tapped quite reasonably from machinery merchants who stock them in both red and black for machine tool lever knobs. The bottom ends of the rods should be screwed to fit the tapped holes in the knobs.

Now cut a slot about ½in. into the top end of the rod that is to form the standard, soft solder or preferably silver solder in position the ⅛in. thick plate which is cut and drilled ¼in. clearance as shown at B, Fig. 2. Also sweat the ring screws into holes already drilled for them; these rings are for the flex eventually to pass through.

Next attach the rod forming two of the feet by filing flats on it and on the standard and silver soldering together. It will be found a help if these are first screwed together by means of a small steel screw passing through the foot section and tapped into the standard.

The strip steel is next drilled and bent as shown at C and D, and the lampholder adapter is sweated into position. The bolt and wingnut is used for assembly as shown at D.

Finishing

This completes the construction, the finish being left to the taste of the constructor, but whether it is proposed to finish in cellulose or enamel the metal should first of all be thoroughly cleansed with fine emery cloth and all grease removed with turpentine substitute. A priming coat is applied and this is a dark brown turpentine-based paint obtainable in small tins and very easily applied with a brush. Do not apply too thickly and allow about twelve hours to harden. The undercoat should next be put on, and again this is a turpentine-based light grey paint, equally easily applied. This, too, takes about twelve hours to harden, after which the finish-coat may be put on. This may be either a brushing cellulose or one of the modern synthetic lacquers.

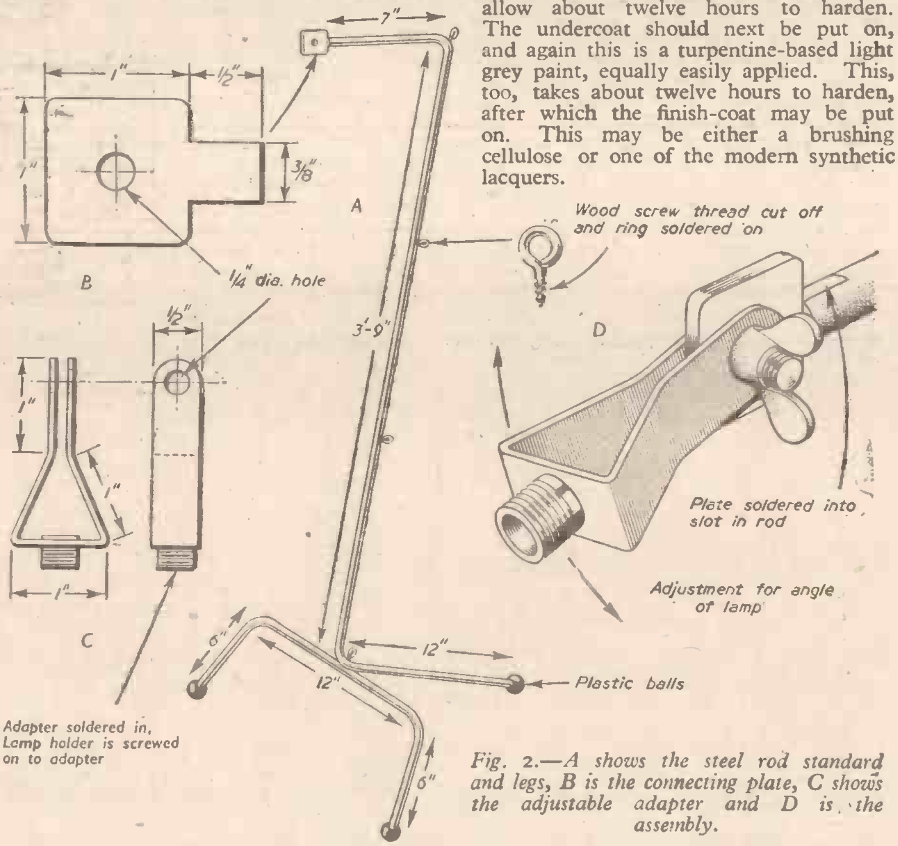


Fig. 2.—A shows the steel rod standard and legs, B is the connecting plate, C shows the adjustable adapter and D is the assembly.

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RADIO CONTROLLED MODELS

By Members of I.R.C.M.S.

9.—A Six Valve Superheterodyne Receiver for Model Control

READERS who have attended radio controlled model meetings or watched demonstrations will realise that in most cases only one model can be operated at a time and that it is always necessary to take great care to avoid the accidental switching on of any transmitter not being used for the control of the model, so as to prevent putting the model out of control. This is due entirely to the fact that super-regenerative receivers (such as that described in our September issue) are highly sensitive but very unselective. This type of receiver will usually respond to a transmitter tuned anywhere in the model control waveband, although a small amount of success can be obtained with two models by tuning transmitters and receivers to opposite ends of the waveband and keeping the models well apart and away from the other transmitter.

The 27 Mc/s model control waveband is, however, 320 kc/s in width, and by using selective receivers it can easily be split up into a series of channels which can be allocated to members in the case of a club. With the superhet receiver to be described the selectivity is of the same order as a broadcast receiver, i.e., 10 kc/s approximately between channels. Therefore, it is theoretically possible to use up to 32 models simultaneously. Due to lack of models fitted with this receiver we have so far operated only three together, but the principle has been proved.

The Design

The receiver described in this article was designed to fulfil the following requirements:

- A. To be highly sensitive and selective.
- B. To be reasonably light (it is fitted to a 36in. long boat).
- C. To be reasonably economical on batteries.
- D. To use the mark/space system of control (carrier wave transmission only).

It should perhaps be pointed out that, due to the very highly selective nature of this receiver, the simple transmitter described in the October issue cannot be used, and it is essential to make use of a crystal-controlled transmitter. This is, however, a simple one-valve affair using an overtone crystal (Q.C.C.).

Due to the confined space in the model, all tuning adjustments must be carried out from the top of the receiver, and consequently all trimmers and the potentiometer were made accessible for screwdriver adjustment looking down on to the top of the chassis. Fig. 2 shows this view.

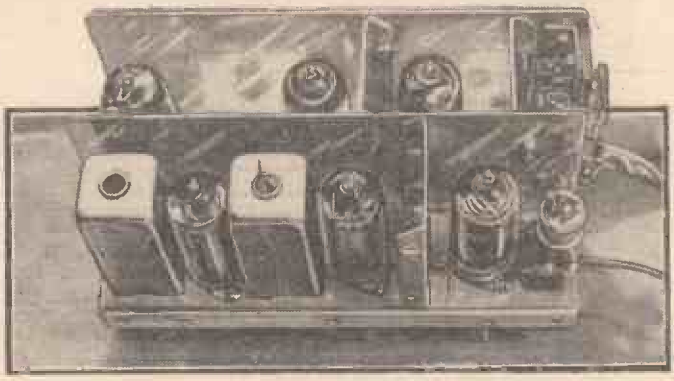


Fig. 2.—A top view of the completed receiver.

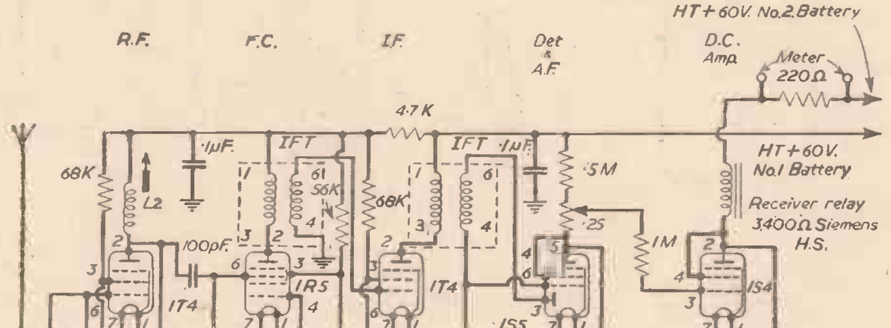


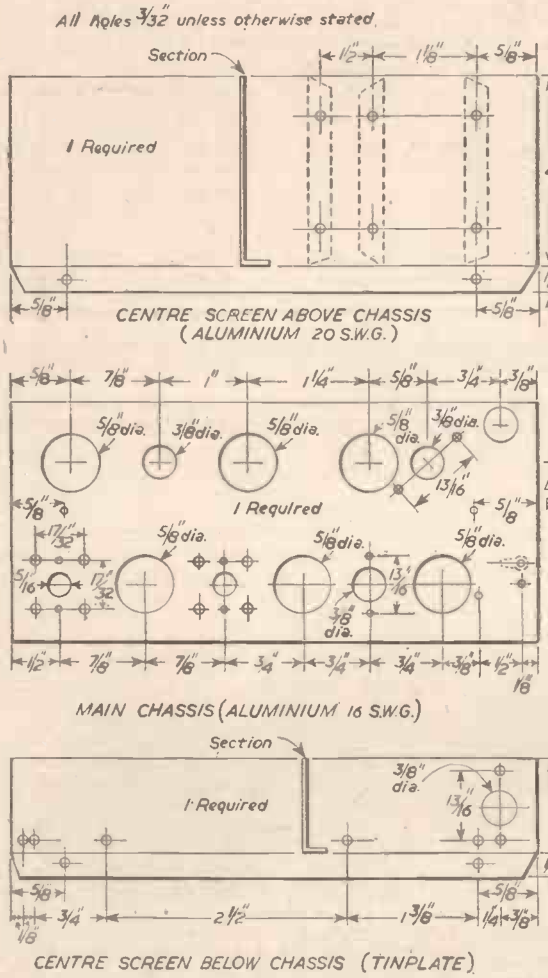
Fig. 1.—Circuit of the six-valve superhet model control receiver.

As in all superhet receivers, it is the oscillator circuit which exercises control of the received frequency, and it cannot be emphasised too strongly that this stage must be wired up rigidly so as to avoid any possible movement of components or coil turns when in use. To avoid so far as possible the effects of falling voltage from the H.T. source, a separate battery of 60 volts is provided. As the current consumption of this stage was only 0.7 mA in the original, the voltage drop was negligible on an average run.

A considerable number of experiments have been carried out on the stability of this receiver, and without doubt the major change of frequency is caused by temperature variation. The writer has therefore made a point of switching on the receiver and leaving the model in the water for at least 10 minutes before tuning up to the transmitter.

The Circuit

Referring now to Fig. 1, the circuit follows orthodox practice, except in the last stage, which is a direct-coupled amplifier. A radio frequency amplifier (IT4) is capacity coupled to the mixer grid of an IR5, which in this case is used solely as a mixer. Local oscillations are generated separately in the IS4 oscillator stage, which is triode connected, and these are injected into No. 1 grid of the IR5. The intermediate frequency thus developed is fed into the I.F. transformer and then into the IT4 I.F. stage. After the second I.F. transformer, detection is carried out normally using the diode of the IS5, and the rectified output is then fed by direct coupling to the grid of the amplifier section of the IS5, which is triode



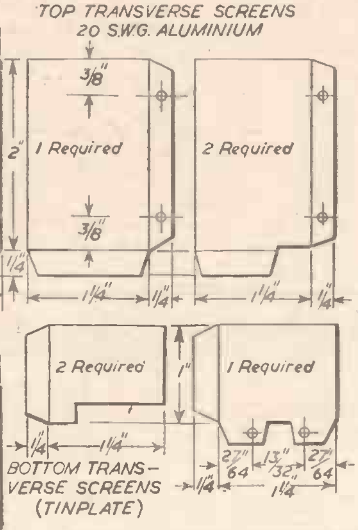


Fig. 3.—Drilling diagram for main chassis and screens.

connected. No A.V.C. circuit is used or is necessary.

At this point it is necessary to digress to mention that the receiver was designed for receiving non-modulated transmissions for mark/space control, and if at this point conventional capacity couplings had been used the signal would have been lost. If, however, it is required to use the receiver to operate tuned reeds, then normal audio couplings and bias circuits can be introduced.

The anode of the IS5 is thus now rising and falling in voltage at mark/space frequency due to the current flowing through the potentiometer and fixed resistor of .5 MΩ forming the anode load.

The slider of the potentiometer is arranged to select, within a prescribed range, the exact voltage necessary just to feed by direct coupling (via the 1 MΩ safety resistor) the grid of the final triode connected IS4, so as to cause current cut off when a space (no signal) is transmitted. To attain this condition, which would normally be impossible as the anode of the IS5 would be positive with respect to the grid of the IS4, it is necessary to raise the D.C. potential of the filament of IS4 (not the applied voltage, of course) by connecting the H.T.— of this valve to the 30-volt positive connection of the normal H.T. supply. With battery valves this unfortunately means that the filament supply of the IS4 must now be separated from the supply to the remainder of the receiver, as it is 30 volts positive with respect to chassis. A single U2 cell feeds this valve.

The operation of the last two valves is then as follows:

Normally the IS5 amplifier section draws a fixed current through its anode load, which causes its voltage drop, and the anode is, therefore, at a potential of, say, 20 volts positive. This voltage appears at the grid of the IS4, but since its filament is at a voltage of 30 volts positive (with respect to earth) the effect is as if the grid were 10 volts negative. Hence no anode current can flow and the relay in its anode circuit is open.

If, however, a signal appears at the last I.F. transformer, it is rectified and a negative voltage is applied to the grid of the amplifier section of the IS5. This causes the anode current to drop and the potential at the anode then rises in a positive direction. The grid of the IS4, therefore, is driven positive, and at a point of about 5 volts negative the valve starts to pass anode current. Usually the signal is sufficient to drive the grid of the last valve to a point where it is positive with respect to its filament, and the full anode current will pass with the consequent closing of the relay. Grid current is limited by the 1 MΩ grid resistor and anode current by the relay resistance and the limited H.T. voltage applied. The potentiometer is used to set the anode current of last valve so that it is just cut off when no signal is being transmitted.

Readers should note that this receiver works on the current rise principle, not the current drop on receipt of a signal, as is the case with the single-valve super-regenerative receiver.

Construction

The construction of this receiver is a little more difficult than anything described so far in this series, but it should not prove beyond the capabilities of anyone with a small amount of experience in radio and model work. The chassis is built up from a piece of 16 s.w.g. aluminium sheet 5½in. by 2½in., and in the original ⅜in. flanges were added at each side for the mounting of side plates to protect the valves and assist screening. Later models dispensed with this, however. As can be seen from the photographs there is a central aluminium screen (20 s.w.g.) running the full length of the chassis on top, which separates the R.F. mixer and I.F. stages from the L.F. and oscillator stages. In addition there is a small vertical aluminium screen between the R.F. and mixer valves and between the D.C. amplifier and oscillator valves. These screens assist stability in the receiver and also make the chassis strong and rigid, which is very necessary with the superhet

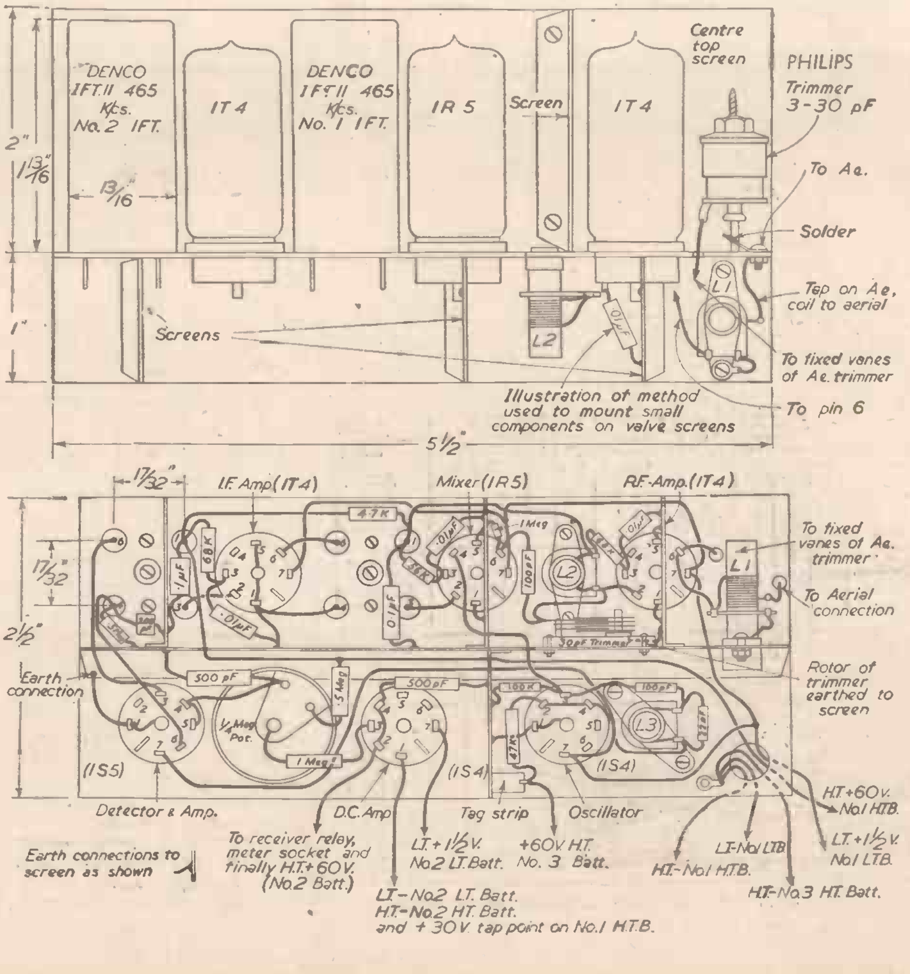


Fig. 4 (Top right).—The R.F. and I.F. side of chassis. (Right below).—The underside of chassis.

design. A further aluminium screen is used just past the oscillator trimmer so increasing chassis strength and assisting screening. Below the chassis there is a similar full-length screen and in addition there is a number of small screens, two of which (R.F. and mixer) lie across the valve bases to screen the input and output pins, also to separate the aerial and H.F. coils. These under-chassis screens are all made from tinplate, which means that soldering is easily accomplished. They are, in fact, soldered in place both to the valve base and to one another. The central screen must be bolted to the aluminium chassis.

Figs. 3, 4 and 5 illustrate the general lay-out of the receiver and the screens, and they also give the main dimensions for drilling the chassis and screens.

The precise positioning of some of the holes will depend to a certain extent upon the actual components to be used and it is, therefore, as well to collect all of the parts before drilling.

Details of the coils are given in Fig. 8, and as readers will see use is made of paxolin terminal boards to anchor the ends of the wires used in winding the coils.

These are necessary as none of the commercially available paxolin tag boards is small enough for this receiver. The coils are all simple single windings with the exception of L1, which is tapped at five turns from the start (earth end) to make the aerial connection. Winding direction is not important. Coils should be wound very tightly and doped with Polystyrene cement to fix the windings.

Full wiring details are given in Fig. 4, from which it will be seen that all wiring takes place under the chassis except for the aerial trimmer connection which is made through a hole in the chassis. The aerial lead also passes through a nearby hole.

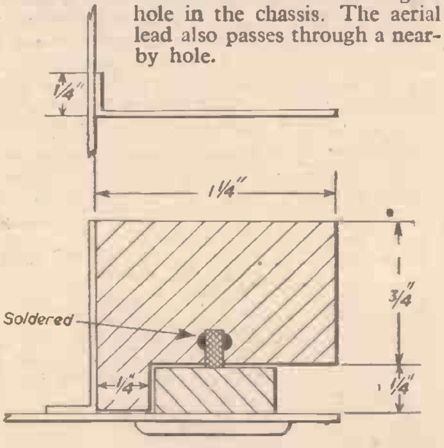


Fig. 5.—Method of cutting and mounting valve base screens in R.F. and mixer stages. (Material : thin tinplate.)

A little difficulty may be experienced when attempting to fit the under-chassis valve base screens, and care must be taken first to mount the valve holders the correct way (see wiring plan) and, secondly, to ensure that the centre spigot is firmly soldered to the screen.

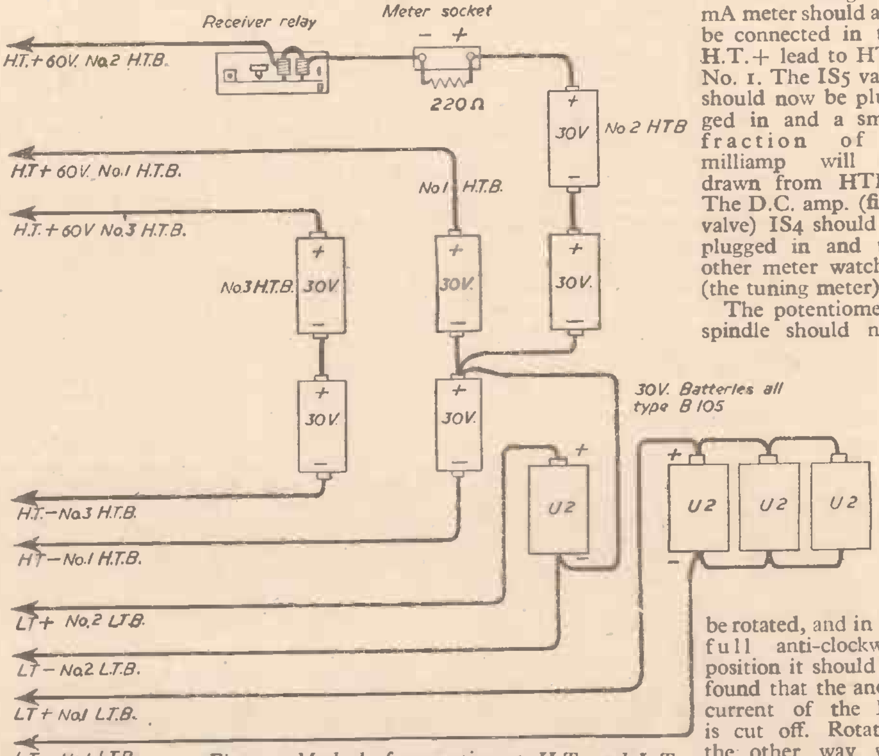


Fig. 7.—Method of connecting up H.T. and L.T. batteries, also relay and meter socket.

Tags 1 and 5, both of the R.F. stage and the mixer stage valve holders, must also be earthed by soldering to the screens, but no other tags must touch them.

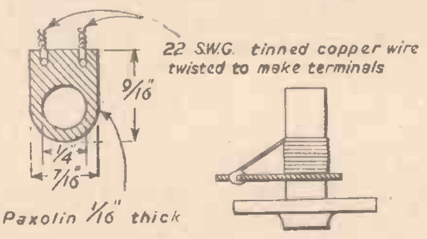


Fig. 8.—How the coils are wound. All formers ⅜in. Aladdin type. L1, 15 turns 32 s.w.g. enamelled copper tapped at five turns from bottom (earth end). L2, 15 turns 32 s.w.g. enamelled. L3, 10 turns 24 s.w.g. enamelled. The direction of winding is unimportant.

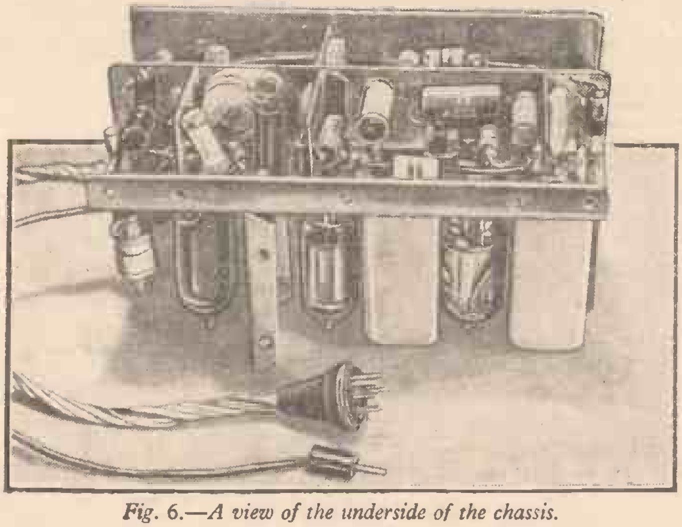


Fig. 6.—A view of the underside of the chassis.

Testing and Aligning

When wiring has been completed tests should be carried out. Batteries relay and meter should first of all be connected up as shown in Fig. 7. This may seem complicated, but, as previously mentioned, it is partly caused by the requirements of the D.C. amplifier and partly by the need for frequency stability in the oscillator. In the original, six type B105 hearing-aid batteries were used for the H.T. and three U2 cells for the main L.T., while one U2 cell supplied the D.C. amplifier valve.

While testing a 5 mA meter should also be connected in the H.T.+ lead to HTB No. 1. The IS5 valve should now be plugged in and a small fraction of a milliamp will be drawn from HTB1. The D.C. amp. (final valve) IS4 should be plugged in and the other meter watched (the tuning meter).

The potentiometer spindle should now be rotated, and in the full anti-clockwise position it should be found that the anode current of the IS4 is cut off. Rotating the other way will cause full current to flow and the relay will close. A rise of about 7 mA is given in the original, which is more than adequate for good relay action. Now reset the potentiometer so as just to cut off the IS4 current.

The IT4 I.F. amplifier valve should now be plugged in and an increase should be noted in the meter to HTB1. The IR5 mixer should then be plugged in and a further increase noted. At this point the I.F. transformer must be aligned to 465 kc/s, and this is a job calling for a signal generator, although it may be found possible to align on the transmitter if by chance the slugs of the I.F. transformer are sufficiently near to tune to enable a response

PARTS LIST

Six-valve Superhet Model Control Receiver

3 ⅜in. Aladdin coil formers with slugs.
1 3-30 pF Philips trimmer.
1 3-30 pF midget air spaced trimmer.
6 Ceramic B7G valveholders.
2 "Denco" miniature I.F. transformers (Ref. No. IFT11—465 kc/s).
1 ¼ MΩ miniature potentiometer (linear law if possible).

Resistors (all ¼ watt)

1 4.7 KΩ
1 220Ω
1 47 KΩ
1 56 KΩ
2 68 KΩ
1 100 KΩ
2 1 MΩ
2 .5 MΩ

Condensers

1 22 pF ceramic.
2 100 pF ceramic.
1 200 pF ceramic or silver mica.
2 500 pF mica or ceramic.
3 .01 μF 150-volt wkg. (Hunts midget type).
2 .1 μF 150-volt wkg. („ „ „).

