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EDITOR: F.J. CAMM

NOVEMBER: 1958

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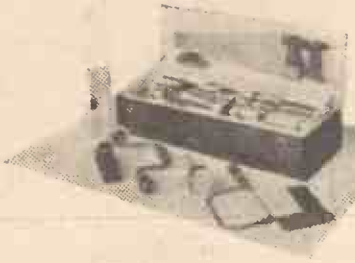

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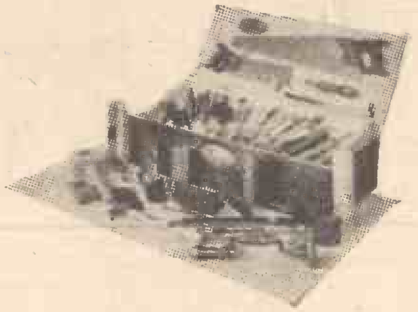

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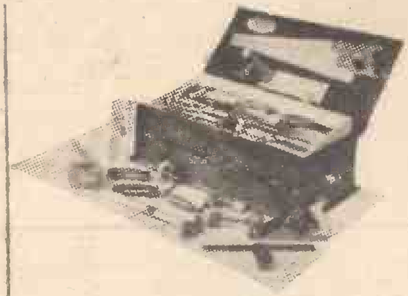

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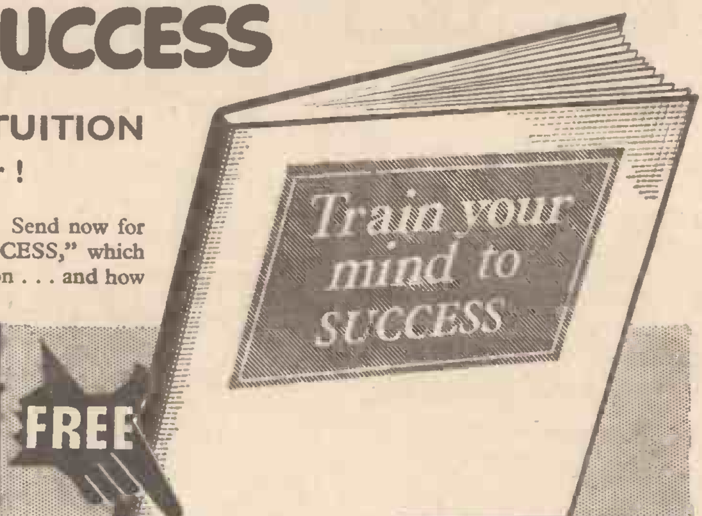

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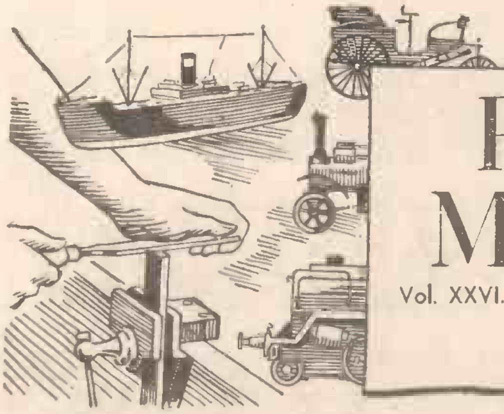

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FAIR COMMENT

PROTECTING AN IDEA

A VERY high percentage of our readers is of an inventive turn of mind, judging from the large number of queries we deal with asking advice on how to take out a patent. A useful pamphlet explaining how to apply for a patent design or a trade mark is obtainable free from the Patent Office, but, of course, that can only cover the legal requirements. It does not give practical advice. The drafting of a provisional or a complete specification is a highly skilled business, and I always advise readers to place this matter in the hands of a really competent patent agent, for it is full of pitfalls. The patent specifications, when published, are eagerly scanned by interested parties, and some simple omission in your specification can enable them by a suitable disclaimer to obtain a patent which does not infringe yours. A good patent agent will save you money by cutting claims which he knows have already been covered in other specifications. He will improve your specification by putting in fresh claims for your invention which you had not thought of yourself. Remember that you cannot obtain a patent for an idea—only for methods of carrying it into practice, and it is very essential to make quite sure that your claims are as broad as possible, so that they cover practically every known method of putting the idea into operation. There are many examples of valuable ideas which have produced no reward to the inventor, yet which have enriched others who have found a flaw in the specification. The patent agent will make a search of previously published specifications to make quite sure that your idea has not been anticipated. If he finds that it has, he may improve your specification so that you may obtain Letters Patent for it.

An inventor may not have technical knowledge, although his idea is sound, and he may make extravagant claims which cannot be justified.

Many inventors are very poor and cannot, in some cases, afford the Patent Office fees. They think, therefore, that they should offer their ideas to manufacturers in the belief that they will take out a patent for them. This is a very dangerous practice. It is not unknown for the idea to be turned down, and for the unscrupulous to obtain an independent patent on their own. Publication of an idea before an application for a patent has been made can in certain circumstances amount to publication, and invalidate a claim to a patent. The possession of a patent is the only evidence that you are the proprietor of the idea, and that your idea is, therefore, original. A provisional specification is not sufficient evidence—it merely dates your application, and may give the unwary a false sense of security. The official search does not take place until the complete specification is filed. My advice, therefore, to all readers is to patent the idea, and then approach manufacturers who might be interested. The question of foreign patents arises here. A British patent only gives protection in this country and certain of our possessions. Unless you have protected the idea in foreign countries, anyone in those countries can adopt the idea, provided they do not export the product to this country. Japan is notorious for filching inventions patented in other countries.

Where possible, in negotiating a patent, endeavour to obtain a sum down, to cover initial work and expenses and a royalty, with a minimum annual royalty clause. Otherwise the manufacturer may acquire the patent without exploiting it. Many thousands of patents are bought up every year, but are not proceeded with if they cut across a manufacturer's existing lines. Even big companies buy up patents in order to kill them. The minimum royalty clause protects the inventor against this unless he receives such a substantial sum that it is of no moment to him.—F. J. C.

The December issue will be published on November 28th. Order it now!

AN ELECTRIC GUITAR

J. E. Turner Describes the Construction of a Contemporary Styled Instrument and a Suitable Amplifier

THIS guitar is designed solely for use with an amplifier, the volume of sound produced by the strings alone is inadequate for serious playing, but suitable for practising. When amplified, the volume is only limited by the output from the amplifier.

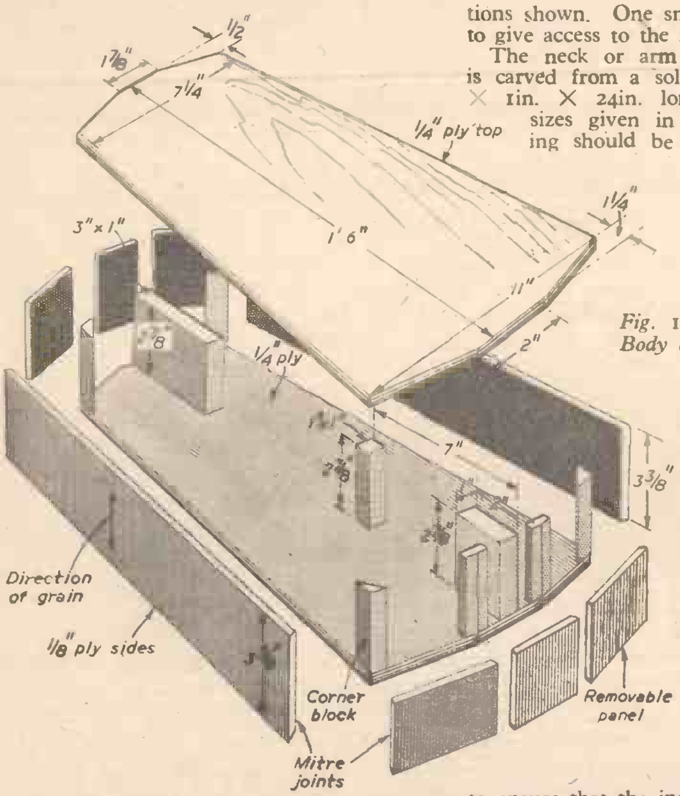
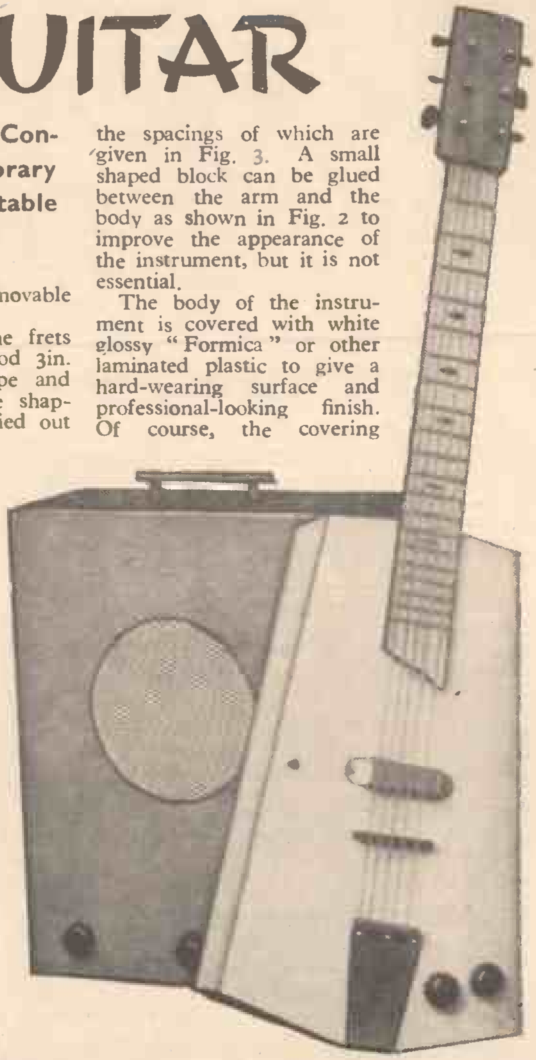


Fig. 1. — (Left) Body construction.



(Right). — A view of the completed guitar and amplifier.

The original is in regular use and proves very successful. One possible criticism is the fact that it is heavier than a normal type Spanish guitar but, as it is usually played in the sitting position and can easily be fitted with a sling, the extra weight does not matter.

The tuning heads should be purchased ready made as it is hardly worth the trouble making them.

Construction

The body is made from plywood, as shown in Fig. 1, firmly screwed and glued together with strengthening blocks glued in the positions shown. One small panel is removable to give access to the interior.

The neck or arm that carries the frets is carved from a solid piece of wood 3in. × 1in. × 24in. long to the shape and sizes given in Fig. 3. The shaping should be accurately carried out to ensure that the instrument is comfortable to play.

The type of wood for the neck should be a close-grained hardwood that is fairly easy to carve. A well seasoned wood is essential and not one that tends to move or warp when a fresh surface is exposed. Fruit woods are prone to this and should be avoided. Beech or mahogany would be ideal.

Softwoods are not really suitable.

The type of timber used for the neck is important because, of course, any movement due to warping or to the pull of the strings (which is considerable) would be disastrous to the instrument. The neck should be sanded perfectly smooth on the curved underside. The top surface, also very slightly curved as indicated in Fig. 3, should be true but as this is to be covered with a plastic a slightly rougher surface is desirable.

A further view of the completed guitar.

Before the neck piece is permanently fixed to the body it should be temporarily fixed with screws to check the very slight incline of the neck given by tapering the underside shown in Fig. 3. The arm is now securely glued and screwed in its correct position on the body. The screws should be well countersunk and positioned to come between the metal frets, the spacings of which are given in Fig. 3. A small shaped block can be glued between the arm and the body as shown in Fig. 2 to improve the appearance of the instrument, but it is not essential.

The body of the instrument is covered with white glossy "Formica" or other laminated plastic to give a hard-wearing surface and professional-looking finish. Of course, the covering material and colour is a matter of choice.

Laminated plastic is not a difficult material to work. It cuts easily with a fine-

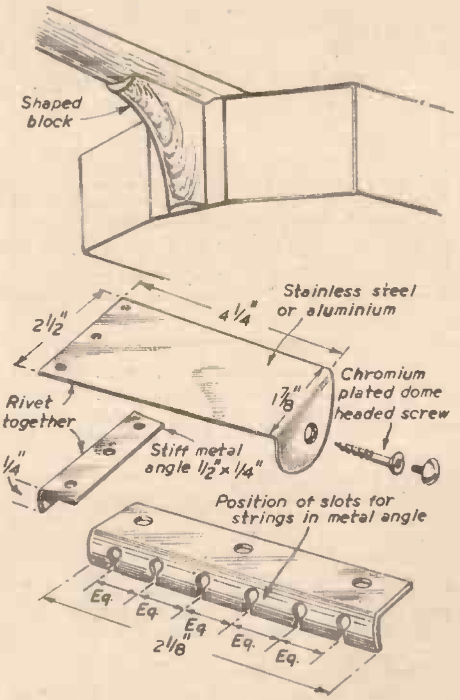


Fig. 2.—Details of the shaped block, tail-piece and metal angle.

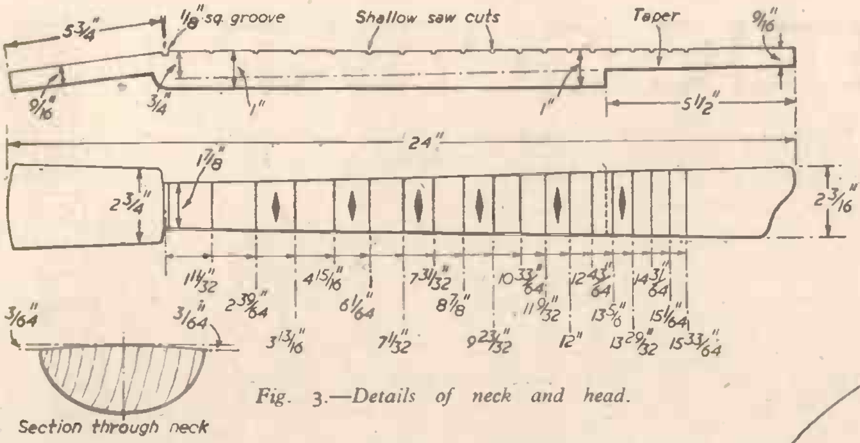


Fig. 3.—Details of neck and head.

toothed saw and the edges are easily cleaned up with a small plane. The best cutting action is obtained with the plane blade reversed, although some of the small, cheap planes have the blade this way round. Fig. 4 shows this point.

The best adhesives are the resin glues and the impact adhesives. With the latter great care has to be taken in placing the plastic on to the surface as it is practically impossible to move it without breaking once the surfaces are in contact.

The top and bottom surfaces should be covered first and the edges of the plastic planed or filed flush with the sides. The side pieces can then be fixed and the edges flushed up with the top and bottom surfaces and finally given a chamfer, as shown in detail in Fig. 4. This gives a neat-looking arris and prevents chipping.

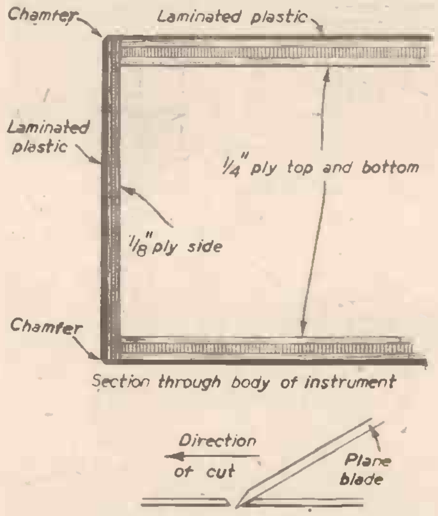


Fig. 4.—Section through the body showing how the plastic is glued and chamfered; also the arrangement of the plane blade for cutting.

The removable panel is also covered with plastic and secured with four small chromium-plated countersunk screws.

A pair of worm-geared tuning heads are now required. These can be obtained quite cheaply at most musical dealers. They are left and right handed to fit on both sides of the head, which has to be drilled or slotted to suit. There are two general types, either of which is suitable and both of which are shown in Fig. 5.

Drill or slot the head to suit the type being used and carefully fit the mechanisms to the instrument.

The Bridges

Two bridges are now made, as shown in Fig. 6. They can be in bakelite, plastic or hardwood. The top edge supporting the strings should be very slightly curved to suit the curve of the neck. The grooves for the strings can be marked but the depth of the grooves is best decided later. The small bridge fits in the slot at the top of the neck, but it should not be glued in position until the instrument can be tested, when any slight alterations can be made.

The Frets

These are made from lengths of nickel silver oo gauge model railway line. They cross the neck of the instrument at varying distances as shown in Fig. 3. Shallow saw cuts are made across the neck: a little experimenting on a strip of wood will be worth while before the instrument is touched to obtain the right width and depth of saw cut. The spacing of the frets should be very accurately measured as the correct tuning of the instrument depends on this. The shape of the railway line is ideal for the purpose as it forms a key for strips of "Formica" cemented between them, as shown in Fig. 6.

The frets require to be curved slightly to match the neck and this is best done with the rail in a long length before being cut. Small diamond shapes are cut in the fret spaces indicated in Fig. 3 and are inlaid after gluing in position with a darker coloured plastic. These are mainly for decoration but do offer some indication of fret positions to a beginner.

The small plastic sections between the frets require to be accurately fitted and bound with string to hold them to the curve of the neck until the glue is set. The metal frets should all project up from the neck the same amount and should all touch a straightedge held along the frets.

If required, more frets can be added using the following method for calculating their positions.

The dimensions given in Fig. 3 have been calculated to the nearest 1/64in., which is quite accurate enough. The method given applies to any fretted instrument, irrespective of the length of the strings, although this length must be known or decided on in advance.

In this case the length is 24in., that is, the free length of string from bridge to bridge. Four-figure logarithm tables are required.

For the first fret position, that is the fret nearest to the head, the logarithm of $\sqrt[12]{2}$ is subtracted from the log. of 24, the antilog. then gives the distance in inches of the first fret from the main bridge, i.e., 1.38020 (log. 24)

.02508 (log. $\sqrt[12]{2}$)

1.35512

Antilog. of 1.35512 = 22.66in.

The second position is log. 24 − twice log. $\sqrt[12]{2}$ which is:

1.38020 (log. 24)

.05016 (2 × .02508)

1.33004

Antilog. 1.33004 = 21.38in.

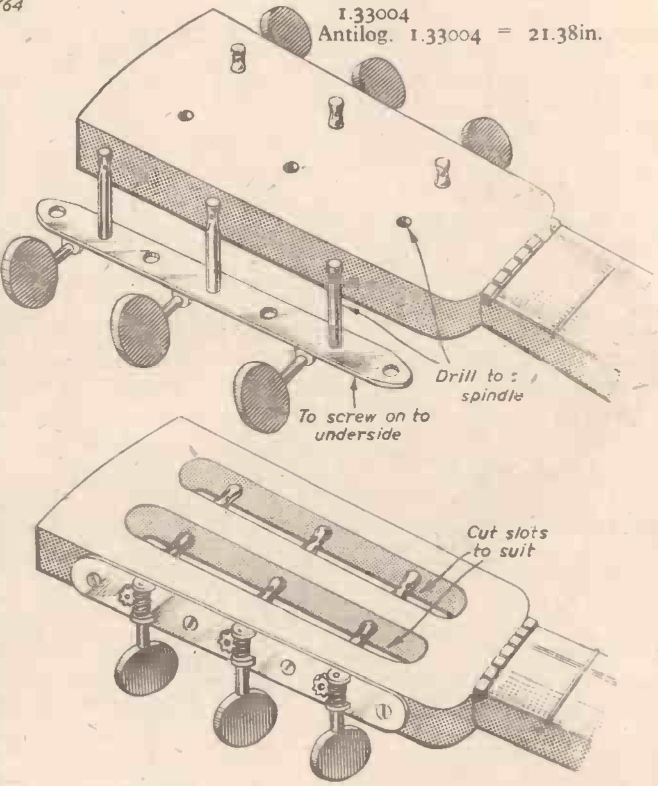


Fig. 5.—Two types of tuning mechanism.

The same method is used for the remainder of the frets. Each time the logarithm of $\sqrt[12]{2}$ is multiplied by the number of the fret position and this is subtracted from the logarithm of 24, or whatever is the length of the open string, in inches. The antilogarithm then gives the distance of the fret from the bridge in inches.

The Tail-piece

This is sketched in Fig. 2 and can be of any suitable metal. Stainless steel or chromium-plated brass will give the best appearance but bright aluminium or even painted sheet steel will do. The strings are provided with brass ferrules which hook behind the stiff angle riveted to the tail-piece. A chromium-plated, dome-headed screw is ideal for securing the tail-piece to the body.

The strings can now be assembled on the instrument and the bridge heights adjusted for comfortable playing and to avoid any rattling of the strings on the frets.

Suitable clearances between strings and frets are indicated in Fig. 7, which also gives the exact position of the bridge. The position is important, being exactly twice the distance from the small end bridge to the twelfth fret position.

It should be noted that all the strings should be of steel to give the necessary electro-magnetic effect for use with an amplifier. The heavier strings are all covered with copper wire but the inner core must be of steel.

The Pick-up

This consists of six magnetic poles each wound with a coil of fine wire all connected in series and enclosed in an aluminium case. Fig. 8 shows the requirements but the actual construction and type of units used can vary to suit available materials. The main points to bear in mind are that the pole pieces must be magnetic and spaced exactly the same as the strings on the instrument and that the outer casing must be non-magnetic, such as aluminium or brass.

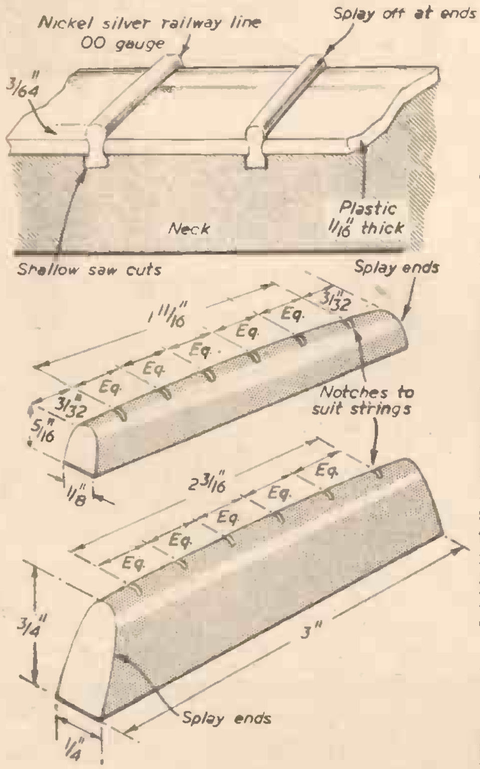


Fig. 6.—Details of frets and bridges.

The units may be made up to suit or satisfactory units may be obtained from earphones or throat microphones that can be purchased for a shilling or two at most government-surplus stores.

It may be found necessary to rewind the coils to obtain the best results with any particular type of input transformer although a suitable transformer can probably be obtained to suit the coils as they stand.

As the quality of the instrument's performance is largely dependent upon the pick-up it is well worth while spending some time getting this just right. Some form of amplifier is necessary, of course, to test the pick-up but this can quite well be done by using the gramophone pick-up sockets provided on ordinary radio sets, providing the input is matched with a suitable transformer. The volume will not be great but it should be sufficient.

It is not possible to give any coil winding data for the pick-up without full details of input transformer, but generally if the existing windings are of the low resistance type, i.e., somewhere in the region of 100Ω, then a high ratio transformer will be required. If the windings are of high resistance, say, 1,000Ω or more each, then the input transformer will require to be a closer ratio type, possibly between 5 to 1 and 1 to 1. The resistance of earphone coils is usually marked on the actual windings or on the back of the case.

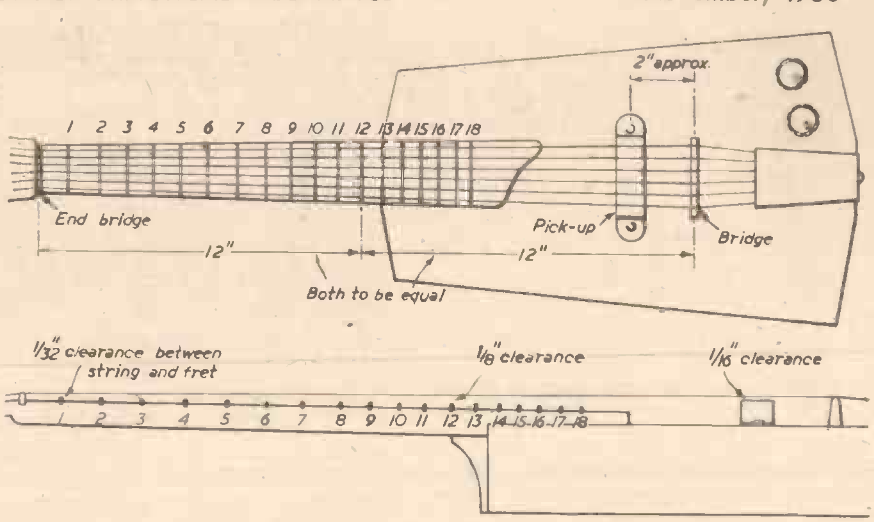


Fig. 7.—Position of bridge and clearances for strings.

The separate coils are connected in series, as previously noted, which leaves two connections from the pick-up, the beginning of the first coil and the end of the last coil.

When satisfactory results are obtained the units are placed in the aluminium casing which is made to suit, having slots cut in the top surface through which the ends of the pole pieces are inserted flush with the outside of the case. The units are wedged in position, avoiding damage to the windings, and the casing is filled with molten wax. Melted candle grease is suitable but care should be taken when melting wax as it very easily catches fire. Stouter connections will have to be soldered to the coils for the lead-out wires.

When completed and tested the pick-up can be screwed to the body of the instrument in the position given in Fig. 7. A small hole will have to be drilled to take the connections from the pick-up and should be situated below the pick-up to carry the wires inside the body without being visible.

A point to note is that the clearance between the strings and the pick-up should be as small as possible without the strings touching and rattling on the pick-up when struck fairly hard. If the depth of the pick-up is too great to fit below the strings it might be possible to raise the bridge a very small amount. Alternatively, the body will have to be recessed and the pick-up sunk the necessary amount. This should be avoided if possible. Too much clearance below the strings can easily be taken up with packing below the pick up.

(*To be concluded*)

Next month's instalment will include the final details of the guitar construction and circuit, components list and notes on the constiuction of a suitable amplifier.

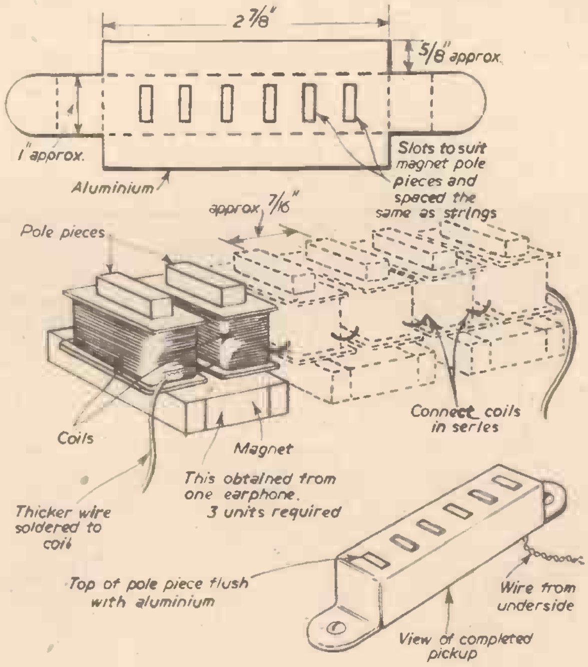


Fig. 8.—Details of the pick-up.

HAVE FUN WITH FIREWORKS

How to Plan Your November 5th Celebrations

By Victor Sutton

WHY not organise your firework night? Make it a social event and give pleasure to all. It takes a little planning but it can be a great success and appreciated much more than the haphazard way of the normal display.

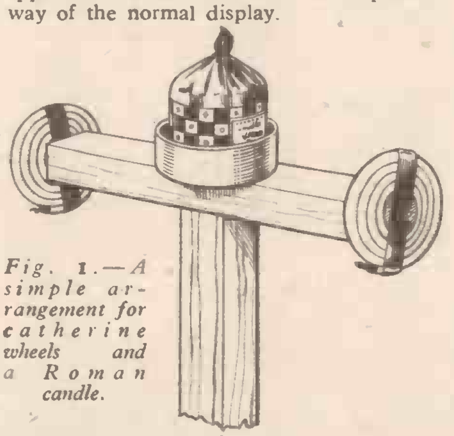


Fig. 1.—A simple arrangement for catherine wheels and a Roman candle.

Early Preparations

Supports, nails and hammer, spills, matches and flowerpots filled with damp earth should be handy for the smaller displays. A first-aid kit for any emergency is wise, but if you are careful this will not be needed.

Very simple, even crude, gadgets can be made up in good time. In Fig. 1 is shown a simple wooden strut with a cross bar for two pin wheels for the Catherine wheels and an inverted tin lid on which a set piece can be set off at the same time. This is a little set to fill in spare moments when other fireworks are being prepared.

In Fig. 2 is shown a box from the grocer's, cut to shape and filled with damp soil. In one end is fixed a bottle at an angle and well-supported with a block inside the box to take the thrust of the blast. This should be well sited so that anything sent off will not set fire to trellis or fir trees, both of which will burn very quickly. On one end is fixed a simple gadget for wheels and the inverted tin lid is again arranged to take the cone shaped fireworks. Note the holes in the sloping top of the box and into these small fireworks can be fitted and will be safe in every way.

The Main Groups

Start your show with a real bang and finish up in the same way. Smooth working with the gadgets made up should then follow but reference to the list below will help the planning scheme. Here are the main groups:

(a). Rockets.
(b). Roman candles.
(c). Catherine wheels.
(d). All the usual silver rains and golden flowerpots need careful arrangement.

Fig. 3.—A cane and taper for lighting fireworks.

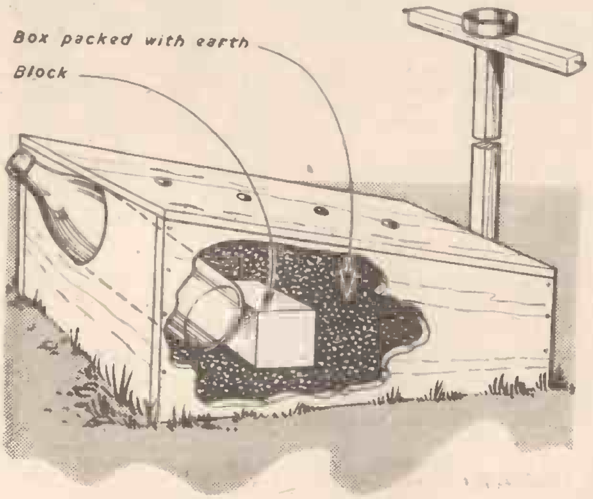


Fig. 2.—A bottle supported inside a box for firing rockets, etc.