Valves

2 IT4
1 IR5
1 IS5
2 IS4

Miscellaneous

Tinplate and aluminium for chassis.
6 B.A. and 8 B.A. nuts and bolts.
Systoflex (1 mm.) enamelled copper wire for coils, tinned copper wire (22 s.w.g.) for connecting up, flexible wire for leads, paxolin, Polystyrene dope, etc.

to be obtained. This cannot, of course, be done until all the valves are in position and the oscillator set to a frequency of 465 kc/s under or over the normal frequency of the transmitter.

Using the signal generator to align the I.F.s, a signal should first of all be applied to pin 6 of the I.F. valve (IT4) through a 50 pF condenser and IFT2 cores adjusted for maximum reading of the D.C. amplifier anode current (taking care to keep the signal strength low). Secondly, IFT1 should be adjusted by injecting the signal at the grid of the mixer valve (IR5) pin 6. It is most important that all cores peak to maximum without instability arising, which will show as a reading on the D.C. amplifier meter even with the signal generator off. The good screening and decoupling of this receiver helps a lot in this respect, but in difficult cases a resistor of about ¼ MΩ can be shunted across pins 4 and 6 of IFT1. This will damp the grid circuit of the I.F. stage, and the slight loss of selectivity does not matter.

Finally, all remaining valves should be inserted, when it will be found that the total H.T. B1 current is about 4 mA. HTB2 varies from zero to 7 mA on signal and HTB3 should be less than 1 mA, as previously stated.

By adjusting the oscillator coil tuning slug it should now be possible to receive the transmitter signal, and this should be peaked by adjusting the aerial trimmer condenser in conjunction with the slug of L1 and the air spaced trimmer (below chassis) and the slug of L2.

The oscillator adjustment is the master control; it is useless adjusting L1 and L2 until you get a signal by setting the core of L3. The setting of the oscillator slug is very critical and it must be turned slowly.

As would be expected, the transmitter will be received at two points when adjusting the oscillator tuning slug, and if there is any difference in strength, then obviously the stronger should be chosen.

Satisfactory results have been obtained at ranges up to 150 yards, at which point the model is practically invisible. This receiver is not so critical to aerial length alteration as are super-regenerative types, and in general the longer the aerial, the better; make sure, however, that L1 can be peaked for maximum signal strength.

Readers will note from Figs. 2 and 6 that in the original a midget B7G type plug is used to connect up the receiver to the battery socket in the model. This is very useful, as it means that the receiver can be removed at any time without the trouble of disconnecting leads and heating the soldering iron. A single plug and socket also connects the aerial.

As previously mentioned, all adjustments for tuning the receiver are made from the top (except the two slugs of the I.F. transformers, which are under the chassis and which should not need touching after once aligning). Tuning should be carried out in the model by using a plastic knitting needle or similar non-metallic rod which has been sharpened to a screwdriver, and this will avoid difficulties due to metallic objects affecting the tuning. Slugs in the Aladdin formers should be made firm by rubbing something like zinc ointment into the threads. "Fluxite" could be used.

(To be continued).

A DARKROOM HEATER

Rewiring an Existing Heater to Give Either Dark Heat or Bright Heat

By G. W. McDONALD

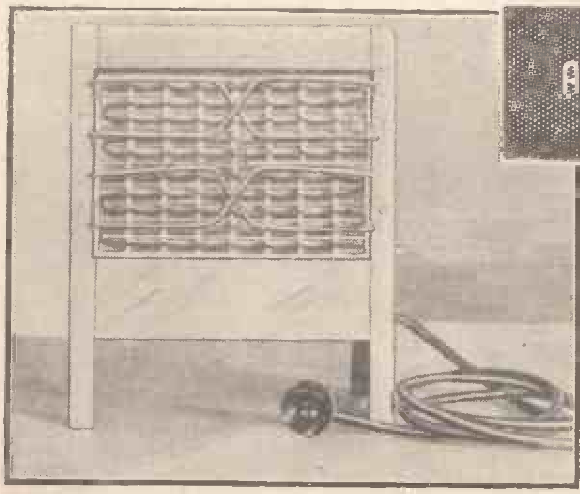


Fig. 1.—A typical two-bar electric fire.

HEATING a darkroom is largely a problem of cost due to the necessity for some form of dark heat. Tubular heaters are the ideal, with convector type heaters a close runner-up, but for a less costly method a two bar open-type electric fire, suitably modified, can be very satisfactory.

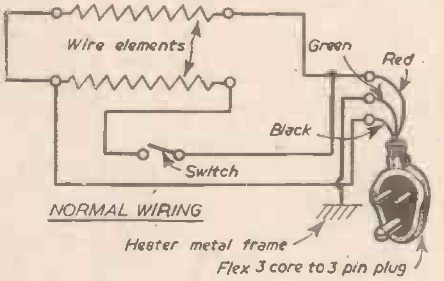


Fig. 2.—The normal wiring of the electric fire.

Many readers may already have such a fire and a typical example is shown in Fig. 1.

The modification is simple and requires no extra parts; it is a matter of rearranging the connections to the elements. Removing the back plate of the fire gives access to all the wiring and terminals. In normal operation the two elements are connected in parallel across the mains supply; a single-pole switch cuts off the supply to one element when the heat from one bar only is required. This arrangement is shown in the circuit Fig. 2 and the photograph Fig. 3.

The modified circuit shown in Fig. 4 puts the two elements in series across the supply, giving a dark heat. The switch is now wired to short circuit one element; this gives normal bright heat from one bar only if required.

The fire used by the writer was rated at one kilowatt or 500 watts per bar. The rating of the modified fire is 250 watts of dark heat or 500 watts of bright heat. These ratings were found to give satisfactory heating in a small darkroom, provided the heater was run at bright heat for about half an hour before photographic work started. Thereafter the dark heat added to the heat from the enlarger, and the closed room keeps the temperature comfortable for working.

In complete darkness a faint glow can be seen to come from the fire. This will have no effect on photographic paper, but if high speed film is being handled some care may be necessary to avoid fogging.

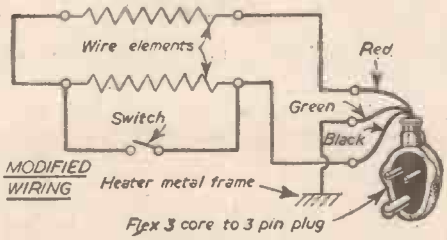


Fig. 4.—The modified wiring circuit to give dark heat.

The Earth

Make sure that the earth wire of the three core flex is connected securely to the metal frame of the heater. This is an important safety precaution to prevent electric shock when there are water taps within easy reach of the operator. Three-pin connectors, properly wired, are necessary to prevent accidents and to conform to I.E.E. Regulations.

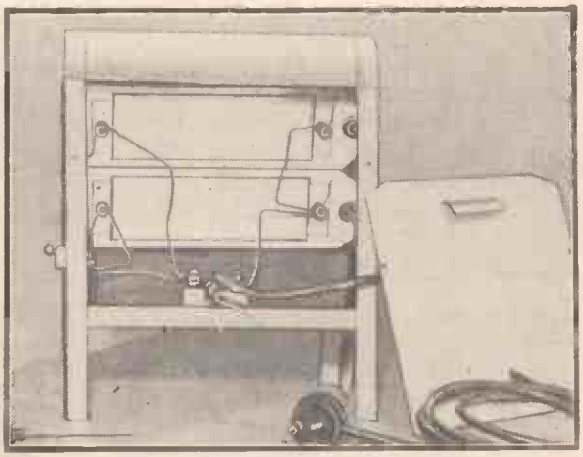


Fig. 3.—The unmodified heater wiring.

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CONSTRUCTING A Challenge Cup

Detailed Instructions for Spinning and Turning a Handsome Cup and Base

By "MACHINIST"

A TROPHY for recognising some auspicious club occasion is an article not often attempted by the amateur. The first step is to decide on the shape, height and whether sufficient material is available from stock for the various details. Brass sheet is recommended as it is so easy to work. A base or plinth is necessary—no cup is complete without one, and the material to use is ebonite, plastic or a really good piece of oak. Metal is excluded because it is not the "traditional" material, but if oak is not available, ordinary white wood stained a dark colour may be used.

Fig. 1 gives a drawing for a typical cup with handles and the usual style of base, but if this profile does not find favour the reader is advised to draw his own choice of shape to scale before attempting any work on the arbors necessary for the spinning of these parts.

It will be seen that the assembly is a series of separate pieces spigoted together and eventually soldered. Sheet brass of about 28-gauge or .015in. thick is the suggested material; you can vary this if a different thickness only is available, but it should not be too thick otherwise the completed cup will be cumbersome. The principle of these cups is a combination of outline and weight, and failure to achieve an excellent balance means that much of the beauty is lost.

Spinning the Details

The spinning operation may be new to many and for this reason a simple outline has been chosen.

The work can be carried out on either a wood-turning or metal-turning lathe—the latter for preference because, generally, the design is more robust. A series of arbors is needed, or perhaps it would be better to say a series of shapes is required, because after making the largest member, a reader can turn the former down to the next size and carry on with that section.

Thus, the largest piece (the actual cup) is tackled first. For the arbor or former a piece of hard wood is preferable. First mark out the necessary templates from stiff cardboard as shown in Fig. 2 and use these to obtain the outline on the former. The most important thing is a pleasing profile; so ensure all the radii "flow" into each other and that no projections occur. A cup which is nothing but a series of flats and bumps has a very poor appearance.

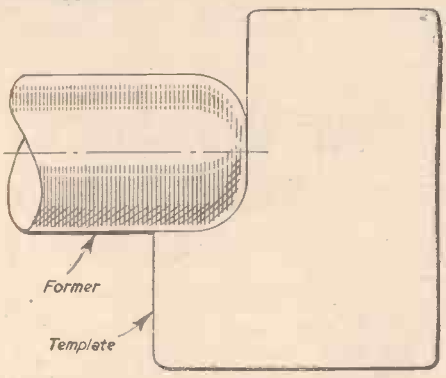


Fig. 2.—How the templates are applied. A similar example is used for the smaller radius underneath the lip.

Fig. 1.—A sketch of a typical trophy mounted on its base.

When the templates have been made, turn the outside shape. You may find, especially as it is so easy to make and cut out, that a roughing-out template will prevent you taking off too much wood at the initial stages. Leave ⅛in. on all faces, i.e., ¼in. on the diameter and then proceed to finish the form. For simpler outlines a smaller allowance is required, but for the first attempt ¼in. is ample.

Thoroughly anneal the brass sheet by heating it in the domestic boiler fire or a gas flame, and either plunge it into a bucket of clean cold water or allow it to cool naturally in the atmosphere.

Take off the chuck holding the arbor and substitute the faceplate. Secure the brass plate to it and bore the central hole where the spigot detail locates; remove the burrs and the sheet is ready for the spinning operation.

Replace the chuck and former and set up the plate in the manner shown in Fig. 3: the flat type rear centre holds the plate securely against the former and provides the drive while the spinning operation is taking place.

To describe spinning in detail here would take up too much space, and the amateur who has never seen this operation should consult a textbook in the library for precise information. Fortunately, the tools used are very simple and can be made in the home workshop. For this particular operation a rather broad-nosed member is needed—similar to that shown in Fig. 3. With the pegs set into the special holder, also depicted, it will soon spin this cup to the outline. The tool is a long bar which tucks under the operator's arm, pressure being exerted by bearing against the pin and workpiece.

You may find that after a few minutes the plate becomes hard to work. Hardness has taken place; the grains of metal have been compressed and are much more difficult to "flow." When this occurs, the only solution is to soften the piece of metal, an operation which is very easy even for the tyro mechanic. Place it over the domestic gas flame, either on another sheet of steel or by holding it in a pair of tongs. Do not concentrate too much heat in one particular spot, but keep turning it the whole time that the flame is in contact. After about five minutes, withdraw it and let it cool naturally in the atmosphere, whereupon it will again "work" easily when the spinning tool is applied. A water-quench is also possible, but beginners are advised not to bother with this until they have a little more experience.

As the shape is simple, the spinning of this profile should be completed without further annealing (this is the name given to the process of softening of any piece of metal).

Some readers may prefer to bore the hole in the sheet and attach the thick washer prior to the spinning process: this is optional, provided the latter item rotates concentrically when set up on the lathe. Solder the washer to the plate, and to assist this process a small countersink on what will eventually be the inside of this cup is made and serves to take a

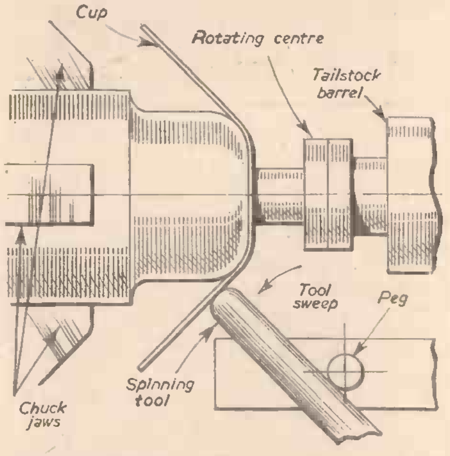


Fig. 3.—The sheet set up on the former and partly spun over by the tool shown in the foreground.

fillet of solder. The washer is merely a disc of brass 1/8in. thick.

When the cup is finally spun to the correct outline, put it aside for a while until the other parts are made; there is no need to polish it at this stage because all the details can be polished together before final assembly. Just scrape off any burrs to make it easy to handle and so avoid cut fingers when picking it up quickly.

The Stem

The stem on many trophies is also another spun article, but the shape chosen for this member is not easy for a newcomer to spin, and a turned detail is thus specified. The best way to machine this piece is to chuck a bar of brass in the three-jaw chuck and drill, recess, and turn the spigot and outside diameters. The bar is then reversed and set to run truly with only a light grip on the outside diameter in order to avoid marking the surface, and then the remaining operations of turning the radii are completed. It may be considered that the large radius is awkward to turn; it will mean making a special form tool and working very carefully while producing the radius, but this outline has a better appearance than a straight cone. The latter is very easy to machine and simply requires the top slide being turned round about 12 degrees to give a 24 degree included angle. In both cases blend the corners smoothly, and a tool with a fairly large-nose radius is ideal for this.

Set the lathe to rotate at the fastest speed and polish all the machining parts from the surfaces, using varying grades of emery cloth for the purpose until a really fine finish is secured.

The Handles

Two are required, and they are made up from 20 gauge sheet brass, .036in. thick, and once again simple templates are extremely useful to ensure that the shape of each piece corresponds. Hand polish these, or use a fast rotating brush set up in the lathe chuck.

An alternative method of making these parts is to secure a strip of brass about 1in. wide and bend the shape as shown in Fig. 4D. This width is sufficient to make two handles—a very careful sawing operation through the centre soon severs the pieces and a file is employed to dress off the sharp edges left by that operation.

The handles are eventually silver soldered to the cup before plating is carried out.

The Plinth

The plinth is a simple turning stage and requires no comment other than to say the 2½in. diameter should match the stem detail. Check this with a micrometer or pair of calipers before releasing it from the chuck. The spigot turned on the stem will fit closely into the recess—and may even be made a light drive fit, as this makes future handling much easier; do not overdo this, as it is possible to split the base member, despite the fact the wall of material is fairly thick.

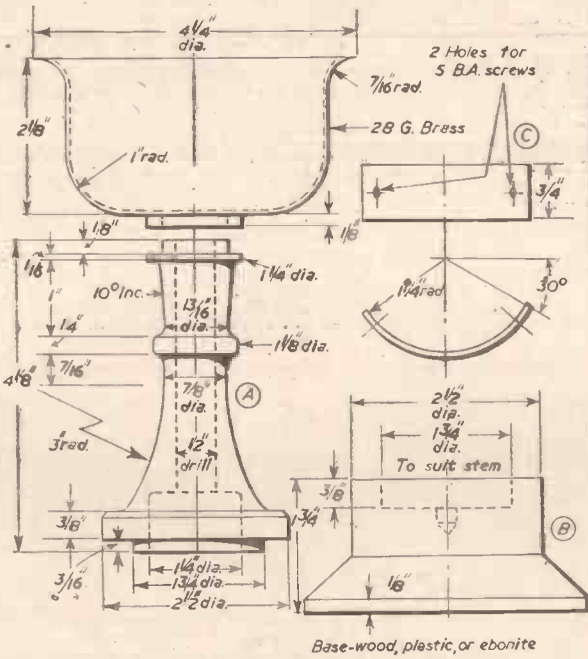
Black ebonite properly polished is the "traditional" material for the plinth, but this is not easy to obtain. Plastic will serve, but does not look well for this purpose. Oak may be used and suitably stained black.

Fig. 1 shows a thin plate which can be attached by means of two tiny screws to the plinth. It is best made from a thin tube, drilled and a piece sawn out to form the segment shown in Fig. 4C. A trophy of this description is not large enough for a series of plates on which to record the annual holders, so this plate is merely to state the donor or the event for which the cup is competed each year. Two chromium-plated self-tapping rivets, if obtainable in this size, will hold this plate closely to the base. If these are not available, screws are used instead. You can tap the wood or ebonite base if you take care to clear the tap frequently. The plate will be plated before fixing.

Polishing

If the standard of workmanship has been high, polishing should not take very long. The most obvious point to observe when machining or spinning is to avoid deep marks in the surfaces. Score marks are easily formed if an attempt is made to rush the latter stage and to use too much pressure in an endeavour to complete the operation quickly. Lubricate the surface liberally, but not with so much oil that it smothers everything when the lathe is started up. Grease is better, and tallow best of all.

Polish all the surfaces carefully, removing all the burrs and sharp edges beforehand with a very fine file. The time taken on this operation is by no means lost, as when finishing an article for plating any blemishes that show up are usually reproduced by the plating and then they look much worse. The handles need special attention in this respect, and afterwards may need to be reset; it is assumed that they have not yet been silver soldered in position.



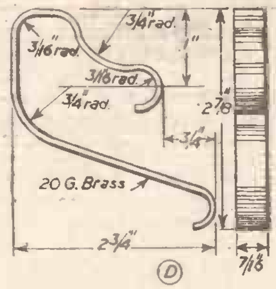


Fig. 4.—The dimensioned details of the cup. A is the bowl and stem; B is the plinth; C is the plate for engraving and D the handle.

Plating

Plating is not a process which the home mechanic can undertake; certainly the work of making all the accessories is not worth the trouble for a single or even a few articles. The best course to adopt is to send or preferably take the completed cup to a firm who specialise in this type of work, and let them plate and polish it. The curved plate for attaching to the base must also be treated in this manner.

Perhaps the firm who plate the article can also undertake the engraving, but if not, then the local jewellers is your next visit. It is, however, advisable to keep the amount of lettering on the plate to a minimum. Two lines or at the most three is all that is needed, but I believe the actual date of commencing the competition is essential, so make sure this is stated.

ANDY MANN .... **THE PRACTICAL MECHANIC**

Plastic Moulding

This article contains information in detail for making medals for small boys, but the pattern making, mould making and casting in plastic processes described can easily be adapted for making brooches, small ornaments, etc.

By P. CREER

Of the four stages involved (i.e., pattern making, mould making, casting and colouring) making the patterns is the most difficult. If these, however, are made in soft aluminium and built up in layers it becomes simple enough and only a junior hacksaw, a steel-point (such as a small bradawl) and one or two small files are needed.

Ribbons, as well as medals, are made in plastic and there are several reasons why ordinary ribbon is not used.

Cheap ribbon needs some sort of metal-stretcher arrangement if it is not to pucker and drag out of shape, and it also has to be stitched in joining; colour designs are very limited and all colour combinations must be already in use on "official" medals. The moulded plastic ribbon permits a design that can be decorative and original, which will keep its shape and is actually cheaper in cost and labour. The strength of the plastic mixture is more than ample for all ordinary wear and tear.

Making the Pattern

The main shapes of ribbons and medals are given in Figs. 1 to 4 and the thicknesses of aluminium suggested build up to a good total gauge from the standpoint of strength and appearance. A heat-resistant adhesive is used to cement the layers.

Obtaining a reasonably symmetrical finish to the main shape of ribbon and medal is the most important. The decorative "bits and pieces" need do no more than to present a noticeable relief.

In the soft metal used the figures of the rider, gun, etc., and the inscription plates are much easier than they might seem. Once the shape has been cut out roughly, filed to the required silhouette, and the first bodylines scored in, it becomes merely a matter of a little further filing and scraping to bring up a passable relief. Perfect detail is not required and most of it would pass unnoticed in the finished article in any case.

Inscription Plates

In preparing the inscription plates do not cut out the shapes until the lettering has been well advanced or finished. You will need something to provide a "hand-hold" while engraving. Make a template for the shape (of card or stiff paper) and scribe a firm outline to give the necessary boundaries for lettering. Then after marking out the letters in pencil or ball-point close-prick them firmly with the steel-point (Fig. 3).

It will be found that the steel-point will follow the pricked dots in ploughing the first furrow and not tend to skid at wild tangents. File off the burrs, note any necessary corrections and continue ploughing until a fair depth is reached. In this, as in the case of all indents and sunken lines, over-emphasise the engraving a little as the impression will naturally be a little "softer" in the finished cast. In the finished patterns bevel off all corners and edges slightly, as acute angles tend to form air pockets in casting. There need be no fear, however, that there will be cutting edges in plastic as there are in metal. Finish off with a smooth face. If your gauge of metal is too light, double the layer or, if too heavy, reduce with the file.

In cementing the patterns on the tray base for mould running remember to make a pinhole through the tray directly under each eyehole in ribbon and medal so that the air can escape before the flow of the rubber, otherwise your casts will have half-sunken eyeholes.

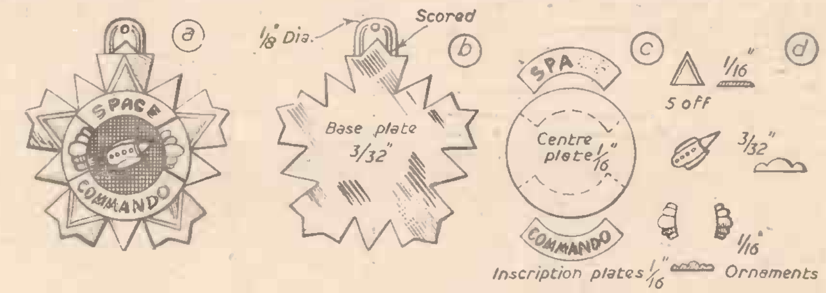


Fig. 3.—Space man medal: a—completed medal, 5/8 scale; b—base; c—inscription plates; d—ornaments.

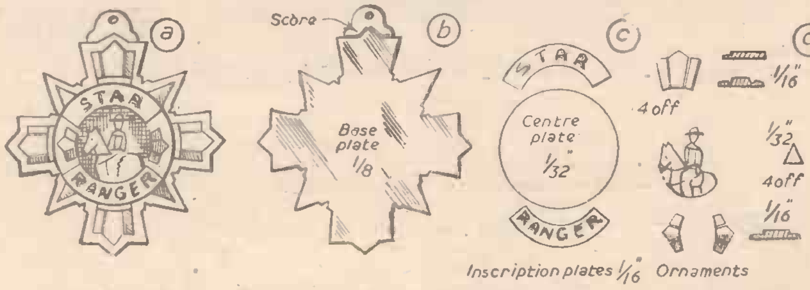


Fig. 4.—Wild West medal: a—completed medal, 5/8 scale; b—base; c—inscription plates; d—ornaments.

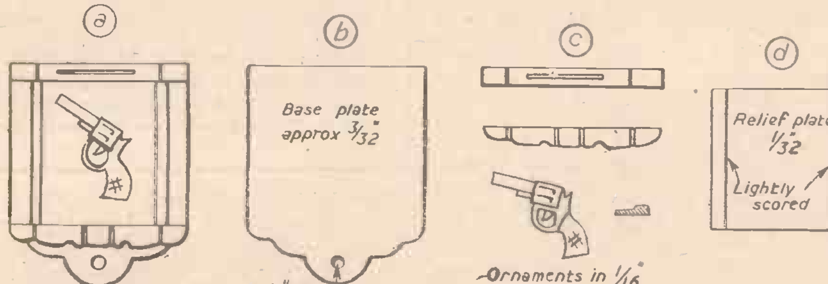


Fig. 1.—Wild West ribbon: a—completed ribbon, 7/8 scale; b—base, c—ornaments; d—relief plate.

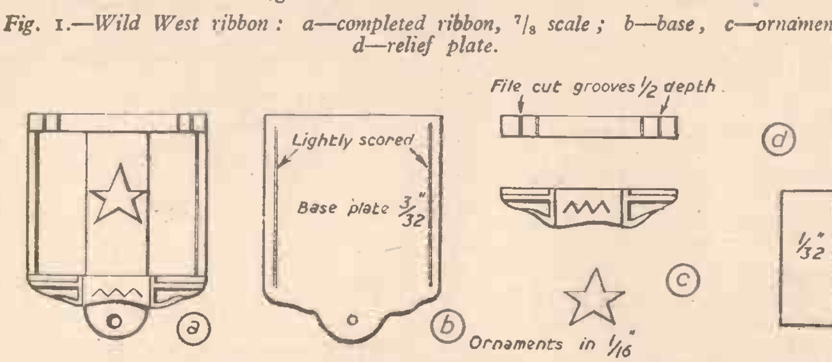


Fig. 2.—Space man ribbon: a—completed ribbon, 7/8 scale; b—base; c—ornaments; d—centre relief plate.

The patterns can be grouped on the tray fairly closely and about ⅜in. clearance will be sufficient in framing. The frame might be ¾in. deep and bevelled on the inner face to facilitate removal of the moulds. Mark a "Plimsoll line" around the inside of the frame calculated to show a rubber level of approximately ¼in. above the highest point in your patterns. The frame, of course, is *not* fastened down. But it should be weighted if necessary to avoid movement when pouring the mould rubber. (See Fig. 5.)

The Mould-running Procedure

Cut the mould material into pieces of sugar-lump size and put enough for one mould into an old (but clean) aluminium (or enamelled) saucepan and use only a gentle to moderate heat. The rubber listed below has a fairly low melting point and, like other things, it will stick and burn if overheated or not stirred. In a few minutes it will be liquidated and in the meantime the tray of patterns should be near the heat so that it, too, can warm up to avoid premature cooling and congealing of the rubber when pouring. See that the rubber is in a free-flowing state and pour steadily in from the side of the frame area so that the tide flows gently around and over the patterns. Tap the tray a little to shake up the air pockets. Finish to the "Plimsoll line" neatly and levelly and do not wait to add final drips and dribbles for the rubber congeals quickly. Leave the tray undisturbed for five minutes or so and it can then be moved to a cooler site to set. After about half an hour in a really cool temperature it can be stripped gently by easing up frame and mould from one side. If the patterns have been faced up smoothly and contain no lips or under-cuts the mould will come away cleanly. Any little tears or faults can usually be repaired with a heated knife-blade; or the material can always be cut up and remelted!

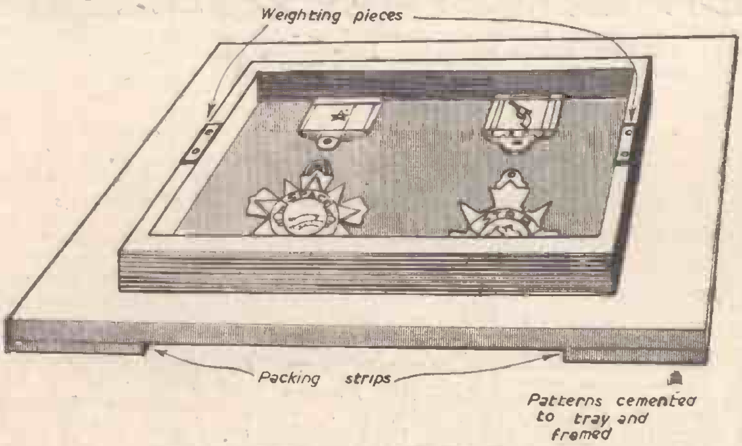


Fig. 5.—Patterns cemented to tray and framed.

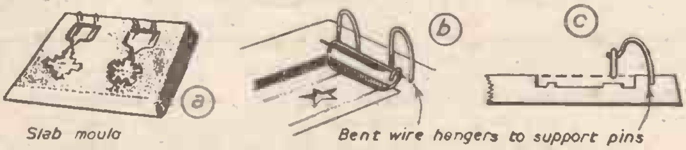


Fig. 6.—The slab mould and method of supporting pins.

Making a Test Casting

This is probably the easiest part of the whole job. When you start production in earnest you will, of course, need to place the brooch pins in position over the ribbon moulds to be cast in, but for test samples this is not necessary. Mixing instructions accompany the casting materials.

The plastic flows freely and should be poured gently, prodding a little with a match-stick to encourage the flow into small corners. Level up, but do not overflow. A little cold water may be added for thinning if necessary.

In normal room temperature the casts should be set enough to allow gentle removal after 30 minutes, but twice this time will be all to the good. It will take casts about two days to reach their *full* strength and to be quite ready for colouring.

No trimming or touching up of the casts should be necessary, and a fast rate of production can be achieved with a number of moulds. Do not forget to place the brooch pins in position overhanging the ribbon moulds before casting when in serious production.

Fig. 6 shows a simple form of bent-wire hanger to support the dangling pin so that it is slightly immersed in the liquid. Of course, other convenient forms of hanger for this purpose could be devised. Brooch pins in a cheap and simple style can be bought or they may easily and quickly be made from light "piano" wire (obtainable from most ironmongers) and fashioned as shown in Fig. 7, with the aid of a pair of small neat-jawed pliers. After a little experimenting it will be found that two or three deft twists of the wrist speedily turn these out and if the points are left fairly blunt they make "safe" pins and very suitable in every respect.

Colouring

The colour scheme suggested here can, of course, be varied somewhat. The ribbons and medals have been designed with a view to streamlining the job of colouring. Dealing first with the medals, the Wild West design is all silver except for the centre field around the horseman, which is made blue afterwards. The space medal is all gold except for a centre field of red. With a good No. 2 pencil-brush these centres can be speedily filled in. For the gold and silver coats I stand the medals in a small saucer containing a fair amount of colour, hip-bath fashion, and with a stiff-haired brush prod and slap the colour on. Then, shaking off any excess of colour, I hang them up to dry, looking over each dozen or so and scooping off with the brush any surplus paint collected in the hollows. The Wild West ribbon (with gun) is first coated all in bright yellow. The centre panel is then done in red and, if time permits, the gun and upper and lower bars may receive a rub of the silver brush. The space ribbon is coated all yellow, followed by a red coat for the left-hand strip and blue for the right-hand strip. The star face may receive a dab from the gold brush. The various steps and straight edges in the ribbon designs will now be found to help a great deal in applying the colours in quick, easy strokes.

A Drying Rack

A simple type is shown in Fig. 9. This is made of wood lath and has rows of panel pins or small-headed shoenails for hooks. Fig. 8 illustrates how joining rings may easily and very cheaply be mass produced by winding lengths of 20 s.w.g. copper wire (some tinned, some plain) in an open spiral on ¼in. diameter rod and then snipping into separate rings, which are ready for threading through and can be closed by finger pressure. Such rings are more than strong enough for their purpose.

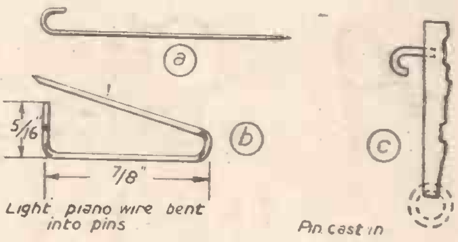


Fig. 7.—The brooch pin.

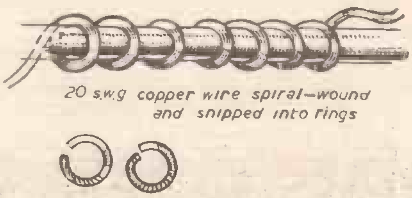


Fig. 8.—How the joining rings are made.

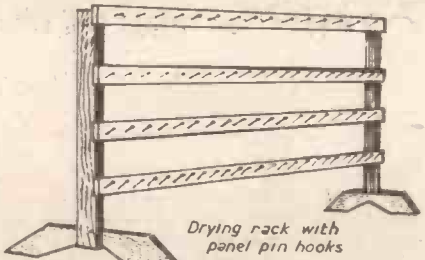


Fig. 9.—A simple drying rack.

LIST OF MATERIALS

- Aluminium scraps.
- Heat-resistant adhesive.
- Mould-rubber from Technical Products, St. Giles Close, Dagenham. (1lb. at 6s. 6d. will make 4-6 moulds).
- Plastic PX—from Quality Plastics, Ltd., Shenfield, Brentwood. (This costs 1s. 6d. per lb.)
- Cellophane packets from Messrs. Allan's, 424, Edgware Road, London, W.2.
- "Starline" (or other brand) gold and silver powder with clear medium—locally.

To finish off the medals effectively for presentation and sale they should, of course, be carded. Any jobbing printer can run off some 4in. by 2in. tinted cards at low cost. To complete the effect put each medal in an unsealed cellophane packet. Such packets can be obtained at about 3d. a dozen.

NEWNES ENGINEER'S POCKET BOOK
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A Simplified GAS HEATER

Fig 1. — The finished heater.

A Stove for Low Temperature Heating for Long Periods

By TUBAL CAINE

A MAJOR problem during the winter months is the heating of the workshop, particularly with fuel at such a high premium.

Most workshops require about two hours heating before the temperature reaches a comfortable level. Also to be considered is the fact that rust occurs on tools and implements if a cold atmosphere is allowed to exist for any length of time. The ideal condition is, of course, a gentle heat throughout the day and night to prevent dampness, but to keep a fire burning for such a long period makes the cost prohibitive.

To overcome this difficulty in a room which faced north in an exposed situation, I devised the simple type of heater shown in Fig. 1, and although it obviously does not replace the usual heater apparatus, it promotes a certain amount of warmth and never allows the room to become too cold; consequently work can be started without a long delay and the tools never rust.

Fig. 2.—Eliminating the ragged edge.

The Design

A five-gallon oil drum forms the chief component, and this is easy to obtain from any garage where oil is sold in bulk. Select a drum which is not dented and choose one in a reasonably clean condition. Rub a rag soaked in petrol over the outside surface to remove congealed oil, and empty any small amount that remains inside.

Punch a hole close to the top rim—the size and accuracy are not important because this is merely an access hole to allow you to cut off the top portion. A fairly large pair of tinman's snips will soon do this work, and when it is finished thoroughly wash the inside with petrol until all traces of grease are removed.

After the cutting process the edges will be very ragged and sharp, so the next stage is to turn this edge inwards.

A series of short cuts at right angles with the snips are made about 6in. apart, as shown in Fig. 2; then by gentle tapping and the use of a pair of pliers the edge is induced to assume the necessary position, making the drum safe to handle.

This drum reaches a fairly high temperature when in use and, as it may be necessary to move it when in this condition, some form of handle is required.

These have been added, one to each side, as shown in Fig. 3, and they are merely lengths of 3/16in. diameter rod bent over and held with nuts and bolts.

The punching of the holes for the bolts should not present much difficulty if a long, round bar is clamped in the bench vice and used as an anvil on which to carry out the "knocking." There is no need to pivot the handles as they only project from the drum about 1in.

While punching the holes for the handles, mark off and pierce those for the legs and wires; holes, ¼in. diameter for 2B.A. screws, make assembly very easy, and with washers between the heads and drum a secure fitting is obtained.

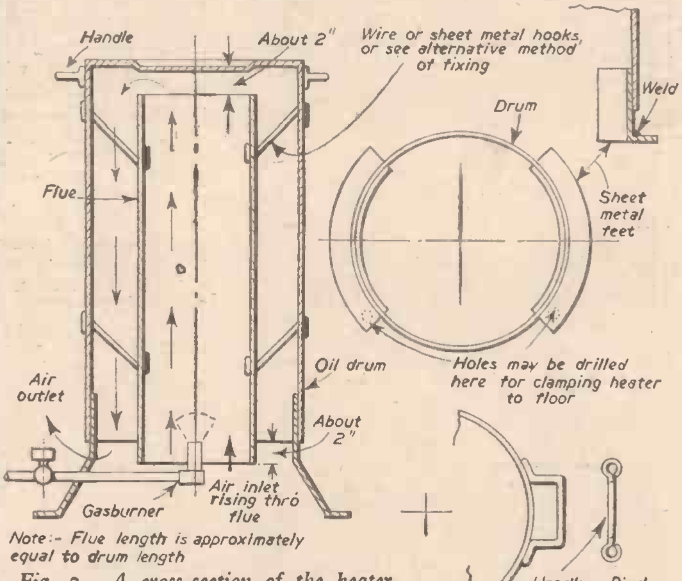


Fig. 3.—A cross-section of the heater, showing one method of fixing flue, and details of the handles and legs.

The Legs

How these parts are constructed will depend solely on the available material, but heavy gauge strip or plate is suggested. Four simple steel brackets is the first apparent solution, but two semi-circular parts which nearly touch is also satisfactory and a brief sketch of this method is included.

The legs or semi-circular parts could be riveted to the drum, but nuts and bolts well-tightened are easier to fit and do not work loose if spring washers are fitted beneath the heads.

Next coat the inside with aluminium paint as this saves time dismantling the inner member for this process. Aluminium paint is suggested because of the heat-resisting qualities it possesses. It brushes out well and dries in half an hour or so.

The Flue

Any tubular material with a diameter greater than 4in. is suitable for this item, provided a length within an inch or so of that shown in Fig. 3 is obtainable. This depends on the length you cut the drum. Copper, of course, is too expensive, so use steel or even cast iron if nothing of similar dimensions is available.

Drill a series of ¼in. dia. holes where shown in the elevation and, if it is decided to extend the flue lower than indicated, cut a slot to clear the gas jet. This method ensures all the heat rises in the flue and the flame is hidden and cannot blow out. Cut some pieces of wire—copper or soft iron will do—and bend them until they hook easily into the flue—the top members being the first to engage. To facilitate this work the drum is turned over and the flue lowered inside—then it becomes an easy matter to locate the wire in the different holes. As each passes through, a pair of large pliers are used to again bend the wire to an angle until it assumes roughly a Z or S shape. This work appears easy, but it is one of those occasions when another pair of hands is useful to hold the tube while you bend the wire; but do not use thick rod for these pieces otherwise difficulty is experienced in this bending process. The three remaining hooks are installed next, and this will leave the flue member suspended inside the drum.

If an alternative method is desired, the application of two ¼in. diameter rods solves the problem. These are threaded for the complete length and they pass right through the inner tube; they are held in position by nuts being tightened against the tube and the drum side. Fig. 4 illustrates the assembly; they enter the drum sides at right angles to each other, giving the tube a certain stability which is not possible if both the screwed rods are parallel to each other. Screwing these rods for the whole length is essential, otherwise assembly with the nuts inside is not feasible.

The Gas Bracket

Existing arrangements will influences the method of attaching the item, but unless another gas point is situated at a convenient site, which can be used without disturbing this member, it is suggested that a temporary rig is made, and the heating unit simply placed over it.

Gas is thus immediately available for other operations without having to spend time loosening two or three nuts and bolts, but I must admit that in my own workshop I prefer to keep my heater integral and in one corner where it can come to no harm.

If it is decided to follow the latter course, then a simple fixing on a leg is suitable and, in fact, the pipe can pass through one of these, being secured by a nut each side. This is not difficult as probably a special tubular member will have to be made in order to reach inside the flue, and while making such an item it becomes easy to include the gas tap outside the heater.

By now the outside has become greasy, so before attempting any painting clean it with petrol and allow this to evaporate. Whether it is painted to match the workshop fittings is a matter of personal taste—mine is aluminium both inside and out, and when soiled, usually through liquids being spilled on the surface, another coat takes only a few minutes to apply.

The handles become appreciably hot and may conveniently be bound with asbestos string.

Make a stand for the jet and secure this detail to a length of rubber tubing—enough

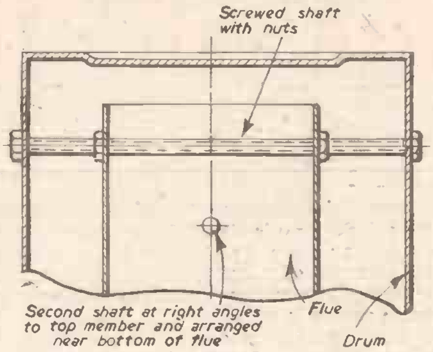


Fig. 4.—An alternative method of fixing the flue.

to give several feet movement when you pick up the heater and carry away the jet.

This is not designed as a form of heating to the exclusion of all others. As a space heater to stop the workshop from becoming stone cold it is extremely useful, and left burning all day it allows you to commence work at any time without delay.

The tools and machine slides will not rust as the slight dampness that occurs in the atmosphere during the late autumn and winter months is eliminated from inside the shop. There is no need to "roar" the burner—a flame about 1½in. high is sufficient and this does not, of course, use so much gas as the average gas fire.

The heater will warm a room about 10ft. square or say 800 cu. ft., and as a matter of interest I use a 1,000-watt electric fire for the very cold evenings as additional heating.

If the workshop is draughty this appliance will not cure this condition; the figures quoted are for a room with reasonably well-fitting doors and windows, and not a garden shed which may have cracked walls and floors.

Science and Observation

By Prof. A. M. LOW

Silent Railways

NEARLY 30 years ago experiments were made by Sir Arthur Du Cros with the use of rubber-sprung railway carriage wheels. It was an important idea and is now being used on some French railways. Shock and vibration lead to serious wear, and running costs might be greatly reduced by this new plan. What is more, the irritating clack-clack of wheels on rail joints could be eliminated.

Those Windscreens

SAFETY glass is fascinating, for the principle was discovered well over a hundred years ago when a certain Prince Rupert used to drip molten glass into water. If you try it you will find that the resulting pear-shaped affair has a little tail which, if you pinch it off, causes the whole piece of glass to break up into dust with quite a bang. Most safety glass is only ordinary glass which has been chilled outside while hot, so that inside the glass is strained. The least little scratch breaks the hard outer skin and pop goes the whole screen into pieces too small to do any real harm. Fancy waiting a century to use and apply this idea!

"Explosive Girls"

IT is a queer thing but true that girls use many of the materials needed for guns. Think of nail varnish, for example. This can be made of celluloid, which itself is easily made into explosive, dissolved into amyl-acetate which smells so strongly of pear-drops. Acetone can be used also to mix gun cotton and nitro-glycerine into cordite, but just as easily it can be applied to silk stockings. It is a fact that if every factory making nail varnish, silk stockings and cinema films were to go full speed ahead in wartime it would interfere very seriously indeed with the manufacture of explosives, even if it did not wreck the business altogether.

Cold Can Burn

A BURN is usually due to sudden passage through the skin of heat, which travels so quickly that the skin cannot conduct it without itself being injured. Arctic explorers dare not touch any metal with the bare hand. It burns as painfully as a hot poker.

With some modern deep-freezing methods where extreme cold is used the temperature is lower than that of ordinary ice in England. It is Arctic and, apart from any chemical leakage, the cold alone can be unpleasant. Very cold ice-cream is seldom so good as when it approaches the melting point.

Hardworking Crystals

CRYSTALS, and some Russian scientists think that they have sex, are very important. They control our B.B.C. wavelength, they can pick up radio, they separate important drugs from coal, and now they are used to detect the baleful results of atomic bombing more delicately than by any other method.

Fig. 1.—The Atmos clock. It measures 9¼in. × 8¼in. × 6¼in.

No-winding Clocks

A CLOCK has been invented that goes for ever. This is not new and it is not perpetual motion, because it uses a definite source of power. Every time the barometer rises or falls the air pressure can be made to move a needle, as we all know. If this needle is connected to a light spring the spring can be kept wound up and made to run a clock through a free-wheel device as used on a bicycle, only much smaller. The Atmos clock in Fig. 1 is one of these types of clock.

Turbine Locomotives

ALREADY in action is an experimental locomotive driven by a gas turbine. Only a blast of hot gas leaves the chimney and there is no steam, no smoke and no "puffing." This type of loco is likely to be the means of improving all railways, increasing speed, improving comfort and saving money. Control is electrical—the driver has little more to do than push buttons.

Rockets and Research

A GREAT deal of humbug is talked about co-operative research. This type of work is often a little more than a set problem such as "how many drops of water commonly fall on a window." Results are mathematically expounded with endless complicated detail, but the true result is a paper in a pigeon hole which is never opened.

Original research is different and far divorced from "papers" of which the real object is to provide examinations for theoretical degrees. Investigation of the genuine kind has now been made into the possibilities of using nuclear fuel for space rockets, and the results are rather disheartening. It is doubtful if atomic energy will be practicable as rocket fuel for very many years. Most hopeful types of fuel are those used by Germany in the war for the V.2, etc. Many were originated in England but neglected by authority as "useless."

Safety First

WATCHING a clown twirl his fool's cap through the air has led an inventor to design a new type of plane which can take off or land in 100 ft., manoeuvre at 30 m.p.h. and cruise at 120 m.p.h. It may be the answer to the family plane, and is likely to be important for short business journeys in countries where distances between towns make ground travel wasteful.

Atomic Defence

EXPERIMENTS have developed an instrument, as simple as a fountain pen, for testing if the wearer has been dangerously "radiated" in the event of atomic attack. What is more, tests with new pills and new injections suggest that protective measures are far from hopeless, as the sensation-monger likes to hint. Zirconium seems likely to prove an important remedy. We all know Zircon the sapphire-like stone, and now the metal Zirconium has eliminated large quantities of the fatal plutonium from mice long after these had been made radio-active.

A Photo-flood Control Unit

A Device to Give Gradual Dimming and Brightening

By H. T. COX

AMATEUR photographers who employ the use of photoflood bulbs will appreciate the fact that it can be quite a costly business replacing burnt out lamps. Take the standard Photoflood No. 1 as an example; the average life of such a lamp is approximately two hours, after which time the filament usually burns out. This is largely due to the fact that the filament is rapidly heated and cooled by the switching on or off of the supply voltage.

This fault can be readily overcome by the use of a simple system which allows the filament to be gradually heated up to its working temperature.

The unit to be described in this article does this adequately and efficiently with the added asset that it enables the lamps to be left burning, at a low power, between exposures without shortening their working life.

The Circuit

This is shown in Fig. 1 and requires little explanation: The "live" side of the main supply is connected to the S.P.S.T. (on/off) switch S1 and the "neutral" to one side of the S.P.D.T. (change-over) switch S2. At this point, however, it is important to ensure that the switches are in the correct positions, i.e., S1 is "off" when pressed up (the "up" position being toward the B.C. lampholders), and S2 should make connection to point "C" when in the "up" position.

N.B.—Wiring must be of at least 5 amp. capacity.

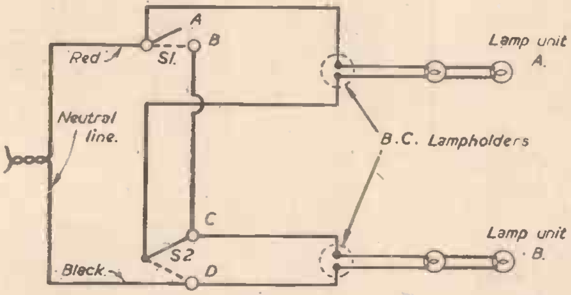


Fig. 1 (Left).—The circuit. Switching sequences:
AC=Series.
AD=Unit "A."
BC=Unit "B."
BD=Parallel.

The Box and Cover

The box is made of ¼in. plywood to the dimensions of Fig. 2, the joints being either nailed or screwed. Two holes are cut into one end to retain the lampholders and a smaller hole is drilled in the other end for the entry of the mains flex. After assembly the box can be sanded and a few coats of "shellac" or other varnish applied.

The cover is made of bakelite or hardwood and is 1/16in. thick. The dimensions for this are shown in Fig. 3 and it is screwed to the box when the assembly of the components and the wiring has been completed.

The mains flex is knotted just inside the box to prevent the connections from being tugged loose, and the mains connection can either be by a plug to a power point or by a B.C. adaptor to a lighting circuit.

The switches are the standard flush-mounting type and they are attached to the cover with the knurled nuts supplied with the switch units.

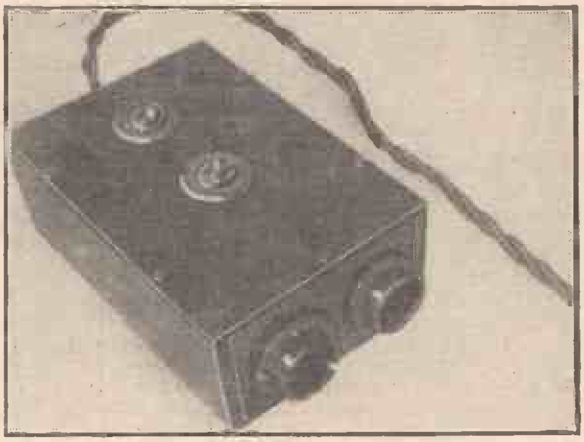


Fig. 4.—The completed control box.

Operation

With both switches in the "up" position the lamp units are in series, thus burning dimly. When both switches are moved to the "down" position a parallel circuit is obtained causing the lamps to operate brightly and normally.

By operating either switch independently, i.e., S1 up and S2 down, or vice versa, only one of the lamp units lights, which one depending, of course, on what selection has been made. See Fig. 1 for the switching sequences.

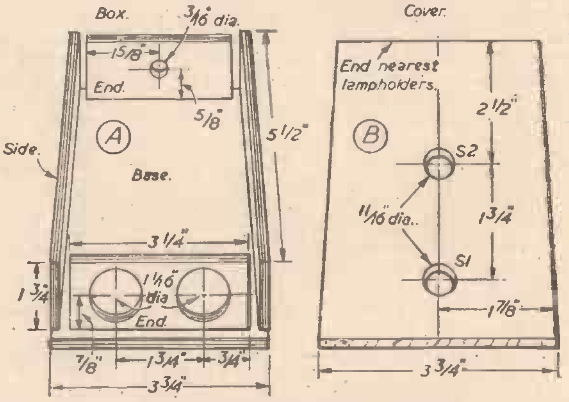
Fixing

The completed unit can be fixed, by means of a spring clip, to the lamp standard if required and other arrangements can be made to suit the individual, although I preferred to place it on the floor.

MATERIALS REQUIRED		Approx. Cost s.	d.
Two	B.C. Lampholders	2	0
Three yards	Twin flex (5 amp.)	1	6
One yard	Single core plastic covered (1/.044)		6
One	On/off switch (standard flush mounting type)	3	6
One	Changeover switch (standard flush mounting type)	5	0
—	Wood for Box and Covers	—	
	Approx. total cost =	12	6

All the electrical materials may be obtained from an electrical store.

Materials for Box:
- 2 Ends 3¼in. × 1¾in. × ¼in.
- 2 Sides 5½in. × 1¾in. × ¼in.
- 1 Base 5½in. × 3¾in. × ¼in.
- 1 Cover 5½in. × 3¾in. × 1/16in.



Figs. 2 and 3.—Details and dimensions of the box and cover.

REFRESHER COURSE IN MATHEMATICS

By F. J. CAMM

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AN ALL PURPOSE EAS

A Home-made Item of Light, S

By E. S.