(e). Demons, rip-raps, which slide off a flat surface.

A little wise-cracking and cross-talk will increase the fun of the evening and new names will add to the effect, Royal Salute, Mighty Crash, Big Wallop, Star Spangles, Atomic Squib, Space Rocket, Devil's Squib, Eruption Cone, Jet Rocket, Olympic Cone and certainly Bombshell, Martian Rocket and Flying Saucer will cause laughter.

Safety First

Always stand back when fireworks are being let off and if it says "Do not handle," keep to these instructions. Bottles make good holders for fireworks with a stick and recoil. You will see the precaution

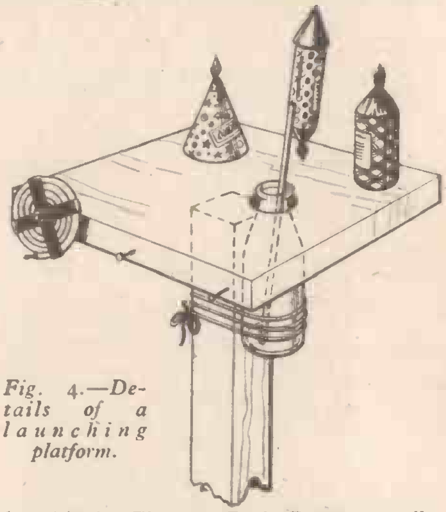


Fig. 4.—Details of a launching platform.

for this in Fig. 2. Push Roman candles well into the earth in the box. The holes in the top of the box will not interfere with "Little Demons," which will slide off the surface and at the right height and safe from the faces of the gathered children. Anything from 1in. to 1½in. will be safe on the upturned lid. All the equipment should be above waist-line for safety and ease of working. Always have the operating area clear and not too many inquisitive youngsters milling around and liable to handle fireworks.

General Rules

Always turn the rocket apparatus to a clear section of sky, if possible, into the wind.

Light all items with a long spill and a cane, hollowed out at the top to hold it (Fig. 3). A lamp inside a biscuit tin set in a doorway is a useful thing to have.

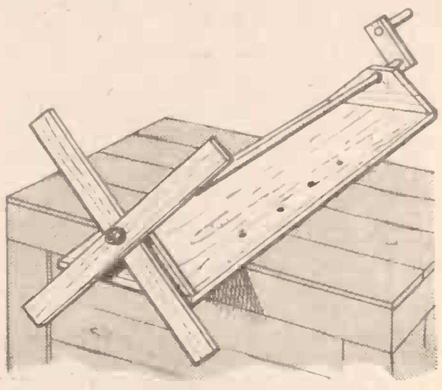


Fig. 5.—An arrangement for forming an impressive set piece.

If a firework apparently goes out, do not stoop to examine it. It is not wise to even bend over it but stand away and tap with a stick. Leave a little while and then re-light.

A flop can be made with the display of Catherine wheels if you are not careful. Remember, these revolve in the opposite direction from which the jet comes out. This is useful to know when one starts to burn and it needs a flick of the finger to set it off.

Storage before the show is important because dampness, however slight, is the enemy of all fireworks.

Other Gadgets

A useful stand for operating the fireworks can be made on the normal trellis-type household steps. Tall ones can form quite an effective stand for a display.

Odd bits of wood from orange boxes, dowel rods and small nails can be used to make up the simple idea shown in Fig. 4. The centre strut must be securely fitted and the platform on the top is about 12in. square × ½in. thick. A centre dividing partition from an orange box will do amirably for this. The bottle needs a hole so that part of the neck comes through the platform. Nails can be put into the edges to hold Catherine wheels.

The gadget shown in Fig. 5 can be fitted on such a platform to give a very realistic set piece. Two light triangular-shaped pieces of wood about 9in. high are fitted at back and front and drilled to take a length of dowel which goes right through and acts as a propeller shaft. To this is added one or two pieces of wood about 12in. long and 2in. wide. On these woodblocks are fitted to hold the fireworks and the use of bull-dog clips is a further handy idea. In these the fireworks can be placed and held firmly whilst the gadget rotates. On the inner sides of the revolving piece you can add Catherine wheels and once these are started you have the idea of the "wheels within wheels." To make the idea work, a handle is required. For this add another piece of wood, about 6in. long to the other end of the spindle and provide it with a short length of broom handle.

Aluminium Bridge

AT Letten, in Sweden, one of the world's first all-welded aluminium bridges has been designed and constructed by AB Svenska Metallverken. It is 130ft. long and can carry a maximum load of 15 tons.

In America another welded aluminium bridge is being planned. It will be 222ft. long, will have a reinforced concrete deck and is to be built near Des Moines, Iowa.

Space Telescope

AT the International Astronautical Federation in Amsterdam an American scientist has said that it will soon be possible to put a telescope on an earth satellite so that the stars may be observed free from the masking effect of the earth's atmosphere.

Radiation from celestial bodies would be focused by the telescope and an electronic scanning device would provide a picture of an area of the sky at a monitoring station on the ground. Telescope operation would be by means of remote control. It is thought that the telescope could be constructed, launched and operated after only simple modifications to existing instrumentation.

Solar Flares and Satellite Connection

A SCIENTIST at Queen's University, Belfast, has daily plotted the flare activity of the sun and compared this with the rate of decrease of the second Russian Sputnik's orbit time, with the result that the similarity of the two sets of fluctuations suggests a connection.

Earth's Magnetic Field Can Reverse

CARBON-14, the radioactive chemical which is used to date archæological finds, may have had its rate of production changed by a reversal of the earth's magnetic field (this means that a compass needle would point to the South Pole).

This possibility has been investigated mathematically by means of a computer, and although it has been shown that such a reversal could occur, the research is not yet complete.

Differences in the rate of production of Carbon-14 would, of course, affect radiocarbon dating, and any difference between the historical or archæological date and the radiocarbon date of specimens would indicate that the rate of production of Carbon-14 before the specimen's death was not the same then as it is now.

Radio Telescope to Track Lunar Probes

WHEN the lunar probe was launched recently in the U.S.A., only to fail shortly after firing, the radio telescope at the University of Manchester's Jodrell Bank Experimental Station was ready to track it through most of the time it was above the horizon.

The lunar probe carried a small transmitter and the radio telescope would have received the signals emitted. The approximate position of the probe would have been teletyped straight to America and then worked out more exactly by means of a computer. The second job would be to pick up the information transmitted about the scientific measurements made as the probe approached the moon. The super sensitivity of the radio telescope enables these weak signals to be picked up at very great distances, probably up to a million miles, and the narrowness of its beam width allows the probe's position to be determined with considerable accuracy.

Visual Glide Path Indicator

RECENT research has shown that many aircraft accidents which occur on landing are caused by the pilot's inability to see the whole runway due to bad visibility and then landing short in consequence. The glide path indicator, which is in process of being tested, is designed to prevent these accidents. It consists of two bars, about 30ft. wide, arranged transverse to the runway at the fore and aft limits of the desired touchdown area. Besides marking this area, the bars tell the pilot when he is approaching the runway along a path which is between certain safe limits, and incidentally provide roll guidance just before touch down. If the aircraft is too low, both bars are red, and if the pilot continues to fly "in the double red," he will touch down short of the runway. If the aircraft is too high, both bars are white, indicating a touch-down too far down the runway, and perhaps a run off the far end. If the aircraft is within the desired limits, the pilot sees the furthermost bar red, and the nearer bar white. The indicator is easy to use because, as the aircraft approaches the runway, the vertical width of the pathway never gets so narrow that the pilot cannot keep the aircraft between the limits.

British Centre for Rocket and Satellite Data

A WORLD data centre for rockets and satellites is now operating at the Radio Research Station of the Department of Scientific and Industrial Research at Ditton Park, Slough, Bucks. This is the third of three centres established under the International Geophysical Year arrangements for centralization of this type of information. Previously there has been rocket and satellite data centres only in Moscow and Washington.

In most subject fields of the International Geophysical Year there are already at least three centres, one in the U.S.A., one in the U.S.S.R. and others in Australia, Japan, Sweden, etc., according to the subject concerned. There is already a data centre for the ionosphere at the Radio Research Station and other centres in Britain are concerned with visual auroral observations (Edinburgh) and glaciology (Cambridge).

Constructing a Spindle Moulder

A Useful Piece of Equipment for the Small Workshop Described

by Jameson Erroll

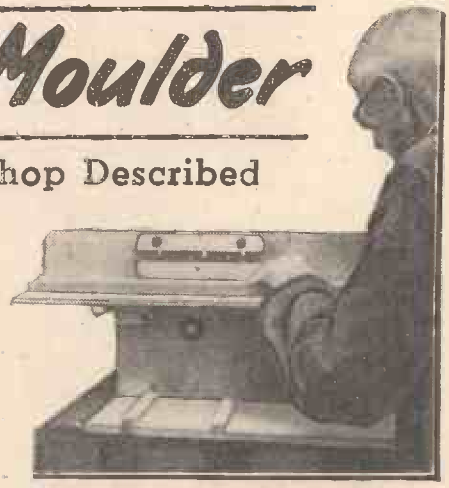


Fig. 1.—The machine ready for action.

CONSTRUCTION of this unit is based on the horizontal machine advertised largely as being one of the accessories now available to the lathe user. It is not, however, intended to be fitted to a lathe (although it could be made to do so), but it can be connected quickly to any general-purpose motor and placed aside when not required, thus releasing the motor for other uses. Fig. 1 shows the machine ready for action.

For the small workshop the horizontal spindle moulder has the advantage of simpler construction; it is easier to guard, and thus safer, and its use does not involve a quarter-twist in the belt which, with V-belting, is not very practicable where space is limited. It is almost as versatile as the vertical type and possesses the advantage that work can be fed to it either on edge or on the flat. For inside curved work it is certainly at a disadvantage, but this *can* be overcome in many cases by removal of the straight fence. It is not advisable, however, to attempt it

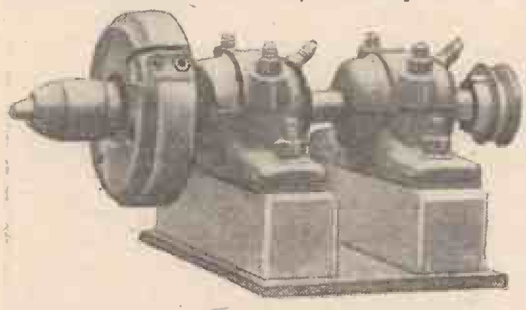


Fig. 2.—The working parts of the spindle moulder.

until one is perfectly at home with the machine, and even then it is dangerous since suitable guards are difficult to make and frequently not worth the trouble unless a large quantity of inside curved work has to be done.

Once the machinery has been bought or made and assembled, its housing is largely a matter of individual taste, subject only to certain basic rules as to safety, collection of the shavings, and the raising or lowering of the table within quite narrow limits. The reader may, therefore, improve, alter, or elaborate the general construction to suit his own needs and to accommodate it to his own particular workshop.

The Working Parts

The mechanics of the job (see Fig. 2) call for two good quality ball-bearing units to carry the spindle; a cutter head to carry the various cutters and a pulley of such diameter (not under 2in.) as will ensure a speed of between 4,000 and 6,000 r.p.m. The size of this pulley will, of course, be governed by the speed of the motor and the size of the pulley or pulleys with which it is fitted. If the motor runs at 1,425 r.p.m. (as many do) and has a 6in. pulley, then a 2in. pulley on the spindle will do quite well. If the motor is fast —in the region of 3,000 r.p.m. —and is fitted with multiple pulleys, it is an advantage to use the large pulley on the motor and a medium-sized pulley on the spindle rather than smaller ones on both. The motor should be ½ h.p., although work can be done quite well with ⅓ h.p. if it is fed to the cutters without too much haste. It would also be advisable, if the cut is a deep one, to run the work through once with the table higher than necessary and thus take off a half-cut first, and then to lower the table to the correct height to complete the cut.

The Bearings

Those used in the machine being described are a pair of Rota No. 6 carrying a ¾in. shaft; the cutter head comes from the Coronet Tool Company and is their larger one, 5⅛in. dia.; the pulley is for ½in. V-belt, and is 2in. in diameter. At the end of the spindle a ½in. capacity drill chuck has been fitted with a view to carrying out router work, but at present this stage has not been completed. The plan (Fig. 3) shows the set-up. The bearings B are mounted on a steel bed-plate A 8in. × 6in. × ¼in. which, in turn, is mounted on two 6in. × 2in. × 1¼in. wooden bearers. The whole of the bearing unit, except the cutter head and drill chuck, is totally enclosed (see Fig. 12), partly by the side walls of the main structure J and partly by two inner walls K of ⅛in. hardboard and a top (not shown in plan) of the same material lightly screwed down. This arrangement keeps all the shavings from the mechanical parts but gives ease of access.

The Baseboard and Main Structure

The baseboard L measures 21½in. × 18¾in., and is ½in. good quality ply. This size is arbitrary, merely being chosen as reasonable for the class of work generally undertaken, and fitting nicely on the baseboard on which the motor is mounted and which is used to run other woodworking machines. Built around the machine and part of the baseboard is a box J made up of ex. 7in. × 1in. deal. This is fastened to the base by a number of strong 1½in. × 1½in. angle-plates E bolted through both base and walls. Note that the top right-hand corner is fitted with an L-plate since a portion of the wooden back has to be cut away to allow the belt to run to the motor. Also, in the left-hand side of the box, a

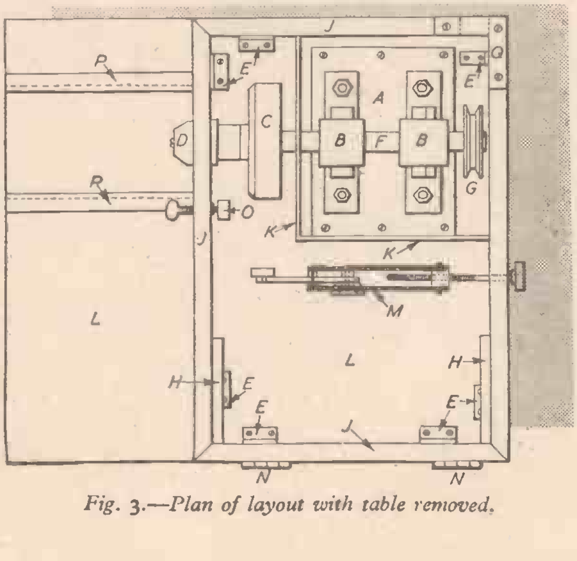


Fig. 3.—Plan of layout with table removed.

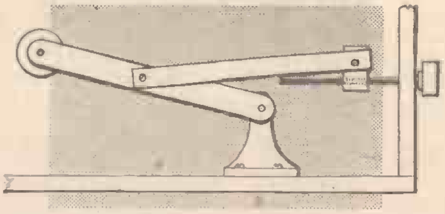


Fig. 4.—Details of mechanism for raising and lowering table.

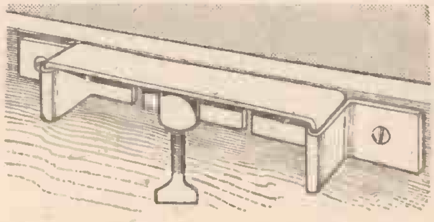


Fig. 5.—Alternative rise and fall movement.

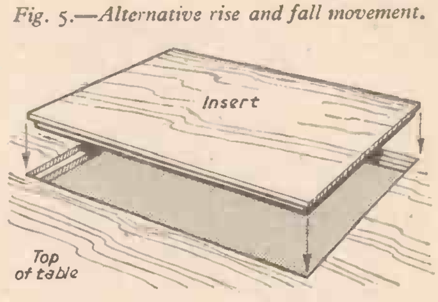


Fig. 6.—Renewing cutter-gap in table.

hole is drilled to permit the drill chuck D to protrude. The two bearers H are 4¼in. × ½in. × ¼in. and carry a box 11¼in. × 4½in. × 3in. in which the cutters, Allen key and other oddments are kept; a half-button on the back of the box falls into a slot in the left-hand wall and prevents the box working forward off the bearers owing to vibration.

The remainder of the baseboard—to the left of the main structure—is left clear except for two guides, P, which will take a thin steel plate on which a two-way tool and/or work rest will be fastened; this will be used when routing or groove cutting, etc., but, as already mentioned, has not yet been developed.

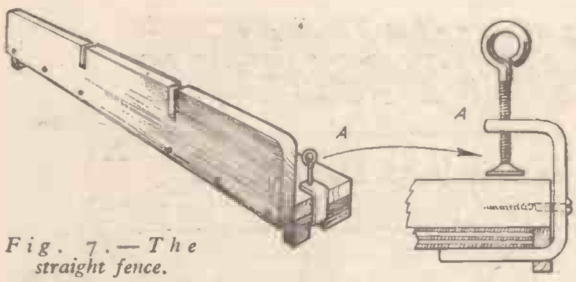


Fig. 7.—The straight fence.

The Rise and Fall Mechanism

Designated M in the plan and shown in more detail in Fig. 4 and in the photograph (Fig. 13) this is elementary but quite satisfactory. It will be seen that the moving arms are connected to a threaded bolt passing through the side of the box and engaging in a drilled and threaded block of steel or brass which is loosely pivoted to one arm—thus, when this bolt is rotated clockwise it pulls the arm towards the side of the box and so heightens the roller on which the hinged table-top rests. It will be found in practice that very little adjustment of the table height is necessary since the normal height of the table is such that it falls level with the upper surface-edge of the cutter head and thus brings the full shape of the cutters into operation without alteration. However, when one side of some of the larger cutters is being used, or when it is desired to take a half-cut, it may then be necessary to raise

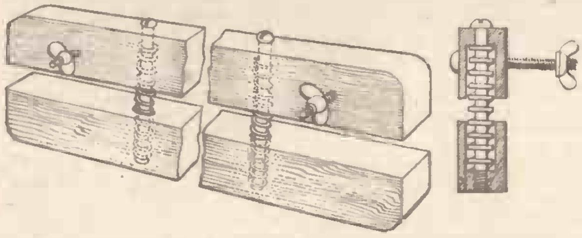


Fig. 8.—Combined spring hold-down and top guard.

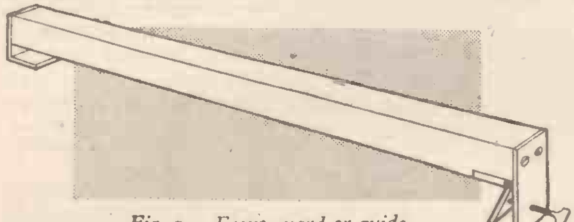


Fig. 9.—Front guard or guide.

the table ¼in. or so. But, unlike the circular saw table, it will never be necessary to raise it more than about ½in. An alternative rise-and-fall movement is shown in Fig. 5 for the benefit of those who might wish to incorporate it. It comprises a bent steel plate riding easily in two side bearers; on the top of this plate the table rests. A bush, centrally drilled and threaded for 2B.A., is fastened to the outside of the box and a bolt threaded into this bush. Turning this bolt raises or lowers the steel plate and thus the table also.

The small bolt and fly-plate O in the plan acts as a guide when fixing the cutters in the head and ensures that both are in perfect alignment. It is essential that they should be, since, if they are not, two serious faults will develop: only one cutter will really be doing the work and, if they are moulding-cutters, the moulding will not be true. While on the matter of balanced cutters it might be well to mention that should one of a pair become badly damaged, do not attempt to finish the job by removing the damaged cutter; lower it in the head so that it does not engage the work, and complete the task on the one good cutter by running the work through quite slowly. There must always be *two* equally sized and equally weighted cutters in the head at all times; if there is not, the balance of the head will be upset and, at 5,000 r.p.m., this can prove dangerous.

The Table Top

This is of ½in. plywood and measures 26in. × 17in. This, again, is arbitrary, but is a reasonable working area and not too cumbersome for the small bench. It is hinged to the box as shown at N in the plan and can be seen in Fig. 12.

The gap through which the cutters will protrude is best made when the machine is running for the first time and, subsequently, re-cut when different cutters are used if the hole is not sufficiently large to accommodate them. It is most desirable that the gap should be kept as small as possible, but it will be readily appreciated that after considerable use of varying sized cutters the hole will have been widened to such an extent as to constitute a danger, particularly when a narrow cutter is being used and the wood being moulded is, perhaps, on the short side. If the work is allowed to "dip" into the over-large gap results can be very serious: the wood will be shot across the workshop at high speed and one's hand—which was pressing on the work—caught in the cutters—so be careful!

Periodically, therefore, it will be necessary to renew this part of the table by the insertion of a piece of ½in. ply. The best method of doing this is to square up the gap, rebate all four edges of the hole and the insert (Fig. 6), glue up and re-cut the hole with the cutters next being used. When doing this it will be essential to cramp down the new piece—by means of a piece of thick waste—so that the cutters do not force it out of the rebates, which they will certainly do if the insert is not temporarily fastened down.

The Fence and Guards

Every precaution must be taken to prevent accidents and, whenever possible, the cutters should be completely covered either by the work being moulded and/or by additional guards, hold-downs, and an adequate guide fence. The writer uses the straight fence shown in Fig. 7, the spring hold-down illustrated in Fig. 8 and the front guard or guide detailed in Fig. 9. See also Fig. 14.

The fence consists of two pieces of 4in. × 1in. deal of sufficient length to overhang the table by ¾in. These two pieces are joined at right-angles, noting that towards the centre no screws are used. This is for the reason that, according to the type of work being carried out, part of the cutters will engage with the centre of the fence and carve out a segment from it. The method of fixing the fence to the table is shown in the larger detail at A, Fig. 7, and consists of a pair of light cramps through the sides of which has been bored a slot about ½in. long and wide enough to permit a No. 6 R/H wood screw to slide easily in it. Two end pieces of 1in. × ⅜in. hardwood are fastened to the horizontal ends of the

Fig. 12.—Completed unit showing table raised for access.

fence to prevent lateral movement. These pieces require to be slotted in order that the bottom of the cramps can engage with the underside of the table.

The front guard or guide serves the double purpose of confining the work in its forward motion and of covering any part of the cutters or the gap in the table which might otherwise be exposed. It is of 1½in. × 1½in. material to which, at one end, is screwed an angled piece of ⅛in. metal and, to the other end, a hinge and straight piece of metal drilled and tapped to take a ¼in. Whitworth bolt with fly-head. As this bolt is turned clockwise it tightens the free flap of the hinge against the edge of the table.

The spring hold-down is 12in. long and consists of two pieces of hardwood 1½in. × 1in. rounded at the outside top and bottom corners. These are bored, 3in. from each end, with central holes, those at the top being an extremely easy fit for ¼in. Whitworth bolts and those at the bottom being a threaded fit. In addition, all four holes are enlarged to a depth of about 1in. to take with ease a spiral compression spring of moderate to slightly weak strength. The bolts are dropped in the top half of the hold-down, the spring passed over them, and the bolts then threaded into the remaining ½in. of the smaller holes: they should be screwed until just short of the bottom by about 1/64in. The springs are of such length that,

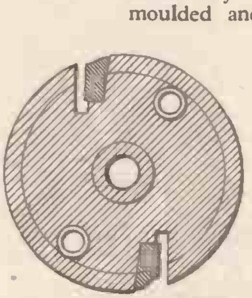


Fig. 10 (Left).—Plan of cutter head.

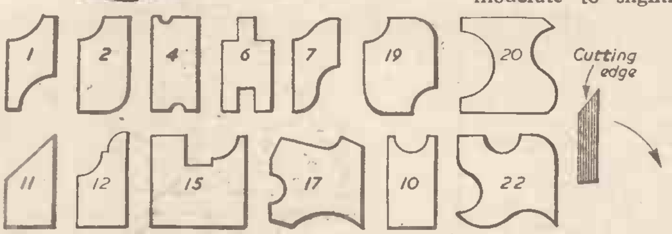


Fig. 11.—A few examples of cutter shapes and end view of a cutter.

when not compressed, they keep the two pieces about ½in. apart. Two holes are now drilled 1½in. from each end of the top piece to take ¼in. × 2½in. cup square bolts, the square shoulders being forced into the front. Washers and wing-nuts are added so that the hold-down may be firmly fastened to the fence. In order to take these bolts it will be seen that two slots have been cut in the fence, Fig. 7. The hold-down is set on the fence so that it rests firmly on the work but not so tightly as to impede the even feeding. If the work has to be forced through, not only is an even rate of feeding impossible but a slightly thinner section of the wood being moulded might cause a sudden plunge forward which could prove dangerous.

Use of Guards and Guides

With these three fittings it should be possible to cover the cutters completely and to take all precautions to protect the hands and leave them entirely free to pass the work through the machine. Where short lengths of wood are being moulded and the length already passed through the machine is insufficient to enable the operator to "pull" the remaining work when nearing the end, a pusher-stick should be used to feed in the last 2in. or 3in. This can be any piece of scrap of suitable size and, where the hold-down cannot be used, should be bird's-mouthed so that the stick can push downwards as well as forwards. It will be understood that when the edges of wood are being moulded—as in a table top—the hold-down cannot be used, but it will be unnecessary to improvise any substitute since the work can be held at sufficient distance from the cutters to ensure safety—but the auxiliary guide should always be used in these cases. It helps to keep the work against the fence and will cover up the unused gap in the table.

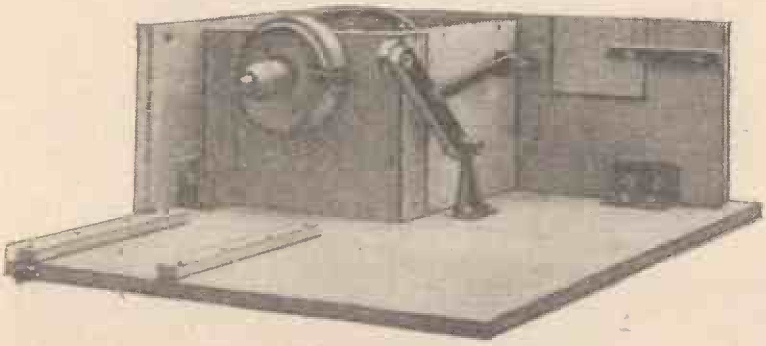


Fig. 13.—The rise and fall mechanism.

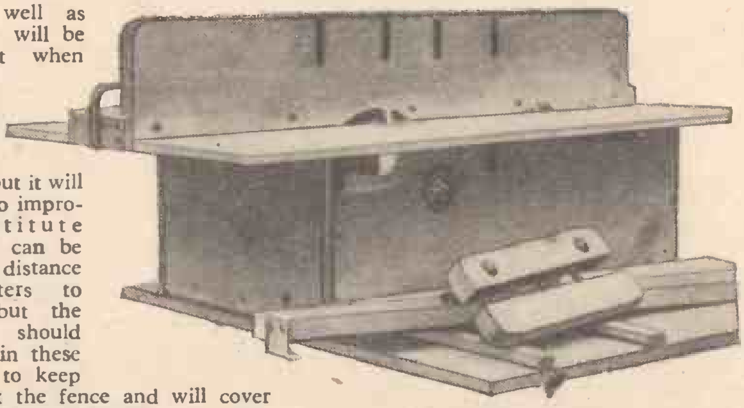


Fig. 14.—The completed machine with fence in position and hold-down and guide lying on baseboard.

The Cutter Head and Cutters

Fig. 10 is a plan of the Coronet 5in. × 1⅛in. cutter head. A smaller one can be obtained from the same source but this will accommodate only the smaller cutters (12 in number) whereas the larger one will take all their standard cutters—24 in number. The wedges shown deeply shaded are tightened by means of Allen screws—for which a key is provided—and permit of fine shades of adjustment coupled with vice-like holding powers. The centre hole in the cutter should be ordered of a less diameter than the spindle so that a shoulder may be turned on the latter to ensure accurate fitting: the cutter head must be at a perfect right-angle to the shaft.

A few of the cutters available are shown in Fig. 11 and are given the Coronet Tool Company numbers, but they are not necessarily true either to shape or size. A leaflet can be obtained from the makers giving scaled illustrations. The cutters are hardened steel approximately 3/16in. thick and have an acute-angled cutting edge; note that the apex is the actual cutting edge and that the cutters should be fixed in the head so that this apex comes in contact with the work to be moulded. These cutters can be combined to cut almost any section of moulding—not, of course, at the same time—and it will be seen that even with those illustrated a remarkable variety of mouldings, etc., can be cut. No. 6 is for tonguing and grooving and can be bought ¼in., 5/16in. and ⅜in.; No. 11 is for bevelling, and No. 20 for stair nosing; No. 12 is a useful table-top moulding, while No. 10 can be repeated to give a pilaster effect. A straight-edged cutter can also be obtained, and this is extremely useful for the cutting of rebates.

Final Warning

The speed of the machine and the nature of the work it performs places it in the category of dangerous machines—so do exercise the greatest care when operating.

An Electronic Photographic Enlarger

The First of its Kind in Europe

A NEW electronic photographic enlarger designed to produce perfect enlargements even from poor quality negatives has now been developed by the Graphic Arts Division of E.M.I. Electronics Limited.

The conventional methods of "dodging," or shading, certain portions of the negative by hand to obtain correct exposures have been replaced by a fool-proof electronic system. The electronic enlarger uses a scanning light beam from a cathode ray tube to obtain automatic shading and exposure control. When the exposing spot of light from the cathode ray tube encounters a dense region on the negative it instantaneously becomes brighter. Conversely, brightness of the spot is reduced for thin regions of the negative, thus producing maximum print detail in both highlights and shadows.

A special light integrating system terminates the exposure automatically to produce a uniform print density without adjustment for widely varying negative densities.

The electronic enlarger is capable of printing from 35 millimetre to half plate size negatives, and provides a maximum print area of 30in. × 40in.

Science and industry will benefit from its use because by effectively matching the negative density range to the exposure scale of printing paper it is able to produce amazing clarification of detail.

For the commercial photographer the electronic enlarger means greater detail in catalogue, instruction manual and advertising illustrations, with great savings in retouching time. Automatic control means increased production without the necessity of increasing dark room staff.

Newspapers and photographic agencies will find the new enlarger of great value because it enables news pictures, in which circumstances do not permit good negatives, to be printed perfectly. Normal negatives produced on the electronic enlarger reveal a wealth of detail, enabling blocks of a higher quality to be produced.

Build an Efficient Timer from an Old Clock

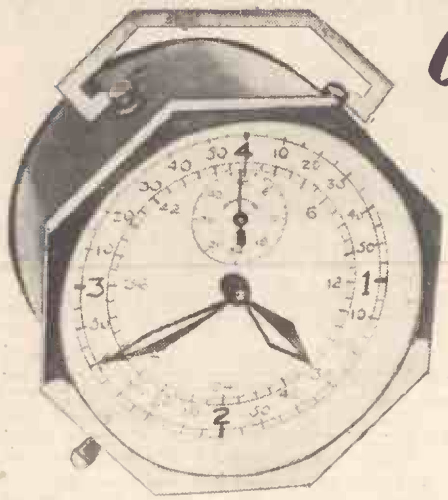


Fig. 1.—The completed timer.

These Few Simple Modifications Will Provide a Useful Darkroom Accessory

By D. Brown

THIS timer was made from an old alarm clock, the moving parts of which were so well worn that it no longer functioned. The modification required is simple and makes so much more energy available at the escapement that even well-worn movements will run dependably. An ordinary non-alarm type of clock may be used, the only disadvantage is that no audible warning can be given for longer time periods such as those involved in the tank development of films.

The finished timer is shown in Fig. 1 and it will be seen that the large "minute" hand now revolves once in four minutes. This presents ample room for individual seconds to be measured accurately. The hour hand revolves once in 48 minutes and this is very useful for measuring film development times. One other feature of the timer is that the "ticking" is both slow and clearly audible. This is particularly useful during the shading of selected areas of an enlargement with the hands, since it is unnecessary to have one eye upon the clock during the process. The ticks of the timer may be counted while the whole attention of the eyes is given to controlling the shading.

The modification requires that fourteen of the fifteen teeth on the escapement wheel should be removed. As a result the hands revolve at fifteen times their normal speed.

Having acquired the necessary clock, remove the winding keys and other knobs from the back and take the clock movement out of its case. The hands must be removed with care and this may be done either by levering with the tip of a small screwdriver or by pushing in the tapered end of a pair of pointed tweezers as shown in Fig. 2. The movement may now be separated from the face of the clock.

Do not remove the back plate of the movement without first securing the mainsprings. If this is not done they will suddenly unwind, distributing the various parts of the clock all over the bench! The springs may be restrained by tying thin wire around them (with the springs fully wound to make them as small as possible), or by making up stout wire rings "C" to just fit over the springs as shown in Fig. 3.

Pull out the taper pin which secures one end of the hairspring and slide the end of the spring clear of the slot in the regulating lever. Remove the securing nuts and gently prise the back plate up until the mainspring can be secured as described above. The loose plate may then be lifted up to reveal all the separate cog wheels.

(Concluded on page 91)

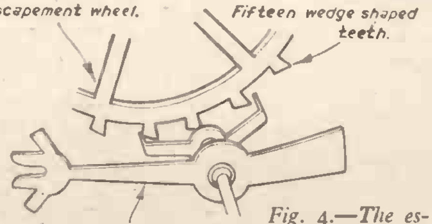


Fig. 4.—The escapement wheel meshing with the escapement lever.

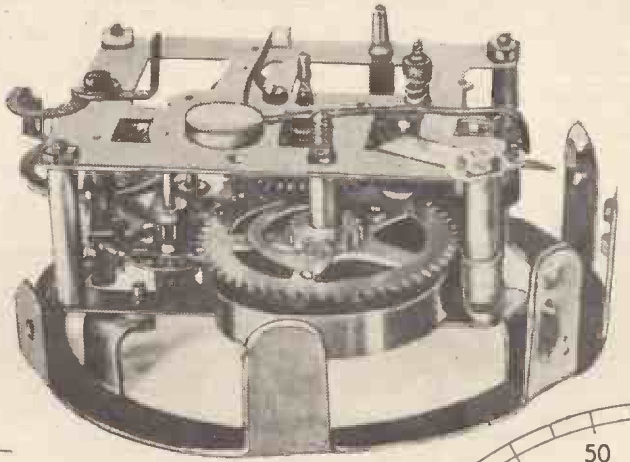


Fig. 5.—Modified clock mechanism.

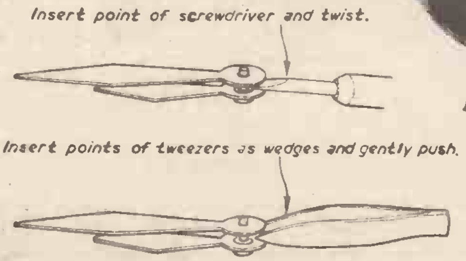


Fig. 2.—Removing the hands.

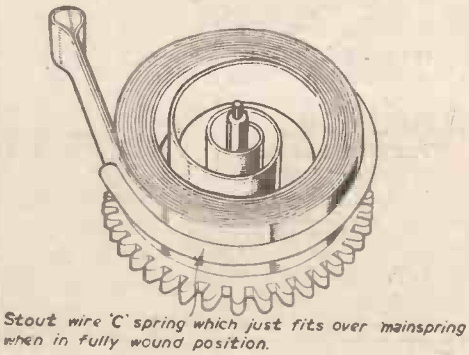


Fig. 3.—Securing the mainspring.

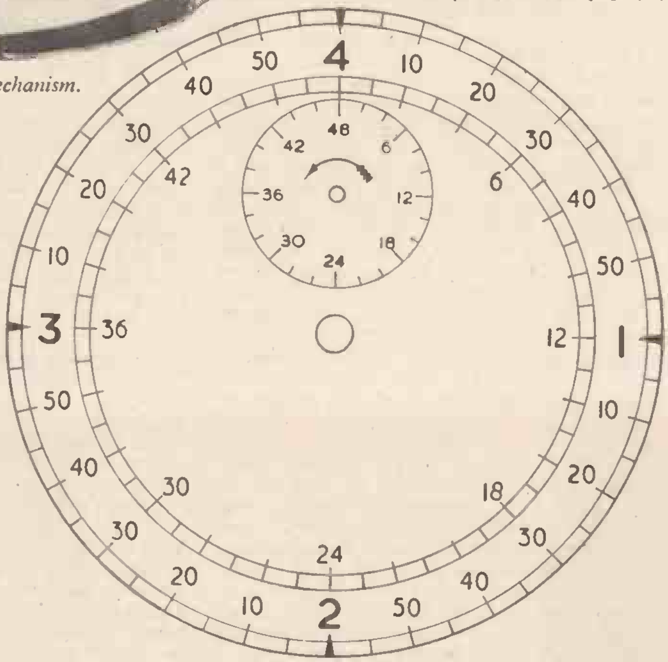
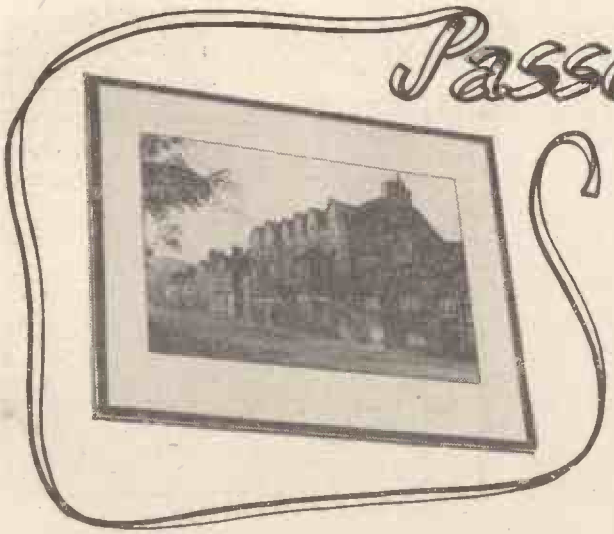


Fig. 6.—New dial for the timer.

Passe Partout Frames



The Range of Subjects Which May be Produced Using Passe Partout Cement-coated Binding is Almost Limitless

By Frederick T. Day

ENDLESS varieties of picture frames, both simple and ornate, deep show-cases, decorated calendars and folders, wall panels and designs, toys, lampshades, trays and other items, may be made with passe-partout for a few pence.

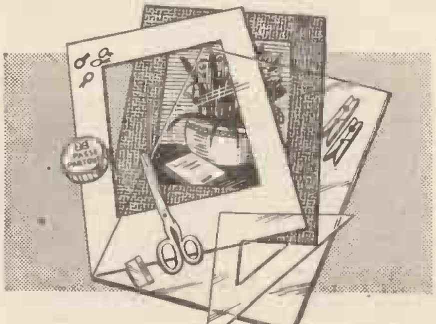


Fig. 1.—The materials for framing.

It undoubtedly excels as a picture framing medium, and in this field of work alone, all kinds of frames may be produced in one or more colours, conventional and shaped, including the deep display or show-case which has so many uses in the club, institute and the home.

The Material

These bindings are sold in all stationers and handicraft stores in coils of 1in. × some 12yds. in length depending upon the colour and material. Gold, silver, fancy printed, embossed, imitation wood grain and several colours, are included in the range. The binding is score lined so that it may be accurately folded over the turn of the picture edge, thus ensuring a true and clean edge to a framed picture. The strong cement will stick to glass permanently and while the tongue is perhaps the most natural source of moisture to damp cut strips of binding, if much work is contemplated a small damper should be used. Among useful accessories to have at hand are some metal or linen hangers (these are used to hang pictures from the wall), thick cardboard to serve the purpose of a backing board, some white or pale-tinted mounts (used to lay the subject to be framed), some clothes pegs (to hold work firmly in position while work is in progress), some glass or Neerglass (the recent substitute for glass), a pair of scissors and a razor blade for cutting mitred corners for the picture. In this connection a set square will assist in obtaining a well-cut mitred corner for the binding.

Any spots and specks of cement or markings from fingers may be rubbed away with a piece of rag and some spirits when all work is completed. The worker will soon determine which of these items are necessary for the work in hand.

Mounting and Framing Suggestions

In the make up of a simple frame, one colour binding is often sufficient. Black and white photographs, designs, certificates, sketches and club notices are best framed in black, or a sepia. White binding often makes a splendid contrast. When framing subjects with several colours in their composition, the bindings used should be in harmony with the subject and usually the most predominant colour or colours may be chosen for the binding. Subjects with sky,

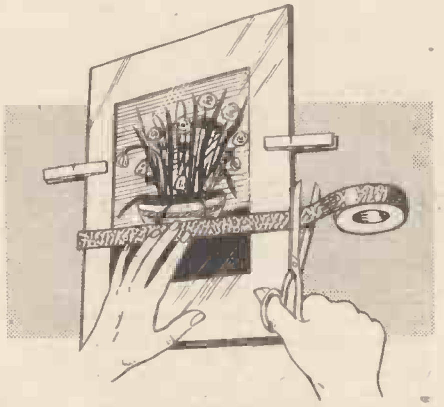


Fig. 2.—The parts should be held together with pegs or paper clips.

sea or lake motifs may well be framed with a blue binding and landscapes with a lot of green look first class in a similar colour binding. Two predominating colours in a picture may be matched by two similar colours of binding, the second being applied by superimposing the strip over the first colour to give a two colour effect to the picture's edge. Gold or silver binding often suits certificate framing work while matt black or brown is best for etchings and sketches.

A further point about colour scheming is that when the decoration of the room is changed, the colour of the frame may also be changed to match. Old bindings need not be removed, the new colour being over-layed to cover up the former binding.

Pictures may be framed to hang or to stand, the metal hangers being used for the former. Most types of picture hangers will suit. Framed subjects made to stand can be supported by a cut out cardboard strut which is glued to the back of the picture. Struts may be purchased in the stores in various sizes, ready punched and prepared so that the picture may stand either vertically or horizontally.

Any suitable clean material such as white or tinted cartridge paper will serve the purpose of the mount, unless white lined card is available and such material will serve the dual purpose of both mount and backing board. Many subjects and pictures will look far better when placed upon a larger white, grey or other coloured mounting material. A good rule to bear in mind is to have the margin narrowest at the sides of the picture and widest at the bottom of the mount. The placing of the picture on its mount is a matter of some thought as good placing will lend style and some dignity to the finished frame. A single or double drawn line in pencil or ink, as desired can be effective in some cases, so that the subject includes a border surround.

Simple Framing

With the subject to be framed and all the necessary material to hand (Fig. 1.), the work may now proceed. The operation takes far longer to describe than actually carry out. Indeed, several pictures may be framed in an hour.

Take a piece of glass, previously cut to size with a glass cutter, or Neerglass, which may be cut with a pair of scissors,

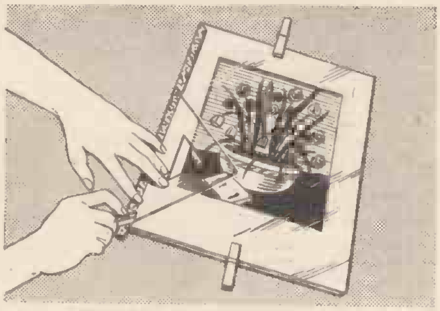


Fig. 4.—Mitre cutting using a set square and razor blade.

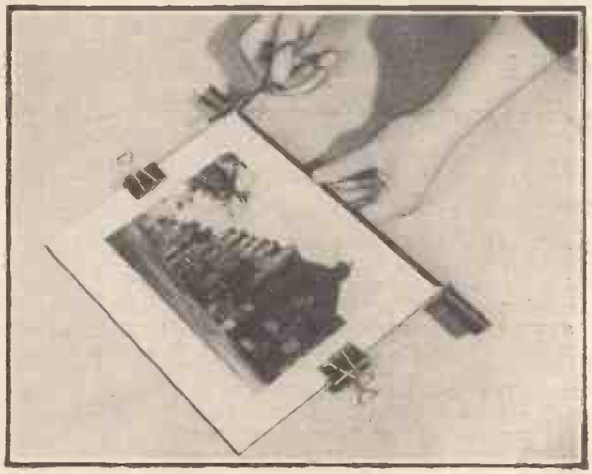


Fig. 3.—Unwanted ends of binding are trimmed off.

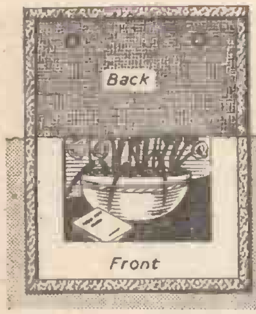


Fig. 5.—A finished picture.

and a piece of cardboard for the backing board, each to be the same size as the mounting material on to which the subject has been mounted. If a hanging picture is contemplated, metal hangers should be pierced through the backing board at this stage. A piece of gummed tape will hold them down inside quite flat if affixed over the turned-over pointed ends. Adhesive hangers, may of course, be added later as these are stuck to the back of the framed subject. The hangers in both cases will be applied suitably for a vertical or horizontal picture.

It is a good idea to fix the subject to be framed on to its mount with some adhesive thus holding it in position so that it will never slip down when hanging from the wall.

With backing board, mounted picture and glass all one size and in position, use two clothes pegs or paper clips to hold all parts together ready for the application of binding (Figs. 2 and 3). Four pieces of binding will be cut and, unless the picture is to be square, there will be two long and two shorter lengths to cut off the coil. Cuts should be slightly longer than the length of the glass to allow for trimming at the corners (Fig. 2). It is advisable to deal with the two long sides first as there is less likelihood of materials slipping one from another. Each strip should be folded on the score line to ensure a good clean edge and then each piece of binding should be thoroughly moistened; some workers wet both sides of the strip, thus making it very supple. In the case of oval or other unusual shaped pictures, the tape will be found most suitable for pleating work round corners.

Well moistened tape in all forms of binding is most important and the cement coating must be thoroughly tacky to ensure a strong and permanent adhesion. Cut strips are placed on the working table, moistened side upwards and the peg-clipped work is placed glass face down so that the width to be bound takes up the tape. The worker then turns over the rest of the binding and rubs it neatly over the back of the picture. Every care must be taken not to disturb the picture and firm, even rubbing of the binding strip when in its position will ensure a clean straight edge if the strip has first been score line folded for the turnover edge.

The second long strip is dealt with in the same way and any unwanted ends of binding either cut with scissors or trimmed off with a razor blade (Fig. 3). The two shorter lengths of tape are now applied to complete the four-sided frame. The corners are not stuck down, but are left so that a corner may be neatly cut for the mitre. With the picture face upwards, a 45 deg. set-square will enable the worker to produce an accurate mitre cut (Fig. 4) while a good eye will be able to perform this simple operation without any aid of this kind. There will, of course, be four mitre cuts, one for each corner of the picture. The binding will soon harden off and any cleaning up may be carried out when the work is quite dry. The picture is then ready for hanging or standing on the table as desired (Fig 5).

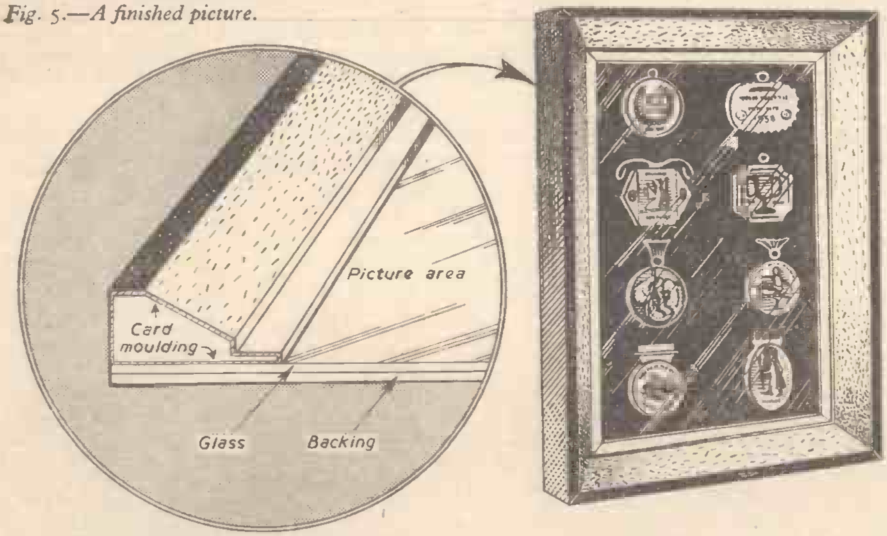


Fig. 6.—Method of frame build-up from cut cardboard.

Fig. 7.—A finished moulded frame.

Such items as unmounted mirrors may be framed in black pebbled binding with good effect while the edges of good white cardboard may be similarly treated and used for notice boards in the club room.

With the aid of a glass cutter, all kinds of fancy shapes may be made from suitably prepared glass. This work will probably be carried out by the firm supplying the glass at a little extra cost. Lantern slides may be suitably edged with matt black binding.

The method of using a two- or three-coloured binding as separate overlays, revealing a multi-colour effect, has been described. This is simple work, calling merely for neatness and an even edge to the work.

Deep Frames

Deep frames are very attractive and have the finished effect and appearance of a moulded frame (Fig. 7). The work is quite easy to carry out and consists of cutting cardboard strips in suitable width and thickness, covering them with the binding and affixing them down with adhesive to the edge of the glass, so building up a frame moulding from the cut strips, as shown in Fig. 6. The corners are cut to give a good mitred fit and when the moulded frame is ready, passe-partout is overlayed to cover entirely the added moulding and the backing board. Any thickness of cardboard may be used and one, two or more depths of card may be applied to the edge of the glass to make a really deep moulding.

The width across the moulding may vary, normally a width of 1¾in., almost twice the width of the actual binding itself, is the style most popular for this kind of frame. Imitation wood grain binding will give an added effect to the work and it is worth noting that this binding is made in greater width suitable for this type of work.

Wallcases and Showcases

This form of handicraft is well within the scope of the material and such cases are most suitable for holding awards, medals, floral motifs and posies, butterflies and moths, stuffed fish and birds and other dimensional objects which need a deep case in order to display them to the best advantage. A backing board and mount are necessary in much the same way as required for the simple frame. A whole series of, say, ⅛in. thick cardboard strips should be cut and glued together until the desired depth of the showcase is reached. The depth will, naturally, depend upon the type of specimens to be exhibited; in the case of floral sprays or artificial flowers (Fig. 8), a showcase of some 1½in. deep should prove suitable. Four such completed glued bundles of cardboard strip will be needed

(*Concluded on page* 101)

Fig. 8.—A display case for artificial flowers.

Photographing Birds

B. Melville Nicholas Tells You How to Achieve Success

A whitethroat at its nest.

WHEN I embarked upon bird photography, I discovered the ideal recreation, for photographing birds is a game where your skill is ranged against the cunning of your quarry, and some birds are very crafty. It is an absorbing hobby and not as difficult as most people imagine.

Hunting with a camera calls for a higher intelligence than hunting with a gun or a rifle. There are many difficulties to face and snags to be overcome, but when at last you succeed, and can show your photographs to your friends, you will experience a thrill that few other hobbies can give.

The "Hide"

It is best to make a start with birds at their nests and to have some sort of "hide" in which to conceal yourself and your equipment. Such a structure need not conform to any particular design or pattern and although some photographers often use branches, heather, gorse, ferns, bracken and leaves to make the finished object look a part of its surroundings, I have had good success with a small tent-like affair consisting of four poles about 6ft. long, see photograph on right. These are driven firmly into the ground and kept in position by four shorter poles fitted over the top. The framework is then covered with a waterproof hessian fastened at the back with tapes, in which are peep-holes for watching the birds and larger holes to accommodate the lens of the camera.

If the birds I am trying to photograph are very shy—and some are more nervous than others—I first erect my hide some distance from the nest, bringing it nearer on each alternate day so that they may get accustomed to it gradually, and I have occasionally camouflaged it with branches and bracken. This latter precaution, however, is necessary only with the *very* nervous species, for the majority of birds take no exception to it provided it be erected quietly and fixed firmly. It must not shake or wobble with the wind, for birds are very suspicious of anything that moves.

Barn owl at rest.

(Top right).—Greenfinch with her twins.

(Right).—Author's hide, used for nests from 6 ft. to 10 ft. from ground.

A carrion crow at nest.

(Left). — A blue tit.

(Right).—Moorhen's nest.

(Below).—A pair of song thrushes at the nest together.

The Camera

The type of camera is a matter of personal choice, some experts recommending one type, while others strongly advise some other variety. Some of the miniature cameras are wonderful little instruments and very versatile, if expensive.

Personally, however, I began with a quarter-plate reflex camera where, by looking down through a hood, I can see the object I want to photograph, reflected on a glass panel.

That same camera is still in use to-day. I also have a field camera where the focusing is done at the back (my head being under a black cloth to keep out all unnecessary light).

But one of the most important parts of any camera is its lens, and for photographing birds I prefer an anastigmatic lens of not less than 8in. focal length, but a telephoto lens is also of immense value when trying to snap birds from a distance.

One other essential is a tripod, but be

sure that it is strong enough to keep the camera steady and avoid camera shake. The tripod I use is made of wood with extending legs to a height of 10ft. and has a central pillar, raised or lowered by a handle. Attached to the pillar is a tilting top (9in. × 7in.) to which the camera is securely screwed. Once the camera is focused and speed and aperture set, there is nothing else to do, except wait for the bird to get into the right position.

The time never drags, however, for there is always something of interest to watch. I always take a notebook with me in which to describe the birds I am photographing—their colours (whether the male differs from his mate), how often they feed their chicks, what kind of food they bring them and so forth. If these details are pasted in your album with the photograph, you will soon compile quite an interesting book of which you may be justly proud.

Always try to get a series of photographs of each bird. Perhaps first of all the nest and eggs, then the bird incubating, followed by the parents feeding their brood, then the youngsters just before they leave home. You may be fortunate enough to get both parents at the nest together, or by placing a perch nearby, snap one of the adults as they alight on it. Some photographers lift the tiny chicks from their nursery and place them on branches to photograph them, but this practice had perhaps better be done only by expert naturalists, as the chicks are easily injured.

Protect the Birds

The importance of giving every attention to the comfort of the birds cannot be too strongly stressed, and although to photograph certain nests you may have to tie back protruding herbage, be sure to restore it to its normal position when you leave. Baby birds need shelter and shade if they are to grow and develop, that is why most birds build their nests in shady places. They like to carry out their family affairs in secrecy, and if you disturb the protecting foliage around their homes you not only expose them to wind, rain and sun (and the direct rays of a hot sun will prove fatal) but also make them an easy prey for hawks, jays and carrion crows. For the same reason, tell only those you can trust about the nest.

Bird photography is a hobby which calls for care and patience, but is well worth while, for not only does it bring pleasure and excitement, but it can prove profitable as well. It more than pays its own way, for good nature photographs are always acceptable for use in magazines and newspapers.

MAKING PHOTOFLOODS LAST LONGER

John Dee Explains an Efficient and Economical Arrangement

THE life of a photoflood is very short —somewhere in the neighbourhood of two hours. This time can soon be used up if the floods are switched on while arranging, focusing, etc. On the other hand, if the lights are but used for the brief times of the exposures, they can seem to go on interminably, as may well be expected when they are burned for seconds only on each occasion instead of minutes.

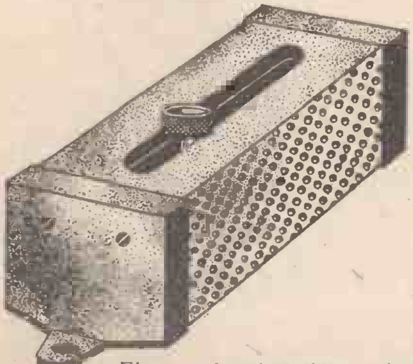


Fig. 1.—A typical sliding resistance

But there is a snag in using the lamps for the exposures alone, and that is that one never knows till all is over the exact effect obtained, when, if the lamps were unsuitably placed, it is too late to do anything.

There is a line of compromise, however, between never using them till the moment of exposure and burning them while all the preliminaries are carried out, and that is to run the bulbs at a greatly reduced consumption (and intensity) till the last moment before pressing the trigger, when they are taken up to full consumption and intensity.

The Sliding Resistance

Control of this nature can be brought about in several ways, but the most fully embracing is to introduce sliding resistances into the circuit of each lamp. Several firms turn out suitable resistances, but they can often be picked up from depots dealing with Government surplus, usually at quite a low figure. Many of the resistances so offered are extremely compact and convenient to handle.

Inserted into a circuit, these additions give excellent rheostat control, and the lamps can be adjusted over a wide range of intensities, which, quite apart from the lengthening of life, is just what is needed for serious portraiture, where lights of varying intensity are essential for good modelling.

The resistances are in the form of a metal cage, see Fig. 1, along the top of which a knob slides. Terminals permit ready connection with the two ends of a severed lead while there are often loops so that the resistance can be hung to a wall or otherwise fixed in some position if desired.

Inside the cage is a coil over which runs a contact, the current always passing through this. The less coil the current has to pass through, the less the resistance and the brighter the light. At the end of the coil the whole length of the wire has to be traversed and the lamp dims to almost extinction. At the other end there is no resistance and the lamp burns at full intensity, while between these two extremes there is a smooth scale of intensity variation.

Using a Secondary Bulb

A second and quite practical way of reducing consumption till the last moment is to wire each flood in series with an ordinary bulb (even two). A switch is placed so that the secondary bulb can be cut out at will (A in Fig. 2) when the flood will receive full current. When wired in series with other bulbs the flood will burn with less intensity. When these are cut out, full intensity is at once restored. This method of life lengthening is very sound and the wiring needed well within the scope of any amateur.

Series/Parallel

Again two photofloods of the same grading can themselves be wired together in series and also supplied with a parallel wiring, the two types of wiring being isolated by a "series/parallel" switch (obtainable at about 3s. 6d.). With the switch in one position the lamps are in series, and in the other in parallel. In series both lamps burn dimmer than normal as with the auxiliary bulb, and it may be found that one is dimmer than the other, but in any case the time of service of each is being greatly lengthened as against any form of full current use.

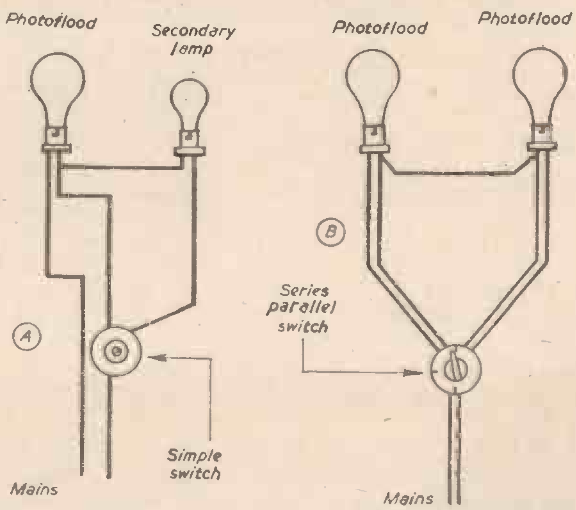


Fig. 2.—(A) Using a secondary lamp and (B) wiring in parallel.

CAMPING EQUIPMENT

A Lightweight Trailer for Camping Gear

F. Hook Describes a Carrier for the Family's Tent and Luggage

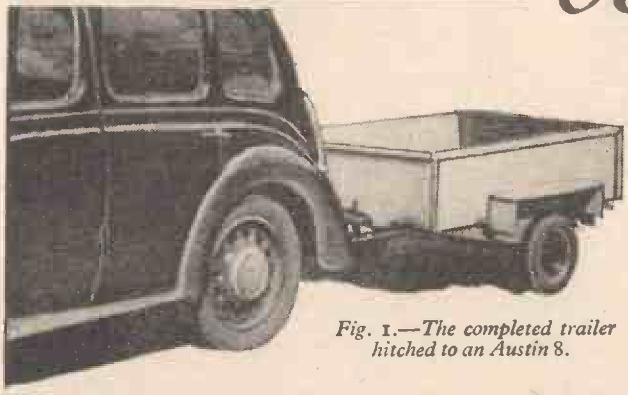


Fig. 1.—The completed trailer hitched to an Austin 8.

THIS trailer was designed to carry the entire camping gear for the family behind a light car. With children in the back seats of the small car it is inconvenient to use that space for stowing very much camp gear, especially if long journeys are being made, when the children will appreciate being able to move about a little.

In order to reduce the weight of the trailer and to keep the centre of gravity low, a pair of small industrial type pneumatic wheels were used. The tyres are 4.00-8 (16 × 4) of 4-ply rating and have been run successfully at a pressure of 50lb. per sq. in. Unladen, the trailer weighs a little over 1 cwt. and, fully loaded, has proved very stable at good touring speeds. As the trailer is under 2 cwt. unladen weight there is no legal necessity to incorporate an automatic brake in the towing hitch.