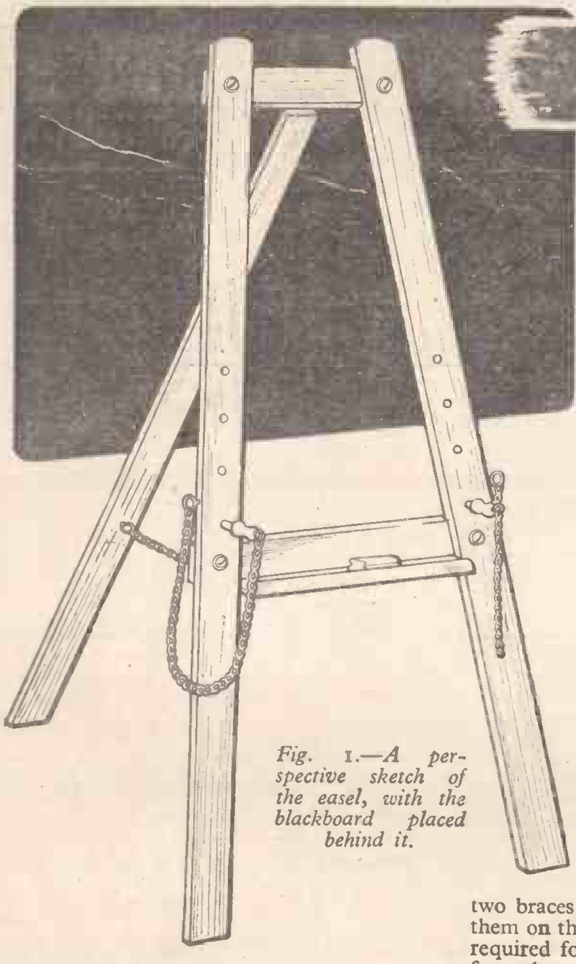


Fig. 1.—A perspective sketch of the easel, with the blackboard placed behind it.

THIS useful easel, besides being suitable for children (for homework, etc.), has been used as an artist's easel for outdoor sketching. Being assembled by four bolts with butterfly nuts, it can be speedily dismantled for storing when not in use, or carrying to a sketching site.

All parts should be good quality hardwood such as beech, ash or oak. Beech has the advantage of being close grained and easy to work. Should the material be obtained from a joinery firm, order it machine dressed; this costs a little more than "off the saw" but is worth the saving in time and labour. Fig. 1 illustrates the completed easel.

The Legs and Braces

Fig. 5 shows the general arrangement and setting out dimensions, which should first be drawn down to actual size on brown paper. The brown paper should be drawing-pinned, or fixed with "Sellotape" to the floor and the pieces of wood for the legs and braces set on the diagram and marked off to length and shape.

When they have been cut to size and shape, they should once more be set on the diagram and held temporarily but firmly in position by nailing small blocks of wood to the floor. The $\frac{1}{4}$in. diameter holes for the four bolts should first be bored through the two legs and carried through the braces to a depth of about $\frac{1}{4}$in. The braces can then be removed from the template and bored through completely, thus ensuring that the easel will assemble correctly.

Consideration should be given to the method of jointing the braces to the legs. Fig. 2 shows a plain joint, and although this is quite suitable, a stronger job will result if the braces be increased in thickness to receive the legs, as shown in Figs. 3 and 4. Such a joint does not rely so much on the bolts for rigidness.

Assemble the two legs and two braces with the bolts and again position them on the template and measure the length required for the chalk ledge and its rounded fore-edge. Cut to length and bevel to correspond with the slope of the easel legs. Glue and $\frac{5}{8}$in. panel pin the fore-edge to the ledge-board, and glue and screw the ledge to the brace (Figs. 3 and 4). Four screws will be sufficient.

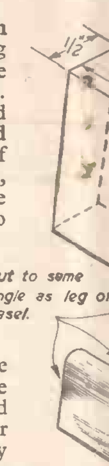
The peg holes in the two legs should now be bored, using a joiner's bit. First, set out the hole positions on one leg and bore the holes. These should not be bored completely through from the face, but just enough to allow the gimlet point of the bit to show on the back, and then bore from the back; this will prevent surface splitting of the wood. Place the bored leg upon the other, insert the bit so that the gimlet point marks the lower leg, then bore out as before. Wrap a piece of No. 1 glass-paper round a piece of $\frac{3}{8}$in. dowel rod, and clean up the holes.

The centre leg may now be cut to length and hinged to the top brace (Fig. 8), taking care to set the hinge at right angles to the brace, and in the centre of it.

The Pegs

The two pegs (Fig. 6), should be made of hardwood similar to the easel. Should the constructor have access to a wood-turning lathe, it would speed up production, but they can be made by hand as were the author's. If made by hand, the pieces of wood should be about 6in. long by $\frac{7}{8}$in. by $\frac{7}{8}$in. the extra length being necessary so that it may be held in the vice without damage to the actual peg during manufacture. First, square the ends of the wood, and glass-paper them. Draw diagonal lines to find the centre, and describe a circle of $\frac{3}{8}$in. diameter on one end and $\frac{7}{8}$in. on the other end. Plane the square of wood to a round rod section, $\frac{7}{8}$in. diameter, and roughly glass-paper to remove plane marks. Draw pencil lines round the rod to determine the position of the $\frac{1}{4}$in. wide flange, and the overall length of the peg.

With a dovetail saw make a saw cut about 1/16in. deep round the rod on the pencil lines fixing the flange position, and with a sharp bevelled-edge chisel cut a "V" on the "waste" side of the lines. Increase the saw cut and depth of the chisel cut until the thickest part of the tapered peg measures slightly more than $\frac{5}{8}$in. (a pair of outside calipers will be helpful). Pare away the wood to form the tapered shank, using first the chisel, and then a cabinetmaker's or shoemaker's rasp. Hold the piece of wood in the left hand and rotate same whilst rasping,



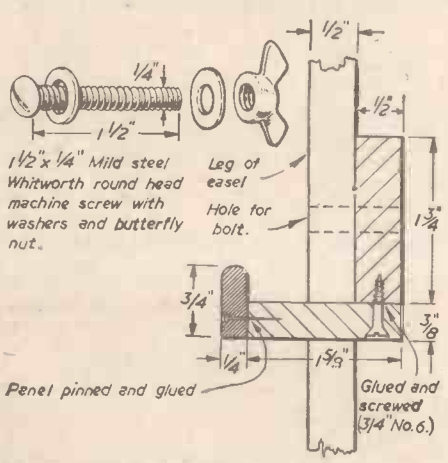


Fig. 2.—Section through chalk ledge showing butt joint between horizontal brace and leg; also one of the bolts with washers and butterfly nut.

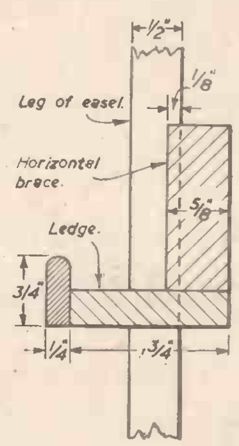


Fig. 3.—Section, showing alternative checked joint between horizontal brace and leg.

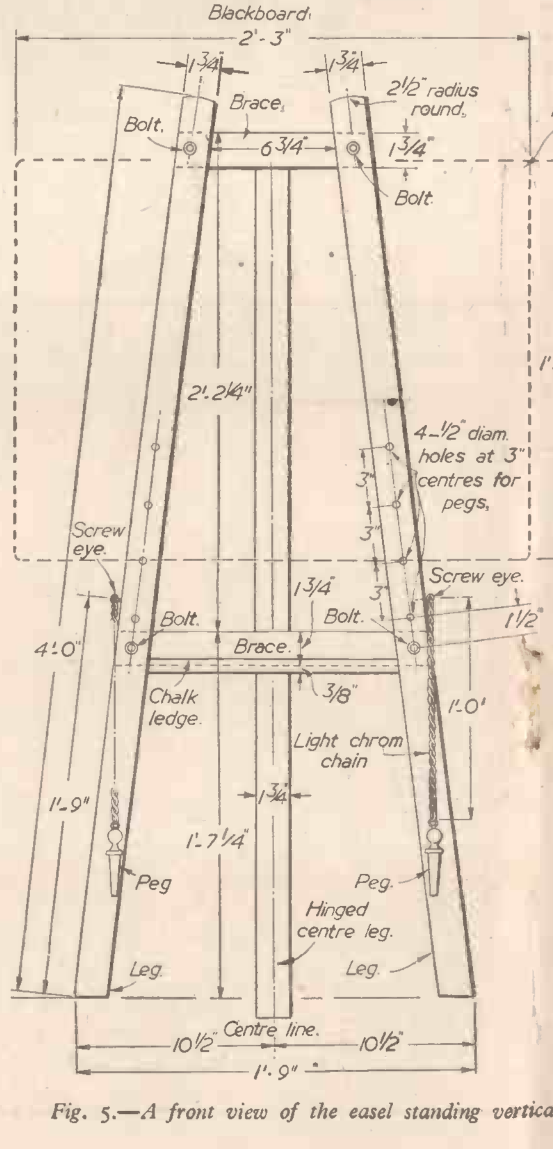


Fig. 5.—A front view of the easel standing vertica

SEL AND BLACKBOARD

imple and Sturdy Construction

CARDEN

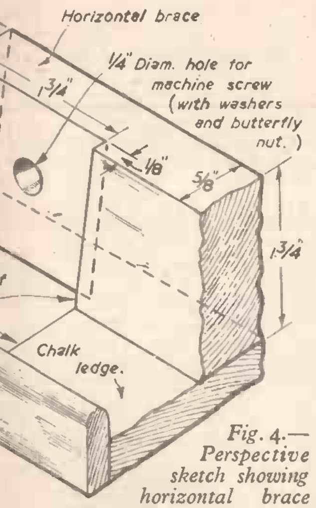


Fig. 4.—Perspective sketch showing horizontal brace checked to receive easel leg; also end of chalk ledge.

using the bench as a bearing. This cutting motion is practically as good as that of a wood-turning lathe. Leave the diameter a little larger, glass-papering to a fine finish, and exact size.

The knob part of the peg should be reduced to ¾in. diameter with the rasp (checking with the calipers). Now form the hollow of the knob immediately behind the aforementioned flange, with a round file, holding the square end of the wood in the vice. The file should be about 12in. long and tapered from ½in. to ⅛in. When the rounded sinking has been roughly formed, revert to rotating the peg in the hand whilst filing, and check the "neck" diameter with the calipers. Make a saw cut at the top of the knob and form a bevel with the chisel to both sides of the cut. Work the knob shape on the peg with the rasp, using the hand rotation method aforementioned. Using No. 1 grade, glass-paper the peg to final finish and size, before sawing the peg off the waste wood holder. Although this process may appear difficult to the beginner, it is really simple once a start has been made.

The pegs will look well dyed with black shoe dye. This will raise the grain, and when dry the peg should be lightly glass-papered and given a further coat. Two coats of shellac spirit varnish with a fine hair brush will seal the stain.

Finish of Easel

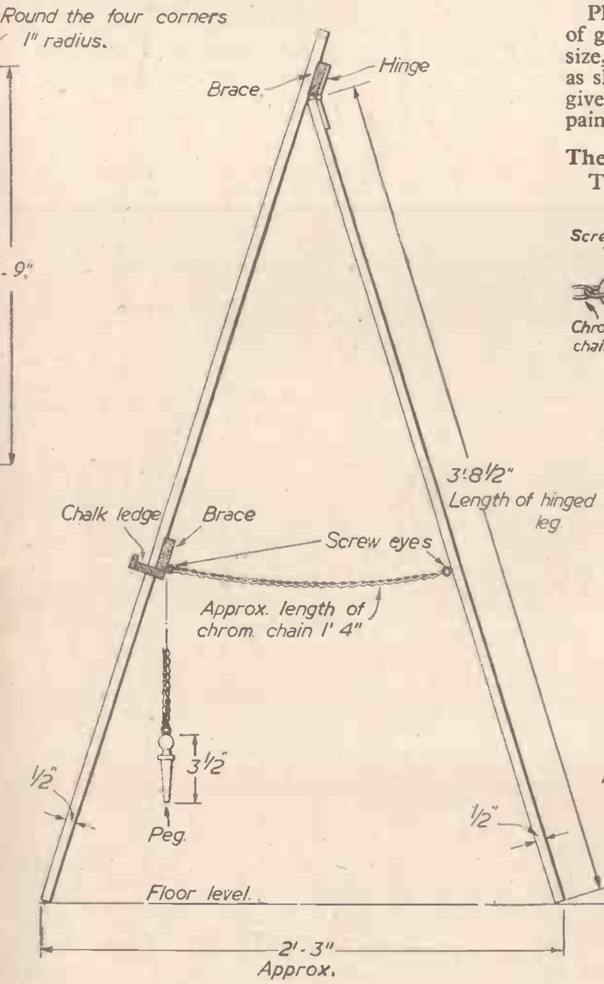
Glass-paper all parts with No. 1 and No. 00 glass-paper. If the easel is intended for a child, a bright enamel finish is attractive. Valspar two-four hour lacquer is ideal, and two coats (allowing a day between coats) will give a brilliant and lasting finish. No primer or undercoat is necessary when using this lacquer. If the easel is for artistic use, the wood should be left natural, and protected with two coats of Valspar clear varnish.

The Blackboard

Plywood ⅜in. thick, selected for closeness of grain, is satisfactory. It should be cut to size, the edges planed, and corners rounded, as shown in Fig. 1. The plywood should be given at least three coats of "blackboard" paint.

The Blackboard Duster

The hardwood back is made to the shape



...l with the leg closed and a side view in the open position.

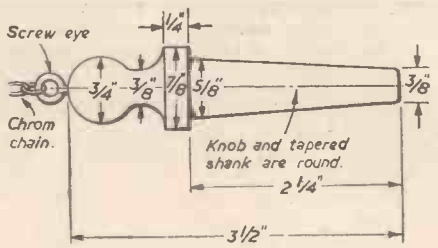


Fig. 6.—Details of one of the hardwood pegs—two are required to support blackboard.

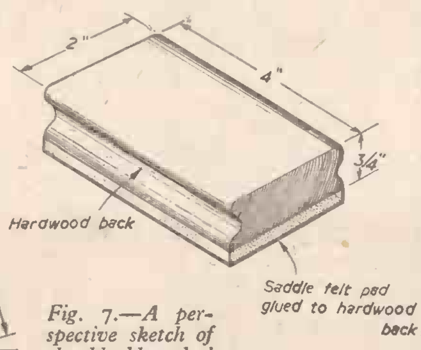


Fig. 7.—A perspective sketch of the blackboard duster.

shown in Fig. 7, although the finger-grip shape is optional and a rectangular block would also be suitable. The finger-grip may be formed with a gouge and round file, finishing off with a piece of glass-paper round a length of dowel rod. Protect the back with three coats of shellac spirit varnish.

The piece of felt may be obtained from

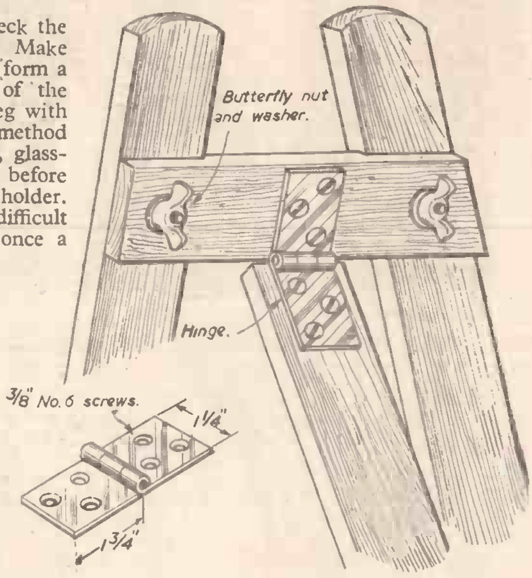


Fig. 8.—The top brace and hinged centre leg.

a saddler's and is glued to the block; Croid universal glue is suitable. This glue is also suitable for the other glued parts of the easel.

The backflap hinge is a common type obtainable from any ironmonger.

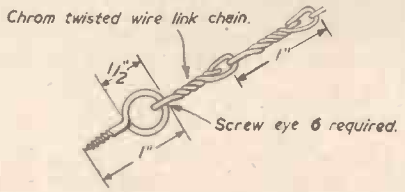


Fig. 9.—Screw eye and two links of the twisted wire link chain.

Fig. 9 shows the type of chromium-plated chain, recommended for lightness and strength.

British Standard for Light Gauge Copper Tubes for Water, Gas and Sanitation

(B.S. 659: 1955)

THE British Standards Institution has published the above standard, which is a revised edition of that first issued in 1936 and revised in 1944.

B.S. 659 provides for tubes for water, gas and sanitation suitable for connection by compression fittings or capillary fittings, or by bronze or autogenous welding.

The 1936 specification standardised the tubes on the basis of the outside diameter. The 1944 revision effected a reduction in the thicknesses of the tubes, the thicknesses in the earlier specification being regarded as more than adequate. The outside diameters established in the first issue were retained in both tables in order to avoid disturbance of the existing ranges of fittings for connecting the tubes.

In this revision the method of designating tubes has been retained but that of expressing tolerances has been clarified; additional sizes, viz., 5in. and 6in. have been included. The value of the tensile strength has been reduced from 17 to 16½ tons per sq. in. Other amendments are the introduction of a weight clause and a new method of marking the tubes.

Copies of this standard may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1. Price 2s. 6d. each.

THE EVOLUTION OF GUIDED MISSILES

No. 4.—Aerodynamic Facilities : The Tridac Three-dimensional Analogue Computer : Testing Components : Woomera : Accommodation Needs of Personnel : Radio Telemetering : Pursuit of Reliability

By G. W. H. GARDNER, C.B.E., B.Sc.
(Director-General of Technical Development (Air), Ministry of Supply)

(Concluded from page 265, February issue)

THE process of development of a new military interceptor or bomber aeroplane is usually a step forward into the unknown and the collection of the necessary design data demands extensive system analysis, engine experimental work, wind-tunnel exploration, aerodynamic structural and performance calculation and equipment experiment. Subsequently, components and systems are exhaustively tested on the ground. Even so, test flying amounting to many hundreds of hours is required before the aeroplane can be declared fit for Service use. During this period many features are recorded by automatic observers, by the pilot and the crew. These are analysed and faults or shortcomings are rectified by adjustment or redesign and modification.

Up to the present, development of guided missiles has been, in some respects, an even greater step into the unknown and demands the same kind of preliminary work as the aeroplane (Fig. 36). An acute difference arises, however, in relation to test flying because, in the absence of a reliable means of recovering a missile undamaged after each flight, some way must be found to avoid the need to manufacture, fly and each time destroy the many hundreds of thousands of missiles which would be required to produce all the necessary flight information. A large contribution can be made by intensifying and extending the preliminary ground work.

Aerodynamic Facilities

The difficulty of creating adequate aerodynamic facilities to meet advanced requirements is emphasised by the fact that a wind tunnel with a working section 8ft. square and capable of running continuously at two and a half times the speed of sound would cost about £10,000,000. Furthermore, a vast supply of compressed air is required to test powerful air-swallowing engines. A modern propulsion-test plant capable of handling 300lb. of air per sec. at sea level and of appropriate altitude operation would also cost about £10,000,000.

Another type of facility, the flight simulator, is playing an increasingly important part in guided-missile development. A new giant calculating machine of this kind called "Tridac" (three-dimensional analogue computer) has now been installed at the Royal Aircraft Establishment (Fig. 37). Tridac is the largest computer in Britain and among the biggest in the world. It requires 6,000 sq. ft. of floor space, contains 8,000 thermionic valves, requires 400 h.p. to drive mechanical computing elements and consumes altogether 650 kW. of electricity.

Tridac

Tridac is different from other "electronic

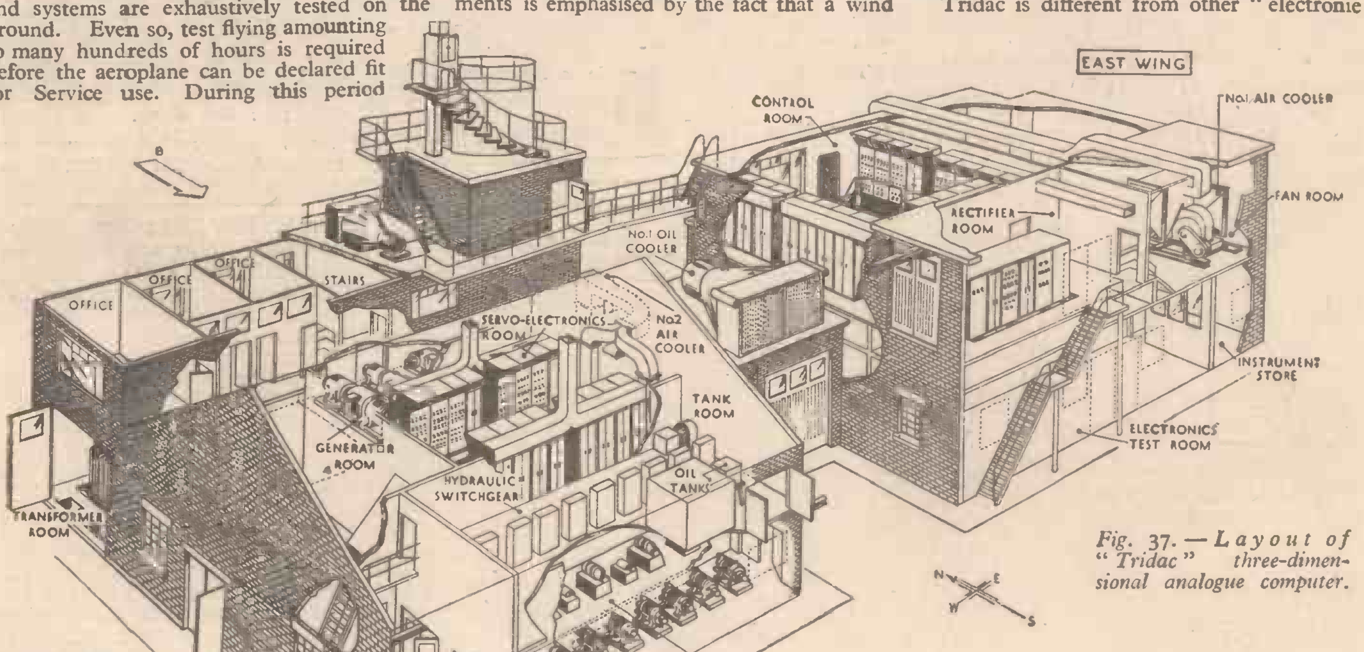


Fig. 37.—Layout of "Tridac" three-dimensional analogue computer.

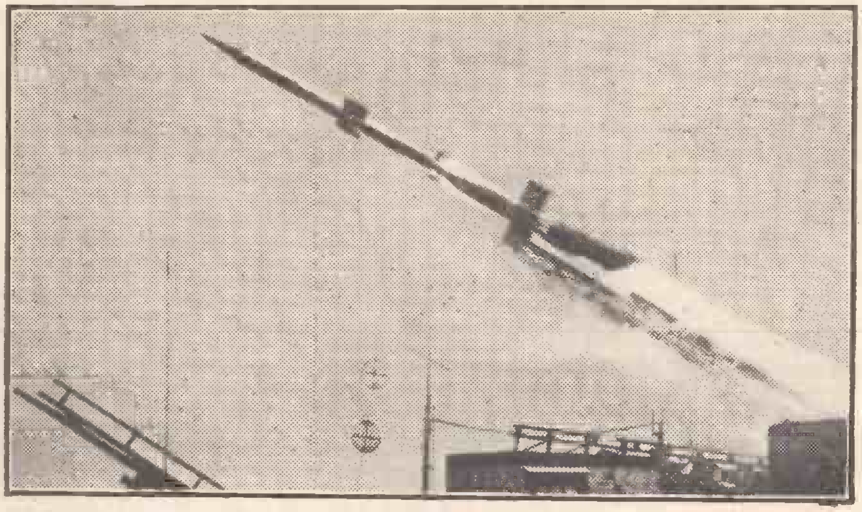


Fig. 36.—Launching of rocket test vehicle.

brains" in that it provides a model of the system being studied. When making a calculation of a missile intercepting a bomber there are sets of meters, pens moving automatically over charts and moving diagrams on screens—one of them three-dimensional—which give the operators a complete picture of what would happen in such an operation. The positions of the missile and bomber, their manoeuvres, speeds, heights, etc., are all calculated and displayed. All the calculations are made at the same rate as that at which the events would happen in real life, so that parts of an actual missile can be connected into Tridac for test purposes.

The use of Tridac for guided-missile problems will undoubtedly reduce the number of actual missiles which need to be flown for test purposes, thus saving time and expense. Tridac has been designed jointly by the Royal Aircraft Establishment and the research

Fig. 38.—Servo-motors for "Tridac."

laboratories of a commercial concern by which it has been constructed (Fig. 38 and Figs. 39 and 40).

Testing Components

Great attention must be paid to testing components over the whole range of environmental conditions which they will experience in storage, transit, handling and in flight, and this demands further equipment for simulating shock and vibration, acceleration, hot, cold, tropical, sea-spray, dust and any other likely conditions.

Valuable information can be obtained by flight-testing missile components or by measuring effects in relatively cheap, often very small, purely experimental missiles or "test vehicles." For this purpose, and for the inevitable full-scale missile tests, free flight facilities are required comprising tracts of country or sea areas, launching installations and a complex of instrumentation and communications. Some small ranges are used in Britain and the magnificent range which has been created at Woomera in Australia.

Woomera

Woomera — a name borrowed from the aboriginal, meaning a "throwing stick" used for increasing the carry of spears — is located about 270 miles to the north of Adelaide and contains several complete ranges with associated central technical and air-traffic facilities, and a township. Its prime feature is the main launching site, and the main range can be extended over 1,250 miles of almost uninhabited land and is capable of further extension over the sea if required. The isolation of Woomera is a major asset from considerations both of safety and security, but the price of this isolation is the unavoidably higher cost of general services. Fortunately, there is the Long Range Weapons Establishment at Salisbury, near Adelaide, the responsibilities of which include the provision of facilities required for the missile-flight tests, the assembly, modification and testing of missiles and the computation of the results of the actual firing trials.

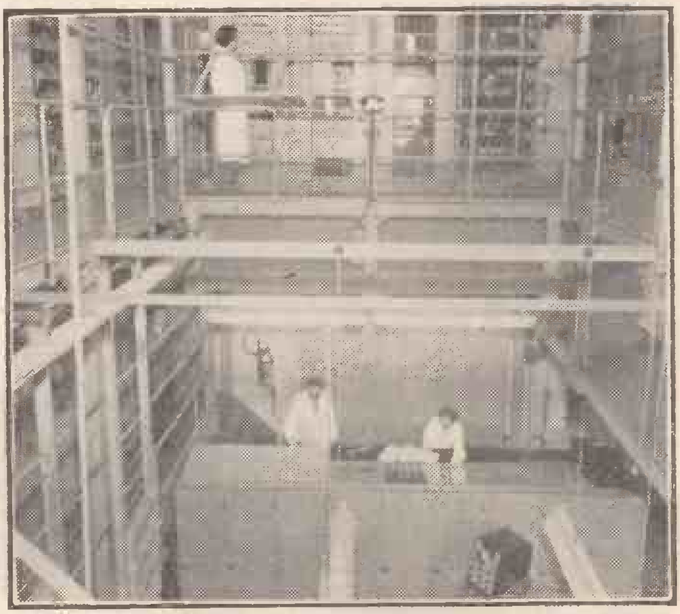


Fig. 39.—Control room for "Tridac."

Town Planning

To meet the accommodation needs of personnel employed at the range and of their families, and to relieve the hardships of living in what is virtually a desert, few of the amenties normally associated with modern town planning have been overlooked. An aerial view of the township is shown in Fig. 41. Essential services, water, power and sewerage have been provided; the water is supplied from Morgan on the Murray River through 354 miles of pipeline and five pumping stations. A well-equipped hospital and school cater for the medical and educational needs of the community. The amenities include a community store, theatre, cinema, tennis and basket-ball courts, football and cricket oval and a swimming pool. In view of the summer average temperature of 96 deg. and an occasional maximum of over 110 deg., it may not be surprising that Woomera also possesses a cordial factory. Main roads skirt the residential sections, and hundreds of thousands of trees have been planted in a green belt area half a mile wide surrounding the township; the whole character of the region will change as these reach maturity.

Radio Telemetering

The efficiency of the flight-testing method depends critically on instrumentation and, in particular, on reliable radio telemetering, by which is meant the measurement of physical quantities in the missile and their transmission to the ground by radio. On the ground recording equipment with capacious memory can be fed with streams of information simultaneously through many radio

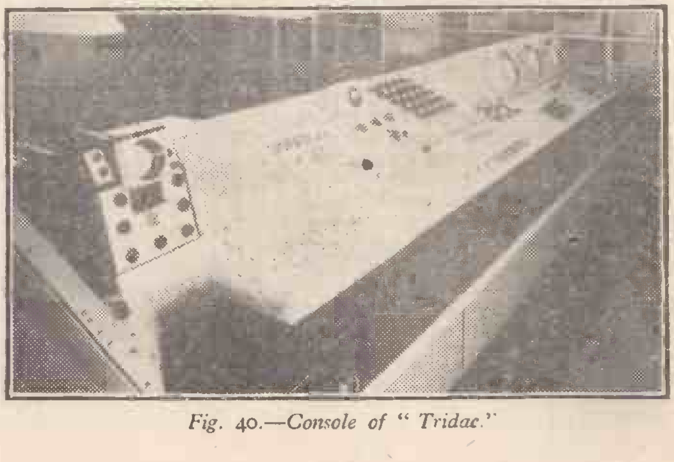


Fig. 40.—Console of "Tridac."

channels during the course of the flight, and these records can be examined later (Fig. 42). The importance of achieving reliable telemetry cannot be over-emphasised; it represents the eyes and ears of the designer. The development of efficient recovery of experimental missiles would make an enormous contribution to speed and cost of research and it would probably be justifiable to increase the size of the missile in order that it may accommodate recovery aids, such as parachutes.

Pursuit of Reliability

It is hard to imagine a more difficult engineering problem than that of developing a guided missile of the kind discussed to a satisfactory degree of reliability before it is outmoded by counter-measures or by other advances. It must be designed to withstand a wide range of conditions during storage and transit and in operation. It is entirely automatic and the failure or partial failure of any component is likely to render the missile ineffective. It is not possible on the ground to simulate all conditions, and it is impossible to adjust anything once the missile is fired, after which it is difficult to find out the cause of a failure or even what has failed.

The missile is a complex of advanced aerodynamic, structural, propulsion, hydraulic, electronic and instrument techniques, and room for duplication of vital services can be provided only under great penalty. The required performances can be obtained only by refining and miniaturising until there is little reserve. An example of this was the V.2 weapon, which, to save structure weight, was unable to carry its fuel except in the vertical position. This problem of achieving adequate reliability, which may be the greatest of those mentioned, requires the attention of our best engineers at all levels in order to ensure that sound engineering principles and practice are followed and that the potential value of these important weapons becomes a reality.

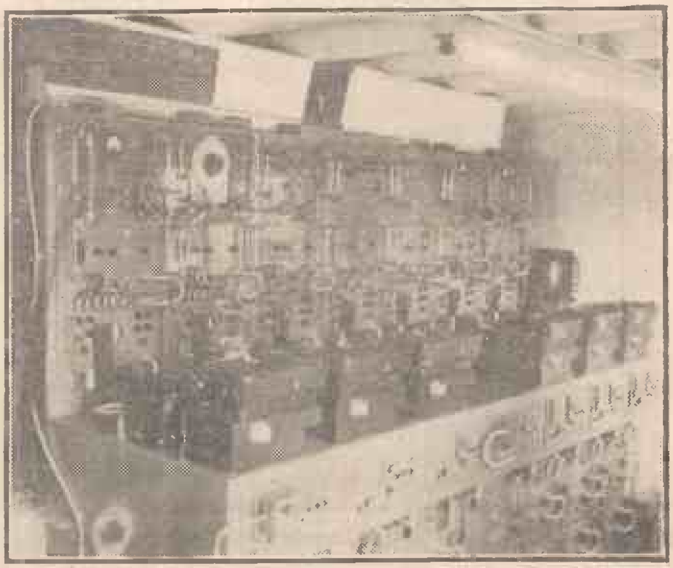


Fig. 42.—Telemetry receiver.

Conclusion

The majority of intricate mobile devices, like ships, tanks and aircraft, require the intervention of human beings to enable them to operate. This fact simplifies the designer's task enormously in that he relies on the human beings to act as links between otherwise separable functions and to provide intelligent monitoring and discrimination. Many components can, therefore, be designed separately and their separate functions need not be known to the vehicle designer but only to the operator. They need never work in unison until the operational stage is reached.

Fig. 41.—Aerial view of Woomera.

In the guided missile, because all components are interlinked and interdependent, and because highly efficient overall functioning is necessary, the system must be conceived as a whole and must be extremely closely integrated during design, development and production. Then a difficult question raises, namely, whether to create in one firm the ability to conceive, develop and manufacture all parts of the missile or to rely on close partnership between established specialist firms. I am sure that either can succeed given the necessary managerial will and ability and appropriate organisational arrangements.

The problem of air superiority is like a game of chess in which one is unaware of one's adversary's last move. Offensive weapons will retain their deterrent value and defensive weapons will ensure the protection of our territory only so long as they remain superior to any possible answer of an adversary. Guided missiles will play a most important part in this struggle for superiority, and in this struggle a major contribution is required from the mechanical engineer.

Acknowledgments

In conclusion I should like to say that all opinions expressed are my own and do not necessarily reflect those of the Ministry of Supply, to which I am indebted for permission to deliver this lecture.

I should also like to pay a tribute to the magnificent photographs of "Nike" taken by the United States Army and to express my gratitude that these have been released for open publication.

(Reproduced by kind permission of the Institution of Mechanical Engineers.)

Paris-London Automatic Telephone ?

SINCE April, Paris and Brussels telephone subscribers have been able to dial one another, making communication without any intermediary assistance. It is thought that London may be the next to link up with Paris by automatic telephone service.

A New Flame Discovered

ORANGE-RED, shaped like a flat disc and burning without air, this flame was discovered when methyl nitrite vapour was burned in a large glass tube. It was seen as a bright cone which peeled away from the base of the greyish-yellow flame burning at the mouth of the tube. The discovery was made at the department of chemical engineering at Cambridge University and is ascribed to chemical decomposition of methyl nitrite. Other similar chemical reactions have been known to give chemiluminescent glow, but not flame.

Voice-powered Transmitter

THE U.S. Army has developed a tiny radio transmitter having no batteries or external source of power, this being provided by the voice of the sender alone. The human voice contains so little energy that it would take a crowd of a million persons to create enough energy to light a single 100-watt bulb. It is hoped that the range of the device will be extended from the present 600 feet to a mile.

The Sun and the Weather

IN the Middle West of America daily weather forecasts are now being made by observing the sun, even when it is not shining locally. The forecasts use a new solar weather index, which is an indirect measure of the temperature and density of the solar corona, the sun's giant pearly white halo, until recently only visible during an eclipse. The meteorologist who first noticed the correlation between the sun's activity and weather on the earth believes that it is world wide and that the earth's weather is directly controlled by the sun. Weather Bureau scientists in Washington, however, are cautious in their comments.

U.H.F. Television Development

A KEG-SHAPED ceramic vacuum tube about the size of a bracelet charm that is more effective in ultra-high frequency television sets than any existing tube has been developed in America. Instead of the usual glass bulb, ceramic and titanium rings are used, providing ultra-high heat-resistant qualities. The tube will operate while glowing red hot at 1,000 deg. F.

New Supersonic Heat Problem

ACCORDING to research in a University of California wind tunnel, projectiles travelling at around 760 m.p.h. get hotter at altitudes above 20 miles than when flying low. A suggested explanation is that thin air is more viscous than air masses at lower altitudes and that the heat generated by friction in the stratosphere cannot be conducted away so easily.

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Photograph of EMI factories at Hayes—Our Industrial Background

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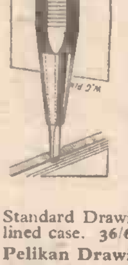

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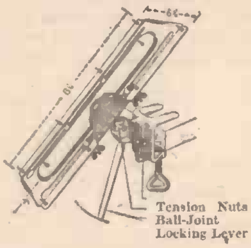

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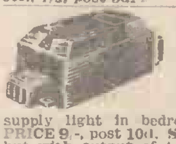

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THE clock is made in two parts, the dial below the ceiling and the electric drive above in the loft. The dial may be made of sheet metal on a wooden

base and may be circular or square or to any design. The reduction gear (minute hand to hour hand) can be salved from any old alarm clock, and the construction is as shown in Fig. 1.

The movement which carries the minute hand must be a tight fit in the small gear wheel and an easy fit in the long bush, the length of which depends upon the thickness of the ceiling. The distance between this bush and the dial should just allow a little end play for the central shaft. The dial does not need a glass as dust does not fall in an upwards direction.

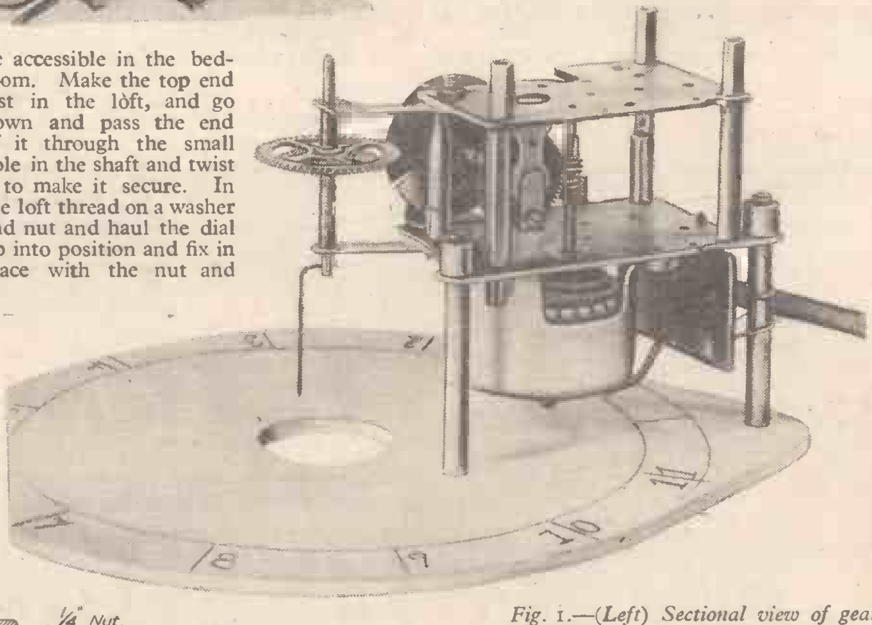
The bush can well be a piece of brass tube threaded ¼ Whit. or B.S.F. with thin nuts on the bottom holding it to the dial support. For preference the nuts, bush and support are all soldered together. The shaft must have a small hole drilled through it near the top. Only a full ¼in. hole is needed in the ceiling and a position for this should be chosen mid-way between two rafters.

A 12in. square of three-ply with a central ¼in. hole is laid above the hole in the ceiling, and a 1½in. circle of three ply with ¼in. central hole laid above this. Thread through these holes a piece of iron wire long enough to be accessible in the bedroom. Make the top end fast in the loft, and go down and pass the end of it through the small hole in the shaft and twist it to make it secure. In the loft thread on a washer and nut and haul the dial up into position and fix in place with the nut and washer, remove the wire and replace it with a taper pin.

The Drive

This is electric and is made from an electricity meter movement sold in many ex-Service disposal shops at about 12/-. Choose the type with the black vertical marks on the drum as shown in Fig. 2.

Strip the meter movement down as far as the horizontal shaft—which makes one revolution per minute—this leaves only one vertical shaft with a worm drive. The horizontal shaft has a differential gear, which must be removed except for the fixed plate, and to this is soldered a disc of tinplate about 1½in. diameter; this should be carefully trimmed up to be concentric with the shaft.



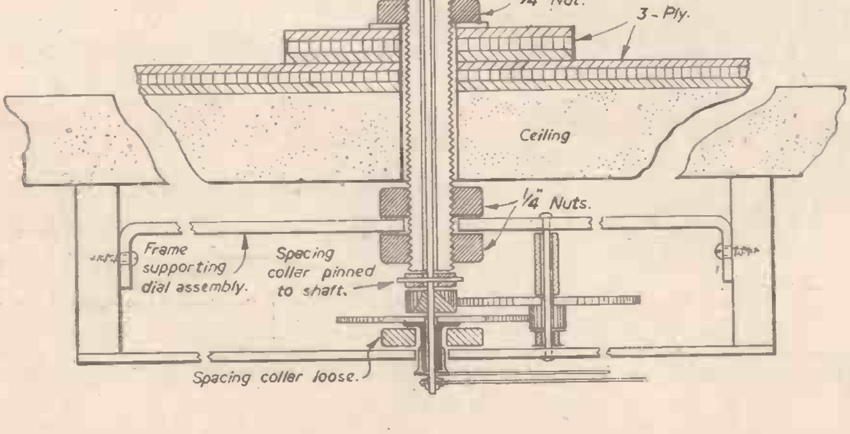


Fig. 1.—(Left) Sectional view of gear-train and method of fixing clock to ceiling.

Fig. 2.—(Above) The power unit and associated gearing.

A lathe is not necessary for this, but would be handy for scribing the circle. When this is done cut one radial slot and bend out the edges of this slightly to form a crude type of worm wheel. This has to gear into a 60 tooth wheel mounted in brackets soldered to the frame as shown in Fig. 3.

An old gas meter has three such wheels which are particularly suitable owing to the deep design of the teeth as seen in the photo, Fig. 3. This wheel is mounted on a vertical shaft as shown with a sort of crank handle soldered to it; this engages with the taper pin in the shaft on the dial and drives the hands.

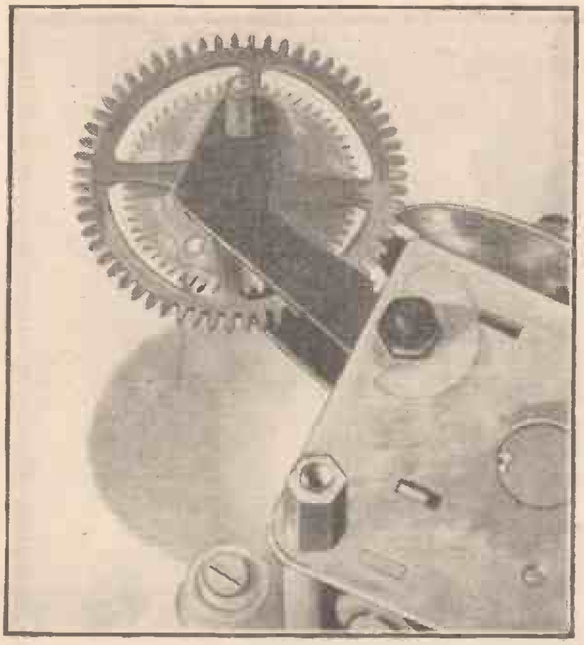
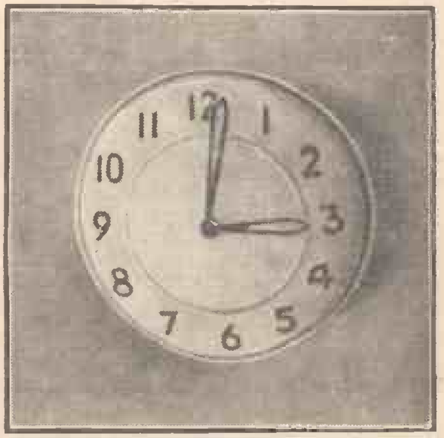


Fig. 3.—(Left) The home-made worm wheel and the ex-gas meter toothed wheel.

Fig. 4.—(Right) The clock dial mounted on the ceiling and seen from below.



Mounting the Drive Assembly

The whole drive assembly is mounted on a piece of three-ply with a 1¼in. hole concentric with the vertical shaft and the whole is placed in position with the circular piece of ply in the hole in the base of the drive unit (from which it was cut with a fretsaw).

The base of the drive unit is cut to a circle so far as possible, but an extension to one side will be found necessary; the figures marked on it in Fig. 2 remind one that in setting the time—by revolving the base round the circular disc of ply—the movement is anticlockwise to advance.

The crude worm wheel does not matter as it only means that movement during any minute is not at a regular rate but it is completed in 60 seconds. Which way the cut in the disc is bent depends upon the direction of movement of the motor, but can be easily altered—see that the entering edge of the disc comes squarely in between two teeth.

The writer has had two of these clocks in operation for over twelve months. The photo of the clock (Fig. 4) was taken lying down in bed.

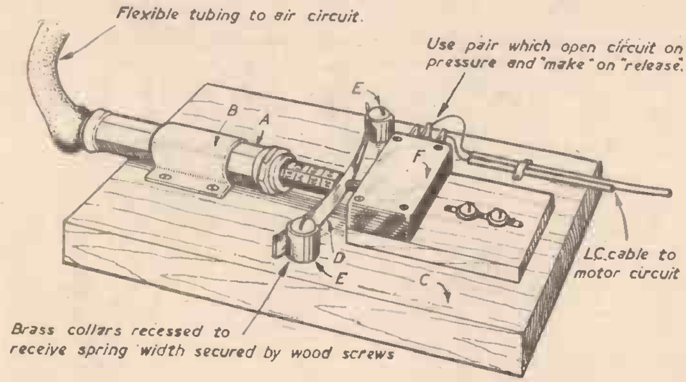
A Simple Automatic Pressure Control

Automatic Motor Switching for an Ex-W.D. Compressor Unit

By R. A. FAIRLEY

THERE are many excellent ex-refrigerator compressor units available as W.D. disposal at very low cost; these are suitable for many useful applications but for the absence of automatic motor switching.

Requiring automatic regulation of one of these units to maintain air supply to a public house beer-pressure system, I made use of the very simple and foolproof apparatus shown in Fig. 1.



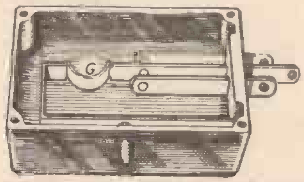


Fig. 1.—(Above) The assembled apparatus.

Fig. 2.—(Below) The switch modification.

This, or any similar purpose, requires a much smaller margin between "on" and "off" pressures than that allowed for in the costly and complicated spring-compensated switch operated by bellows as used in some refrigerator systems. In this particular case pressure has to be maintained, absolutely dependably and without attention, between 12 p.s.i. and 18 p.s.i.; this has been unfailingly fulfilled since installing.

A in Fig. 1 is an ordinary motor-car type pressure gauge, "Kismet" or similar, secured by tinplate saddle B to baseboard C of suitable dimensions.

D indicates a piece of clock-spring approximately 2½in. long bearing against two posts E, and of just sufficient strength to return the gauge indicator plunger to zero as pressure drops. (This spring naturally introduces a slight error in pressure indication—easily assessed by a given pressure observed with and without its presence, and allowed for when positioning switch F for required "knock-off" pressure.)

F is a standard Bulgin microswitch rated 3 amp at 250 volts A.C., screwed to a small slotted wooden base adjustable for position to limits traversed by the indicating plunger. One modification found desirable, though not essential, to this switch is slightly to weaken (by *gentle* heat) the U-shaped "trigger" spring indicated at G in Fig. 2; this enables it to be operated by feather-light pressure, and correspondingly released by a very slight withdrawal of the plunger.

Provided the actual cable joints to switch tags are suitably protected there are no further live parts in evidence, so from this point of view at least a metal or wood cover enclosing the unit is optional.

For other purposes where higher operating pressures than those covered by a tyre gauge are required the latter may be replaced by a metal-bodied cycle inflator cut down to a usable length—approximately 4in. overall. The use of a stronger return spring and calibration by a suitable pressure gauge will, of course, be necessary if this modification is used.

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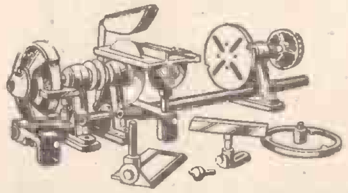

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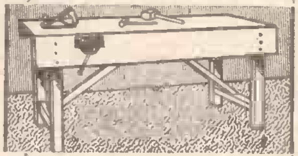

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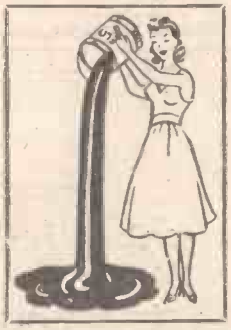

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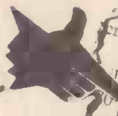

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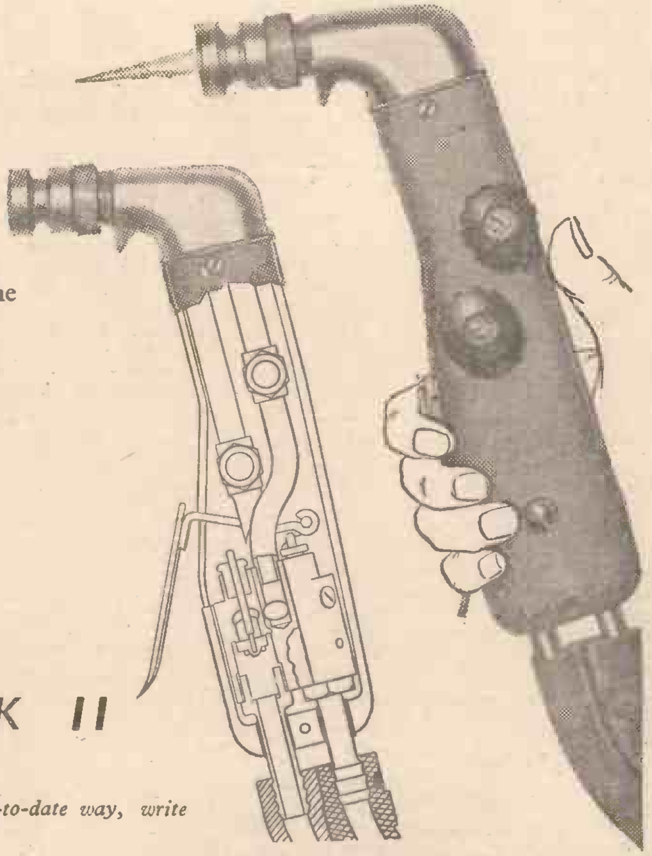

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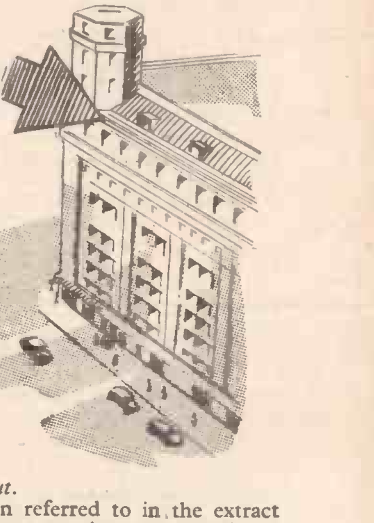


The Editor Does not Necessarily Agree with the Views of his Correspondents

Signals from Jupiter

SIR,—After reading your editorial in the July issue of PRACTICAL MECHANICS concerning "Signals from Jupiter" I feel that the following extract taken from a Current Affairs Bulletin on Radio Astronomy, dated August 1st, 1955, would be of interest.

"Our sister satellites to the Sun, the other planets, are much more distant and so far we have been unable to receive either thermal radiation or echoes from them. Some of them have atmospheres; it was thought, therefore, that it might be possible for the equivalent of our thunderstorms to occur; and if so, that we might be able to receive the equivalent of static from them. Nothing was found, however, until a month or so ago when observers in the U.S.A. reported strong signals from Jupiter, which were intermittent and *did* have the general characteristics of static. These have since been picked up in Sydney. Jupiter's atmosphere is very different from our own, extremely cold (—140 C.) and rich in marsh gas (methane) and ammonia. It seems that it may be possible for electric charges to build up in clouds formed in such an atmosphere, and then discharge in a flash as in our own thunderstorms. But this discovery is so recent that a detailed explanation for these radio signals from Jupiter must await further observations.