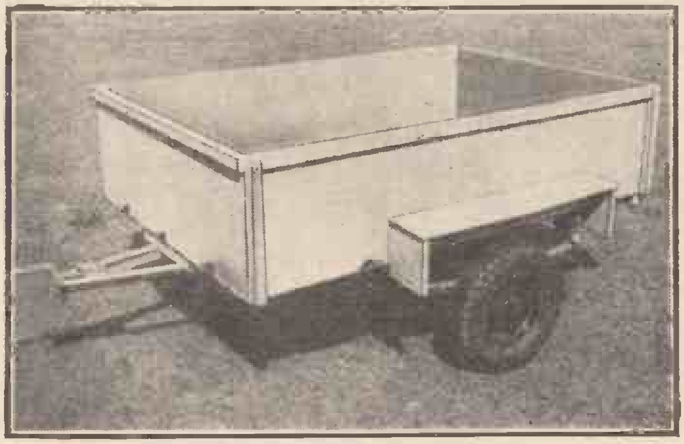


Fig. 2.—A view of the completed trailer.

Two views of the finished trailer are shown in Figs. 1 and 2. In Fig. 1 it is shown hitched to an Austin 8. Incidentally, the springs for the trailer were a second-hand pair of front springs from a similar car.

Construction

Before starting on the trailer it is advisable to procure the two wheels as all work depends on these. There are many suppliers of such wheels, but those who do not know of a source of supply can try Pride and Clarke Ltd., Stockwell Road, London, S.W.9, where those shown in the illustration were purchased. Each wheel is fitted with a pair of ball races when purchased and the centre bore of the races is 1in. diameter.

Stub Axles

Next a pair of stub axles are required to fit the hubs of the wheels, and these are made from a piece of 1½in. × 1½in. mild steel. For the reader who has not the facilities for metal turning it is suggested that a local garage or light engineering works could undertake the work. Due to possible variations in sizes of other makes of wheels certain dimensions have been purposely omitted in Fig. 5, which shows the sizes relative to fixing on the axle bar.

The stub axles fit down in the 3ft. 7in. length of 2in. × 2in. × ¼in. channel. Due to the radius and taper on the inside of the channel the axles will have to be shaped to bed down snugly as shown in Fig. 4.

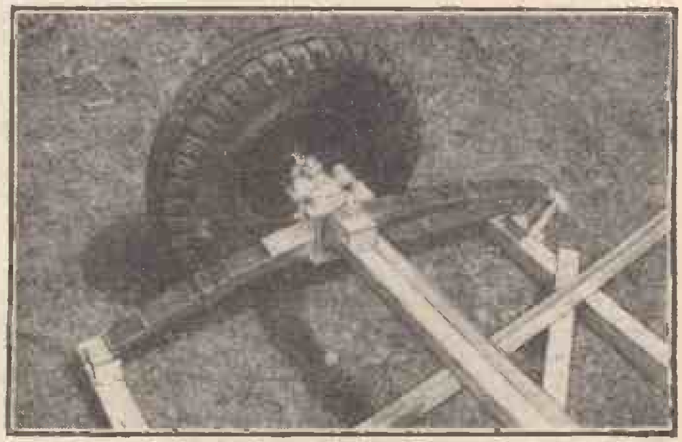


Fig. 3.—One of the leaf springs and stub axles.

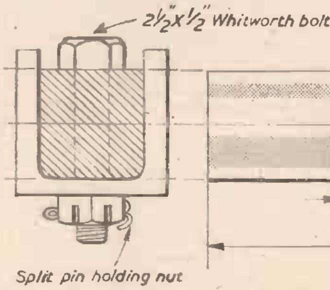
The stub axle shaft must be a light drive fit in the ball races, and the part of the spindle between the two races is relieved as shown to facilitate fitting. A washer with 1in. hole is fitted on each side of the wheel to retain the grease in the hub and to keep out dust. Take care that this washer bears only against the inner part of the race or else the wheel will not revolve properly. The end of the spindle is turned down for a ¾in. Whitworth thread, and the shoulder thus formed must be such that undue pressure cannot be exerted unintentionally on the inner part of the ball race by the nut on the end of the spindle. The pressure should be only sufficient to stop the washers being dragged round by the friction of the grease in the hub. When adjustment is correct a lock nut can be fitted. If no dust cap is provided with the wheel, one must be made. When the top rim of a ¼-pint Japlac Enamel tin was sawn off it was found that the tin just pushed on to the hub of the wheels shown in the illustration. This was a temporary measure at the time of construction, but has been left as a permanent fitment as it has answered quite satisfactorily.

The stub axles are held to the channel section each by two ½in. Whitworth × 2½in. bolts. It is recommended that these bolts are secured with castellated nuts and split pins to avoid any likelihood of their coming adrift at any time. The wheels and axle are now completed.

Fitting the Road Springs

A pair of front springs from the Austin 8 car (now discontinued) was used quite successfully in the trailer illustrated. These can be quite easily procured new or second-hand.

The ends of the springs are fitted to two cross members each 3ft. 3in. long of 1½in. × 1½in. × ¼in. angle iron. At the cross member nearest the tow bar the springs are pivoted by a bearing made from two small pieces of the angle iron as shown in Figs. 3 and 6. The rear ends of the springs are secured to shackles which take up the varia-



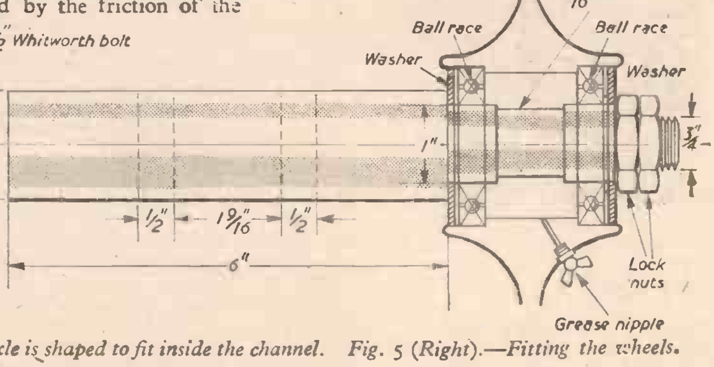


Fig. 4 (Left).—The axle is shaped to fit inside the channel. Fig. 5 (Right).—Fitting the wheels.

tions of the overall spring length when the trailer is on the road. The shackles are made from pieces of mild steel each 4in. long × 1½in. × ¼in. Holes for the bolts are drilled at 2½in. centres (Fig. 7).

The upper ends of the shackles are secured to the cross members by mild steel blocks, each 1½in. × ½in. × 1½in. sawn from the material used for the stub axles. These mountings, as for the angle iron pieces used for the front member, are welded in position, after having been drilled to receive the securing bolts. These bolts securing the springs must be high tensile type and secured with lock nuts.

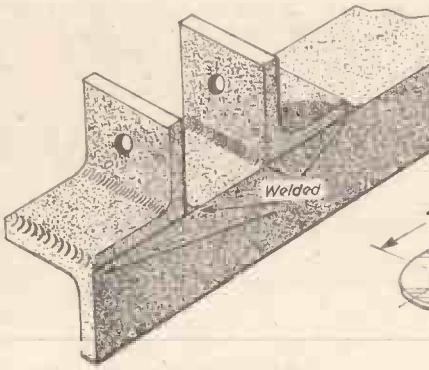


Fig. 6.—Bearing for the front end of the spring.

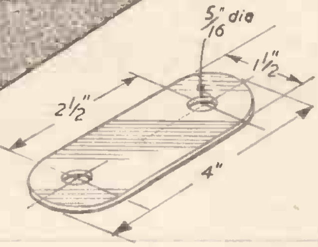


Fig. 7.—One of the shackle plates.

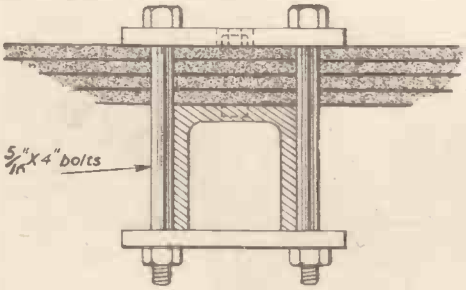


Fig. 8.—Method of fixing the springs to the axle bar.

The axle bar may now be secured to the springs. The arrangement for securing the springs is shown in Figs. 3 and 8. It comprises a top plate 3½in. × 3in. × ½in. mild steel and two bottom plates 3½in. × 1in. × ½in.

The top plate must be drilled in the centre to clear the nut which holds the leaves of the springs together. The axle bar will also have to be drilled to take the locating pin on the underneath side of the spring assembly.

The cross members may now be braced at their correct distance apart by two pieces of steel each 3ft. 3in. long and 1½in. × ¼in. The distance apart of the cross members can easily be found if the shackle bolts are done up tightly, holding the shackle plates vertical as shown in Fig. 9. This distance apart is 30in. to the outside of the angles for the springs mentioned previously. Remember to put a bolt through the intersection of the cross pieces to complete the stability of the assembly.

The Tow Bar

The tow bar is made as shown in Fig. 9 from two pieces of angle iron each 6ft. 6in. × 1½in. × 1½in. × 3/16in.

The front ends of the bars are secured as in Fig. 10 which also shows the arrangement of the hitch to the towing bracket on the car. The two cross plates could be varied in position to take any of the commercial hitches available.

When bolting the long angle irons to the main chassis, make sure that centre line through the towing hitch is at right angles to the axle bar at the mid-point of its length as shown in Fig. 11. At the points where these are bolted to the chassis, packing pieces each 1½in. × 1½in. × ¼in. are required to clear the cross-bracing members. Use 5/16in. bolts to secure the framework.

The completed framework is shown in Fig. 12.

The Box Part of the Trailer

For the sake of lightness the box of the trailer is made of ¼in. thickness resin bonded plywood which, of course, will have to be supported by a frame round the edges.

The foundation frame is constructed from 1¼in. × 1¼in. deal planed to finish about 1⅛in. square. The dimensions are shown in Fig. 13. The various joints are of the half-lap type, glued and screwed together.

Note that the box is not placed centrally on the chassis but overhangs more at the front than at the rear. This is to increase the load on the front of the trailer so that there is a certain amount of weight on the tow bar, which for the car illustrated could be up to 40lb. or 50lb. This forward weight of a trailer makes for steadier towing properties of the trailer.

The two centre cross pieces of the wood frame must coincide with the cross members of the chassis, so mark out the position of the half-lap joints on the sides with reference to the position of the chassis cross pieces.

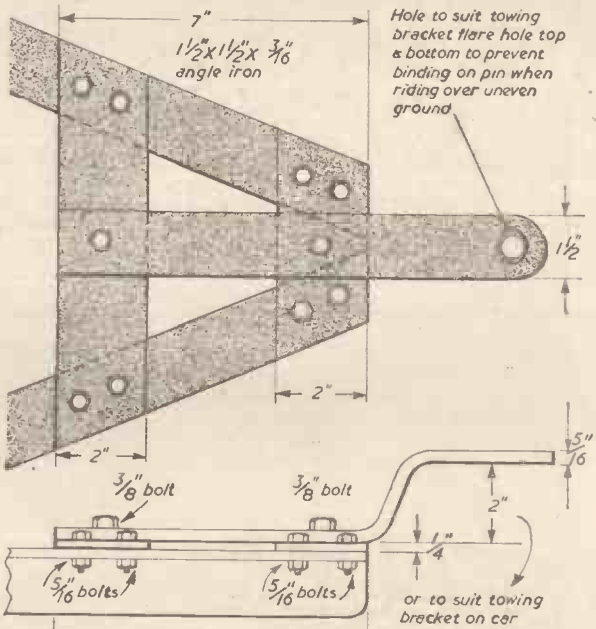


Fig. 10.—(Above Right) Plan and side elevation of the towing hitch.

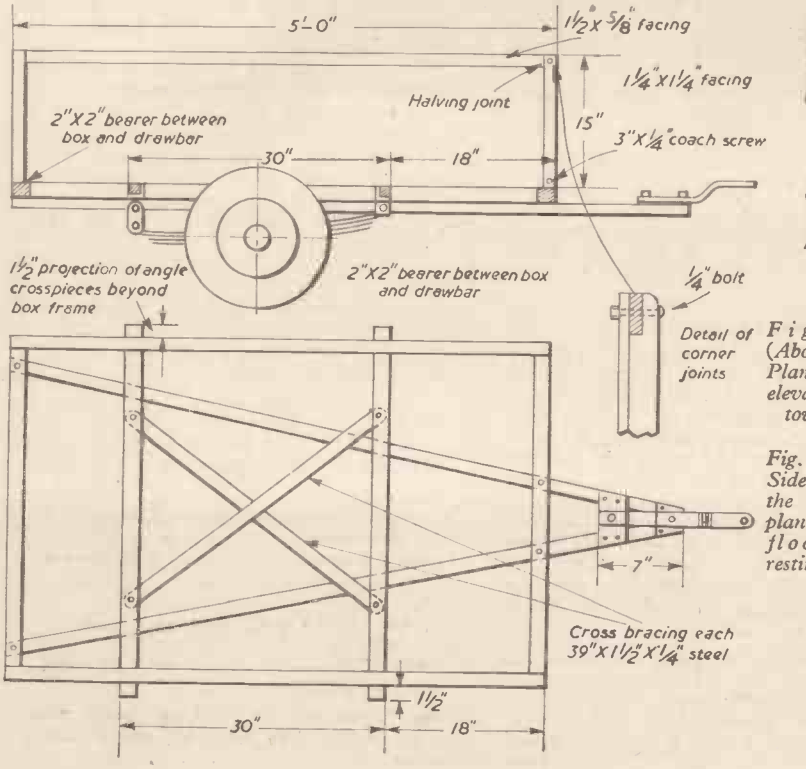


Fig. 9.—(Left) Side elevation of the trailer and plan view of box floor frame resting on chassis frame.

Test the frame for squareness by measuring across the diagonals of the framework as soon as it has been assembled. When the glue is dry the frame can be cleaned up and the covering of ¼in. exterior grade plywood glued and screwed into place. Use a waterproof glue such as Aerolite. Clean off the edges of the plywood flush with the framework.

Next prepare the timber for the sides. Cut out two pieces of plywood 5ft. × 1ft. 3in. The top edges and the ends are reinforced with a framework shown in Figs. 9 and 13. Glue and screw the frames in place on the plywood base. The bottom of the plywood is glued and screwed to the sides of the under frame.

The front end of the box is fixed but the rear end is made to hinge down to form a tailboard which is useful for loading and unloading as well as for carrying long pieces of equipment other than camping gear.

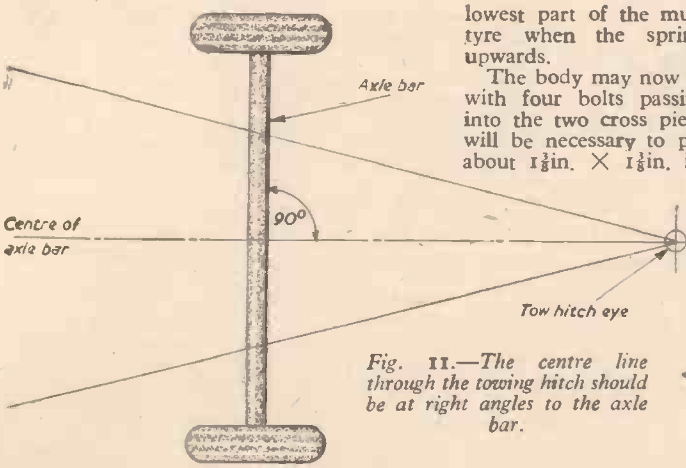


Fig. 11.—The centre line through the towing hitch should be at right angles to the axle bar.

Note how, when making the tailboard, two small grooves must be made in the framework to take the T-hinges between the frame and the plywood before the plywood is secured to the frame (Fig. 13).

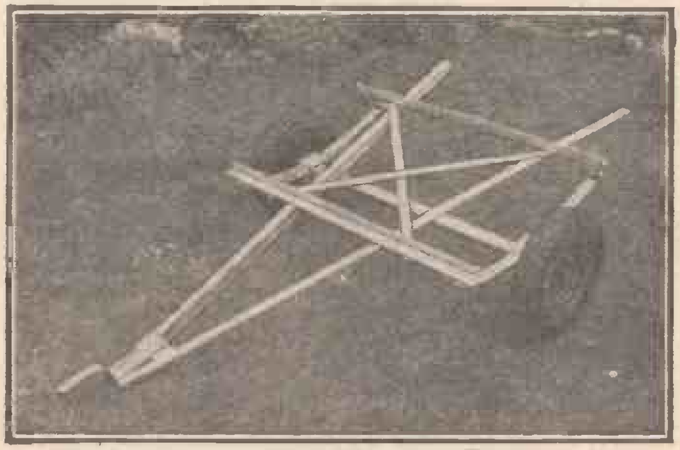
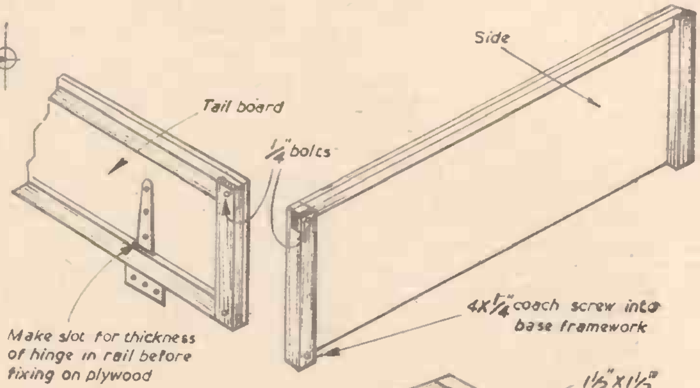


Fig. 12.—A view of the completed chassis.



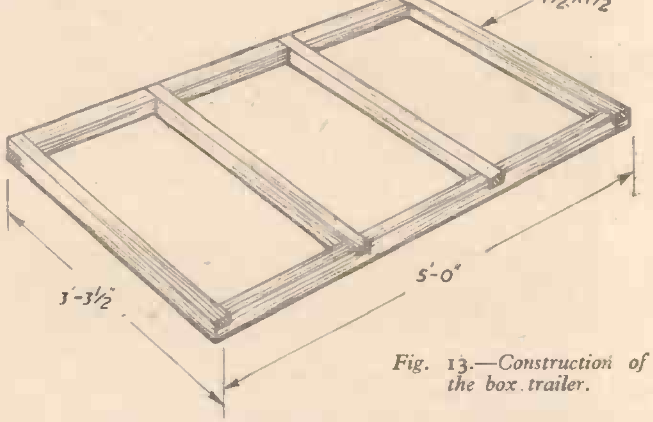


Fig. 13.—Construction of the box trailer.

The Mudguards

These can be of any design to suit the ideas of the constructor and the illustrations show a pair very simply contrived with odd pieces of ¼in. plywood left over from the construction of the body. Ensure that the lowest part of the mudguard will clear the tyre when the springs are fully flexed upwards.

The body may now be fixed to the chassis with four bolts passing through the floor into the two cross pieces of angle iron. It will be necessary to place a piece of wood about 1⅛in. × 1⅛in. in the angle of these cross members to form a pad on which the floor of the box will rest as shown in Fig. 9.

The rear end of the box rests on a piece of 2in. × 2in. timber resting on the ends of the two drawbar angles. Two bolts pass through the floor of the trailer, the 2in. × 2in. and the angle iron.

At the front end of the box a shorter piece of timber (only 13in.) is used for the cross bearer. It may be necessary to plane down these 2in. × 2in. pieces a little so that the floor of the box rests evenly on the whole four cross bearers.

The construction of the trailer is now complete except for the final rubbing down with glasspaper and the application of a coat of priming and the finishing coats of paint.

Remember that a number plate is required and this may be secured to the rear cross piece of 2in. × 2in. If the trailer is used at night then a pair of reflectors and two tail-lights will also be required.

The chassis part, less the box trailer, can be adapted for use as a boat trailer.

PUZZLE CORNER

1—Triangle Base

HERE is a triangle built up on a definite mathematical plan. Work out the figures for a fifth line.

2—6
2—8—6
2—10—14—6
2—12—24—20—6

2—The Tantalising Triangle

DRAW a triangle and put the figures 1, 2 and 3, one at each angle. Then take the figures 4, 5, 6, 7, 8 and 9 and put any two of them along each side of the triangle. You now have four figures (counting the angle figures) along each of the three sides of the triangle. Each set of four figures are to add up to 17. Do not award yourself any marks if you take longer than five minutes to do it, including drawing the triangle.

3—The Three Macpherson Children

MRS. MACPHERSON has three children, and if you add the ages of the children together you get exactly the same result as if you multiply their ages together. What are the ages of the three small Macphersons?

4—The Printing Puzzle

A BOOKLET consisting of eight pages is produced by folding a large sheet of paper longways in halves and then sideways in halves. There is printing on each page, and, of course, it is necessary that the pages run on in their proper order. As the printer does not print each page separately, but does the four pages which come on one side of the large sheet in one impression and then does the same to the other side of the sheet—all before the folding is taken in hand—he has to be very careful where he arranges the matter for each page. Otherwise, they might not follow on correctly when folded.

Draw two rectangles, one to represent one side of the sheet, the other to represent the second side; divide each into four to represent four pages, then number the divisions from 1 to 8 to represent the position of the pages so that they will be in their correct order when the folding is done. Also indicate which way up each page is to come. You are not allowed to experiment with a sheet of paper; you must think out the problem first.

Answers

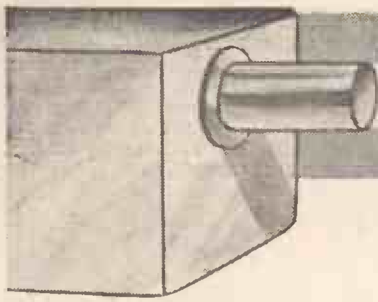
1—For those who are stuck the fifth line is as follows:—
2—14—36—44—26—6

2—The three sides will be:
1, 6, 7, 3.
1, 5, 9, 2.
2, 4, 8, 3.

3—They are 1, 2 and 3 years old.

4—First sheet:
Top left-hand division–page 5 inverted.
„ right-hand „ „ 4 „
Lower left-hand „ „ 8 not inverted.
„ right-hand „ „ 1 „ „
Second sheet:
Top left-hand division–page 3 inverted.
„ right-hand „ „ 6 „
Lower left-hand „ „ 2 not inverted.
„ right-hand „ „ 7 „ „

Now, if you have checked and found your answers correct, why not try them on your friends?



TRANSISTOR-OPERATED

In This Series E. V. King Gives Readers Some Ideas With Many Items of

THE general system used is that light either causes a switch to go on or off through the medium of transistors.

Countless possibilities will occur to readers including, perhaps, the following: Burglar alarms, shop customer warning systems, customer counting, vibration or revolution counting, automatic porch lights, fog or smoke alarms, etc.

Besides various experimental suggestions it is intended to give precise details for the construction of the following units in the order given:

1. Making a photo-sensitive transistor from a "red spot."
2. A lamphouse and infra-red filter.
3. A photo-operated switch.
4. A photo-alarm.
5. A photo-counter.
6. A power pack suitable for this apparatus, which is basically battery operated.
7. Low light level "night-day" switch.

Light Sensitive Devices

The devices used are very simple and do not require expensive H.T. supplies. The simplest light sensitive device is the photo-emissive cell, sometimes called the "barrier layer" type. The cell, which depends partly on the metal selenium for its action, is sensitive but slow in action and the output is low. A typical cell gives about 0.6 μA per sq. cm. of active area 1ft. way from a standard candle. This output falling rather more rapidly than the square of the distance as the candle is moved away. The output is not sufficient to operate cheap, robust, easily obtainable relays. Rapid counting is not possible, and on the whole the cell is rather large, cumbersome and easily damaged.

The Crystal Diode as a Light Sensitive Device

An ordinary cheap crystal diode can be used as a photo-device. Remove the rubber cover if one is fitted and connect up in circuit as shown in Fig. 1. Using a 4½-volt torch battery and a resistor of about 4,000 Ω the dark current will be about .02 mA, and with a 60-watt lamp held 1ft. away from the diode the current will increase to about .04 mA. Take care to connect the "cat's whisker" to battery negative and the germanium to the positive. Greater sensitivity may be gained by using a lens to focus the light on to the contact area in the diode, in the same way as one uses a burning glass.

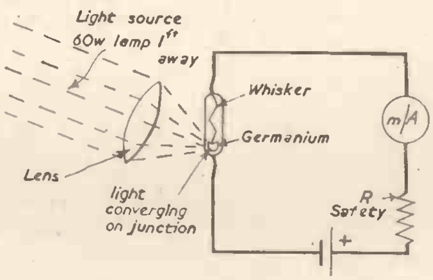


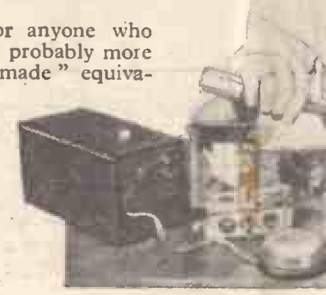
Fig. 1.—Germanium diode as a photo-cell.

It is quite possible to operate a really delicate relay with this device, but the cost and likelihood of trouble make it advisable to seek cheaper and more reliable methods.

The Transistor as a Light Sensitive Device

If a transistor is used in place of a diode, and light is allowed to get to the junction, very much greater sensitivity is easily obtained. In fact the transistor behaves as a resistor which has a value inversely proportional (in some way) to the light intensity.

For the apparatus described the Mullard OCP71 is very suitable and is obtainable on order from any Mullard stockist at £2 7s. 6d. Two were used by the author for experimental work. For anyone who can afford the price they are probably more permanent that the "home-made" equivalents suggested later. It must be emphasised that it is useless to take an old and faulty transistor and modify it, although it is a good idea to do so purely so that one may gain practice in the mechanical operations of the modification.



Modifying an Ordinary Red Spot to a Photo-transistor

The details given here apply to a red spot purchased from Messrs. Henrys Radio Ltd., 5, Harrow Road, Paddington, W.2, but probably the same procedure will apply to many other small audio type transistors.

Take the transistor (Fig. 2 A) and clamp

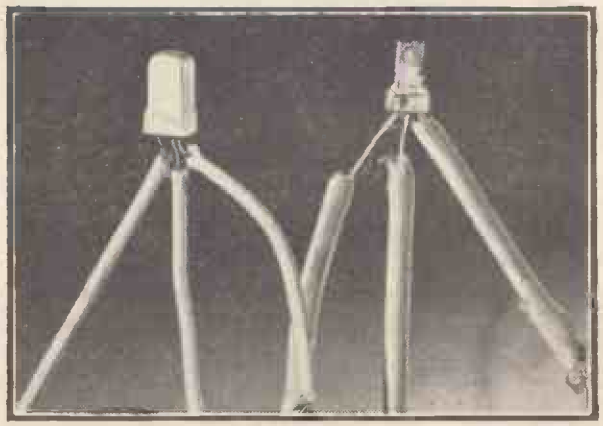


Fig. 3.—Red-spot transistor before and after modification.

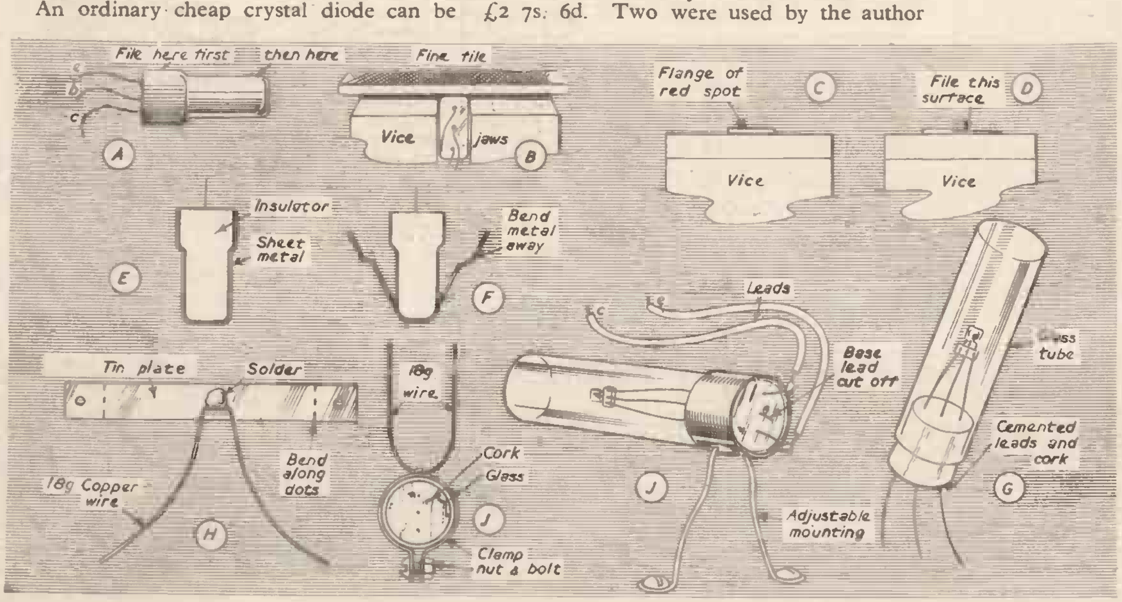
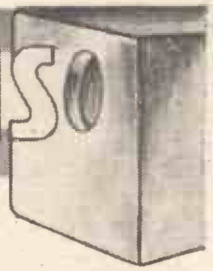


Fig. 2.—Modifying a red-spot transistor.

Fig. 4.—Housing the modified red-spot transistor and the OCP71.

COUNTERS & ALARMS



About Light-operated Equipment Together Definite Apparatus

it very carefully in the vice so that only one edge projects, as in Fig. 2 B. The leads project sideways and part of the flange with the red spot on it is slowly filed away with a fine flat file until it is just through to the inner polythene-like material. Do not clamp tighter or file more than is absolutely necessary.

Now loosen the vice and move the transistor up a fraction of an inch as in Fig. 2 D. File away the newly exposed surface until the metal cover is through.

Turn the transistor over and repeat the whole procedure. With the finger nails or some tweezers carefully prise off the metallic covering (F) making sure you do not pull the wire connectors in so doing. Do not remove the capsule covering as good results can be obtained without. In fact the incident light is diffused somewhat so that the transistor is fairly sensitive to light which is not actually falling on the junction. This is a great help in optical alignment. The transistor before and after filing is shown in Fig. 3.