"They sometimes sound very much like atmospherics from a distant thunderstorm and listeners on short-wave probably heard them more than once—without suspecting they had come from so far away."—M. S. GOODYEAR (Australia).

Automatically-controlled Car Gates

SIR,—With reference to the query in the January issue of PRACTICAL MECHANICS about automatically-controlled car gates, the operation could be satisfactorily achieved by the use of radio control. A series of articles on the radio control of models is appearing currently in PRACTICAL MECHANICS; these are very comprehensive and explain the entire radio link, transmitter and receiver; also where weight is of no consequence a great many difficulties disappear.

The transmitter would be in the car and the receiver is located in the garage and connected through a change-over slave relay to gate actuator.

Thus when the transmitter is switched on, the gates open and when the transmitter is switched off, the gates close.

Limit switches on the gate mechanism would cut the power at the full-open or full-closed positions.

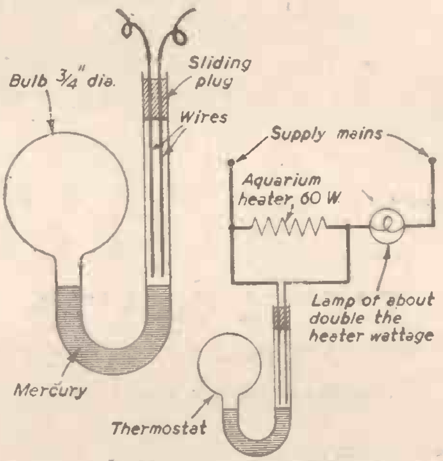
Assuming that the gates are not located near a model flying field or boating pond, I see no difficulty.—G. MCINTOSH (Edinburgh, 9).

An Aquarium Thermostat

SIR,—In answer to Mr. E. Webb's request for information on an aquarium thermostat I offer the following:

This thermostat can be used in water baths and the like. It is extremely sensitive if properly made; when used with the correct size of heater, the temperature should remain well within 1 deg. F. Sensitivity is increased by using a larger bulb and smaller diameter tubing.

Seal the end of a length of soft glass tubing (say, 3 mm. I.D.), blow the bulb on the end, then bend the tubing to form the shape shown. When cool, allow a drop of acetone or other volatile solvent to run into the tube and evaporate in the bulb, thus filling it with vapour. Heat the bulb slightly, add mercury to the tube, then cool the bulb so that the mercury is drawn around the bend in the tubing, as shown. A plug of plastic is made a sliding fit in the tubing, and two fine wires are secured in the plug. Two fine sewing needles work well in place of wires. To adjust, immerse the bulb in water at the desired temperature and slide the plastic plug down until the mercury just closes the contact between the wires.



Mr. E. R. Needham's aquarium thermostat and a simple circuit for its use.

Unfortunately, the action of the thermostat is reversed, the circuit being closed when the vapour in the bulb expands and forces the mercury up the tube to the wires. A relay must be used to open the heater circuit when the thermostat closes. A simpler method is to use the circuit shown above, but this is more wasteful of electricity.—E. R. NEEDHAM (Matanzas, Cuba).

Cutting Glass Bottles

SIR,—Perhaps the following extract may be of interest to readers. It comes from an English translation, dated 1888, of a French book on popular science, and concerns cutting bottles:

We will close this chapter with an illustration of a spiral bottle, which can be done in the manner now to be described, so that the bottle will actually become a glass spring.

Take a mixture of 180 grammes of lampblack, 60 grammes of gum arabic, 23 grammes of adraganth, and 23 grammes of benzoin. Make these ingredients into a paste with water, and fashion a pencil of the charcoal thus obtained. This pencil, when heated, will cut the glass wherever it is applied.

The process is commenced by scraping the bottle with a file and following the instrument with the red-hot pencil. Wherever the hot pencil is applied the glass will be cut, as shown in the illustration herewith. It will be necessary to blow on the heated pencil to maintain the incandescence as long as possible. The bottle, as cut, and representations of the instruments are given in the cut.

The illustration referred to in the extract shows the bottle, cut continuously round and round, being held up by the neck and stretched slightly by its own weight so that it resembles a spiral spring. On the table lie a file and what appears exactly like a lead pencil, glowing red-hot for about a quarter of its length.—B. L. KERSHAW (Leeds, 16).

Blower Heater Calculations

SIR,—In your January issue Mr. D. F. Burgess writes about "Blower Heater Calculations" and states that 70 deg. F. ≏ 27 deg. C. Surely this is wrong?—D. FRYDMAN (N.W.10).

Author's Comments

SIR,—My apologies for the error in my letter regarding the blower heater calculations. The centigrade value of 70 deg. F. is, of course, not 27 deg., but 21 deg., thus making the temperature rise which is desired 12 deg. C., and the average temperature over this period is then 15 deg. C.

Following the same line of argument as before, we alter the mass of air to 34.7 gms./cu.ft. at 15 deg. C. (from density tables), and this then gives a value for t of 5.45 min. for a room 22ft. × 12ft. × 9ft. when these corrections are applied to the basic formula.

Perhaps we may account for the discrepancy between this value and the stated time of 7½ min. by remembering that there are certain unavoidable heat losses in practice, more especially due to convection and to other air currents, and these losses are bound to be greater using a blower heater of the type described than the normal radiant electric fire.—D. F. BURGESS (Redhill).

SIR,—In his calculations—your January, 1956, issue—Mr. D. F. Burgess has neglected to take into consideration heat losses through the walls, ceiling, window glass, floor and door of the room (I assume the fireplace flue was closed). These losses, particularly through the window glass and ceiling, would be considerable.

Also warm air would escape through gaps in the upper window frame and over the door, the warm air being replaced by cold seeping in through the lower window frame, under the door, and through floor cracks.

In view of these factors the result of the calculation made by Mr. Burgess is likely to be misleading!

I find it hard to credit the extremely rapid rise in temperature of 22 deg.F. in a room of 2,376 cu. ft. in 7½ minutes. Perhaps this figure can be verified?

I have carried out the following experiment; it may be of interest. In a slightly smaller room, 2,232 cu. ft., a convector heater (no fan) of 2¼ kW. only. Fireplace flue closed,

Query rules appear on page 326.

window curtains not drawn, door not opened during test. Heater in the middle of the floor, thermometer halfway up a wall and shielded from the window and the heater. After two hours the temperature rose from 47 to 51 deg. F.—a rise of 4 deg. only !

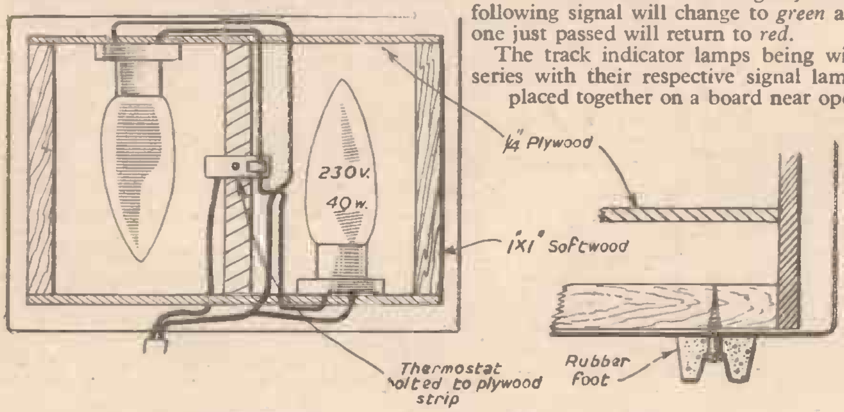
It is, of course, appreciated that a fan cannot increase the amount of heat given off by a heater element, additional heat can only be obtained by an increased consumption of current.—O. DAVIES (London, S.E.12).

Imitation Coal for Electric Fire

SIR,—I note in the February issue a Mr. Wright, of Hounslow, seeks information regarding imitation coal for an electric fire. I have found that Polythene sponge (preferably white) suitably arranged in chunks stuck on a wire mesh and illuminated from below with a red bulb and judiciously daubed with black paint makes a very realistic coal fire. I also made a small propeller, operated by the hot air, to give a flicker effect. Trusting this will be of assistance.—J. H. BROOKS (S.E.17).

Alternative Dishwarmer Heating

SIR,—With reference to the article on making a photographic dishwarmer in the December, 1955, issue of PRACTICAL MECHANICS I think that an alternative method



Mr. C. Birch's scheme for using bulbs as alternative dishwarmer heating.

of heating may be of use to readers who, like myself, were unable to obtain the recommended heating mat.

Instead of the heating mat I used two candle type 40-watt electric light bulbs mounted on a wooden frame, as shown in the diagram. The recommended thermostat (type SN/40) was used with excellent results.

The wooden framework is held in place by the four wood screws which hold the rubber feet in position.

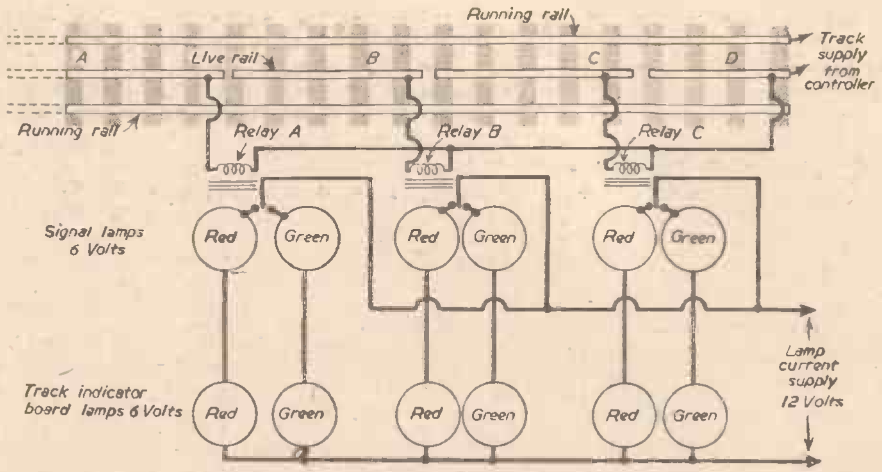
The total cost of the dishwarmer amounted to 12s. 6d.—C. BIRCH (Staffs).

Auto-controlled Signal Lights for Model Railway

SIR,—Below is a diagram of a system of auto-controlled signal lights which I have designed and which may be of interest. The three-rail (centre live rail) method of current feed to trains is shown, but it can be worked equally as well on the two-rail feed providing the supply current to track is direct and not alternating.

The system can be arranged in two ways :

1. As shown on diagram. All signal lights normally show *green*, but as a train enters, say, section "C" relay "C" will close, being energised by the current taken by the train motor, and the lights controlled by relay "C" will be changed to *red* and will remain so until the train enters following section "B," when relay "B" being energised will turn the light to *red* and relay "C" being not now energised will open and return the light to *green*, indicating train being "out of section" (to use correct railway signal procedure !).



Mr. J. H. Chapman's system of automatically controlled signal lights for model railway use.

2. By reversing the connections at relay contacts to lamps and re-positioning the relays to other end of sections, all signals will show *red*, but as the train enters a section in front of a signal that signal light will show *green* and remain so until the train enters the next section behind the signal, when the following signal will change to *green* and the one just passed will return to *red*.

The track indicator lamps being wired in series with their respective signal lamps are placed together on a board near operating controller for train so that the position of train can be seen by operator in true railway signal-box fashion. The relays are Government surplus and can be obtained at a reasonable price from most radio shops. The ones I used were 1,000 ohm with single-pole two-way contacts. The thin wire on the relay bobbins was stripped off and the bobbins rewound with 18-gauge enamelled single cotton-covered wire. The thicker wire is essential to allow sufficient current to pass to operate the motor in the train.

The various sections may be as long and as numerous as the space permits, but they *must* be insulated from one another.—J. H. CHAPMAN (Flints).

Duplicating Photographs

SIR,—Mr. Larson, of Sheffield (Information Sought, PRACTICAL MECHANICS, January, 1956), who wishes to duplicate photographs, will find the book "Silk Screen Process Production," by H. L. Hiett and H. K. Middleton, published by Blandford Press, Ltd., 16, West Central Street, London, W.C.1, very helpful.

Very briefly, the making of a stencil from a photograph relies on the fact that a thin film of gelatine on a backing sheet, when sensitised with a solution of potassium bichromate and exposed to strong light through the negative or positive to be copied, is rendered insoluble where the light has affected it, and will thus remain on the backing sheet when the unexposed gelatine is washed off. This remaining gelatine can then be transferred to the duplicator screen and printed in the usual way.—G. B. JOHNSTON (Chester).

BOOKS Received

How a Car Works. Published in association with "The Light Car" by Temple Press Ltd. 50 pages. Price 2s. net.

THIS book is Number One in the "Modern Car Easy Guide" Series and the general title indicates the mission of the whole series —to pass on knowledge to the beginner in a way that is both practical and easily understood. Unnecessary technical terms are avoided. Briefly, "How a Car Works" describes the various parts of a normal car, their function and reason for existence and aims to instruct the driver as to how and why the wheels go round.

Power System Plant. Edited by E. Openshaw Taylor. 300 pages. Price 30s. net. Published by George Newnes, Ltd.

THIS book is a symposium of the Power System Plant Lectures given at the Heriot-Watt College, Edinburgh. These were designed to enable advanced students and practising engineers to become familiar with modern developments. The authoritative and up-to-date information in each section was contributed in each case by an engineer closely connected with the theory and practice of his subject. The book includes 178 illustrations and separate chapters are devoted to synchronous machines—non-salient pole-type ; synchronous machines—salient pole-type ; load, frequency and excitation control of synchronous machines ; transformers, reactors and voltage regulators ; switchgear principles ; switchgear practice and substation plant ; underground cables and overhead lines. A comprehensive index is included at the end of the volume.

Perspective Drawing. By H. F. Hollis. Published by The English Universities Press, Ltd. 198 pages. Price 6s. net.

AS the title suggests, this book will be of interest primarily to the artist and draughtsman, but its aim is to give an up-to-date survey of drawing in perspective to a wide variety of readers. Contained in its pages are chapters of theory and geometrical constructions for the student, practical advice to the professional designer and draughtsman who must use quick and efficient methods, and some useful information for the artist who probably prefers freehand drawing. Liberal use has been made of explanatory diagrams.

READERS' SALES AND WANTS

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COMPRESSORS for sale, 2½ CFM, 180lbs. sq. in., on metal base, with driving wheel and receiver, price £3; ¼ h.p. Heavy Duty Motors, price £3; carriage forward. Wheelhouse, 13, Bell Road, Hounslow, Middlesex.

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SUNLAMPS, brand new, super quality, very powerful, only £4 each. Send stamp for illustrated brochure. Dept. A, Scientific Products, Cleveleys, Lancs.

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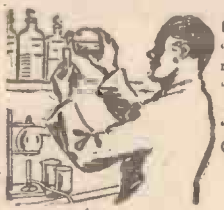

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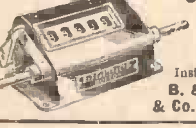

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WANTED, "Practical Householder," Oct., Nov., Dec., 1955, and Feb., 1956. Box No. 129, c/o PRACTICAL MECHANICS.

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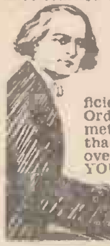

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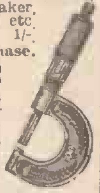

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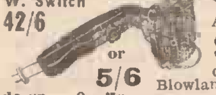

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Trade Notes

New Orbital Sander Attachment

THIS addition to the Black and Decker range can be fitted either to the ¼in. Utility Drill or the Sander-Polisher Drill and its relatively low price should enable the average handyman to install it in his workshop.

The chuck is removed and replaced by a screw-head and the attachment is fitted to either of the two power units by means of two clips, which fit into the ventilating slots of the tool. The abrasive paper clips are operated from the side of the bottom plate and remain open when changing abrasive paper, permitting use of both hands to clamp the paper in the tool quickly. The machine can be used right up against edges such as stair risers without marking the surface in any way.

(Left) The Black and Decker orbital sander attachment.

(Right) New Wolf sanding attachment.

The bottom plate makes thousands of 3/16in. orbits per minute and good results, without surface marking, can be obtained when sanding with, against or across the grain. Some of the recommended uses are cabinet work, furniture finishing, boat maintenance, removing rust and old paint, etc.

The price of the new attachment is £4 15s. and a special abrasive and polishing pack is available for 17s. 6d.

The "Eureka" Floor Surfacing Machine

THIS 12in. floor planing machine uses high-speed steel blades which can be adjusted to give a light or heavy cut and power is by either a 2 h.p. repulsion induction electric motor or a Villiers petrol engine. Dust is picked up by a fan and collected in a detachable bag and only a short time is needed to change surfacing papers or cloths. The makers are John Gregory (Nelson), Ltd., Norfolk Street, Nelson, Lancs.

New Wolf Sanding Attachment

DESIGNED for use in the finishing of castings, pressings, dies, fabricated metalwork, etc., in ferrous and non-ferrous metals, the new attachment is used in conjunction with the 6in. high-speed Wolf heavy duty grinder which possesses sufficient power and speed to permit the 2in. wide by 2ft. long endless abrasive belt to operate at a light load of 6,000ft. per minute.

The attachment consists of a patented 4in. diameter by 2in. wide rubber typed contact wheel and a cast aluminium bracket at the end of which is mounted a steel pulley running on a ball bearing. The abrasive belt is mounted on the steel pulley and is correctly tensioned by means of a spring-loaded eccentric, the assembly position being controlled by an adjusting screw.

The attachment bracket is mounted on the

end of the GQ6 grinder gearbox in place of the existing wheel guard, and uses the same fixing screws, the rubber typed contact wheel being fitted on the grinder spindle.

A selection of abrasive belts is available all of which are suitable for use on materials ranging from cast iron to wood. Details are available from your local Wolf stockist.

Range of Miniature Electric Switches

THESE have been developed to meet the specifications of the Ministry of Supply

One of the Dunlop pressure switches.

by Dunlop's aviation division at Foleshill, Coventry.

The pressure switch shown, with a penny alongside to indicate its size, has been designed to meet the requirements: pressure to break, 60^{+0}_{-3} lbs./sq. in.; pressure to make 40^{+0}_{-3} p.s.i. These figures are adjustable to any desired value. Switches in this range have a maximum non-inductive current capacity of 10 amps and a minimum life of 100,000 operations, and are suitable for use in systems working at pressures up to 4,000 p.s.i.

After several million vibration cycles in tests carried out with the switch mounted on a vibration table the contact resistance showed little change.

The Crown Electric Hand Pump

THIS labour-saving hand tool is designed for the inflation of car and bicycle tyres. It consists of a single cylinder air compressor, coupled to a universal motor and housed under a cover as one complete unit. Output is about ⅓ cu. ft. per min. and pressure can be obtained up to 85lb. per sq. in. From flat a car tyre is inflated in

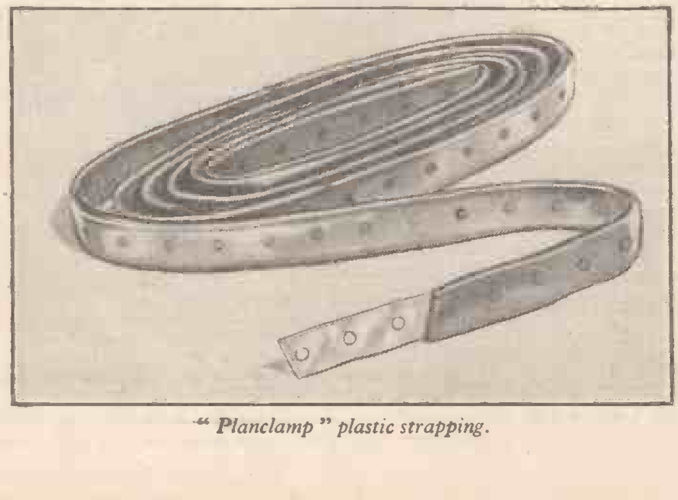
The Crown electric hand pump.

about 4 minutes and a bicycle tyre in 20 seconds. A dial pressure gauge can also be supplied and fitted as an extra. The size is 6½in. diameter at the base and 6in. high and the pump weighs 8lb. The manufacturers are Messrs. Motor Electrics Co., Crown Lane, Marlow, Bucks, and the price of the Crown electric hand pump is £13 5s.

"Planclamp" Plastic Strapping

AS will be seen from the photograph, this material is made of thin pliable metal strip, covered with plastic, with ⅛in. holes punched at intervals along it. It may be shaped into any desired form in the fingers and is designed for use by the housewife to secure small items in use frequently during the day; for the engineer who wishes to keep readily accessible numerous small tools and, in fact, for anyone who wishes to keep a number of small objects in position neatly and inconspicuously.

"Planclamp" is manufactured by Creators, Ltd., Plansel Works, Sheerwater, Woking, Surrey.



"Planclamp" plastic strapping.

Your Queries Answered

Removing Developer Stains from Porcelain Bath

I HAVE tried potassium permanganate to remove Johnson's Universal Developer stains from my porcelain bath, but with no success. Can you suggest any other solution that will remove these stains ?—D. Ruse (Truro).

TRY "twenty-volume" hydrogen peroxide, or if that fails Fehling's Solution. This can be bought ready made from any good chemist, or you can make it as follows :

Make up solution (A) by dissolving 70 grammes of copper sulphate in 1 litre of water. Solution (B) is made with 346 grammes of crystallised rochelle salt in ½ litre of hot water, and 142 grammes sodium hydroxide in ½ litre of water. These two solutions are poured into a 1-litre bottle to form (B). Mix A and B in equal parts and use as bleach.

Smoothing Rectified Current

I HAVE recently made up a transformer and full-wave metal rectifier unit to operate a "00" gauge model railway (12 volt D.C.). This works satisfactorily, but the engine displays less power and there is more sparking at the commutator than when operating from a battery. Does this call for condenser smoothing in the rectifier unit with also a choke ? Would a condenser/resistance strap across the commutator also assist ? If so, would you indicate approximate values ?—J. C. H. (Dorset).

IT is quite likely that you may require a slightly higher rectified voltage than 12 in order that the motor may develop the same amount of power as when fed from a 12 volt D.C. battery.

In order to minimise the sparking at the brushes it would be advisable for you to smooth the D.C. output considerably. We suggest that you try connecting a condenser of large capacity, say, about 50 pF, across the output terminals of the rectifier.

Preserving a Lobster for Stagework

FOR our drama production we need on the stage a lobster. As we wish one lobster to last the run (three weeks), can you tell me any way of preserving it ? Any method used must be cheap and the lobster able to stand a fair amount of knocking about.—J. Smith (Ashford).

FIRST, slit your lobster the full length of the belly and remove as much as possible; all, if you can manage it, of the putrifiable flesh and guts. Then pour a solution of formalin (8oz. to a gallon of water) into the carcase after rinsing with plain water from the tap. Sew or wire up the carcase after you have stuffed it with cotton wool. Then immerse the whole object quickly in a further solution of formalin ; allow to dry and paint lightly over with any clear varnish. If the object is to receive much harsh treatment, wire it with two or three strands of fine wire at suitable intervals along its length.

Oil flash Points

WHAT are the flash points of oils used in motor cars ? Is a mineral oil higher than a vegetable oil ? Is there a book available on the subject ?—H. L. Hunt (Lincs).

RULES

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

MINERAL oils have a much lower flash point than vegetable oils.

Mineral oils are tested for flash-point, i.e., the temperature at which the oil gives off sufficient vapour to form a momentary flash when a small flame is brought near its surface. The fire test determines the temperature at which the oil gives off enough vapour to maintain a continuous flame if ignited. These mineral oils are usually tested for the two above-mentioned tests, as well as for viscosity, congealing point and colour.

Vegetable oils are tested for specific gravity, saponification value, iodine test, the Maumene test and the elaidin test.

Any reference library will contain a book which will list the flash points of the various mineral oils. "A Short Handbook of Oil Analysis," by A. H. Gill, Philadelphia, would probably have all the information you seek.

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The above blue-prints are obtainable, post free, from Messrs. George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

*An * denotes constructional details are available free with the blue-prints.*

Preventing Tree Trunks Shooting

I HAVE a number of tree trunks protruding about 8ft. out of the ground and should like to prevent them shooting out or growing again and, if possible, destroy the roots. Have you any suggestions ?—L. Noble (Lincs).

TO destroy the roots you will have to dig down to the main leads, saw them off and paint cut to a few inches of root between cut and trunk with creosote. Paint the top exposed section of trunk in same way.

Bleaching Out Wood

TO eliminate the rather tedious scraping of a wood surface to remove an existing dark stain (after polish or varnish has been removed, of course) could you please suggest a suitable quick-acting bleach which will effect a white as possible finish to the wood without basically harming it ?

What neutraliser would be required before restaining to the desired colour ? —Geo. Laing (South Shields).

AFTER removing the polish and varnish with methylated spirit treat the surface with oxalic acid solution to bring up the grain, and rub down again with sandpaper.

Purchasing New Eyepiece

I HAVE gradually stepped up magnification with an ex-Government equipment telescope till with an object lens of 24in. f × 80 mm. diameter and an eyepiece of 1¼in. f I get a magnification of 19.2. I should now like to increase the power, so if you can help me with any information that is within the range of a workingman's pocket I shall be grateful.—J. H. Beckley (Smethwick).

YOUR calculation of your present magnification is quite correct. Working on the same lines a ½in., *f* eyepiece would yield a magnification of 48, and that is what we suggest you should purchase. A ¼in. E.P. would give ×96, but unless the O.G. is of superfine quality it would not stand such a power and you would see little, if any, more than with a ½in.

We suggest that with such a ratio of aperture to focus in the object glass it would be advisable in looking at the moon to put a cardboard stop over the O.G. and cut down the aperture to about 1½in. This would not affect magnification, but would reduce brilliancy, which, with full aperture, would be somewhat painful, especially if the moon were nearing the full.

The type of eyepiece you will require is the "Huyghenian" ; this will be better for your object glass than the "Ramsden" or the "Kellner." Other types which are achromatic would be too expensive. We suggest you write to Broadhurst Clarkson & Co., Ltd., 63, Farringdon Road, London, E.C.1., or J. K. M. Holmes, Dept. P.M.12, 65, Stephenson Street, North Shields, Northumberland.

(Continued on page 329)

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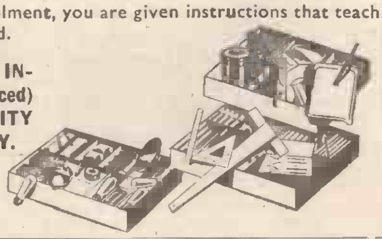

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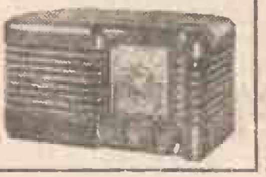


Available in basic form. This contains all the essential items, i.e., prepared metal chassis, 3 valves, mains transformer, gang condenser, coil, volume control, valve holders, smoothing condenser, bias condenser, 6 paper and metal condensers, 7 resistors and data. Special Offer all for 32/6, plus 2/6 post and insurance.
If pleased with the results you can add the extra parts to make the "de luxe" set as illustrated.

THE TWIN 20

Complete fluorescent fitting. Has built-in ballast and starters—stove-enamelled white and ready to work. Ideal unit for the kitchen, over the workbench, uses two 20-watt lamps. Price complete, less tubes, 29/6, or with two tubes, 39/6. Post and insurance 5/-. Extra 20-watt tubes 7/6 each plus 2/6 P./P.

MULTI-METER KIT

Parts suitable for making a multi-meter to measure volts, milliamps and ohms. Kit containing all the essential items including moving-coil meter, resistors, range selector, calibrated scale, etc., etc., is only 15/-, plus 1/- post and packing.

THE "CRISPIAN" BATTERY PORTABLE

A 4-valve truly portable battery set with very many good features as follows:—
- Ferrite rod aerials.
- Low consumption valves.
- Superhet circuit with A.V.C.
- Ready built and aligned chassis if required.
- Beautiful two-tone cabinet covered with I.C.I. Rexine and Tygan.
- Guaranteed results on long and medium waves anywhere.

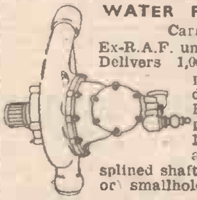
All parts, including speaker and cabinet, are available separately or if all ordered together the price is £7.15.0 complete, ready built chassis 30/- extra. Instruction booklet free with parts or available separately price 1/6.

All parts including valve, paxolin panel, coil formers, etc., etc., to build regenerative receiver, given in September "Practical Mechanics," price 14/6 plus 2/- post.

GRAMOPHONE AUTO-CHANGERS

The latest models by very famous manufacturers. 3-speed with crystal turnover pick-up, brand new and perfect, in original cartons. Prices from £7/19/6, carriage, etc., 12/6.

WATER PUMPS, 32/6,



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Ex-R.A.F. unused but soiled. Delivers 1,000-1,500 gallons per hour when driven by ¼-½ H.P. Motor or petrol engine. 1½in. Bore inlet and outlet, splined shaft. Ideal for farm or smallholding.

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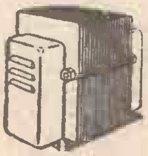

Fully shrouded—standard 200-250 v. primary. 280-0-280 at 80 m/a. 6.3 v. at 3 amp., 5 v. at 2 amp.

12in. T.V. CABINET, 15/-

We are offering these for not much more than the cost of the plywood they contain. Many useful items can be made—record storage cabinet, H.F. loudspeaker case, book case, etc., etc. Price 15/-, carriage 3/6.

CLOCK CASE

Also suitable for barometer or other instrument. Nicely polished. Price 4/6, post and packing 1/6. Clock numerals to suit these cases etched on metal, 2/6.

OFFICE TELEPHONES

New G.P.O. telephone sets with internal bell and push button switch easily connected together to form office intercom. Price £2.10.0 each. Post etc., 2/6.

SPECIAL OFFER—OFFICE INTERCOM

This is a 2-station "master" unit comprising an A.C. mains operated push-pull amplifier with built-in P.M. speaker which acts as microphone or loudspeaker depending on whether switch is set to "talk" or "listen." Complete in polished cabinet ready to work. Price only £4/19/6, plus 3/6 carriage and insurance.

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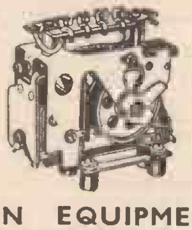

Somewhat soiled due to storage but mechanically O.K. Price 2/6, plus 9d. post. Booklet giving some circuits price 1/- post free. Few available not soiled, 5/- each.

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American make type No. R.01D. This has adjustment to delay opening and closing, and has secondary contacts suitable for heavy currents operating coil; 110 v., 50 cycles. Price 37/6 each.

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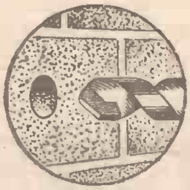

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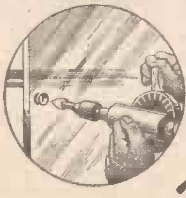

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Electrically Heated Gloves

I HAVE a James Cadet 122 c.c. motor cycle, and am interested in making a pair of electrically heated gloves.

The electrical system consists of a Villiers flywheel magneto generator, which supplies the lighting as well as ignition.

The headlamp uses a 6-volt 30/25 watt twin filament lamp and it was my intention to fit a 3-way switch in place of the existing dip switch so that the gloves would only be in circuit at such time as the headlamp was off.

Could you please advise me if this is a practical proposition, also where it is possible to obtain a suitable length of black heat resistance wire of about 24Ω resistance?

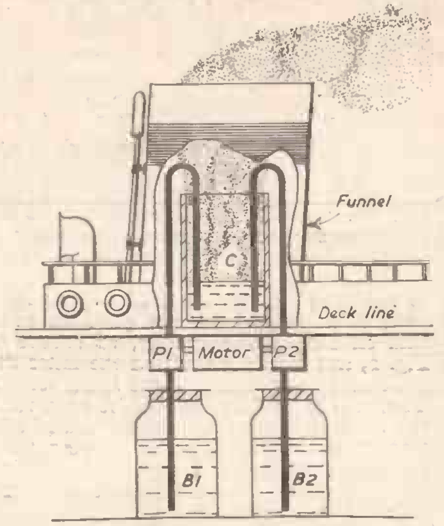
Would it be in order to sew this element straight on to the inside of the glove?—G. M. McIlwrick (Edinburgh).

WE consider that 24 ohms would be too high a resistance for your purpose as this would permit only 0.25 amp. to flow, giving 1.25 watts. We would suggest that the elements in the two gloves be connected in parallel with each other, using flexible leads to independent two-pin plugs and sockets for each glove. Each glove could have about 3.5ft. of 23 s.w.g. nickel-chrome resistance wire. The wire could be stitched up and down each side of the fingers and round the hand of the glove, inside the glove if required. You could probably obtain the wire from Messrs. Henry Wigging & Co. Ltd., of Grosvenor House, Park Lane, London, W.1.

Smoke Screen for Model Boat

COULD you help me with the following problem? I have a large radio-controlled model of a cruiser which I would like to make give a smoke screen effect. The smoke must be produced by mixing two liquid chemicals.

The diagram shows the method of operation which I intend to use.—C. H. Reynolds (Hove, 4).



Mr. Reynolds' proposed method for mixing chemicals for producing a smoke screen.

THE chemical used by the Royal Navy for their smoke screens is chloro-sulphonic acid. This, when a few drops of water are added, produces vast volumes of smoke. We would warn you that this substance is violently reactive to the slightest trace of water and must be kept sealed from the atmosphere until the time of release.

Eyepiece Calculations

I SENT to a well-known firm for an astro eyepiece 100x for my 2in. astro telescope. They sent me a list of eyepieces 1in., ¾in., ⅝in., ½in., ⅜in. ⅓in., and ¼in., and said that the one used depended on the focus of the object glass. Could you please tell me a simple way to work it out?—N. Holland (Birmingham, 28).

THE firm to whom you sent for an eyepiece is, of course, perfectly correct. The power of a telescope depends upon the ratio between the focus of the eyepiece and that of the object glass and may be stated thus $\frac{f\text{O.G.}}{f\text{E.P.}} = P$, the power (P) being the unknown figure.

If your O.G. has a focus of, say, only 20in., then a 1/5in. focus E.P. would be required to give 100x.

We mention this size, 20in., because we happen to know that there are many 2in. O.G.s being sold of this short focus, but the normal astronomical focus for 2in. lenses is 30in. If your O.G. is of this length, then you will want an eyepiece $\frac{30}{100} = .3$in., which is between the ¼in. and the ⅜in. and, of course, is unobtainable.

From the foregoing it will be seen that everything depends upon the focus of the O.G. and if you do not know what this is you will have to measure it by bringing the image of either the sun or the moon to a sharply defined image on a piece of white card, alongside of a rule. Should you find that it is approximately 30in. we would recommend purchasing an eyepiece of ⅓in. focus, which would yield a power of 90x, probably quite high enough. A ¼in. would give 120x with, most likely, less satisfactory vision.

Information Sought

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

"Crackle" Finish

CAN you tell me how to achieve the "crackle" or "wrinkle" black finish as on photographic and optical instruments?—C. HIGGINSON (Grimsby).

Converting Coke Fired Boiler to Oil Firing

I HAVE an ordinary automatic hot water boiler, coke fired, which I wish to convert to heavy oil firing. I wish to convert this to use oil direct from a standard 50 gallon container if possible, situated in the back garden about five yards or more from the boiler.

What I desire is something after the blow-lamp style, burning clean diesel fuel and pressure fed, thermostatically controlled, similar to those used in American households. I believe the power for pressure is by a small electric motor, or the fuel tank is on a small tower to get the pressure. I think a burner of this type is made into a metal plate which replaces the bottom door of the boiler. My boiler is a Glow-Worm A-25, now burning coke, which is so poor to-day the boiler needs frequent cleaning. I think sheet steel could be used.—G. LOFTLEY (Woking).

Electronic Power Pack

PLEASE advise me on the construction of an electronic power pack used in photography. Also components which would be necessary, and approximate costs.—E. PAYNE (N.17).

Pump-agitated Washing Machine

I WISH to construct a clothes washing machine, using a pump to produce the agitation necessary (such a washer is manufactured by a gas appliances firm).

I intend to utilise a modern gas boiler for the clothes and would be glad if you could tell me what type of pump is required and capacity (g.p.h.) necessary to create sufficient turbulence, size of electric motor required to pump the above and diameter of tubing from pump outlet (two jets into washing machine).—A. AITKEN (Fife).

Hydraulic Car

I WAS surprised recently to see an article on a hydraulically driven car. The name was La France, the year 1907, H.P. was 47/70. It had no gearbox, no clutch and no brakes.

Transmission was 87½ per cent. efficient, and it was claimed to have drawn 21 tons over a 1-in-10 gradient.

Is there any such car in Britain? Why are they not common? Can you tell me any more about it?—G. PATTERSON (Belfast).

Ex-A.A. Telescope

SOME time ago I purchased an ex-A.A. telescope. The suppliers were unable to give any operating instructions, and H.M. Stationery Office could not help either. Could you tell me where I could obtain such information? Would it be possible to increase the range of the telescope by changing the lenses?—V. SANCTS (Gillingham).

A Photo-electric Colour Temperature Meter

I WISH to make a photo-electric colour temperature meter. I believe that red and blue filters are used in conjunction with a photo-cell and galvanometer. Could you tell me what filters are used, where they may be obtained, and any other information that I may find useful in its construction?—E. M. McGIBBON (Surrey).

Making Match Head Material

COULD you tell me how to make the red substance which forms the head of a match? Could I make it at home without too much difficulty or danger?—R. J. MURPHY (Cork).

Refrigerator Conversion

I HAVE an Electrolux gas refrigerator which I propose to convert to electricity. Please tell me the best position for, type and size of element; also type and fitting of electrical thermostat.—K. WATSON (Perth).

The Heat Pump

WOULD you kindly inform me if there are any books available on the subject of the heat pump? Heat from the earth is the system I have in mind.—R. DICKENS (Northants).

Swimming Pool

I HAVE built a small swimming pool which has been most successful except that I have not yet found a successful method of filtering the water, which becomes discoloured after a few days' use.

Can you please suggest a suitable filter which I can include in my circuit, preferably one that I can reverse and wash back and remove dirt, etc.? I use a 600 g.p.h. Stuart Turner centrifugal pump.

So far I have been unsuccessful in my efforts with a sand and gravel filter (open, not under pressure). I do not feel that an expenditure of more than £10 would be justified.

The discoloration that I am seeking to remove is not algæ; continual chlorination and aeration keeps this down. Can you also suggest an algæ repellent paint?—R. HANDS (Minchinhampton).

A Steam Engine and Boiler

Constructional Details of a Simple High-speed Unit

(Concluded from page 279 February issue)

FOR the crankshaft use a piece of steel rod ⅛in. diameter and 2¾in. long, and a short piece 7/16in. long and 3/32in. diameter for the crank pin. A piece of a straight French nail will answer very well for the latter. Now take the piece of metal on which the crank webs have already been marked out, and separate these from the bearing plates. File the webs down to the scribed line, leaving the edges as square as possible. One face of each

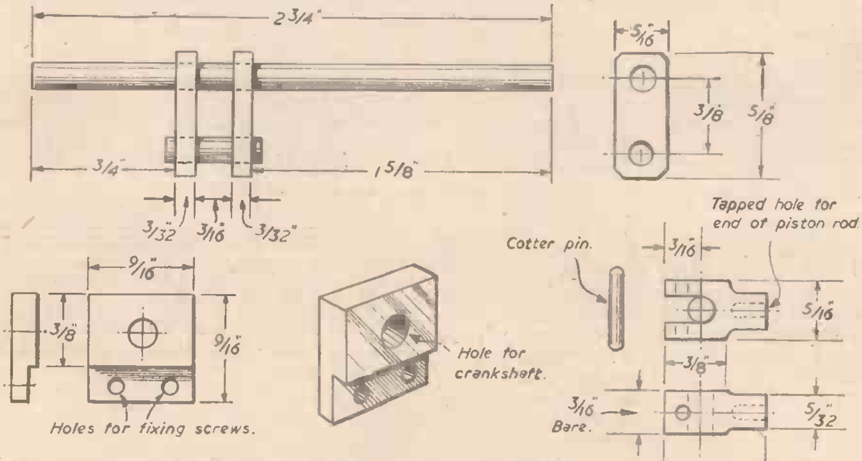


Fig. 8.—Details of crankshaft, bearings and piston rod head.

can now be tinned by coating with a thin film of solder after which they can be clamped together so that the edges register, and held over a Bunsen burner or gas-ring until they become sweated together. Care should be taken to have the face of the web with the centre-punch marks on the outside. The holes for the shaft and crank-pin can now be drilled through squarely, one ⅛in. diameter and the other 3/32in. diameter, after which hold the parts over the gas flame to separate. Having removed the solder and cleaned up both faces, slip the webs on to the shaft in the position indicated in Fig. 8, leaving a space of 3/16in. between them. Next press the crank-pin in place, and sweat the whole together, allowing the solder to run well into the four joints. The projecting ends of the crank-pin can be filed down flush and the part of the shaft between the webs must be removed with a hacksaw, and the ends filed flush with the inside faces of the webs. This completes the crankshaft, which may be cleaned up with fine emery-cloth. If the flywheel is provided with a screwed hole in the boss, the end of the crankshaft must be screwed for a distance of ⅜in., but if a plain hole is provided it can be fixed with a grub screw.

Fixing and Bearing Plates

The two bearing plates can be cut out and filed to shape after drilling the two ⅛in. dia. holes for the fixing screws. Each plate has now to be filed down a distance of 3/16in. from the bottom, an amount equal to the thickness of the bearing bracket, as shown in Fig. 8. After these parts have been filed away, hold one plate in position on the bearing bracket, as shown in Fig. 2, and carefully mark on the latter the position of the two holes for the fixing screws. These can be 3/32in. round-headed screws and the holes in the bracket can be drilled and tapped to receive them, the bearing plate being then screwed in position. Before fixing the other plate the crankshaft must be slipped in position in the bearings, after putting on two small brass washers (see Fig. 2). See that the shaft is maintained in an easy running position before marking out the holes for the fixing screws in the second plate. Having screwed both plates in position, the sides of these, together with the edges of the bracket, can be neatly filed flush, as indicated in Fig. 1.

Cylinder and Steam Pipe

The latter consists of a 1¼in. length of brass tubing screwed at each end and bent as shown in Fig. 3. One end is arranged to screw into a socket soldered into the boiler barrel in the position indicated in the drawings. This socket can be made from a piece of 3/16in. dia. brass tubing, ⅜in. long, tapped with a thread to suit one end of the steam pipe. On the other end of the pipe the steam block is arranged to be screwed as shown. The working face of this block must be quite vertical, and must be in such a position that when the cylinder is in place the piston rod is in line with the centre of the crank. The position of the block can be adjusted in this respect by giving it a turn one way or the other on the end of the steam pipe. When the necessary adjustments have been made the steam pipe can be neatly soldered to the socket. The piston rod head, shown in Fig. 8, can be fashioned out of a small piece of stick brass, the slot to take the crankpin being first drilled and then cut out with a hacksaw and finished with a small file. The hole for [the cotterpin, which is simply a ¾in. length of No. 16 gauge hard brass wire, must be drilled so that when the pin is in position the crankpin is free to turn freely without any shake or rattle. A new piston rod will no doubt have to be fitted, as the one supplied with the cylinder may be too short. This is easily made from a piece of steel rod of the required diameter and should have a thread cut on each end for screwing into the piston and piston-rod head.

Baseboard

For the baseboard a piece of deal ½in. thick can be used, measuring 9⅜in. by 4in., chamfered along the top edges as indicated in Figs. 1 and 2. Two strips ¾in. x ¼in. can be nailed on underneath to act as feet running the whole width of the board.

Before screwing down the firebox the boiler must be clamped in position. For this purpose two short pins should be screwed and soldered into the bottom of the boiler in the positions indicated in Fig. 3. These pins engage with the slotted lugs in the top curved parts of the firebox, a nut is then slipped on each pin and tightened up, so holding the boiler firmly in position.

The Spirit Lamp

The construction of the spirit lamp is clearly shown in Fig. 9. The reservoir, it will be noticed, is circular in shape and can be made from a cocoa or other round tin cut down to the required height. The top consists of a circular piece of tinplate in which the hole for the filler is drilled, the latter being a short piece of brass tubing soldered in. This top part should not be soldered on till the rest of the lamp is completed. To make the cap, a short piece of tubing is required which slips easily into the filler tube, a circular piece of brass being soldered on and a vent hole 1/16in. dia. drilled in the middle. The wick tubes may be cut off a little over 1in.

(Concluded on page 333)

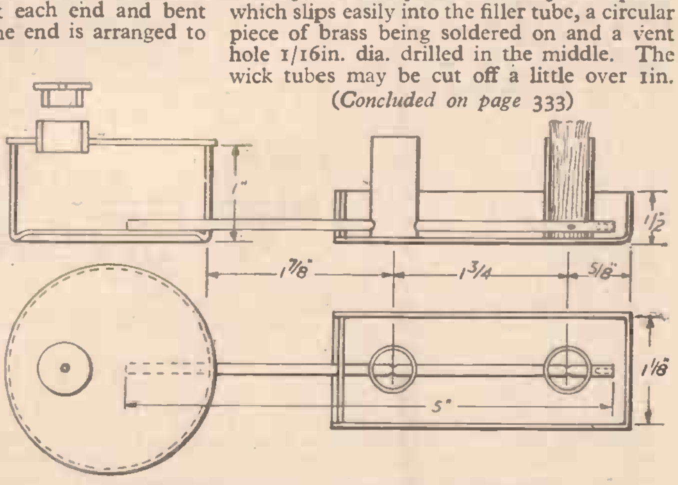


Fig. 9.—Sectional view and plan of spirit lamp.

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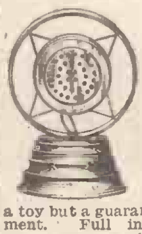

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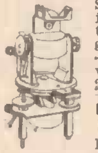

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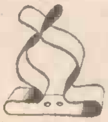

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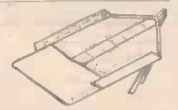

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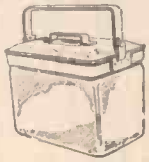

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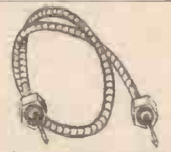

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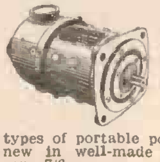

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long, and the ends squared up. A ¼in. dia. hole has now to be drilled through each piece of tubing so that the edge of the hole comes within just 1/16in. of the bottom of the tube. Now take the brass tube for the supply pipe and at the points indicated make nicks on each side of the tube with a small round file. The holes so made should be about 1/16in. in diameter and must be arranged sideways in the pipe when the latter is in position in the wick tubes. Having slipped these on the pipe, see that the little nicks come about the middle of them, and then solder in position. Two discs of brass or tinplate will now be required, which have to be soldered into the bottoms of the tubes. At the same time, stop the end of the pipe up with a plug of brass wire and solder in place.

With regard to the drip tray, the bottom and three sides can be formed from one piece of tinplate, cut out as shown in Fig. 10 and bent to shape. The end is a separate piece, a hole being drilled to take the supply pipe, which can be slipped through and soldered in place, after adjusting the wick tubes to the proper position. Now drill a ⅜in. hole near the bottom of the reservoir, so that when the supply pipe is pushed through the wick tubes are in line with the filler. Solder the joint where the pipe passes through, and also on the inside of the reservoir where it touches the bottom. This being done the top of the reservoir can be soldered in place. The best material to use for the wicks is what is known as asbestos yarn. Purchase a yard of this about the thickness of ordinary string and cut off two lengths sufficient to fill the wick tubes, allowing about ½in. to project so as to give a good flame.

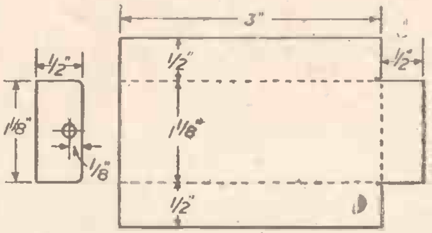

Fig. 10.—Tinplate blank for forming drip tray of lamp.

Keep the flames of the lamp well under control when running the engine, and do not let them get too high. It is also important that the level of the water in the boiler should not be allowed to get below the bottom test cock while the lamp is burning.

Simple ELECTRICAL EXPERIMENTS FOR THE JUNIOR MECHANIC

Making a Battery and a Leyden Jar

AN inexpensive primary battery for working small electric motors or shocking coils (and other apparatus to be described later) is that known as a bichromate battery, so called after one of the chemicals used for the electrolyte. A two-cell battery, giving about 4 volts, is quite simple to make and an example is shown in Fig. 1.

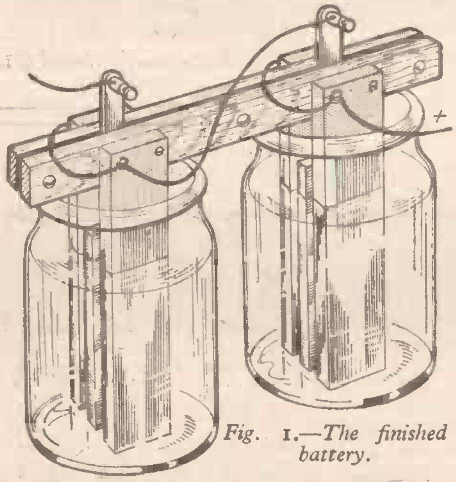

Fig. 1.—The finished battery.

Materials Required

Two 1lb. glass or earthenware jam jars.
Two strips of wood 9in. × ⅞in. × ½in.
Four carbon plates, 5in. × 1¼in. × ¼in.
Two zinc plates, 3in. × 1in. × ⅛in.
One strip of brass, ½in. wide × 7in. long.
Eight ½in. long wood screws.
Three ⅜in. long wood screws.
3ft. covered bell wire.

The carbon plates with holes drilled can be obtained from any electrical stores.

Assembling the Battery Elements

Take the piece of strip brass and, after cutting it in half with a hacksaw, round the ends of each piece with a file and drill a small hole at each end, as indicated in Fig. 2. One brass strip is to be riveted to each zinc plate, but before doing this clean thoroughly with emery paper the parts that come into contact, as these have to be finally sweated together with solder. Bend each brass strip so that the zinc plate hangs centrally below it as shown in Fig. 2.

Take the wooden strips, clamp them together and drill the three holes for the clamping screws, one in the centre and one near each end, as shown in Figs. 1 and 4. Clamp the brass strips, with zinc plates in place at a distance of 1½in. from each end of the wood strips. The carbon rods can be screwed in on each side of the wooden strips opposite the zinc plates, using the ½in. screws for the purpose. Make sure that the ends of these screws do not touch the brass strips. The stems of two small terminals can now be soldered in the holes in the tops of the brass strips, as indicated in Figs. 1 and 3.

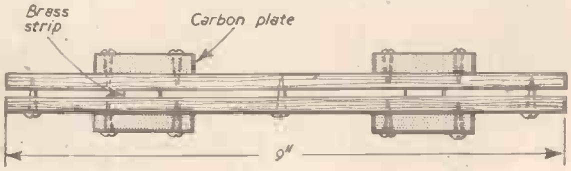

Fig. 4 (Above).—Details of the clamping screws.

Making the Connections

The battery elements, as they are called, can be placed in their respective jars and the connections made. It will be noticed on referring to Fig. 1 that both the carbon plates of each cell are joined together and that the carbons of one cell are joined to the connecting strip of the zinc plate of the other cell. The cells being thus connected together in series the battery will give the added voltage of the two cells, which will be found to be about 4 volts, as previously mentioned. Where the bared ends of the copper wire are held under the screwhead a brass washer should be provided under which the wire can be effectively clamped.