A small test or pill tube is obtained

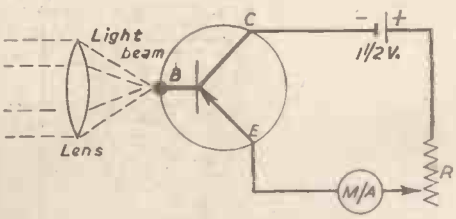


Fig. 5.—Test of the photo-red-spot or OCP71 transistor.

together with a cork. Three holes are burnt with a red-hot needle so that the transistor leads will pass through them. The holes must not run together, but must be parallel or the wires will short. The tube mouth, cork and leads are smeared with cellulose cement, which is allowed to become tacky and then the cork is pushed home in the tube so that the assembly is airtight and looks as shown in Fig. 2 and Fig. 4. Needless to say the tube must be quite dry when this is done.

A small tin-plate clamp is made from a piece of tin plate on the lines of a condenser clip (Fig. 2 H and J and Fig. 4). About 8in. of 16 or 18g. copper wire is soft annealed by heating to redness and plunging into cold water. The centre of this wire is soldered in the middle of the clip. The leads may be twisted (as shown in Fig. 2 J) or left free. The ends of the supporting wires are curled so that they may be clamped down by screws.

When mounted, the transistor is free to be moved in any direction by the bending of the soft copper wire, the connecting wires being connected freely with thin pliable insulated flex wire.

There is a possibility that some transistors may have an inner insulator of opaque material. Such transistors would not be suitable for this modification and an OCP71 should be used.

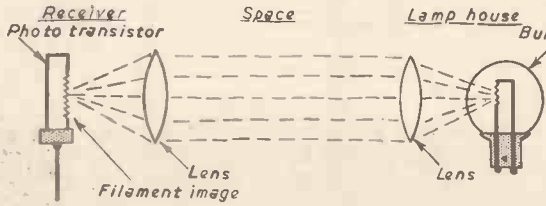


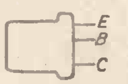
Fig. 7.—Basic principle of lighting system.

Testing

If you have purchased, or intend to use, an OCP71 there is actually no need to carry out these tests, but they will prove instructive and in any case it is as well to be thoroughly conversant with a new article of apparatus that is to be used.

When an OCP71 is viewed in the vertical position with the white line on the left, the light should be focused to a few millimetres from the top of the transistor. That is, about 12/13 mm. up from the start of the leads, from the observer towards the transistor.

Many converted red spot transistors were tested by the following procedure. The transistor is first mounted, as already described, on a piece of wood. The circuit in Fig. 5 is wired up using a small $1\frac{1}{2}$ cell, a 0 to 5 or 0 to 10 mA meter and an optional variable resistance of about 1,000 Ω. The resistor is adjusted should the current exceed 5 mA so as to safeguard the transistor. The arrangement is taken to a darkish place or the curtains are drawn.



The current should be very low and in the region of only 100 μA but could be used safely up to about 250 μA (temperature and the actual transistor affect this figure). Now arrange a spot source of light by using a magnifying glass and a torch or, better still, say a 60-watt lamp. Experiment with the spot source of light and shine it on the photo-transistor from *all* directions and at *all* angles, but always at the same distance away. Note the point of illumination on the transistor, and the direction of incidence, for maximum deflection of the milliammeter. Make a diagram of the results for further use, or paint a circle on the glass tube *round* the spot where illumination gives best results.

In the circuit suggested with 100 μA dark current over 1 mA will flow with an ordinary torch lamp held close to the transistor with no lens used. With a lens in use much more deflection will occur. An OCP71 is even more sensitive than this.

Often, readers are advised that if they connect transistors the wrong way round they will be damaged. In this case it will do no harm. In fact, it is worth while trying the converted transistor both ways round as sometimes the emitter works better as a collector. As a general rule, when connected as in Fig. 5 the best results are obtained when the spot of light is at right angles to the germanium wafer and shining on the collector junction, that is, the larger of the two pieces of p-type germanium.

Note that the base connection is not used; if it were, the above notes about polarity would not apply.

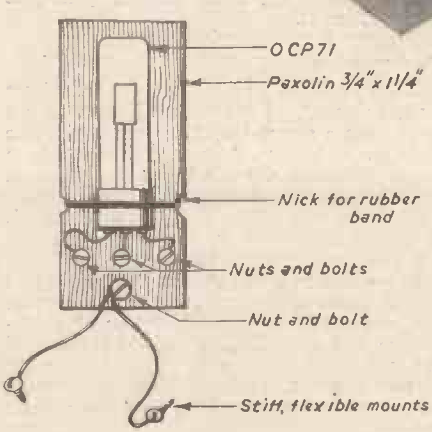


Fig. 6.—Suggested mount for OCP71.

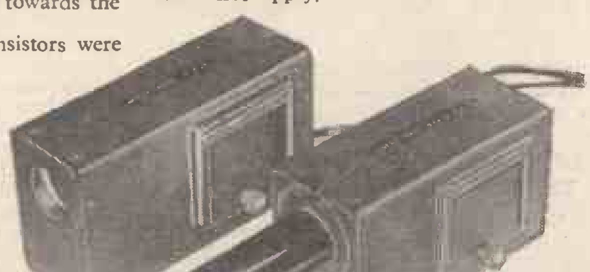


Fig. 8.—A view of two completed lamphouses, one with hood and one without.

The OCP71

When purchased it is in a protective packet much like a valve carton and it should be left within after testing until it is actually required. It could be mounted exactly as the converted red spot (Figs. 2J and 4) but it is better to mount it as shown in Fig. 6.

A small piece of paxolin or varnished plywood is fitted with three small screws to hold transistor leads (which are not shortened) and one larger hole to take a nut and bolt to hold the assembly on soft copper wires which serve as flexible mounts.

They may be twisted, as in Fig. 2, if it seems necessary. A small file will nick the sides of the strip so that a rubber band will hold the OCP71 firmly but harmlessly in position. Adjustment is made by moving the strip by bending the soft copper mount and *not* by sliding the transistor about. This latter would give rise to trouble with the transistor leads.

Infra-red Rays

The photo-transistor is very highly sensitive to infra-red radiation, which is invisible to humans, but will cause chemical changes in silver salts, i.e., photographs. Using infra-red rays, apparatus will work with no apparent illumination. Readers are advised

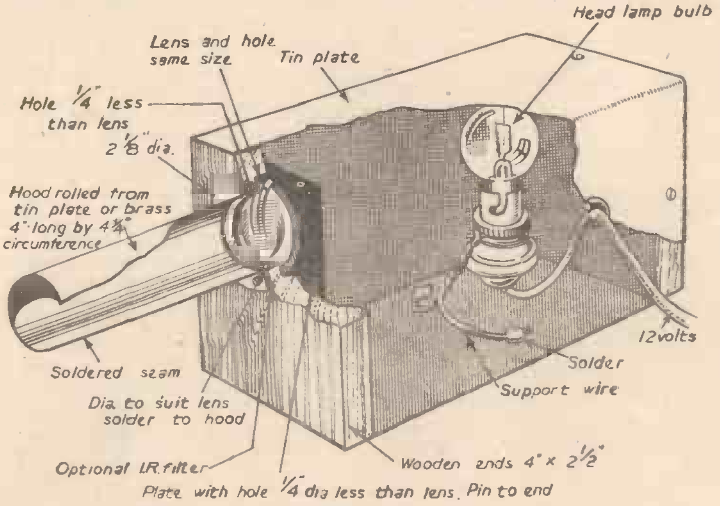


Fig. 9.—Constructional details of the lamphouse.

in all cases to get the apparatus working with "white light" first.

Infra-red rays focus at a slightly different point to white light. Ordinary glass is athermanous to infra red so that a transistor mounted in a thick glass tube will not work as well as one in a thin one, or one with no glass cover at all. It seems that the OCP71 is housed in a very thin tube; whether this is diathermanous to infra red is not known. Ordinary lenses are diathermanous and so do not transmit infra red very well, and while lenses are probably designed which will do so the author was not able to locate any source of supply. The loss in ordinary lenses is not sufficient to cause difficulty.

Making a Suitable Light Source

The parts required incude: Two pieces of softwood, for front and back, 2½in. × 4in. × 1in. thick. Body of tin plate, cut and bent from one piece, 4in. × 13¼in. Inspection cover of tin plate 2⅝in. × 2⅝in. Sliding grooves of tin plate, 8in. × ⅜in. Cylinder black and/or black crackle.

A lens of short focal length and about 1in. to 1½in. dia. Suitable types are obtainable surplus cheaply from Messrs. H. English, Rayleigh Road, Hutton, Brentwood, Essex. These are suitable types: No. 24, double convex, F=2¼in.; No. 65 plano-convex, F=2¼in., which is also available with a screw-on brass mount, probably making the assembly easier to make up.

One 24-watt, double-pole headlamp bulb, small bayonet cap fitting complete with holder obtainable from a popular walk round stores. It is suggested that 12 volts should be used if possible from a car battery or transformer from A.C. mains (Messrs. Henrys Radio can supply a suitable type, 12 volts at 2 amps. is required). Connecting flex, screws, solder, flux, etc.

Infra-red filter (optional), obtainable from Messrs. Harringay Photographic Co. Ltd., Green Lanes, Harringay, N.4. Ex-Air Ministry Type No. 6, Ref. 14A/2651 (2/- plus postage).

General Layout

Apart from some units using barrier layer cells, those to be described require a parallel pencil of light for their operation. The pencil should have the same cross sectional area as the lens in the unit to be operated. The amount of light required is not great, 18 watts being ample even for working distances of 25 yards, though alignment at this distance is very difficult.

It is suggested that a 24-watt lamp be used, the smaller and more compact the filament the better. A 36-watt could be used but it would run rather hot and have a short life. There seems no reason why a double filament lamp should not be used giving choice of at least two, and up to four wattages, by suitable series parallel switching. A motor stop/tail lamp would probably prove suitable.

As long as a parallel beam is projected the design is not of importance. One perfectly satisfactory design is shown in Fig. 8 and the principle of operation in Fig. 7.

The case consists of wooden end pieces fitted into a tin plate metal cover. One end piece contains the lens and the lamp is at the far end of the "box" and is mounted, like the transistor, on a heavy soft copper wire for easy adjustment in any direction. A side inspection door is fitted for this adjustment and for bulb replacement. No cooling is required, as long as the outside is painted black. The dimensions depend on the focal length of lens used. Those given assume the use of any of the lenses already suggested.

If a lens of longer focal length is used (this is not a good thing) the length of the "box" must be increased in the same proportion as the focal length. If calculating by mathematics (see physics books on light), remember to allow room for the radius of the glass envelope of the lamp which lies behind the filament. The lamp must not actually touch the back wooden panel, as it may burn it.

Construction

Refer to Fig. 9 and cut out the end pieces from softwood. An aperture has to be cut in one piece about ½in. from the top. The diameter will depend on the lens used; a stepped hole enables the lens to be clamped in with a tin plate lens retainer, as shown.

The best way to make the stepped hole is to clamp the wood in a vice so that the grain of the wood is compressed; mark the centre of the hole and drill with a brace and bit the large hole just over the diameter of the lens and to a depth equal to the thickness of the lens. If the point of the drill has not come through continue the centre hole with, say, a 1/16in. drill. When through turn the wood over and drill with the brace and bit a hole ⅛in. less in diameter than that of the lens. Go carefully or the result will be a ragged break through. Clean up the edges with a sharp chisel or penknife, making sure that the lens lies flat in the same plane as the front panel.

Take any piece of tin plate (i.e., cocoa tin) and cut a hole in it ⅛in. less in diameter than the lens. This may be done with a tank cutter, curved tin snips, or a series of small holes which are chiselled through and filed smooth. Make four small panel pin holes (see Fig. 9).

Clean the lens in methylated spirit with cotton wool and finish with a leather. Mount it carefully, fixing the tin on the inside.

The lens must be gripped and unable to move about or the beam direction will alter with vibrations, etc.

Cut the tin plate as shown in Fig. 10. Drill and chisel out the inspection hole before bending the tin plate round the end pieces. Keep the tin plate square as you do this and fix each side with wood screws as it is bent. Do not screw too near the lens. Press the ends of the tin together on the underside and solder with a large hot iron. Rivets or small bolts could be used if a large iron is not available. Stick some felt underneath if the lamp is to be used on furniture. A suitable adhesive is available from carpet dealers.

The Lamp Fixing

A few inches of thick (say, 16g.) copper wire is annealed and then twisted round the lamp holder leaving the two ends free for an inch or so. The shade ring is then screwed on and the ends of the annealed wire soldered to the tin plate base, as shown in Fig. 9. Leads are connected to the terminals and are taken via a grommet in the tin or a hole in the back panel to the

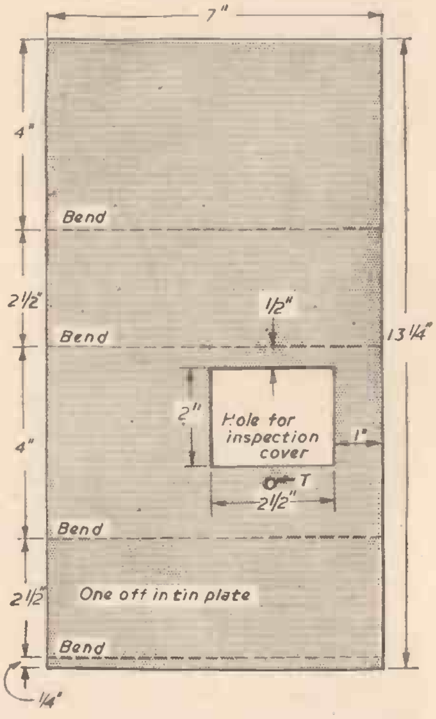


Fig. 10.—Cutting and bending plan for the tinplate cover.

supply voltage. Make sure no shorts can occur between wires or between wires and tin plate.

When the bulb is inserted make sure the filament support wire in the bulb is not in line with the filament and the lens. If it is, twist the holder round a little. The filament should also be about level with the centre of the lens. The outside of the case should be painted black to help radiate the heat. It would probably help, too, if the inside were similarly treated, but this was not done in the prototypes.

Fixing the Inspection Cover

The $\frac{3}{8}$in. tin plate strips are cut to the dimensions shown in Fig. 11, and are bent to the shape shown. This can be done with the vice and flat pliers. The strips are soldered round the edges of the inspection hole. The inspection cover is then inserted and trimmed up if necessary. A 3/16in. hole is drilled through in the position marked "T" in Fig. 10 and also shown in Fig. 11.

An ordinary terminal is then taken to pieces and one female portion carefully soldered on the *inside* of the lamphouse in line with the hole "T." Do not get solder on the threads. If the terminal is tinned and held in position a hot iron placed on the outside of the tin plate will cause the solder to run. On cooling it will be fixed in position. The male portion is then "damaged" a little at one end with a hammer and the terminal head proper is forced on so that it jams. This is now used to screw into the threaded hole "T" fixing the inspection cover.

Testing the Lamp

Wire up to the correct voltage on a transformer or car battery. Stand the lamp on a level table three yards away from a wall. Focus the lamp until you get a clear image of the lamp filament on the wall by bending the lamp supports towards or away from the lens. Then adjust the lamp up or down to get the beam parallel to the floor. A small paint mark inside on the tin plate bottom showing the filament position is useful to act as a focusing guide when a new lamp has been inserted. A vertical movement of only 1/64in. will make a lot of difference to the position of the image.

If a lens exactly the same as the one in the lamphouse is now placed somewhere a few inches from the wall a very bright and intense image of the filament will result, it being the same size as the filament in the bulb itself (see Fig. 7).

The lamphouse may be fixed permanently by bolting through the base, using the inspection cover for access. When finally fitted up it may be possible to "tap down" on the transformer so that it works on only eight volts approximately. This often gives sufficient illumination and greatly increases the life of the lamps.

Fitting an Infra-red Filter

If fitted this should, in any event, be removed during the lining up of the light beam and the initial trials of any apparatus.

Although a suitable filter makes the light invisible it only cuts down the effect on the photo-transistor by about five per cent. The filter, when obtained, should be held between two postcards and cut to the size required while so held. Otherwise it will tend to crack. Ordinary scissors are quite suitable.

The lens is removed, the filter put in first and the lens replaced on top of the filter. The filter must be away from the lamp side of the lens or the heat will damage it.

A better method of fixing the filter is shown in Fig. 12, where a metal ring is used to clamp the filter directly to the front of the lens housing. If using any of the lenses suggested, a suitable clamping ring would have an O.D. of $2\frac{1}{8}$in. and an I.D. of $1\frac{1}{2}$in. This

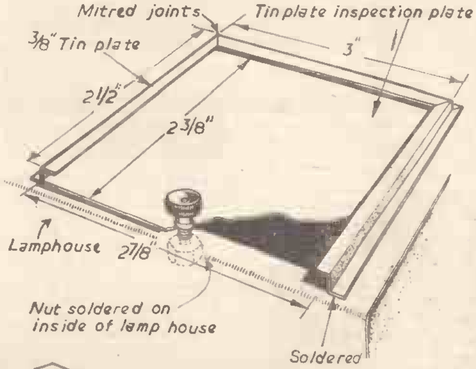


Fig. 11.—*Details of the inspection cover.*

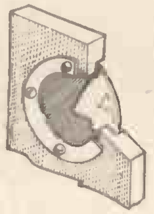


Fig. 12.—*Method of fixing infra-red filter.*

method has the advantage that the filter may easily be removed without taking the whole lamp to pieces.

Readers will observe that if they get directly in front of the lamp with such a filter they can just see the "red" filament of the lamp. This is due to inefficiency in the filter and cannot be easily overcome, other than by fitting a long tunnel-like hood. Fig. 9 gives details of the size of tin plate required to be bent round a broom stick, etc., and soldered to make a tube. This is then soldered to a $2\frac{1}{8}$in. O.D. ring like that already mentioned. It is fixed as shown in Fig. 9. The finished job is also shown in Fig. 8.

Try the outfit in the dark and use modelling clay or other suitable stopping to plug up any cracks of light which show through if the tin plate does not lie flat where it meets the end pieces.

Messrs. H. English can supply surplus a lens of about $3\frac{1}{4}$in. focal length, fitted with an infra-red filter; it is mounted in a brass tube which could easily be adapted to make the hood. (Item 422 or imperfect 422A, 8s. 6d. and 6s. 6d. respectively.)

New, non-ex-Government infra-red filters are available from Messrs. Wallace Heaton Ltd., 127, New Bond Street, London, W.1.

(To be continued)

Build an Efficient Timer from an Old Clock

(Concluded from page 80)

Unless the whole of the mechanism requires cleaning it is only necessary to remove the escapement wheel. This is easily recognised since its fifteen wedge-shaped teeth drive the two pins of the escapement lever as shown in Fig. 4. With a very fine file remove fourteen of the teeth flush with the rim and finally draw the file around the rim to remove all burrs and roughness. This stage has been reached in Fig. 5. Having cleaned as much of the mechanism as is necessary put a drop of clock oil on each spring, do not be tempted to use ordinary oil as apart from the fact that it may be too thick it becomes sticky and will impede the mechanism. The wheels may now be replaced, lower the back plate carefully on to its threaded support rods and feed the top end of each pinion shaft into its appropriate bearing hole. Refit the end of the hairspring, remove the securing arrangements from the mainsprings and put a tiny drop of oil in each bearing cup and the work on the mechanism is complete.

The Dial

A new dial face is required, and for the convenience of readers this is printed full size in Fig. 6. This size will be found to fit most clock faces. The dial should be cut out and mounted on thin card before being attached in place of the existing face.

More Radioactive Fallout

THE earth will be subjected to radioactive fallout for many years to come, even if the testing of nuclear weapons ceases altogether. For how long it will continue is not known; neither is it known how much radioactive debris there is overhead or how long it will take to dissipate. It is estimated that most of it will come to earth within the next five to ten years, but some will dissipate in the stratosphere without ever returning to earth. That which comes down is known as stratospheric fallout and consists chiefly of Strontium-90, which is, of course, dangerous

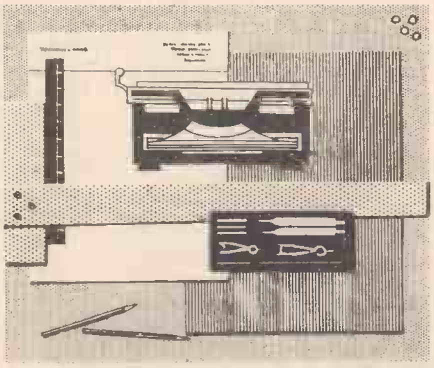
The end of the testing of nuclear weapons would enable scientists to improve their estimates of the radioactive materials present in the stratosphere, but it is thought that provided no more is added to that already present, the level is not enough to cause a rise in the ground level of Strontium-90.

The U.N Scientific Committee reports as follows:

"Analysis of fallout material has shown that Strontium-90 can remain in the stratosphere for many years before being deposited on the earth. The depletion mechanism of the stratospheric reservoir is not yet adequately known. It has been estimated from measurement of fallout rate and stratospheric content that the annual Strontium-90 fallout is about 12 per cent. of the stratospheric content. . . . The concept of a constant fractional removal per year of the stratospheric content is inconsistent with meteorological principle. However, nothing better can be offered at present."

PREPARING PROVISIONAL SPECIFICATIONS

By "Patent Agent"



Some Advice to the Inventor and Prospective Patentee

THE principal function of a Provisional Specification is that it should serve as a proof that the person making the Patent Application is in possession of the invention at the date on which he files the Application. It follows, therefore, that the Provisional Specification must describe the invention. At a first glance this may seem a simple and obvious requirement and one which needs no exceptional skill to put it into effect. First impressions in this connection are, however, most deceiving. A considerable gulf exists between the popular and the legal conception that the word "invention" calls to mind, and it is the legal conception of that word that matters as regards the drafting of a Provisional Specification. This legal conception can only be gleaned from the relevant provisions of the operative statute, that is to say the Patents Act of 1949 and the decided Court cases which have shed light on the way in which that Act is to be interpreted.

Defining "Invention"

Before describing an invention for the purpose of a Provisional Specification, considerable care must be exercised first to determine whether the invention is of a patentable nature and, if it is, great care must be exercised in the wording of the Specification to ensure that no objection is eventually taken to the invention on the ground that it falls outside the ambit of the definition of "invention" in the Patents Act.

The words of the Patents Act that the Provisional Specification "shall describe the invention" have to be construed in relation to the definition of the word "invention" set forth in the interpretation section of the Act. In essence that definition states that invention means any manner of new manufacture or any new method or process of testing applicable to the improvement or control of manufacture.

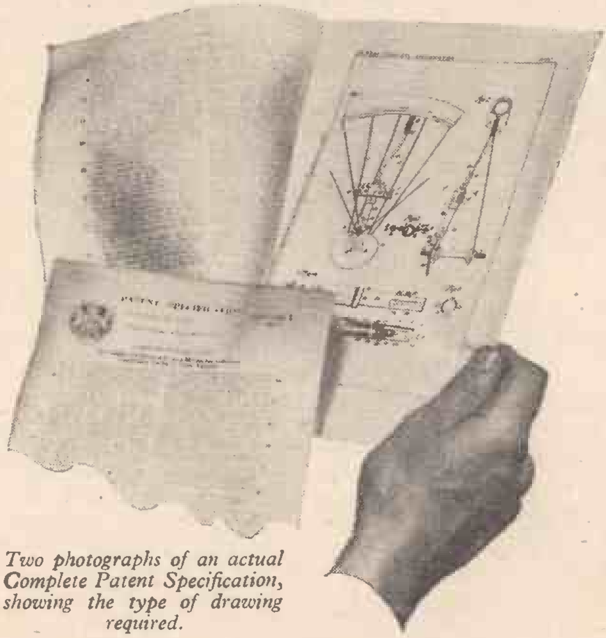
Taking first the words "any manner of new manufacture" it is well established that the question of whether an invention is a manner of manufacture has to be considered quite separately from the question of whether the invention is novel.

Two Classes

Broadly, inventions fall into two classes, namely, articles or products and processes. Accordingly the words "manner of manufacture" have to be construed in relation to each of these classes. Not very much difficulty is encountered with articles or products, and perhaps the most authoritative utterance on this subject was to the effect that an article or product is a manner of manufacture if it is made by hand or man-made machines. From this it will be appreciated that certain articles or products are unpatentable. For example, agricultural produce, though cultivated in a novel manner is, generally speaking, unpatentable. Also, new substances which occur in nature, though they can be protected as synthesised products of a process, cannot be patented in respect of their natural occurrence. New strains of living creatures are also unpatentable.

What constitutes a manner of manufacture in relation to a process has been the subject of a great deal of discussion in the Courts. A method or process is a manner of manufacture if it (a) results in the production of some vendible product, or (b) improves or restores to its former condition a vendible product, or (c) has the effect of preserving from deterioration some vendible product.

The above rules undoubtedly cater for the overwhelming number of methods or processes since such processes do result in some physical end product which is generally a "vendible product." However, the meaning of this expression has frequently fallen to be considered by the Courts in special cases. The general trend of the Courts has been benevolent to applicants, and the words "vendible product" have been liberally construed. It has been established that a vendible product need not necessarily be a physical article, and that, for example, a process for the production of a complex electrical oscillation constitutes a manner of manufacture. Also, a method of extinguishing subterranean fires in a novel manner resulting in a protected subsoil was held to be allowable inasmuch as the protected subsoil might reasonably be regarded as a vendible product. On the other hand, a method of extinguishing incendiary bombs, a method of treating the human body and a method of pumping oil from a well have been held to be unpatentable.



Two photographs of an actual Complete Patent Specification, showing the type of drawing required.

Novelty

On the question of novelty it would appear from the decided Court cases that a certain minimum quantum of novelty is required, though the question of how much novelty is necessary has never been answered. Usually, however, the degree of novelty required is quite slender.

Nevertheless, certain kinds of novelty are insufficient. For example, mere novelty of purpose, that is to say the discovery that a known substance or article may be used for a hitherto unsuspected purpose, generally will not be patentable. In this connection, for instance, the use of rubber to make a flexible razor handle and the use of a known substance as a fertiliser have been held unpatentable. Also a mere collocation of parts, that is to say a mere putting together of known elements which do not co-operate to produce a single result, is not patentable. An example of this is the placing of known parts of a complete apparatus in a single container instead of separate containers.

Lack of mechanical novelty is often a bar to patentability. Thus a mere scheme or plan, for example, a new way of arranging houses in a row, is usually unpatentable as is a mere arrangement of printed matter on a sheet. If, however, the arrangement of the printed matter results in some mechanical advantage a Patent may be obtained. In a well-known case, a theatre ticket was held to be patentable where it was printed to bear information in such a way that on tearing the ticket in either of two directions at right angles, the resulting ticket halves each contained the appropriate information.

The Patent Office practice, which is regulated by the statute and the decisions in cases before the Courts nowadays, amounts to the exclusion from patentability of certain broad fields of human ingenuity and endeavour. These may be summarised as:

(1) Processes which are non-productive, including processes for treating the human body.

(2) Mere schemes or plans.

(3) Agricultural and horticultural processes and produce.

(4) Mere arrangements of printed matter unless such arrangements fulfil a mechanical function.

Before the Patents Act of 1949, applications were frequently refused for methods of testing in the course of manufacture in spite of the ingenuity of such methods because these were held not to amount to a manner of manufacture. The 1949 Act has now enlarged the area of patentability by the inclusion of such methods within the definition of the word invention. As yet the Courts have not made any significant pronouncement with regard to the words "a new method or process applicable to the improvement or control of manufacture." Thus, what precisely may be included in this expression is open to doubt.

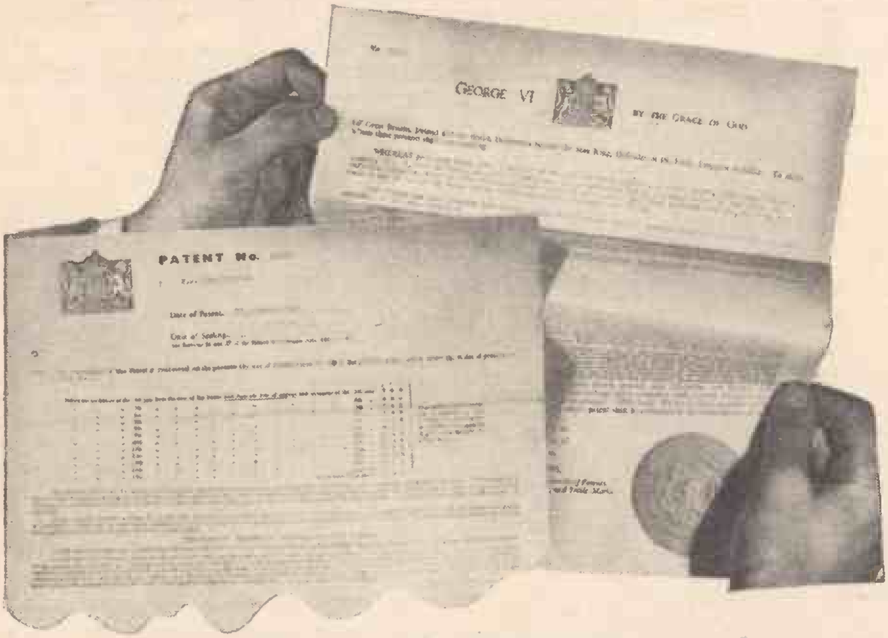
Title

In so far as it regulates Provisional Specifications, the Patents Act, 1949, provides that a Provisional Specification shall begin with a title. The function nowadays of the title is merely that it should act as a ready means of identifying the invention for the purposes of referencing and indexing, and its accuracy and suitability for these purposes is a matter for examiners at the Patent Office to decide.

Description

Provided that the invention is of a patentable nature the next matter to be considered is how much description of the invention is required in the Provisional Specification.

A Provisional Specification in serving as a proof that the invention was in the possession of the applicant at the date the Application was made must clearly foreshadow the monopoly which is to be claimed for the invention in the Complete Specification. If the Complete Specification contains claims which are not adequately foreshadowed in the Provisional Specification, the priority date, that is to say the relevant date for the purpose of anticipation, will be the date on which the Complete and not the Provisional Specification was filed.



Two views of an actual Patent Grant.

Danger of Insufficient Detail

One object of the legislature in providing for the filing of a Provisional Specification was to allow an applicant to perfect the invention before a Complete Specification was filed. Thus, it has been held by the Courts that an applicant need only declare fairly the nature of his invention in the Provisional Specification, and he can leave the description of the particular mode of carrying out the invention until he files his Complete Specification.