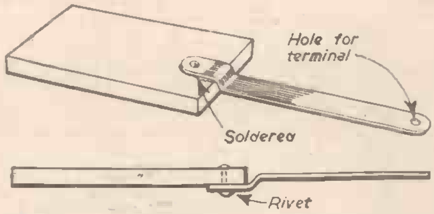

Fig. 2 (Above).—How the brass strip is attached to the zinc plate.

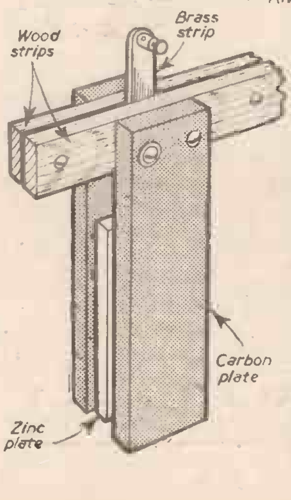

Fig. 3 (Left).—The zinc plate clamped between the carbon plates.

Mixing the Electrolyte

The working solution or electrolyte may consist of chromic acid salts dissolved in water. About one pint of solution will be required for the two cells, and the necessary salts can be obtained from any electrical stores. This is the most convenient way of preparing the solution, but it can also be made up quite cheaply from separate chemicals which can be purchased from a chemist's shop. Obtain 6 oz. of bichromate of potash and 5 oz. of sulphuric acid and dissolve the potash in 1 pint of tepid water. To this solution add the sulphuric acid *very slowly*—great care must be taken not to pour the acid in too quickly or it may splutter and splash up in the face of the operator.

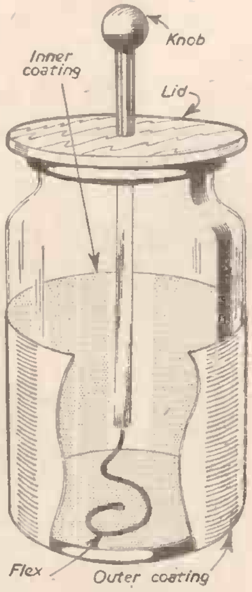

Fig. 5 (Right).—The elements of a Leyden jar.

When the battery is required for use carefully pour in the solution till it nearly covers the zinc plates. On connecting the two wires from the battery to a shocking coil or a small electric motor it should at once begin to work. After use the battery solution should be poured into a well-corked bottle till it is required again. The solution will last a considerable time, but a little sulphuric acid will have to be added occasionally to bring the electrolyte up to proper working strength. Finally, as the acid eats away the zinc in time,

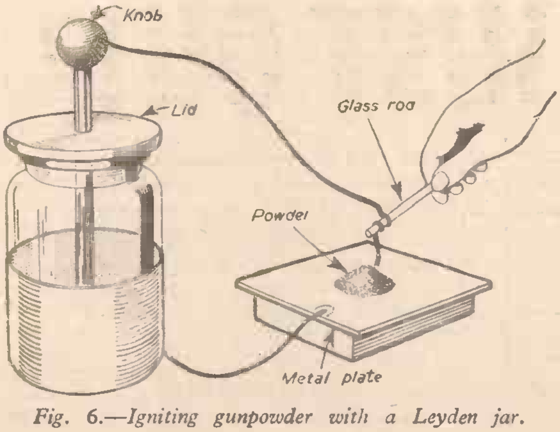

Fig. 6.—Igniting gunpowder with a Leyden jar.

the carbons and zinc plates should be given a good rinse under the water tap after using to remove all traces of acid.

Some Battery Hints

It sometimes happens that one is not certain with a home-made battery as to which is the positive or negative pole. There are several methods of finding out. Connect the two leads from the battery and push them into a half-potato. A green ring will appear round the positive lead. Another method is to dip the two leads in a strong solution of salt and water, when bubbles will emerge from the positive lead.

A Leyden Jar and Electrophorus

Select a good 2lb. jam jar of clear white glass and dry it thoroughly by leaving it in an oven for several hours. Coat the jar with shellac varnish, both inside and out, and stick tinfoil over this to a height of 4in. As this is rather a difficult operation, it should be done on the inside first by cutting a circle and sticking it on the bottom. A strip 4in. wide should now be fixed on the sides and pressed down so that no air bubbles remain between it and the glass; the outside is treated in a similar manner. Cut a circle of dry wood to cover the mouth of the jar and drill it to take an ⅛in. diameter metal rod. This rod should be 8in. long and having a round metal ball at one end, while to the other a length of bare flex is soldered so that when the lid is placed in position the flex makes contact with the inner coating (see Fig. 5).

Charging the Jar

When the jar is quite dry it may be charged from an electrophorus by merely touching the knob of the jar with the charged pole. After doing this about six times bring the finger towards the knob, when a fat spark will pass, causing a sharp shock. Place a little dry gunpowder on a metal plate, connect the plate to the outer coating of a charged Leyden jar, and connect the knob of the jar to a wire wrapped round the end of a glass rod. Take the loose end of the wire close to the plate so that a spark passes and the gunpowder will be ignited (see Fig. 6).

An Electrophorus

Procure a biscuit tin lid and melt a quantity of resin, sufficient just to fill the lid. Great care should be taken here as it very easily catches fire. This is poured into the lid. Make the surface uneven by pressing with a stick.

Make a wooden disc, 8in. in diameter and 1in. thick; round off the edge of this and cover with tinfoil. Glue a strip of foil around the edge first and then glue two discs of foil 7½in. in diameter on the top and bottom. Make a small hole in the centre of this disc, and fix a glass tube into it (B) with a wood knob (C), as shown in Fig. 7.

The instrument, now complete, is used as follows: the resin is first electrified by rubbing it with a piece of fur, which develops a negative charge on its surface. Place the disc, held by the glass tube, in the centre of the resin. The disc is then touched with the finger, and the negative electricity becomes earthed. The disc, now charged with positive electricity, is removed from the resin, and if we place the knuckle within ½in. of the disc a bright spark will jump the gap with a sharp crack.

The Leyden jar is one of the most useful pieces of apparatus in static electrical experiments, as it forms a most useful way of storing energy.

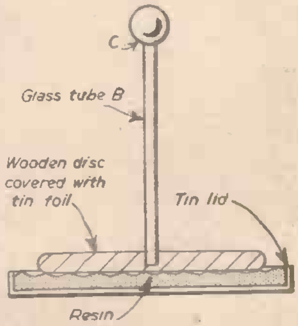

Fig. 7.—The completed electrophorus.

A Rubber Driven Boat Motor

A Simply Made Device, Producing High Speed

THE one drawback to the rubber motor as used in model aeroplanes is that it runs down in a very short time. This, in part, is due to the small amount of resistance offered to the propeller by the air, an objection that does not apply with so much force to a screw running in water. It is possible, therefore, to use a rubber motor for driving a model boat if in other respects it is designed so as to get the maximum power out of the rubber.

The Gearing System

The idea is to use two separate strands of rubber geared together so that they may act as one, and thus operate as a single strand.

Fig. 1 shows these strands broken in the centre for economy of space in the drawing. It will be noted that they are not quite parallel; this does not affect the working, but reduces the width of the gearing at the forward end of the boat. This gearing consists of two meshed spur wheels of equal size running in bearings in an angle plate of sheet brass and carrying hooks to which the rubber strands are hitched (see A).

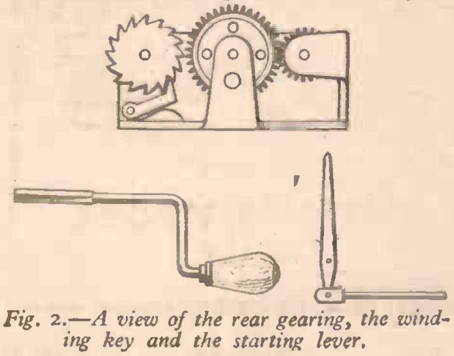

Fig. 2.—A view of the rear gearing, the winding key and the starting lever.

The Rear Gearing

The gearing at the after end consists of the screw shaft running in double bearings, provided with a spur wheel in mesh with one of smaller size to which one rubber strand is hitched (see B). Independently, a ratchet wheel with pawl (see Fig. 2) takes the end of the other strand, and has its pivot extended aft, and provided with a squared end for a cranked winding key, also shown in Fig. 1.

The Starting Lever

This is an actuating lever hinged to a short rod, as shown in Fig. 2. The actuating rod without the lever is shown at C in Fig. 1. The lever is pivoted a short distance from the bottom and the pin for this purpose must be fixed into the hull of the boat or in a U-shaped frame specially made for the job. The angle plate which carries the propeller shaft bearing nearest the bows carries another bearing above this which supports the starting lever rod. Pulling the actuating lever towards the bows pushes the rod rearwards into one of the four holes in the spur wheel on the screw shaft and locks it while the strands are being wound up.

The starboard strand is self locking by means of the ratchet wheel and pawl.

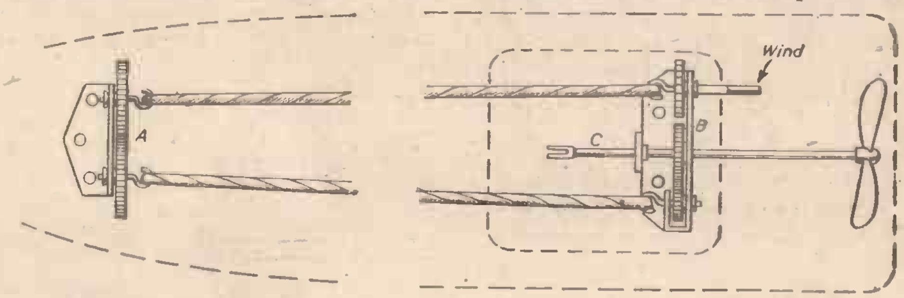

Fig. 1.—General arrangement of elastic driven motor fitted in a model speed boat.

The Hull

This part of the boat may be fashioned from wood and the gears screwed in place, holes in the gear plates for that purpose being made as indicated in Fig. 1.

Toothed wheels suitable for this motor may be purchased from firms specialising in model aeroplane accessories or from a friendly clockmaker.

Carefully made and with all gears running freely, this motor should render good service. The cost for materials should be trifling.

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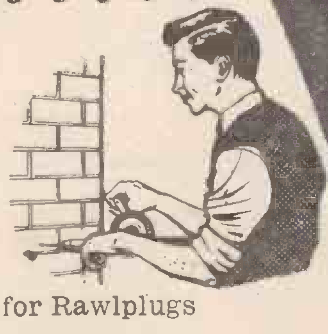

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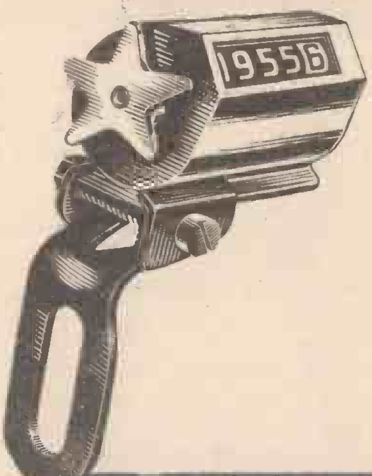

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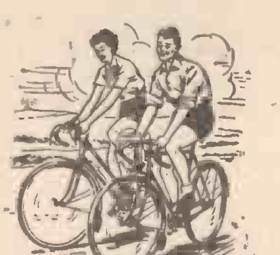

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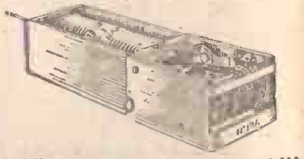

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THE Cyclist

Editor : F. J. CAMM

VOL. XXIV MAY, 1956 No. 406

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WHAT I THINK By F. J. C.

Cycle Road Racing

THE bicycle manufacturers, through their union, state that in the present circumstances it is no longer prepared to be involved in the controversy between the N.C.U. and the B.L.R.C. and that as there are in fact no sponsored cycle manufacturers' teams in existence in 1956 the Road Racing Committee of the union has no team organisation to call upon for the selection and training of a team of Tour de France standard. "It therefore with much regret finds itself unable to accept the honour which has been done to British cycling by the invitation of the organisers to participate in the 1956 Tour."

We think this decision is a wise one, for we have always held the point of view that it was wrong of the bicycle manufacturers to have interceded in the first place. The manufacturers themselves are divided on the question of mass start racing, and therefore could not act as a strictly impartial body. The N.C.U. and the B.L.R.C. are now in *status quo ante bellum*. The B.L.R.C., at its annual general meeting, instructed its chairman to write to the President of the N.C.U. that it had passed the following resolution: "That this A.G.M. wishes to confirm the decision taken at the 1954 A.G.M. and reiterates its desire to formulate an agreement with the R.T.T.C. and N.C.U., using as a basis the Anderson Plan, the defining of categories to be negotiated with these two bodies." As a first step towards unification, they offer in return for the N.C.U. granting joint selection in international events to agree to joint control of the Tour of Britain with the N.C.U.

It is known that there is a growing expression of opinion in all three bodies that an agreement should be reached on the basis of the B.L.R.C. resolution, for the voting at the N.C.U. General Council Meeting was even, but the chairman cast his vote against it. This decision was reached before the A.G.M. of the B.L.R.C. It is obvious that the N.C.U. is the nigger in the woodpile, and having been nurtured in a creed outworn does not wish to subscribe to a new doctrine.

Sense and Safety

ROAD casualties in Britain during 1955 showed a total of over 265,000. Those who wonder how these accidents occur may find their questions answered in a booklet titled "Sense and Safety," published by H.M. Stationery Office at 6d. According to this book the greater part are the result of human error, and while the figure of children injured on the road grows year by year the causes of these accidents follow a pattern. The Ministry says that it is possible to forecast very nearly the number of casualties which will result in any year from particular errors of judgment or from carelessness.

Based on 1954 road casualty figures, the booklet shows how thousands of accidents are brought about by the same mistakes. For instance, in that year over 8,000 drivers met with an accident in turning right without due care. Over 30,000 pedestrians crossed roads carelessly and were involved in accidents. Nearly 7,000 pedal cyclists came to grief through not watching what they were doing.

These are some of the facts and figures given in the booklet, which also contains clear illustrations of errors of judgment and carelessness on the road. In addition to showing the principal causes of accidents among drivers, motor cyclists, pedal cyclists and pedestrians, "Sense and Safety" gives valuable advice to all who use the roads, and includes hints to parents on safety education for children.

Summer on the Thames

Day's Lock lying below Wittenham Clump - A lovely reach of the Thames near Shillingford . . .

I quarrel with this booklet in that it does not include as a cause of accidents our impoverished road policy and that it fails to draw the obvious lesson that the road safety measures which have been introduced (one-way streets, railed-off pavements, more and more traffic signs, pedestrian crossings, poster campaigns, etc., etc.) have positively caused accidents instead of reducing them. They have not only made roads more dangerous, but have reduced the speed of traffic to a farce at the same time. So we have the paradox of traffic being made more dangerous at a greatly reduced speed.

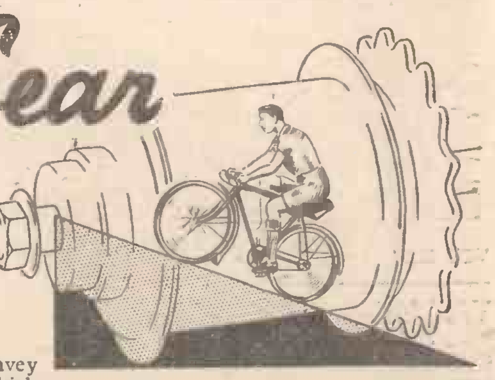
The Ageing Club

HASTINGS C. and A. C., recently celebrated the 80th anniversary of its foundation. Indeed, from now on we may expect a number of other clubs to be celebrating jubilees. I have attended a number of annual meetings of these old clubs, and have always come away with a feeling that I have witnessed an aged body slowly dying. These old clubs tend to live too much on and in the past. Age proves nothing but antiquity. To have been first means nothing, unless accompanied by a long history of activity and progress. To have become first does show activity. There are many of these old clubs and most of them have failed to maintain the glory of their former years. In some cases this is due to an inactive committee, in others to sheer laziness, and in some to vanity of the officials and to internecine conflict. Can the North Road and Bath Road Clubs claim to have the prestige to-day which they had only 20 years ago ? The answer is definitely no. Some of them exist merely to promote opens for outside clubs to win, and are unable to put up riders in their own events. The members do not even support club handicaps, and where annual runs are held those who turn up can be counted on the fingers of one hand.

The R.T.T.C. should refuse to recognise clubs which have not an active programme. Take the clubs I have mentioned, or the Anerley, which recently celebrated its 75th birthday. Can it be said that any of these clubs has distinguished itself in recent years ? No doubt many of these oldsters have done pioneer work for the club in years gone by, but they have been adequately thanked for it, and it seems sad and superfluous that year by year they should be paraded at the annual function for the younger members to admire. After all, the work they did in the former years was not so very much after all. A lot of it was done for reasons of personal vanity, and it was not so very exceptional.

I should like to see a lot of these old men retire from the clubs, for their judgment is crabbed and warped, and they do not exercise a good influence on the younger generation. They want road racing, for example, run to-day as it was run 50 years ago. Some of them, of course, have made a very good thing out of the cycling movement. Some, indeed, have earned a very comfortable living without doing very much, except to preach the wonders of cycling, quite often from the comfort of an armchair. There was one such humbug that I know who would attend meetings hundreds of miles away and always arrived spick and span on a bicycle, informing the guests that "he had ridden all the way." I happened to attend one of these functions and drove down in a car, time being important. Ahead of me was another car, with this said humbug in the passenger seat with his bicycle lashed on the back. I thought I would trail behind and watch events, and I was not mistaken in my conjecture, for about two miles from the venue the car stopped, the bicycle was unlashed and the humbug mounted the saddle and pedalled away. I arrived at practically the same time, and asked him how he had travelled. With a supercilious sneer and in the presence of a goodly company he said he believed in practising what he preached and had ridden down on a bicycle. I must say it gave me extreme pleasure, also in the presence of the goodly company, to debunk him, much to his discomfiture.

The Variable Hub Gear



An Explanation of This Ingenious Mechanism

EVERYONE is probably familiar with the external appearance of the hub three-speed but knowledge of the working procedure is not so common. A typical example is the Sturmey-Archer.

The essential item is one or two sun and planet groups of toothed wheels or pinions of suitable size, such as is shown in Fig. 1. The sun pinion is a twenty-toothed fixture on the axle of the wheel, which is itself, of course, fixed in the fork ends. It therefore never turns round. There are four planet pinions, each of the same size and each having twenty teeth like the sun pinion. Their teeth engage with the sun's teeth and they spin on bearings housed in a circular cage or ring. It is only at first glance that they can be called planets, because they actually mesh with the sun pinion. Their teeth also engage with an outer ring which has sixty teeth on its internal face. This arrangement can be seen in Fig. 2.

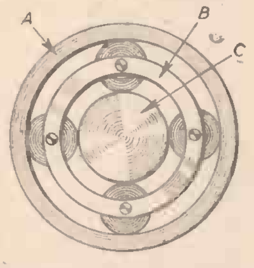


Fig. 1. — Diagram showing the principle of the epicyclic gear. A and B revolve round C. Hence A travels faster than B. A step down in gearing is obtained by coupling A to the chainwheel and B to the hub. To raise the gear B is connected to the chainwheel and A to the hub. For normal the chainwheel and hub are locked together.

Equalising the Strains

These four planets are used where a single such planet would do the job, theoretically, but it is an advantage, practically, to have a group sharing the job and equalising the strains round the sun and inside the outer circle. That is the only reason why the planets are multiplied in the cage. Now in any such epicyclic train the sun has N-teeth and the outer ring has N-teeth, the speed ratio of the outer ring to the cage ring running round the fixed sun is N+N to N, which in our case is the sum of 20+60 to 60 or four to three. Here then is the "variability" in the hub, which we can bring into action in each of two ways or cut out of action and ignore altogether, and it is the ingenious way in which the "solar" system is worked (or short-circuited) that makes the hub a marvel of packed ingenuity. All this is done without unmeshing the toothed wheels either by sliding the sun or disturbing the planetary cage.

The Chain Drive

There is, of course, first need to convey the chain drive from the chain sprocket which is done by a "driver" or collar, provided with slots, which in turn drives a dog-clutch capable of sliding sideways in the driver slots. The driver rotates at chainwheel speed, so does the sliding dog-clutch. When the sliding dog-clutch is at one end of its travel it engages with bosses on the outside of the planet cage and drives the cage round at chainwheel speed. The planet cage going round its fixed sun, with planet wheels revolving, drives the outer ring a third faster than itself, and this outer ring (through pawls) drives the hub shell at this greater rate and the hub shell (by the spokes) drives the road wheel at the same higher rate. This proportion is due to the relative size of the sun pinion and the number of teeth in the gear ring.

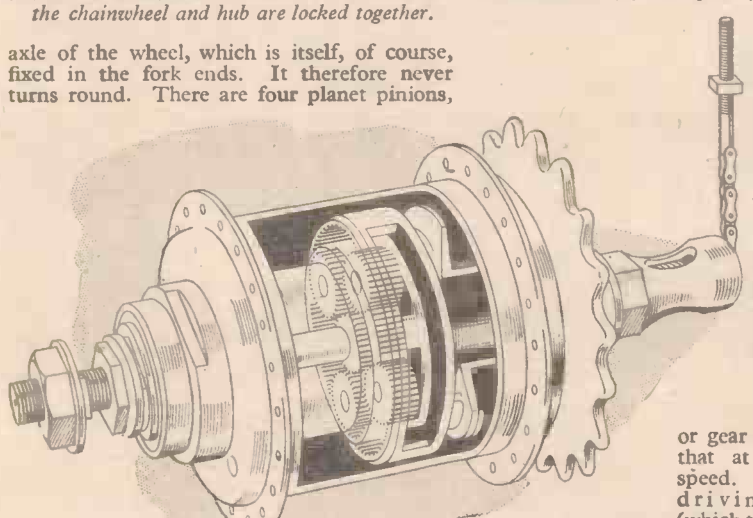


Fig. 2.—A cut-away view of the Sturmey-Archer three-speed hub.

If now, by pulling the control wire, the sliding clutch is drawn to the other end of its travel it loses contact with the bosses on the planet cage and engages the outer or gear ring, and drives that at the chainwheel speed. The outer ring driving the planets (which turn in their cage) causes the cage to go slower than the outer ring. The cage (in another pawl drive) now turns the hub shell at this slower cage speed.

The dog-clutch in its middle position short-circuits the planetary system and drives the outer ring direct at chainwheel speed, the outer ring (by pawls) driving the hub shell also direct, so that there is no change of speed as between the chainwheel and the road wheel.

You can conduct a simple experiment which will demonstrate the principle of the sun and planet or epicyclic gear. Place a penny on the table and, whilst pressing on it, revolve another penny around the circumference, marking the moving one in some way so that the revolutions can be counted. Although the circumferences of both coins are of equal measurement, the moving coin actually makes two revolutions on its own axis in travelling once round the stationary penny. This may be seen in Fig. 3.

The high gear in this type of hub is 33⅓ per cent. higher than the middle direct gear and the low gear is 25 per cent. lower than the middle gear. The free-wheel mechanism inside the hub is automatic.

Removing the Mechanism

Remove the left-hand cone and then unscrew the right-hand ball ring from the shell (it has a right-hand thread). This will detach all the gears except the left-hand ball cup, which screws into the shell with a left-hand thread.

For those who may wish to effect minor replacements, the top gear depends on the engagement of the dog-clutch with the planet cage dogs. The middle gear depends upon the engagement of the sliding dog-clutch with the splines in the gear ring which lock all together, and the low gear depends on the gear ring pawls being depressed out of action by the incline on the sliding clutch and upon the pawls on the left-hand ball cup engaging with the ratchets at the end of the planet cage.

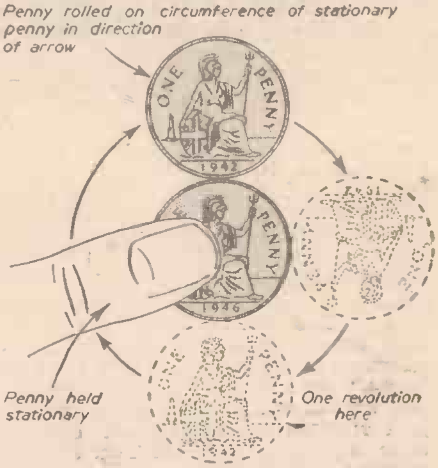


Fig. 3.—The sun and planet gear simply demonstrated.

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By F. J. CAMM

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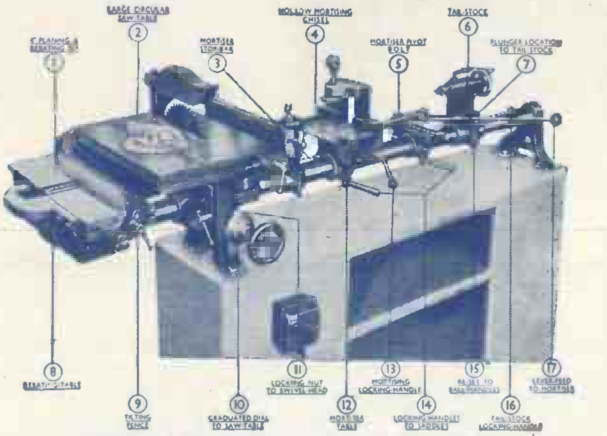

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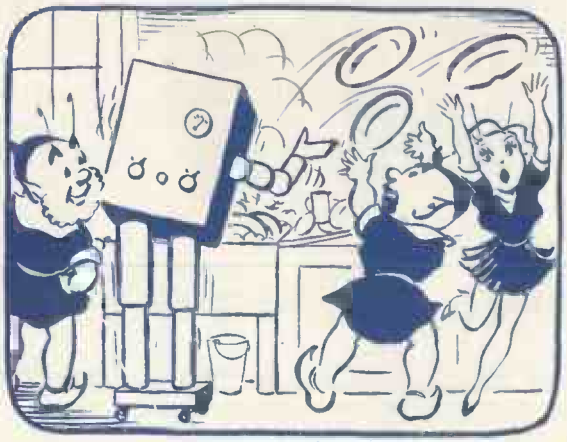

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