This doctrine, although it is, without doubt, good law must be applied with the greatest caution. If an applicant describes the invention in his Provisional Specification only in broad terms and then in his Complete Specification describes in detail an embodiment of his invention, it may happen that when the application is examined, which occurs after the Complete Specification is filed, the only novel features of the invention are features of the particular embodiment described in the Complete Specification only and not in the Provisional Specification. In this case the priority date of the accepted claims would be the date of filing of the Complete Specification. Further, it will be understood that if the applicant or anyone else published in documents or by usage the embodiment of the invention in the interval between the filing dates of the Provisional and Complete Specifications, the accepted claims of the Complete Specification would be invalidated by such publication.

Accordingly, the safest course to adopt is to include in the Provisional Specification as full a disclosure of the invention as possible, including details of all embodiments known at the time. However, the Specification should preferably not set out any admission of prior art because the applicant will be held to this admission and it could, if made in error, eventually deprive him of his rights.

Priority Right

There is another excellent reason for making a thorough disclosure of the invention in a Provisional Specification. After having filed a Provisional Specification in Great Britain, the Applicant may wish to protect the invention in overseas countries. By an international convention the priority right established by the British Provisional Specification is respected by many countries subject to the local law relating to what disclosure in the British Provisional Specification is necessary for the Specification to serve as a priority document. In the United States the law in this connection is somewhat onerous and requires that a proper disclosure of an invention shall include an embodiment of the invention, illustrated where practicable by drawings, and it has been held by a United States Court that if the priority date of a British Provisional Specification is to be proved, the disclosure in the Provisional Specification must comply with this statutory standard.

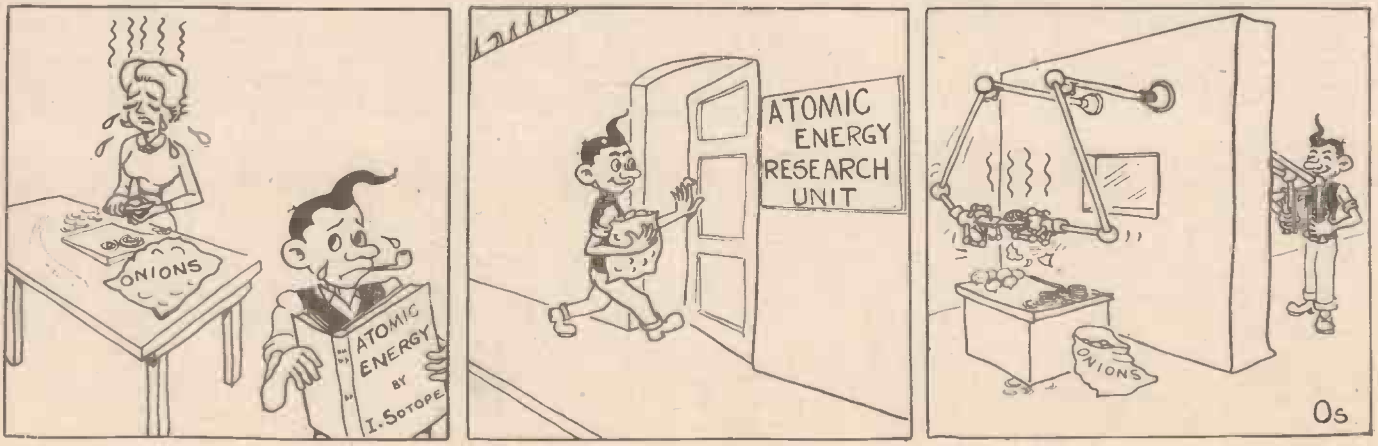
In the case, therefore, of inventions which are to be protected in overseas territories, and in particular in the United States, the disclosure in the British Provisional Specification must, to be on the safe side, be as full and detailed as possible and should contain drawings where these are practicable.

Summing Up.

To sum up the position it will be appreciated that a Provisional Specification must describe an invention which is a manner of new manufacture or a method of testing applicable to the improvement or control of manufacture. Also, it is desirable that no disclosure of prior art be made and that the description be as detailed as possible and include drawings, where practicable, to illustrate the invention. If it is possible, statements should be inserted which are coterminous with the main claims eventually filed with the Complete Specification so that doubt is eliminated as to whether the invention claimed is properly foreshadowed in the Provisional Specification.

From this brief account it should be realised that the preparation of a Provisional Specification is an important task, the execution of which usually requires a standard of skill, normally outside the competence of those who have not had special professional training. An inventor by filing his own Provisional Specification may deprive himself of full protection for his invention owing to neglect of important drafting considerations.

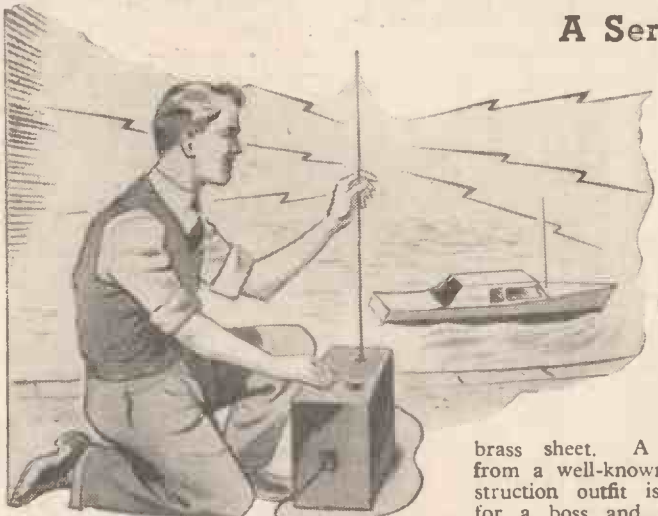
ANDY MANN — THE PRACTICAL MECHANIC



Radio Control for Model Boats

A Series of Three Articles Describing the Necessary Equipment

No. 3.—The Pulsed Pulse System —Final Form By D. W. Aldridge



THIS month an alternative type of speed control switch is described which gives more positive control, as it enables the operator to change speed in rapid, precise steps rather than by the previous method of watching the movement of the model to ascertain when the correct speed had been attained. Reversible sequence is still used, however, as it is most desirable for accurate control, particularly when "docking" the model or carrying out involved manœuvres.

Fig. 23 shows the essential operating parts of the reversible sequence mechanism. The heart of the unit is the ratchet wheel which should be about 1½in. dia. and cut from brass sheet. A collar from a well-known construction outfit is used for a boss and should be soldered to the centre. The teeth should be carefully filed out as shown. The two actuating arms and their cross arms should be built up from brass sheet and the pivots should be arranged as indicated. A tension spring is used to reset the arms after movement to the dotted line position shown. In the original a dial cord spring was used. The two small tension springs used for the cross arms were made from very light springs taken from an electric motor brush gear.

The method of operating the two arms is the very simple one of pulling them up with string wound round extension shafts on the two actuating motors. A small amount of slack in the spring is necessary so that the motor can be free to start turning before taking up the drive. Ever Ready motors are specified for this purpose. Wire loops or other similar devices should be provided to prevent the strings from becoming entangled with the remainder of the mechanism and hence stopping its action. The positions of the two top stops are particularly important, as they decide the exact amount of rotation imparted by each motion of the actuating arms. They should be set so that 15 degree steps are taken for each movement. Fig. 24 shows a practical unit using this principle, but with the two actuating motors mounted differently. The action of this unit is rapid and effective.

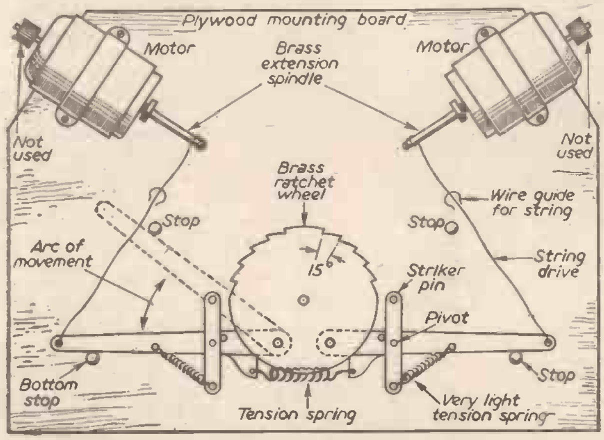


Fig. 23.—Engine speed control switch—actuating side.

List of Principal Components. (Intergear mechanism).

Relay 1.—Receiver relay 3,400 Ω Siemens High speed preferred.

Relays 2, 3 & 4.—Secondary relay Siemens High Speed 1 x 145 Ω coil preferred.

Relays 5 & 6.—Double pole changeover type—Miniature type preferred—coil resistance 170 Ω Coil resistance up to 250 Ω will probably be satisfactory so long as relay will close on 5 to 6 volts.

"Fail Safe" Relay.—Heavy duty type—to pass full current of main propulsion motor. Coil winding to work on 4 volts. This may necessitate rewinding coil (try 32 or 34 swg. enamelled).

Delay Condensers (Bias Electrolytic types).
Two 100 μF 12 volts working.
One 1,000 μF 12 volts working.
One 3,000 μF 12 volts working.

Miscellaneous
Six 22 Ω ½ watt resistors.
Four 0.1 μF 150 volts working condensers.

The only parts turned on a lathe were the small brass extension spindles on the motor shafts. These are about 1in. long and as small in diameter as possible consistent with the need to have a small hole (1/16in.) drilled in one end to fit the motor shaft. A tight fit is needed here. If the spindles are too large in diameter the motors may not be able to wind up the actuating arms against the reset spring.

The Bearing

A construction outfit wheel is used as a bearing and another construction outfit collar forms the centre portion of the contact wipers on the reverse side of the switch. Figs. 25 and 26 show the general arrangements of the contact side of the switch, together with the wiring for the two servo motors. The contact ring is cut from ¼in. thick plywood and is fitted with contacts made from brass or copper shim as before. These are cut out as quadrants of metal and then tacked on to the plywood ring with

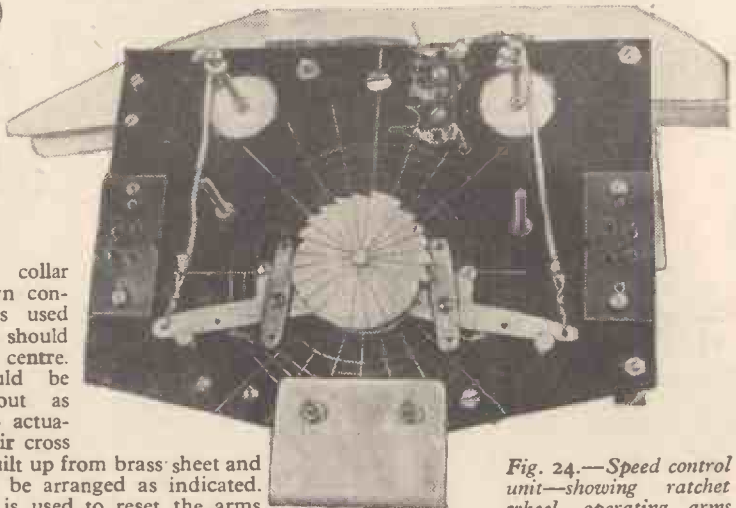


Fig. 24.—Speed control unit—showing ratchet wheel, operating arms and string drives. The two four-pin sockets are used to connect to two separate motors in a twin screw model.

Fig. 25.—Contact side of speed control switch.

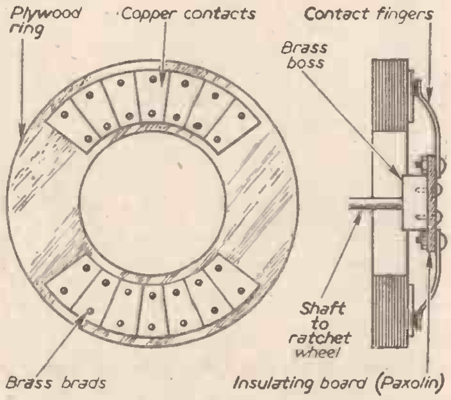


Fig. 26.—Method of making contacts.

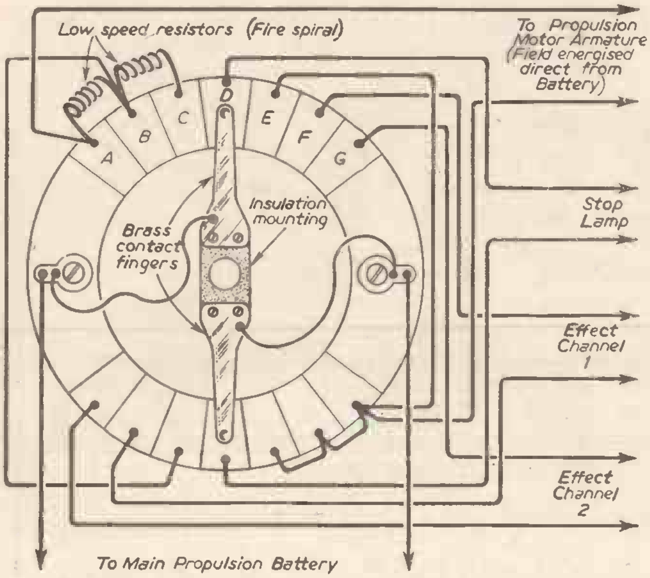


Fig. 27.—Suggested wiring of speed control unit. A—Full speed ahead; B—Half ahead; C—Slow ahead; D—Stop (mast lamp on); E—Half speed astern; F—Effect channel 1; G—Ditto 2.

brass brads. The cutting into individual contact segments is left until later, as it is then simple to saw across with a fine-toothed saw. A suggested method of wiring is given in Fig. 27 and this permits three forward speeds to be obtained, plus stop, astern and two additional positions for special effects. The wiring of the switch unit shown in Fig. 28 is not the same as the circuit suggested in Fig. 27. This unit was developed for a slightly different purpose and uses a reversing relay instead of making the switch contacts carry out the reversal of current. It will be obvious that the basic idea of this type of switch can be modified to suit different requirements and that a greater or smaller number of contacts can be fitted as required. The seven-position switch has, however, been found to be adequate for boat control.

This new type of speed control switch improves on the screwed rod type previously described but it does inherently throw away the "fail safe" characteristics. The screwed rod switch would automatically run to the "stop" position in the event of radio failure (or of going out of range), but this is not now the case and the new switch will simply hold on with one of its two servo motors energised. To counteract this and to bring in additional circuits the following system was devised.

Details of the Pulsed Pulse Circuit—Final Form

The final circuit is given in Fig. 29. This is a development of circuits previously given in this series and consist essentially of the use of an additional delay—Relay 6—plus its associated delaying condenser 3,000 μF 12 volts working and a charging resistor 22 ohms, $\frac{1}{2}$ watt.

The same control box is used as described last month and the pulses used are also the same. The difference lies in the fact that when a continuous Mark or Space is sent to operate the engine speed control switch, the effect is only sustained in the model long enough to permit the function to be carried out and then power is switched off

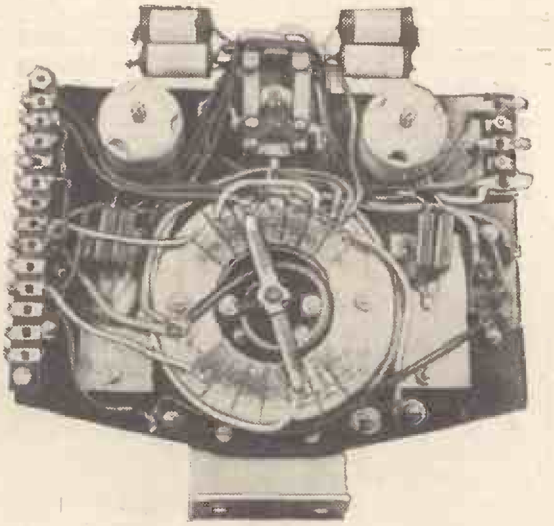


Fig. 28.—Rear view of speed control switch showing contact assembly, reversing relay, suppressing condensers and tag strips for connecting inputs and outputs.

the speed control unit and into two new circuits. These new circuits are (a) where if a Mark is sent then a hooter will blow and (b) where if a Space is sent the result is that a master "fail safe" relay cuts off all power to the propulsion motor and effect channels, thereby stopping the model and saving current until pulsing is resumed, whereupon all circuits reset and the model proceeds on its way.

Circuit Operation

The full functioning of the circuit is as follows (refer now to Fig. 29):

First we shall consider *Neutral Condition* (i.e, steering and engine speed control servos at rest). The receiver relay (Relay 1) is made to pulse at a rate of about 30 per second. Relays 2 and 3 are, therefore, held on all the time by the action of the delaying condensers connected across their coils. Relay 4, consequently, holds on and this holds on Relay 6. Relay 5 is off. No power can therefore pass into any of the external circuits.

Steering

Assume that a Mark is transmitted and that the receiver relay is closed by this action. (i.e., current rise type of Rx) Relay 2 will therefore remain closed but after a very short time delay (about 1/20th second), Relay 3 will open and current will pass through the contacts of Relays 6 and 5 into the steering motor causing it to turn. Whilst this is happening, Relay 4, although no longer energised by the battery, is being held on by the 1,000 μF condenser which is discharging through its coil. Relays 6 and 5 are in consequence unaffected. Before the

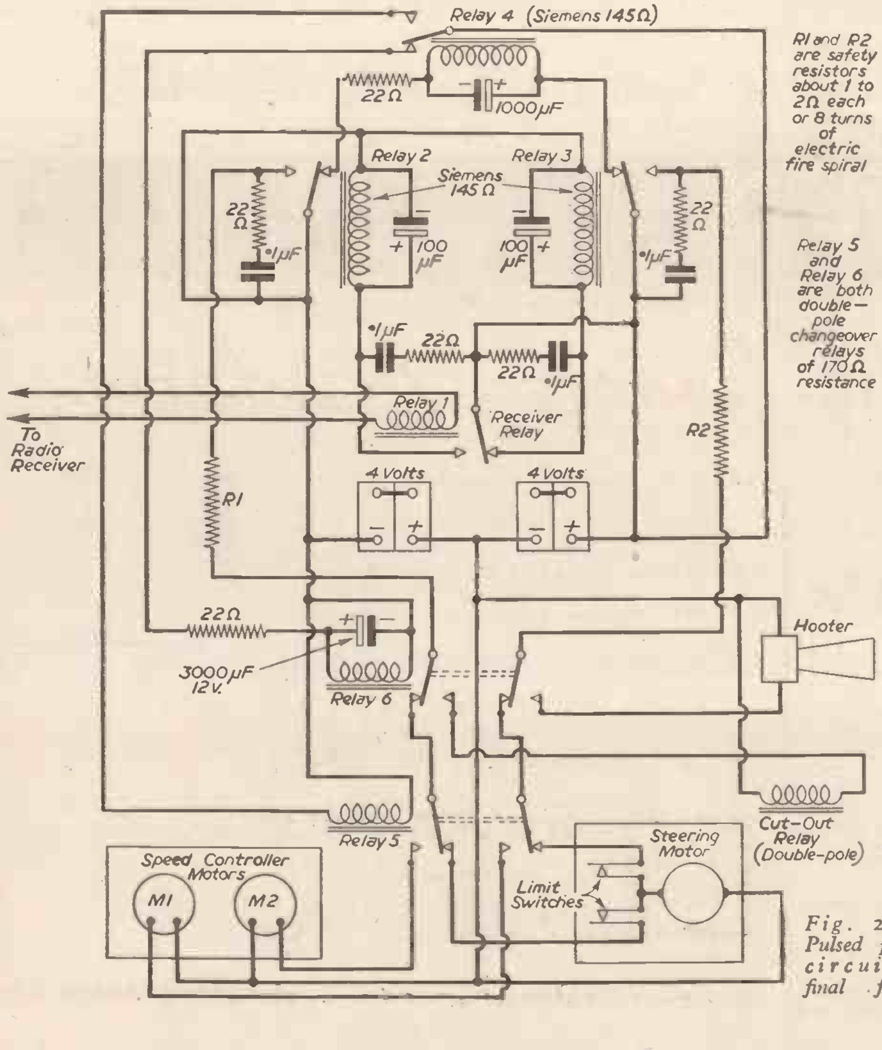


Fig. 29.—Pulsed pulse circuit—final form.

1,000 μF condenser across Relay 4 becomes discharged, it is necessary to boost it up again if steering action is to be continued. High speed pulsing is, therefore, resumed momentarily which causes Relay 3 to close and hence current to pass into Relay 4 and its condenser. Another short Mark can then be sent which causes steering action to continue. The steering motor, therefore, runs in a series of surges with power on about 75 per cent. of the time and power off for the remainder. The transmission of a Space causes a similar action to take place but with Relay 2 opening and Relay 3 remaining closed. The steering motor will then run the opposite way as reverse battery polarity is applied. Interspaced bursts of high speed 50/50 pulses must, of course, be used here to maintain Relay 4 closed whilst steering.

Engine Speed Control

If a continuous Mark is applied then the receiver relay will close and Relay 3 will drop off. A short spurious steering signal will then pass into the steering gear which as stated last month can be counteracted if desired but which is not normally of any importance. Relay 4 will then drop off, immediately closing Relay 5 but leaving Relay 6 held on due to its large delaying condenser. Motor 1 of the speed control mechanism will, therefore, become connected to a battery and will operate. As soon as this has carried out its function, high-speed pulsing can be resumed. If a continuous Space is sent instead of a Mark then the same general pattern of events takes place except that Relay 2 will drop off and it will be Motor 2 of the speed control mechanism which operates.

By these means it is possible to increase speed or reduce it at will, and, as the reversible sequence is used, no unwanted speed positions have to be passed before arriving at the required speed.

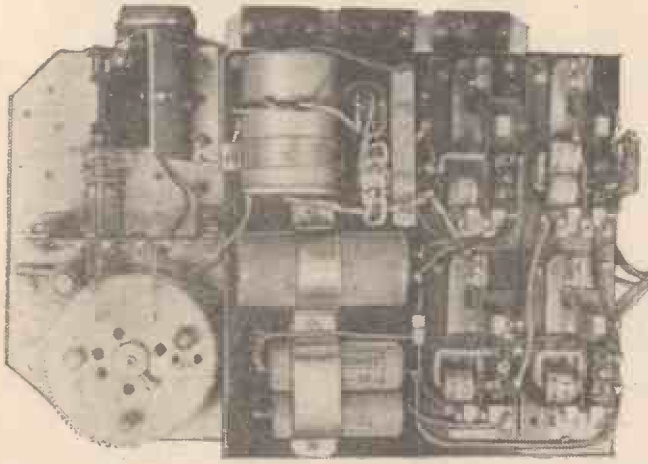


Fig. 31.—Plan view of complete intergear and steering gear unit used by the author—all connections are made by plugs and sockets for easy withdrawal of the unit for maintenance.

Fail Safe and Hooter Controls

In describing the operation of the engine speed control by the transmission of continuous Marks and Spaces it will have been apparent to the reader that once the speed controller motor has been energised, current is needlessly passing through its armature, as the action of winding up the arm takes only a fraction of a second. By arranging for an additional delay circuit it is possible to make the action automatically terminating, even though the operator holds on a pulse of much longer duration than necessary. This is the function of Relay 6 and the 3,000 μF delaying condenser.

As soon as Relay 4 opens Relay 5 closes and the pulse of current passes into the appropriate controller motor. At the same time power to Relay 6 is cut off and it is only maintained closed by the discharging of the delaying condenser. This has a large value and the relay will therefore stay on for about a second (depending upon the relay used). After this time, however, Relay 6 will drop off and power will be applied either to the hooter or to the master "Fail Safe" relay.

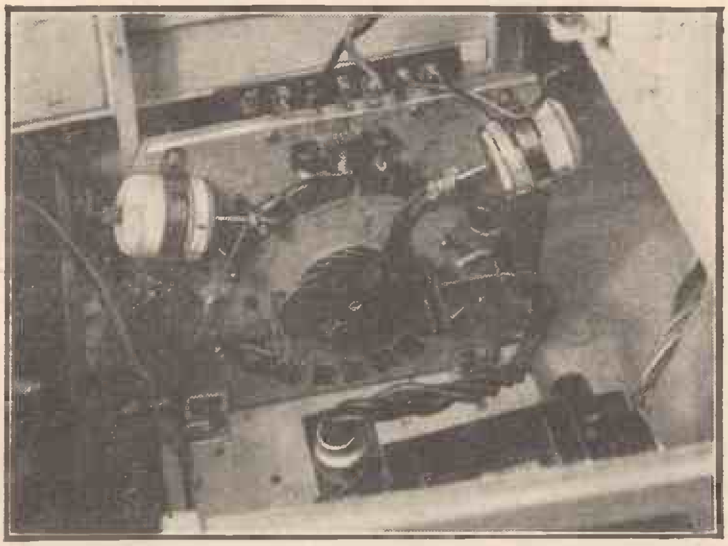


Fig. 32.—View of speed control unit and connection to propulsion motor. Note half-speed resistor spiral between two servo motors.

The circuit should be wired so that the hooter blows when a long Mark is sent and so that the "Fail Safe" relay is energised when a long Space is sent. The model will now stop in the event of radio failure. It also means that so long as it is moving, it is under radio control—a very useful effect for one's peace of mind!

The hooter used in the model described here is a bicycle type, intended for 1½ volt operation, but it can be used on 4 volts if a small safety resistor is used in series (another piece of the ubiquitous electric fire spiral).

Resistors 1 and 2 in Fig. 29 are for safety purposes in case Relays 2 and 3 should by any chance fall out together. This will cause a battery short circuit but these two resistors limit the current to a safe value without noticeably affecting the operation of the servo motors.

Battery Supplies

The entire circuit is built round the use of two 4 volt batteries. These can be two 4 volt blocks of Varley dry accumulators which in addition to supplying the whole of the intergear requirements also supply power to drive the model. For this to be a satisfactory arrangement it is essential that the batteries used be able to maintain a reasonably uniform voltage over the normal operating time it is expected to use the model—say one hour actually in motion on the water. The Varley cells used will do this admirably and are intended for heavy discharges such as are encountered in this kind of work. The type used is a VPT 9/14 which is rated at 14.5 ampere hours at the 20 hour rate and at 9 ampere hours at the one hour rate (supplied by Varley Dry Accumulators Ltd., By-Pass Road, Barking, Essex).

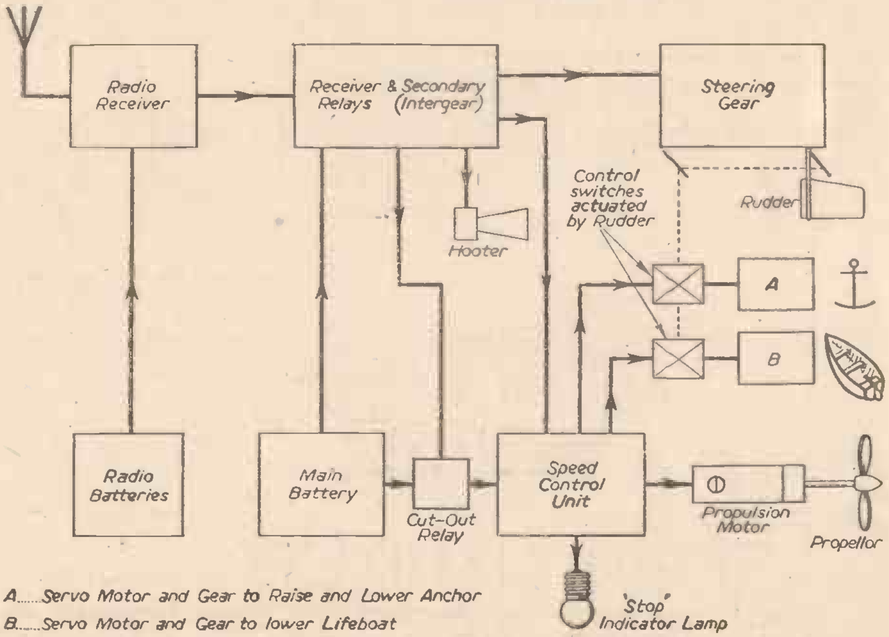


Fig. 30.—Block diagram of system.

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FRACTIONAL H.P. MOTORS, 1/100th h.p., 200/250 volts D.C./A.C., length 3½in., diam. 2¾in., double-ended spindle ¼in. thick, unused. 27/6.

SOLENOID OPERATED OIL DILUTION VALVES, Ref. 5U/3013, 24 volts, suitable for air or oil, maximum air pressure 40lbs. p.s.i., overall size 3½in. long, 1½in. diam. approx. 7/6.
Ditto, 12 volt, Ref. 5U/1566, 9/-.
Special quotation for quantities.

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OIL TEMPERATURE GAUGES, mercury in steel, 0/100 deg. C., Ref. 6A/722, with 20ft., 30ft. or 50ft. capillary tube. 32/6 each.

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NEW "KLAXON" CAPACITOR INDUCTION MOTORS, 230/240 volts A.C., 50 cycles, 1/40th h.p., 1,500 r.p.m., mounted in metal frame 9in. long, 4in. wide, 4½in. high, diameter of motor 3¾in., length 6in., with 1½in. long spindle, diam. ¼in., complete with capacitor, fan cooled. £3.17.6.

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DITTO—Ratio 108 to 1, input and output spindles 3/16in. diam. 20/- each.

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RECTIFIER UNITS, type 2D, maximum D.C. output 10 amps., 22 volts, supply voltage 200/250 volts A.C., 50 cycles, fitted in metal cabinet 21in. x 14in. x 10in., with 4in. diam. meter, fuses, variable 9 to 22 volts. £15.10.0.

HYDRAULIC PUMPS, Ref. IHC/mark IA, suitable for water or oil, flanged mounting, spline shaft, new. 47/6 each.

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EX-AIR MINISTRY GEAR PUMPS, Type RFP/1, made by Rolls-Royce, size approx. 6in. x 5½in. x 5in. 27/6.

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U.S.A. AIR FORCE 12/24-VOLT BLOWER MOTORS, size of motor 3in. long, 1¾in. diam., size of fan housing, which is made of bakelite, 3in. diam., 1½in. deep, outlet ¾in. diam., intake 1¾in. diam. 25/- each.

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MAGNETIC CONTROL UNITS, Ref. 5D/609, 12/24 volts D.C. operating rotating cam, selecting 5 sets of contacts in sequence, ideal for radio control, etc., fitted in diecast case. 15/- each.

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As a propulsion motor, the writer uses a Hoover rotary generator of ex W.D. origin (Type HT11 Watt No. 1). This is altered so that its two field coils are run in parallel instead of series as supplied. This enables full energising to be obtained from the 8 volt supply and, in consequence, adequate performance at this voltage, although it is really a 12 volt unit. Current requirements are quite high and a discharge of 8 amps. has been measured on load. The motor drives twin screws through 3 : 1 step-down gearing.

The block diagram given in Fig. 30 should assist readers in getting a clear picture of the positions of the various items of equipment in the circuit. In this diagram the two effect channels, wired into the speed control switch, are shown as actuating anchor and lifeboat via switches controlled by the rudder. The anchor winch can be arranged so that the anchor runs out and is then rewound by the same direction of rotation or, alternatively, the circuit can be wired so that full Port rudder lowers anchor and full starboard rudder raises it again. Similarly, the lifeboat can be raised and lowered. By arranging extra sets of contacts on the speed control switch it is possible to light navigation lamps or fire a gun, etc., whilst the vessel is under way.

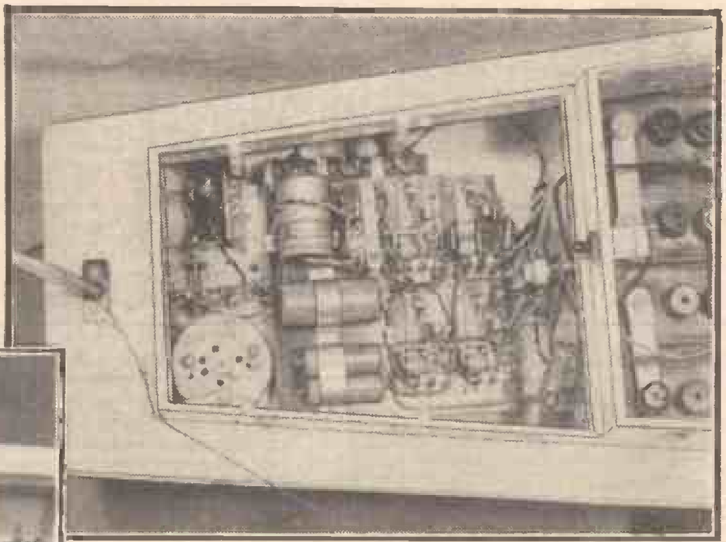


Fig. 33 (Right).—Stern section of model showing intergear and steering unit in position.

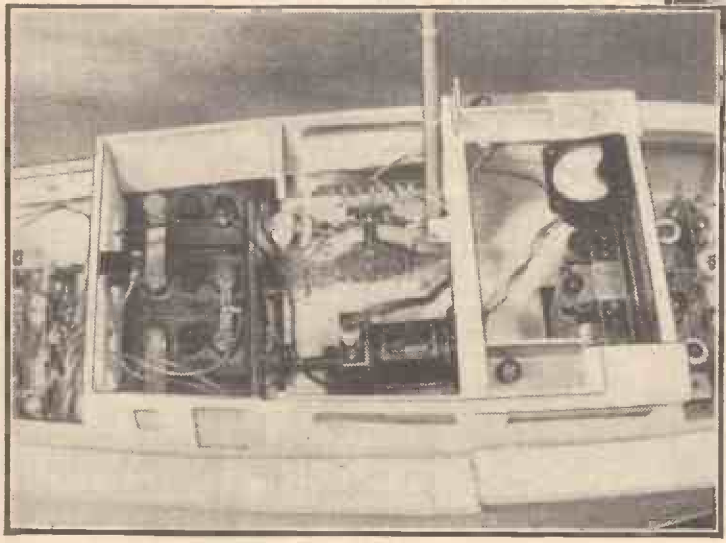


Fig. 34 (Left).—Centre section of author's model showing four two-volt Varley cells which supply power for propulsion and for all servo gear; also speed control unit, propulsion motor and gearing and radio batteries.

Operation of the Model

As only steering and speed control levers are available to the user it takes a little practice to make best use of the facilities offered by this system. Steering will be found to be very effective, which is a good thing as this is obviously the primary control of any remote-controlled model. Speed control is also very good and the slight interaction with the steering will only be found to be noticeable when travelling at full speed and changing to a lower speed. The hooter can be operated in any speed position and follows on an increase in speed if a Mark is held on. If it is desired to stay at the same speed and to hoot, the speed control lever should first be operated so as to cause a slowing down by one step in the sequence, e.g., front slow ahead to stop, and then immediately the opposite order is given and held on, i.e., the model then reverts to slow ahead and the hooter blows. In the case of full speed ahead this procedure is not necessary as the sequence switch will not go any further having once reached its limit. This may sound complicated, but it is quite simple to use once the requisite practice has been obtained.

Passe Partout Frames

(Concluded from page 82)

in suitable length and width, all mitred at the corners to give a good final fit. Cutting may prove difficult en masse and this is best carried out before gluing pieces together. The four edge pieces are now glued down to the backing board and the mounting material is placed into position. The decoration or specimens are carefully placed into a good composition on the mount and the whole is then bound with strips of cut passe-partout binding from front to back as in the case of the simple framing operation.

For added strength in the case of large wallcases, two strips of binding may be applied, one on top of the other to give a double bond.

Such showcases are used for displaying all kinds of materials in public and elsewhere, suitable title strips being added to the bound case to name the subject with any detail. Small cuts of gold passe-partout make excellent name plates for wall cases and neat lettering may be added for titles.

Panelling Work

Artistically cut strips of binding may be used to decorate plain wood boxes, fancy boxes, the covers of books and other work. In addition, many home decorators use these bindings to make all kinds of fancy and decorative panels and borders on walls in various rooms in the home. Gold and black, red and brown and other colours harmonising with the general colour scheme are used. One, two or more colours which blend together, overlapped, make a first-class panel or border for many types of wall.

Curves, shapes, corner motifs on both walls and wood furniture may be obtained by thoroughly moistening the binding when it will be found that it becomes very pliable in the hands. First work out the design, sketch or draw the basic pattern or line and then follow the outlines with the wet binding. Hall and stairways may be considerably improved with a suitable border and the width may be built up to suit available space and proportions. Plain distempered walls and others covered with plain plastic papers, may be considerably changed in character by the application of some strips for borders and general decoration.

Letters to the Editor

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

Reducing Waste of Electric Light

SIR,—I have noticed in the September issue, in Science Notes, a paragraph describing an electronic device which would give the alarm when there is sufficient daylight to enable the artificial light to be turned off.

I felt you might be interested to know that it is now many years since Sargrove Electronics designed a controller for artificial lighting, the object of which was to actually turn the lights off when there was sufficient daylight and to turn them on again as darkness falls. Over the years this system has been expanded to take care of rooms receiving a varying amount of daylight, each having a preset individual adjustment. That is to say a multi-channel system extendible up to 30 remote control stations, so that in a large factory area, for example, the artificial lighting can be so divided that as it grows lighter first one-third of the total lighting is taken off, then another third of the total lighting and finally all the lights go off to provide a smooth transition from artificial lighting to daylight conditions completely automatically.

Just recently this principle has been applied to the control of shop fascia and display lighting, also to the control of shop blinds which come out automatically to protect the articles in the shop windows against the damage from the rays of the sun.

Obviously, if a system only gives the alarm when something is required to be done it is of little help, as someone must be available to take action and there is no guarantee that the lights will be turned off. Whereas, with the automatic control system, once preset adjustments have been regulated to suit everyone's requirements, no further action is needed, and any wastage of artificial lighting is avoided. At the other end of the scale, artificial lighting is provided automatically whenever it is needed so that operatives will never be working with inadequate light.

Our first lighting control system was installed for the Swiss power stations about seven years ago and there are now a number of large industrial undertakings making use of this new development in electronic controls.—R. D. CARTER-PEDLER (Sargrove Electronics Ltd.).

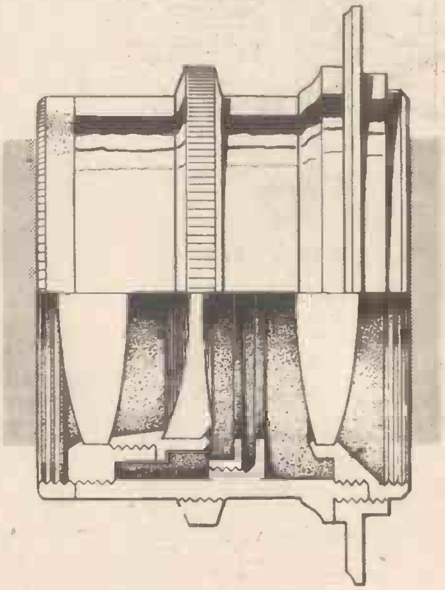
Diagram Correction

SIR.—In J. C. Lowden's fine article on the camera lens (August issue, page 77) Fig. 14 shows three negative lenses as a photographic triplet.

The normal construction of a camera lens of this type is one bi-convex lens followed by a negative lens and then by another bi-convex lens. The system shown is entirely negative and, as Mr. Lowden will know, cannot produce an image.

The metalwork design is wrong in many respects. The iris actuating ring is divorced from the iris. The flange is screwed half-way on to the lens mount and half-way on to the rear cell. The front lens cell has no shoulder.—W. T. RICKETS (Devon).

[*We regret the errors referred to and below is given a new diagram which shows the Zeiss Novar triplet.*—ED.]



The Zeiss Novar triplet.

READERS' APPRECIATION

SIR,—It has been my privilege and pleasure to have been an ardent reader of PRACTICAL MECHANICS since it first commenced publication in October, 1933, and I still await each issue with impatience.

Although, of necessity, some items have through the years beer duplicated, I think the variety and standard of the articles are of the highest quality.

I still have a large number of the back issues and upon looking through them the other day found I still have No. 1 of the 1st Vol., so I thought perhaps you might like a photograph of it.

Many thanks for past pleasures, and my good wishes for the future.—CHARLES A. WADSWORTH (Bedford).

The first "Practical Mechanics" cover.

Mr. Womack's outboard hydroplane.

SIR,—I have for a long time wished to write to express my appreciation of your periodical PRACTICAL MECHANICS.

I have read the magazine now for quite a few years and have found many very interesting and, most of all, "practical" topics.

One, for instance, which I thought I must write and tell you about, was "Building an Outboard Hydroplane," published in April, 1954.

I built this craft according to the details laid out by M. L. Beach, and have, after fitting a 15 h.p. "Anzani" outboard on the transom, had more thrills from this "speed machine" than anything else I have owned. Forty m.p.h. on water is much more thrilling than 90 m.p.h. in any sports car. I only wish there were more facilities in order to encourage this sport

Thank you for making such expensive hobbies and sports come within reach of the average enthusiast, and I hope you will continue to keep up your high standard.

Above is a photograph of my hydroplane on a lake, showing the type of thrill I mean.—A. D. WOMACK (Yorks).

[*Congratulations!*—ED.]

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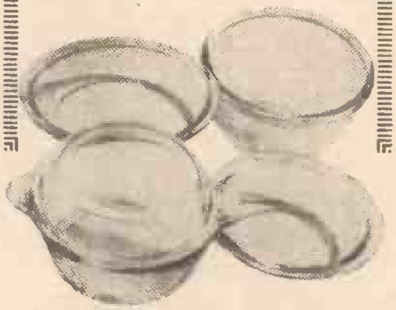

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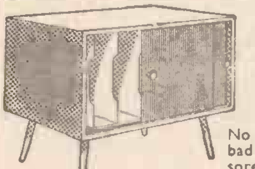


RECORD CABINET, £3.15.0

No more piles of records—bad for them and an eye-sore to you. We are delighted to be able to offer this attractive record cabinet at such a remarkably low price. It is reed fronted and wood partitioned for easy classification and filing. It will take 200-300 records in an upright position. The overall size is 24in. x 24in. x 15in. and the legs are detachable if you so wish. The design is modern and it is space saving because it will serve a dual purpose being ideal also as a T.V., Radio or Record Player stand. Complete, sand papered finish, ready for staining, French polishing, painting, etc. P.P. and Ins., 5/-.

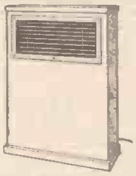
RECORD PLAYER CABINET, 39/6
Amazing offer. Latest contemporary style, rexine covered cabinet in two-tone colour scheme. Hinged, clipped lid, carrying handle. Space available for all modern amplifiers and auto changers, etc. Store soiled. Carr. Ins., 4/6.

COLLARO 4-SPEED AUTO CHANGERS, £7.19.6.
Type R.C.457 incorporating auto and manual control, complete with studio crystal p.u. and sapphire stylus. P.P. and Ins., 5/6.

PORTABLE AMPLIFIER MARK D.I., 59/6
Brand new. Latest design with printed circuit. Dimensions 7in. x 2½in. x 5in. A.C. only. Mains isolated. 2-3 watts output. Incorporating EL84 high gain output valves. Volume and tone controls. P. & P., 3/6.

PORTABLE AMPLIFIER MARK D.4, 69/6
Brand new. By famous manufacturer. Especially built for portable record players. Dimensions 4¼in. x 3½in. x 4in. A.C. only. 2 valves EL84 as high gain output valve. EZ80 as rectifier. Volume and tone controls. P. & P., 3/6.

STEREOPHONIC AMPLIFIER, £7.19.6
(12 months guarantee). Beautifully made for portable stereophonic record players. Latest design with printed circuit. Dimensions 3in. x 5½in. x 9¾in. A.C. only. Mains isolated. Each amplifier gives 3-4 watt output. Incorporating ECL82 triode pentode valves. Full Tone volume and balance controls. Complete and ready to fit. Knobs, 3/6 per set extra. P.P. and Ins., 4/6.

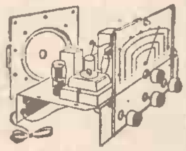


ELECTRIC CONVECTOR HEATER, 99/6
Start to prepare for Winter now. Draughty corners no longer necessary. Electric Convector Heaters will give you a steady, comfortable heat. Don't forget—luxurious warmth at an economical price. They can be used in any part of the house where there is a plug. A.C./D.C. switched for 1 or 2 kW. Illuminated grille. Size 26in. x 18in. x 7½in. deep. Ins. Carr., 10/6.

SOLO SOLDERING TOOL, 12/6

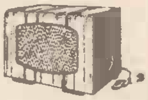
110 v. or 6 v. (special adaptor for 200/240 v., 10/- extra). Automatic solder feed, including a 20ft. reel of ERSIN 60/40 solder and spare parts. It is a tool for electronic soldering or car wiring. Revolutionary in design. Instantly ready for use and cannot burn. In light metal case with full instructions for use. Post, 2/9.

SUPER CHASSIS, 99/6



5 valve superhet chassis including 8in. P.M. Speaker and valves. Four control knobs (tone, volume, tuning, w/change switch). Four w/bands with position for gram p.u. and extension speaker. A.C. Ins. Carr. 5/6.

EXTENSION SPEAKERS, 29/9



Fitted 8in. P.M. speaker W.D. or Goodmans of the highest quality. Standard matching to any receiver (2-5 ohms). Switch and flex included. Unrepeatable at this price. Money back if not completely satisfied. Ins. Carr. 3/6.
If your hobbies take you into the workshop or garage you need not miss your favourite programmes. Fit one of our speakers :
8in. P.M. SPEAKERS, 8/9. With O.P. Transformer fitted, 10/-.
6½in. P.M. SPEAKER, 12/6. Postage 2/9.

MAINS TRANSFORMERS, 15/9. 350-0-350 v. 250 mA., 6 v. at 5 amp. 6 v. at 5 amp. 4 v. at 4 amp., 22 v. at 6 amp., extra winding for 2 v. or 4 v. tubes. Prim. 200-250 v., 50 cycles. P.P., 3/9.

MAINS POWER TRANS., 12/9. 350-0-350 v., 250 mA., 6 v. heater at 5 amp., 4 v. centre tapped. Drop through type. Prim. 200-250 v. (4½in. x 5in. x 5in.). Post, 3/9.

MAINS TRANS., 3/9. 350-0-350 v. 80 mA., 4 v., 4 v. heaters, 200-250 v. prim. Post, 2/3.

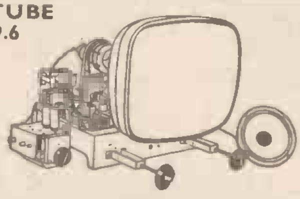
MAINS TRANS., 5/9. 280-0-280 v. 80 mA., 6 v., 4 v. heaters. 200-250 v. prim. Post, 2/3.

MAINS TRANS., 12/9. 425 v. 300 mA. single secondary. 6.3 at 12 amp. 6.3 v. at 0.6 amp., 200-250 v. screened primary. P.P., 3/6.

SOUND AND VISION STRIP, 25/6
Superhet. Tested I.F.s 10.5 Mc/s sound, 15 Mc/s vision. Eight valve bases (6-6F1s and 2-6D2s not included). Size 8½in. x 5in. x 4½ in.high. P.P., 2/6. The Turret Tuner plugs directly into this chassis. State channel required.

SOUND AND VISION STRIP, 10/6
Superhet. Complete vision strip. Less valves. Not tested, drawings free. Postage, 2/6.

17in. T.V. CHASSIS, TUBE AND SPEAKER, £19.19.6



17in. Rectangular Tube on modified chassis. Supplied as single channel chassis covering B.B.C. channels 1-5, or incorporating Turret Tuner which can be added as an extra, at our special price to chassis purchasers, 50/-, giving choice of any 2 channels (B.B.C. and I.T.A.). Extra channels can be supplied at 7/6 each. Chassis size 12in. x 14½in. x 11in., less valves. Similar chassis were used by well known companies because of their stability and reliability. With tube and speaker, £19.19.6. With all valves, £25.19.6. Complete and working with Turret Tuner, £28.9.6. 12 months guarantee on the tube, 3 months guarantee on the valves and chassis. Ins. Carr. (incl. tube), 25/-.

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DUKE & CO

(Dept. H.11)
621/3, ROMFORD ROAD, MANOR PARK, E.12
ILF. 6001/3.

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Lampshade making can give endless fun, beautify your home and delight your friends. There are 83 practical and easy-to-follow illustrations and ideas to show you how to do it.

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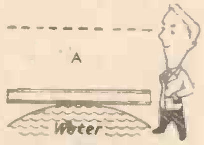
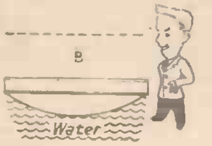
BUTTERFLY BRAND

FIELD THEORY OF THE UNIVERSE

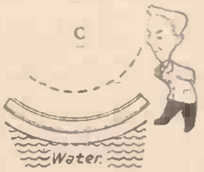
SIR,—In August's edition of PRACTICAL MECHANICS I read with interest an article about the possibility of the earth's being hollow. Two experiments are mentioned apparently claiming to demonstrate the feasibility of the theory, but the results obtained are at *variance with the premises* of the very theory they are claimed to prove (or partly prove)! It is said that space inside the hollow sphere is non-Euclidean, and obeys a law which is quadratic*, well the point is simply this: how can a pair of plumb bobs down a deep shaft prove anything regarding the hollow earth theory? It is said that the distance between the ends of the cords at the bottom of the shaft is greater than at the top, thus backing the theory. *But how was the width measured?* Would not any material measuring rod correspondingly expand as it approached the earth's centre, or, if you like, *contract by the hollow earth assumption?* It would be analogous to the Michelson-Morley experiment. The most reasonable explanation of the increased spacing of the plumb line is a variation in the density of the surrounding earth. The other experiment can be disposed of in the same way. Actually it matters not an iota whether one uses mechanical, optical, electrical or any other "straight" line device, for any pulse or stress is modified by that space in question. This can be demonstrated by a simple hypothetical experiment.

Get a steel girder, say, 2 miles in length and accurately suspend it over a lake of calm water. If the ends of this straight girder were above the water whilst the centre just touched the water, as exaggeratedly drawn at A, that would prove the earth is the usual solid sphere. But supposing B happened, i.e., the centre is above the water and the ends dip in. Would that in all logic prove the hollow earth theory? The answer is no because what would occur, as the rational interpretation of the theory demands is this: the beam would contact simultaneously along the entire length due to the nature of the space presupposed (C).

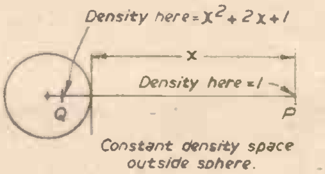




To sum up. Whilst I agree it is an interesting exercise in geometry (pure), as an applied geometrical theory it is pure rubbish!



You do not mention specifically what law this non-Euclidean space inside the sphere (hollow) obeys, but



it appears to be quadratic. Perhaps you could correct me here if I have made a wrong assumption.

Am I right in saying that at a distance x from the *surface*, the density at the "point" Q (corresponding to P outside) is x^2+2x+1?—J. H. PLATT (Scotland).

* Density inside = $x^2 + 2x + 1$, where x = distance above surface.

SIR,—With reference to the reprint article "Is the Earth Hollow?" in your excellent August issue, a few objections to this theory come readily to mind. Although the article states that the ship passing out of sight over the horizon can be explained, how can it be explained (assuming a concave surface) that the man in the crow's nest can see land, or another vessel, before those on deck? Also, I cannot imagine how we could have darkness if the sun were "inside," as surely a light inside a spheroid must be seen from any and all points and at all times, inside the spheroid.

Regarding the experiments in the U.S.A. (1) The "straight and level" line could have been taken at a very gradual depression in the earth's surface (still assuming general convexity); there may be several, or even many such places. (2) The "plumb lines" could have been affected by some local gravitational peculiarity. I seem to remember reading of one place in North America where it is difficult to stand upright owing to the peculiar gravitational pull. My own theory regarding the perpendicular arrival of cosmic rays is that these are so dense as to be affected by the earth's gravitational pull.

Finally, photographs taken by high flying jet planes and published in the "National Geographical Magazine" (U.S.A.) show an apparent convex earth surface.—W. F. CORNES (Staffs).

Model Lighthouse

SIR,—I made the model lighthouse below from a milk churn, a glass globe obtained from a cemetery attendant, a kettle

lid for a ventilator and a 25-watt 250-volt lamp set in a lampholder type flasher unit. —E. G. SMITH (Glasgow).

Black Gloss Finish

SIR.—With regard to the request of Mr. J. D. MacLean of Inverness for information of a black gloss lacquer, I would suggest he tries some black Brushing Belco, made by I.C.I., Paints Division, Slough, Bucks. This is a cellulose enamel, used by myself for quite a number of years. The brush marks remove themselves to give a perfectly smooth finish.

He would, no doubt, be advised to use a black Rexine and stick this on with some good type of waterproof glue or rubber solution.—R. P. BAYLIE (Aldershot).

BOOKS Received

All the books below are published by Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

"Automation in Production Engineering," by J. A. Oates, A.M.I.P.E., M.Inst.Met., C.Inst.W. 326 pages. 45s. net.

HERE is a book that deals with automation in small as well as large machine shops in a thoroughly practical manner. It has been divided into two main sections: first the use of machines for carrying out automatically a series of operations on a component, and, secondly, single machines capable of automatically machining a component from data supplied by punched cards and tape, and magnetic tape. The book contains chapters on automatic loading and unloading installations; copying lathes; gear hobbing; and the automatic gauging and correction of machines. Various types of transfer machines are also dealt with, including examples of typical installations. This book contains over 300 illustrations.

"Radiation Hazards and Protection," by D. E. Barnes and Denis Taylor. 178 pages. 30s. net.

THIS book deals fully with the nature of the possible hazards for people working with radioactive materials and describes steps which can be taken to safeguard personnel against them. This is a vitally important subject which the authors have covered in a concise and authoritative form. Chapters include: Nature and Properties of Radiations; Effects of Radiation on the Human System; Naturally Occurring Radiations; Measurement of Radiation; Personal Protection; Surface Contamination; Air Sampling; Waste Disposal; Transport of Radioactive Material and Other Legal Aspects, etc., etc. The book also contains eight photographic plates and 51 illustrations.

"Handbook of The Atomic Energy Industry," Consulting Editor Sidney Jefferson, B.Sc., A.C.G.I. 270 pages. 35s. net.

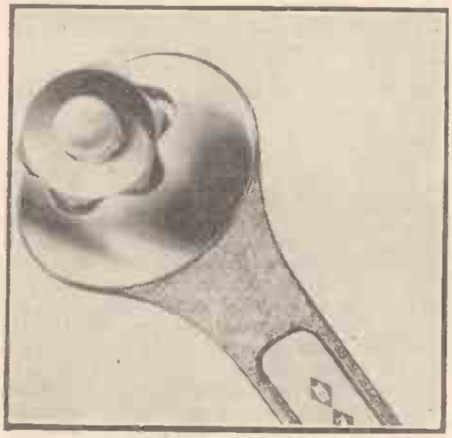
YOUNG people who are planning a career in modern science will find this book particularly appealing. It provides a background of information for all who are concerned wtih the atomic energy industry. Atomic Energy is no longer a field restricted to physicists. There are so many ramifications of this new source of energy that it is entering into everyone's daily life to an extent that increases week by week. This concise, authoritative and up-to-date book covers every important aspect. It includes details of atomic energy authorities throughout the world, and describes educational requirements and training facilities in Great Britain. There are 19 sections including Development of Nuclear Energy; Atomic Structure; Nuclear Fuels; Nuclear Power for Aircraft; Nuclear Power for Marine Propulsion; Nuclear Research Machines; Radio Isotopes; Radioactive Waste Disposal. The book also contains numerous informative tables and diagrams as well as many formulæ.

TRADE NOTES

A Review of New Tools, Equipment, etc.

The Surpans Spanner

THIS spanner is of revolutionary design, as can be seen from the photograph. The conventional open-ended spanner engages only on two parallel faces of the nut and the main impact is on two corners. The new spanner is designed to grip in the centre of the flats and will grip four faces at once instead of only two. It will be found particularly useful on nuts which have had their corners rounded due to the misuse of ordinary spanners.



The Surpans Spanner in use.

Sizes 3/16in. to 9/16in. B.S.F. and ⅛in. to ½in. Whitworth are available and prices range from 2s. 1d. to 5s. 1d. according to size.

The makers are Brades Nash Tyzack, Ltd., Oldbury, Birmingham, and the spanners are available from ironmongers, cycle and motor accessory dealers and tool merchants.

Stanley Tools Catalogue

FROM the well-known firm of Stanley Works (Great Britain) Ltd., Sheffield, we have received a catalogue giving details of Stanley tools for the hobbyist. Included are planes of various types, spokeshaves, routers, bit braces, hand and breast drills, masonry drills, hammers, screwdrivers, etc., etc. Also available from this firm and described in the catalogue are two tool kits. They are called "The Craftsman" and "Do-It-Yourself," and are both packed in a case designed to hang on the workshop wall.

In addition to illustrations of the tools, specifications and prices, the catalogue contains some excellent advice on the assembly of the tools and their use. The catalogue is available free from Stanley Works (G.B.) Ltd., Rutland Road, Sheffield.

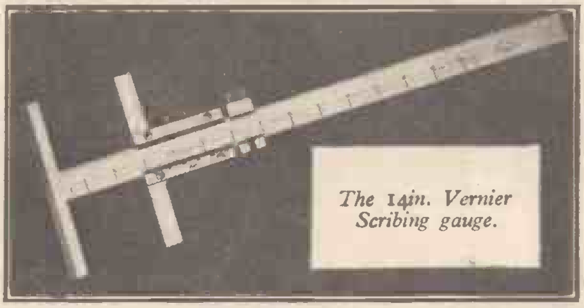
Handicrafts Catalogue

A CATALOGUE listing a wide range of handicraft materials, including basketry and canework, stool frames, upholstery, raffia work, lampshade making, felt work, soft toy making, leatherwork, rug making, marquetry, flower making, gummed paper crafts and jewellery making of various types, is available from Northern Handicrafts Limited, Perseverance Mill, Burnley Road, Padiham, Lancs. In addition to the materials for these and many other handicrafts, tools, books, adhesives, materials for finishing, etc., are supplied.

Every well known handicraft is included and also a number that are not so popular. Kits for the beginner in many fields are featured and the terms and conditions for supply and payment are plainly set out.

14in. Vernier Scribing Gauge

FROM Optical-Mechanical (Instruments) Ltd., 17, Station Road, Egham, Surrey, we have received details of an instrument which offers a new method of marking out from pre-machined edges. The 14in. Vernier Scribing Gauge obviates the use of surface and angle plates and height gauges; it can be used on an ordinary table or workbench. On a large workpiece it is possible to drill small holes where required up to the capacity of the instrument, dowel and re-locate from the pins up to any dimension, progressively.



The 14in. Vernier Scribing gauge.

This scribing gauge can be used to mark out from 0.5in. to 14in. from an edge and is sturdily constructed having a long "easy to read" Vernier with micrometer adjusting screw. Readings below 0.5in. from the edge can be undertaken by use of paired rollers or slip gauges.

They will be on sale shortly and the price will be approximately £18.

MULTI-PURPOSE HEATING ELEMENT

AS can be seen from the photograph, the Flexiheat heating strip consists of a length of mains lead, an adapter and the actual p.v.c. covered heating element which is 42ft. long. It may be used to make an electric blanket, for heating an airing cupboard, a carpet, a garage, greenhouse, etc., or for lagging water pipes. Instructions for its use are given. The element is for A.C. mains. Retail price is 10s. 6d., the makers are Flexiheat, 2, The Oxebode, Gloucester.

Telescope Kits

Readers will be pleased to note that the Seren Astronomical Supplies, of Wharehouse Road, Stebbing, Dunmow, Essex, supply a kit for making the recent P.M. telescope. The kit consists of: mirrors, eyepieces, focusing mounts, spiders, etc. They will supply free details on receipt of a s.a.e.

(Left).—The Flexiheat heating strip.

Kits for Telescope Mirror Grinding

THE articles we published some time ago on grinding a telescope mirror caused wide interest and many readers have asked us for a reliable source of supply for all the materials. Grinding and polishing kits for mirrors up to 8in. dia. are available from L. J. Mays & Co., 20, Clover Road, Timperley, Altrincham, Cheshire, at 25s. plus 2s. 6d. postage and we advise readers to contact them.

Foam Draught Excluder

MARKETED under the trade name "Cling" this draught excluder consists of urethane plastic foam in strip form mounted on a self-adhesive base. It is available in two thicknesses, "Cling" which is 5mm. thick white foam costing 3s. 6d. for a 20ft. coil and "Cling Minor" which is 3mm. grey foam, priced at 2s. 6d. per 16½ft. coil. There are many other uses to which this product can be put, i.e., preventing rugs from slipping, eliminating rattles in the car, protecting walls and furniture and for keeping out dust. The makers are Racasan Ltd., Ellesmere Port, Cheshire.

READERS' SALES AND WANTS

The pre-paid charge for small advertisements is 6d. per word, with box number 1/6 extra (minimum order 6/-). Advertisements, together with remittance, should be sent to the Advertisement Director, PRACTICAL MECHANICS, Tower House, Southampton Street, London, W.C.2, for insertion in the next available issue.

FOR SALE

HOUSE SERVICE METERS, credit and prepayment; available from stock. Universal Electrical, 221, City Road, London, E.C.1.

COMPRESSORS FOR SALE.—Twin Piston with tank, 2½ c.f.m., £4. Single Cyl., £2. All types Motors. S.A.E. for list. Wheelhouse, 13, Bell Road, Hounslow (HOU 3501.)

½OZ., 2/3oz and ¾oz. hand-operated, Bench-Type Thermoplastic Injection Moulding Machines for Hobbies and Industry. Dohm Ltd., 167, Victoria Street, London, S.W.1.

HALF PRICE ELECTRIC DRILL KITS. Lambswool Bonnet, Rubber Backing Pad, 12 Sanding Discs, Grinding Wheel, Buffing Wheel, Wire Brush Wheel and Wheel Arbor, 18/- (usually 36/-).
BARKERS, 70, West Street, Leeds, 1.

"ASTRO TELESCOPE MAKING." Standard Ramsden Push-in Eyepieces, ¼in., ½in., ⅓in. focus, 35/-; s.a.e. list. Object Glasses from 10/6; Eyepieces from 15/6; Newtonian Mirrors, Focusing Mounts, Tripods, also complete Terrestrial Telescopes and Microscopes. W. Burnet, Grand Sluice, Boston, Lincs.

2½ IN. REFRACTOR ALTG. STAND, £20; also Mirrors, Object Glasses and Accessories. G. Mackett & Co., Mfg. Opticians and Engineers, 51, Millers Road, Brighton.

DOBLE STEAM CARS—the basis for modern design—described in detail. Modern steam power unit for light car—switch on to start, steam launches, stationary power. Magazine, illustrated lists of drawings, castings, etc., 4/-. "Light Steam Power," Kirk Michael, Isle of Man, U.K.

FOR SALE (*Continued*)

HOW TO USE EX-GOV. LENSES and Prisms. Nos. 1 and 2, 2/6 ea.; Vertical Enlarger Plans for 35mm. to 2¼in. sq., 3/6 ea.; Optical Condensers and Achromatic Lens to suit, 33/-. Lists s.a.e. H. W. English, Rayleigh Road, Hutton, Essex.

CADMIUM - PLATED AIRCRAFT BOLTS, 2 B.A. to ⅜in. B.S.F., various lengths, nuts. Fibre, Dural Washers, £1 lots, ¼ cwt., 3/6 part carr. Large stocks Alloy Bolts, Nuts, etc. Northern Surplus Equipment, Arnside, Westmorland.

MAINS FROM 12v. CAR BATTERY. American Dynamotor Unit, runs 200/250 AC/DC radios, televisions, tape recorders, etc., from 12v. car battery, continuous duty, perfect, cost £25, 80/-; s.a.e. full details. Scientific Products, Cleveleys, Lancs.

CIRCULAR GLASS DISCS for grinding Astronomical Mirrors. Smoothed and edged, per pair with abrasive 80, 180, 280, 320, 400, 600, superfine finisher. Swedish Pitch, Wax, fine Rouge. 6in. x 1in., £2/15/-; 8in. x 1in., £3/15/-; 8in. x 1½in., £5/15/-, post paid. H. Gibbs, 75, Portmanmoor Road, Cardiff, S. Wales.

ALUMINIUM LAUNCH or Yacht Hulls, 20in. 3/9, 16in. 2/6, postage 1/6. Clockwork Motors, 3/9 and 4/6; Electric Motors, 4/6, 5/-, 6/10 upwards; postage 9d. Clyde Tram and Ship Plans, lists 3d. Glassford's, 89, Cambridge Street, Glasgow, C.3.

MAIL ORDER NEW TOOLS.—Set H.S. Drills, No. 1-60, 47/-: Heavy Table Vice, 2½in. jaw, 13/6; H.S. End Mill, ⅜in., No. 1 M.T., 7/6; H.S. Small Milling Cutters, 6 different, 10/-; Drill Chucks, ⅜in., No. 1 M.T., 11/6; No. 2 M.T., 11/6; Burnerd Independent Chucks, 4in., 72/-; 4½in., 75/-; 6in., £6/4/6; Micrometers, 1in., 10/-; 1in.-2in., 14/6; Spring Dividers, 5in., 7/6; Spring Inside Callipers, 6in., 6/-; Precision Drill Chucks, ⅜in. No. 1 M.T., 34/-; No. 2, 35/-; Dies, 13/16in. 40 T.P.I, 5/32in. 3/16in., 7/32in., ¼in., 3/4 each; Taps, 40 T.P.I, 5/32in., 3/16in., 7/32in., ¼in., 2/- each; H.S. ⅜in. Reamer, 10/-; Wood Saw, 6in. hole, ¼in., 10/-; Dial Gauge, 2in. diam., .005in., £2/16/6. 1/- extra post under 20/- orders. S. Grimshaw, 7, Hall Street, Manchester, 18. (Warehouse: Gorton Lane.)

ELASTIC, catapult, models, etc., 3/16in. round, 9d. yard, post 3d. C. Blundell, 472, Alcester Road South, Birmingham, 14.

MIXED WOOD SCREWS to 1½in., 2/- per gross, post 1/-; over 1½in., 4/- per gross, post 2/-; post on 1 gross each, 2/3. 2,000 items list free. K. R. Whiston (Dept. M.P.S.) New Mills, Stockport.

BALL BEARING Saw Spindle Units with 3in. Vee pulley, hold down bolts, etc., 50/-; Circular Saw Blades, 12in., 9in., 6in. dia.; Wobble Saws; Grooving Cutters; Pulleys and Vee Belts; quick change Motor Mounts, one motor will serve many. Below.

BROOK ELECTRIC MOTORS on deferred terms; low deposit; 6 months to pay. B.C.M.B. Ltd., Rugeley, Staffs.

TECRAGEL, the green, ready-shredded, low-melt plastic for easier and speedier plaster casting. Sample 1lb. 8/9, post free. Add to your income now. Dale's, 2, Boundary Road, London, E.13.

AIR RECEIVERS, 22in. x 5in., 200lb., £1. Pillar Drill, £15. ¼-1 h.p. Motors. 32, Windermere Avenue, N.3.

ELECTRICAL

EXTRACTION FANS, 6in., silent shaded pole, no interference, A.C. only, price 20/-, post 2/-; also New 1/20th h.p. Universal 230v. Geared Motors, 10-1 reduction, suitable for food mixers, price 22/6, post 2/-; 1/6th h.p. Motors, all types, £2/10/-. Wheelhouse, 13, Bell Road, Hounslow.

"STANFORD" ELECTRIC WELDER, 200/250 a.c., complete with heavy welding transformer, welding torch, earthing cable, goggles, carbons, case, instructions. Absolutely as new and perfect, £4; carriage paid. Will send c.o.d. McGrath, 83, Green Drive, Cleveleys, near Blackpool.

MODEL ELECTRIC MOTORS, amazingly powerful. "Mini Mo," 9/6; "Maxi Mo," 13/6, post free 4½ to 9 v., 1⅛in. x 1⅝in., weight 1½ oz. Dept. (Q), "Highland," Alkrington Green, Middleton, Manchester. 3d. stamp full details.

CONVERT your ordinary Washboiler to electric. G.E.C. Circular Washboiler Elements, 200-250 volt, 2Kw., 9¼in. diameter one hole fixing, 22/6 each, plus 1/9 p. and p. London Warehouse, 165, Queens Road, Peckham, S.E.15.

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(*Continued on next page*)

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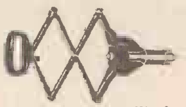

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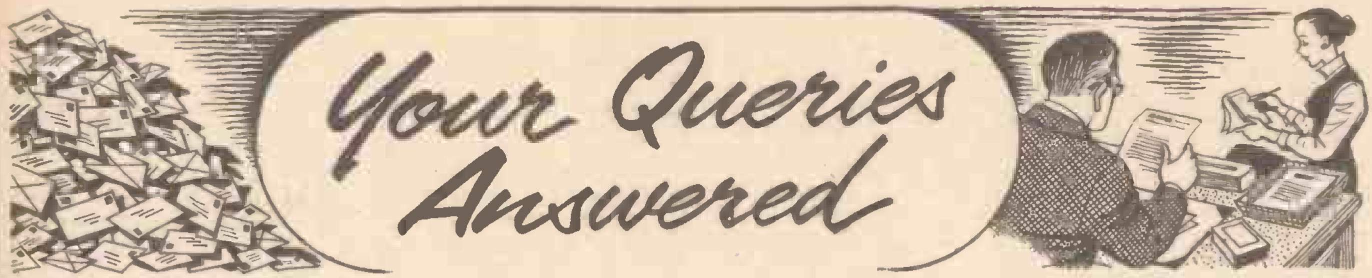

Including Indicator Lamp

I HAVE a 250 watt electric heating mantle working off the 240 volt mains. I wish to include an indicator lamp in a circuit of the 6 volt flashlight type. What is the simplest way of doing this?—H. R. (Ayr).

THE simplest method would be to connect 6ft. of 26 s.w.g. nickel-chrome resistance wire in series with the appliance, and to connect the six-volt low-current bulb across this resistance wire. The wire could be wrapped round a strip of mica.

Battery Charger

I RECENTLY built a battery charger, it is a 10 volt 4 amp. and 20 volt 4 amp. type. Would you kindly tell me what value choke and condenser I should use with same to obtain the highest efficiency?—B. Little (Bristol, 5).

IT is not necessary to use a choke coil or a condenser in a battery charger, assuming that the rectifier is a full wave one. Presumably you intend to use a transformer and metal rectifier. In this case we advise you to connect a variable resistance between the rectifier and battery. The resistance should be capable of carrying the required current continuously without overheating, and should have a value of approximately 0.5 ohm for the 10 volt output and 1 ohm for the 20 volt output.

Easing Threads

I HAVE a war-time pair of Kershaw 6 × 30 prism binoculars, the lenses of which need cleaning. The flanges surrounding the lower lenses, however, are rusted in and I am afraid to force them. The body of the glasses appears to be held together by four round-headed screws; can I carefully undo these and so take the glasses apart and clean them?—G. F. Parsons (Somerset).

YOU may be able to loosen the flanges by carefully depositing about three drops of paraffin around each and allowing this to soak in. If this does not loosen them add more drops and go all around each, rapping each joint thoroughly. It appears to us that the screws you mention hold the body together and we think that the only way to clean the lenses will be to unscrew them. Deposit drops of oil into the screw threads and in half-an-hour or so try to unscrew. On failure to remove the lenses we suggest that you visit your local optical repair agent.

Pipe Fittings Tests

I HAVE recently been testing pipe fittings at 100 p.s.i. air under water, i.e., filling the fitting with air and submerging it in a tank of water. Another method I use is a hydraulic test, i.e., pumping water into the fitting to a pressure of 300 p.s.i. I find that sometimes a fitting that will pass the hydraulic test will not pass the 100 p.s.i. air under water test.

Could you please explain this to me as I have been told the two tests should give the same results?—Thos J. H. Pate (Leeds).

THEORETICALLY the two tests should give the same results and especially as you, in the hydraulic test, use a pressure three times as great as that for the air test. It seems to us that if in the air test all you get is an air bubble escaping at long intervals you can only just be missing getting water in an hydraulic test. The two media are very different in structure and their molecules are of different size. Air is elastic and that is probably the cause of escape. Apart from all this, we cannot see any cause for different behaviour of the two.

An Electro Magnet

WOULD you please supply me with details of the construction of an electro magnet which would enable me to perform the conjuring trick where an aluminium disc or ring is levitated into mid-air from the surface of a table when an electro magnet placed under the table is switched on?—M. Parrish (London).

WE suggest that you use about 1½lb. of 32 s.w.g. enamelled copper wire wound on a straight core built of laminated Stalloy stampings about 0.014in. thick to about 1in. square cross sectional area and about 5in. long This should be fed from a 240 volt 50 cycle A.C. supply.

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Eyepiece Construction

I WISH to make an eyepiece of ¼in. focal length for my astro-telescope. Please tell me how to do it and where I may obtain the necessary lenses. — G. F. Clephane (Maidstone).

PRESUMABLY it is an eyepiece of the Huyghenian type that you wish to make. This is as simple a form as can be found and it is to all intents and purposes achromatic although neither of the two lenses of which it is composed is in itself achromatic.

The two lenses should have foci of

$$\frac{fF \times fE \times 2}{fF + fE} = \text{Equivalent focus.}$$

Where f is the focus, F the focus of the field lens and E the focus of the eye lens. And F should have a focus of three times the length of E. Therefore, if we assume that the focus of F is .48in. and E .16in. the condition is met and you have an equivalent f of .25in. nearly, as a matter of fact, .24in. instead of .25in. The lenses will be both plano convexed. They will be mounted with both their convexed surfaces towards the object glass and be separated a distance of: .48in. − .16in. = .32in. There should be a stop or diaphragm midway between them and the aperture of this stop should be about ⅛in. The diameters of the lenses should be: for F, about 5/16in. and for E, about 3/16in. Buy the lenses from a reputable firm and check on the foci before using them.

Telescope Object Glass

I WISH to construct a telescope and can obtain a double-convex lens, 4in. dia. × 33in. focus, for the O.G. Is there any way by which I can adapt the lens to an achromatic type? If it is too difficult, could you tell me from what manufacturers I could obtain an achromatic objective of about the same specification, and the cost?—V. R. Thorpe (London).

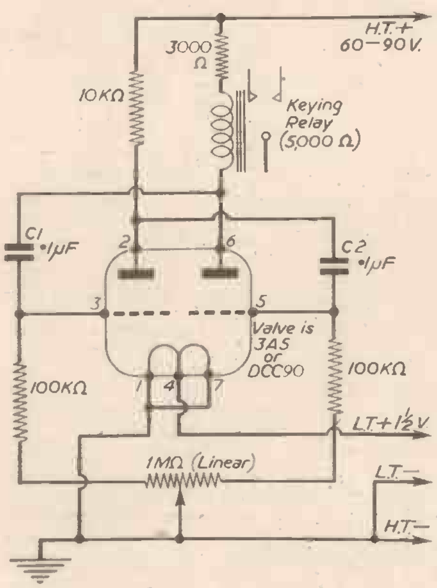
IF the focus of your object glass is to be no more than 30in. then it will be of no use to let the aperture be as much as 4in.; 1½in. will give better and clearer definition.

There is no way in which you can make it achromatic, except by buying an achromatic O.G. You would be well advised to buy an achromatic of as long a focus as possible. Let it be a standard size, say, 30 or 40in. focus and 2in. to 3in. aperture. Messrs. Broadhurst, Clarkson & Co., Ltd., 63, Farringdon Road, London, E.C.1, would supply you, or you could try one of our advertisers such as H. W. English, Rayleigh Road, Hutton, Brentwood, Essex.

It is a fact that on any given focal length, non-achromatic, you see less by increasing the aperture than you do by reducing it. This is due to spherical aberration coupled with chromatic aberration.

Multivibrator Control Box Circuit

IN your January, 1956, issue of "Practical Mechanics" the article on "Radio Controlled Models" gave a circuit for a multivibrator control box using a 6SN7-GT



Circuit details

valve. The writer also suggested the use of a 3A5 valve. Could you please supply me with a circuit diagram which includes valve-pin numbers for this type of control box? Also, would an H.T. supply of 120 v. be adequate for reliable operation?—Brian Dollin (London).

[*The series of articles on "Radio-controlled Models" is incorporated in our book "Radio-controlled Models" which costs 13s. 6d. by post.*—ED.]

THE circuit given here is only a suggestion for a multivibrator control box using a 3A5 or DCC90 type of valve. We have not tested it, but it follows conventional practice and should be satisfactory. If the pulse rate is too low then change C1 and C2 from 0.1 μF to 0.05 or 0.02 μF (these should be rated at 250 volts working to be on the safe side). The 1MΩ potentiometer controls the Mark/Space ratio. Do not use more H.T. voltage than necessary to give good relay action as this simply increases H.T. current consumption and serves no useful purpose. The 3,000 Ω resistor in series with the relay may be omitted but serves to balance the action of the two halves of the multivibrator.

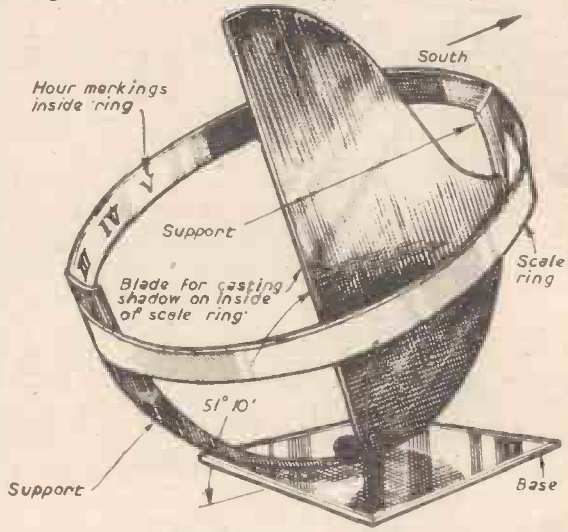
Sundial Details

I WISH to make a sundial of the type shown in the sketch. It consists essentially of an inclined scale ring and an upright blade which casts a shadow on the inside of the scale ring.

Can you give me any information regarding the inclination of the scale ring, inclination of the blade and any other general information regarding the construction and orientation of the parts?—E. Mason (Ashford).

THE information which you require is essentially the vertically fixed angle of the blade edge. This is known as the "gnomon" and its angle will depend upon the degree of latitude of the place where the sundial is to be set up. It is assumed that the scale ring will be fixed with its gnomon at Ashford or near there and as the latitude at Ashford is a little north of 51 deg. this will be the angle with the horizontal which the gnomon must make. The scale ring will be at right angles to this. Make the angle of the gnomon 51 deg., 10′ 0″, or 51 1/6 degrees.

Then there is another matter to get correct readings for time, the orientation of the sundial must point due north and south, i.e., the line of 12.0 and 6 o'clock must do so. The most simple way to get this correct will be by time signal, setting your watch, say, for the 8 a.m. signal and then at 12.0 noon, when the sun is shining, move the sundial around so that the shadow of the gnomon reads noon. It can be done at night or when there is no sunlight, with a compass held against the side of the gnomon and making correct allowance for compass or magnetic deviation. But this method is likely to prove less accurate so it would be better to set the sundial by time signal for 12.0 and check the readings by other hours.



Mr. E. Mason's Sundial

Waterproofing Concrete Floor

I HAVE a prefabricated garage made of wood and asbestos and erected on a concrete base; the garage is 12ft. × 8ft. When first erected I had trouble with water seeping under the walls. I have now sealed the outside and inside with Ruberoid cement but am still troubled with a large damp patch which now appears to come up through the floor. Can you suggest how I might overcome this? Is there some process by which I can treat the floor? The thickness of the floor is 4in. to 5in.—H. Faulkner (Surrey).

TO prevent the concrete of your garage from becoming damp sweep the floor clean and apply two coats of Cementone Floor Hardener and a coat of waterproofer. Treat the whole floor area.

Information Sought

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

Printing Photographs on Canvas

I WISH to find a sensitising solution which will enable me to print photographs on canvas. This must work with artificial light via an enlarger.

Can you suggest a formula or tell me where such a solution may be purchased?—F. J. HOFFMAN (Dublin).

Ink for Plastics: Plastic Solvent for Etching

CAN you give me any information regarding the ingredients of an ink that will take on celluloid or modern plastics, or the name of a firm supplying such an ink?

Or could you name or give the ingredients of any plastic solvent that could be employed as an etching medium, as acid is employed in process block making?—W. MONTAGU (Newcastle).

Remote Control Camera

I WISH to operate my camera by remote control using a solenoid mechanism powered by a hearing aid battery, and I will be grateful if you can tell me how to make such a mechanism—particularly the solenoid—and what materials to use.—J. MATTHEWS (Manchester).

Pianola Conversion

I HAVE a "Weber" pianola piano which I would like to convert to be driven by an electric motor (to replace the bellows). Would a motor driving a suction fan, blower or pump be necessary?—G. H. SIDDLE (Bradford).

Projection Screen from an Old Map

I HAVE an old 6ft. × 9ft. Ordnance Survey map (linen backed) and in excellent condition. Could you tell me whether the back can be treated or coated to serve as a projection screen?—M. J. FEEST (Aldershot).

Air-blown Accordion

I WOULD like to convert the treble side of a piano accordion into an air-blown instrument without the use of the bellows.

My idea is to discard the bass side and bellows of my instrument and mount the treble keyboard and reed blocks on a stand. I require something similar to the "Organa."

The air blower must be electrically operated, as silent as possible and, if it can be done, I would like some degree of volume control. What do you suggest?—N. HODGKINS (Walsall).

Transfers

PLEASE advise me how to make painted transfer numerals from paper to paintwork.

Failing this, could you suggest any literature covering the subject?—D. G. FRANCIS (Kenton).

Mercury U-tube Barometer

COULD anyone furnish me with particulars of the correct height of mercury and weights of glass balances of the long type mercury U-tube barometer; also the setting up to correct working order of the aneroid diaphragm barometer.—W. M. ROBERTS (Wrexham).

THE Cyclist
Editor : F. J. CAMM

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All letters should be addressed to the Editor, "THE CYCLIST," George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2

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

The Tests for 10 Year Old Cars

IT is perhaps a tribute to our manufacturers that the tests for 10 year old motor cars and motor cycles do not also include bicycles. There are hundreds of thousands of bicycles on the roads to-day long past a decade of use, which are in fine condition and quite roadworthy. It is also true to say that the keen club cyclist covers as many miles in the course of a year as the average motorist or motor cyclist. This does not necessarily mean that bicycles are made better than cars or motor cycles, but merely that they are looked after better—the whole of their mechanism is get-at-able and defects are obvious, whereas in motor vehicles they are not, and it is a major messy job to go over the various sources of trouble. Bicycles, of course, are much lighter and not subject to the same stresses as power-propelled vehicles. Bicycle bearings have an incredibly long life and it is very rarely indeed that one has to change them. When a change is necessary, the bearings "speak" to the rider. There is that "cronk" when power is applied to the pedals, and that irritating click when the chain wheel and sprockets are worn. When that occurs on my bicycles I renew the lot, for when one is audibly made aware of wear it is obvious that wear has also taken place in slower moving parts, such as the head bearing. It is a waste of money to put new chains on worn sprockets. It is a wonder that there has not been the usual outcry by motorists clamouring for bicycles to be tested also, but there is little or no evidence that accidents to cyclists have been caused by unroadworthy machines. Our Minister of Transport, who believes in making regulations rather than roads, however, may introduce a regulation roping in cycles for tests, since it is intended to lower the period for tests from 10 years to, say, five years. The idea has been in existence in Australia for some years, where the police carry out the tests, and not private garages. Should the Minister so act I would advise him to see that the tests are carried out by testers unconnected with the trade, the Cyclists' Touring Club or the N.C.U. In view, however, of the enormous voting power which cyclists possess I doubt whether the Minister will be so ill-advised. Indeed, he seems to be having second thoughts about the tests for motor cycles and cars for the appointed day for them has been postponed twice already. My guess is that they will not be introduced at all! And a good thing too, for statistics show that in only 2 per cent. of cases involving accidents has it been proved that the cause was the age of the vehicles concerned.

Blenheim—the glorious park which is open all the year round. It has wonderful views over the lake and palace. The park was designed by Capability Brown (18th Cent.).

My reason for informing the Minister that he should ignore any representations made by the C.T.C. is that its head office does not represent the opinion necessarily of the majority of its members. The policy is made in the office and the members blindly support it, perhaps with the helpless feeling that it would be useless to attend an annual general meeting and get a resolution carried because under C.T.C. constitution the council is not bound to adopt such a resolution. A second reason is that the C.T.C. has consistently blamed motorists for accidents, urged legislation against them, but has consistently opposed any regulations which applied to cycling.

For years, for example, they opposed rear lights and reflectors and any legislation making them compulsory. They conveniently forget, however, that they were the most vociferous in their demands for compulsory rear lighting on horse-drawn vehicles. Such legislation, of course, followed. When the tables were turned on them, however, they vigorously opposed them, as they have opposed everything in the way of legislation concerning cyclists.

Of course, the C.T.C. has to justify its existence in return for the membership fee. It must, from time to time, erect Aunt Sallies, in order to impress the members. They do still, of course, retain the right to erect "steep hill" notices even though by modern standards of braking such hills are no longer considered steep. We must also remember that these paid advocates who mouth their criticisms on every other road user except cyclists are in the same position as a counsel who defends a criminal without necessarily believing in his innocence.

When Were the Clubs Founded?

A READER asks me when the various clubs claiming to be national institutions were founded. The N.C.U. and the C.T.C. were both founded in 1878, the latter as the Bicycle Touring Club. It changed its title in 1882. The R.R.A. was founded in 1888, on the suggestion of A. J. Wilson. The Women's R.R.A. started to function in October, 1934, and the Road Times Trials Council in 1937. It took the place of the Road Racing Council. The British League of Racing Cyclists was founded in 1942. The oldest cycling club, which does not function as a cycling club, was founded in 1870. The members all assume Dickensian characters. The club is really a humorous skit on cycling, and purely a knife-and-fork club. The growth of the club movement is well exemplified by the following figures:

There was only one club in 1870; in 1871/2 there were four; in 1873/4 there were seven; 1875, nine; 1876, 31; 1877, 38; 1878, 40; 1879, 55; 1880, 213. To-day there are approximately 3,500 R.T.T.C./N.C.U. clubs, exclusive of B.L.R.C.

The White Swan, Twickenham.

CYCLING MATHEMATICS

Explained by C. J. J.

Knowing How to Make These Simple Calculations Will Add Interest to Your Cycling

CYCLE gears are always expressed in inches in this country and at first sight this system appears completely illogical, as the figures mean nothing at all, apart from acting as a means of comparison. The system, however, is a relic from the days of the old Ordinary or "penny-farthing." Then a gear of 54in. indicated a front, or driving, wheel of 54in. diameter (Fig. 1).

When the safety bicycle and the chain drive were introduced the same system was carried over and to explain this simply, assume 27in. wheels and a 2 : 1 drive, i.e., 46-tooth chainwheel and a 23-tooth driving sprocket. The gear is still 54in., this being obtained by modifying the new wheel diameter by the ratio between chainwheel and sprocket, i.e., $\frac{27}{1} \times \frac{46}{23}$ or $27 \times 2 = 54$in. See Fig. 1.

From the foregoing there emerges a standard formular for calculating cycle gears; this is wheel diameter × number of teeth on chainwheel divided by number of teeth on rear sprocket. A typical calculation would be for a machine equipped with 27in. wheels, 48-tooth chainwheel and 18-tooth rear sprocket, viz., $\frac{27}{1} \times \frac{48}{18} = 72$in.

Finding Sprocket Size

It may be required to fit a certain gear for some specific reason, i.e., a 72in. restricted gear time trial and a different version of the formula given above can be used to find the size of sprocket required. Here the wheel diameter is multiplied by the number of teeth in the chainwheel and divided by the gear required in inches, e.g., $\frac{27}{1} \times \frac{48}{72} = 18$ teeth for the rear sprocket.

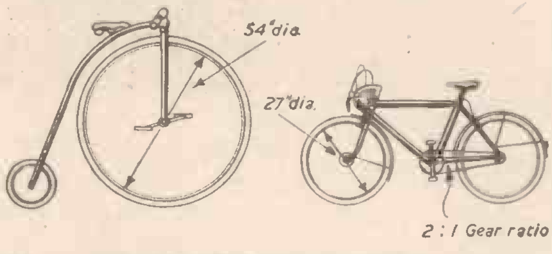

Fig. 1.—How the present system of expressing cycle gears originated.

Gears do not always work out so conveniently, however. Try another calculation and assume that it is required to change the above gear to 64in. The method of working as has been shown is: $\frac{27}{1} \times \frac{48}{64} = \frac{81}{4} = 20.25$. The nearest to this, of course, is a sprocket of 20 teeth. Using this sprocket, the gear obtained is: $\frac{27}{1} \times \frac{48}{20} = \frac{324}{5} = 64.8$in.

To get nearer than this try changing the size of the chainwheel. Use another version of the same formula and multiply the number of teeth on the rear sprocket by the gear required in inches and divide by the wheel diameter. This is: $\frac{20}{1} \times \frac{64}{27} = \frac{1,280}{27} = 47.4$ or a 47-tooth chainwheel. This will give a gear of $\frac{27}{1} \times \frac{47}{20} = \frac{1,269}{20} = 63.45$in.—just a little nearer than 64.8in.

The answers to all these problems can, of course, be obtained from a set of gear tables with much less trouble, but it is interesting to know how they are worked out.

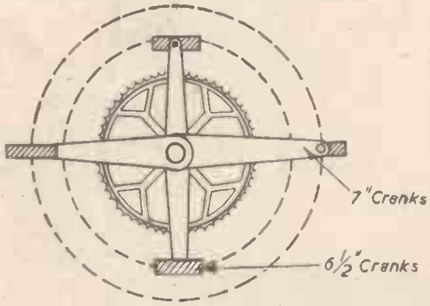

Fig. 2.—With 7in. cranks the feet travel in a larger circle than with 6½in. cranks and therefore travel further for the same amount of forward distance travelled.

Distance Travelled

Remember that the gear size in inches represents the diameter of a directly driven single large wheel. To relate this measurement to distance travelled, the circumference must be found. This is obtained by multiplying the wheel diameter or gear of the bicycle by π or 3 1/7. Assume a gear of 70in. Multiplying this by 3 1/7, viz., $\frac{70}{1} \times \frac{22}{7} = 220$in. This is the distance travelled by the bicycle in one revolution of the cranks or two strokes of the pedals. If this distance is divided into one mile, the number of revolutions of the chainwheel or half the number of pedal strokes is the result. The calculation is as follows: $\frac{1,760 \times 3 \times 12}{220} = 288$ revolutions per mile or 576 pedal strokes.

Calculating Speed

Once the number of chainwheel revolutions per mile is known it is simple to calculate speed. Count the revolutions until one mile is covered, noting the time before starting and after travelling the required distance. If the journey takes three minutes, your speed is 20 miles per hour, if it takes three and a half minutes you are travelling at 17 miles per hour and four minutes would mean a speed of 15 miles per hour. These, of course, are standards on which a quick approximation of speed can be based, but a time in between the round figures mentioned can be worked out by the following method: change the time into seconds and divide it into 3,600 (the number of seconds in an hour). For example, if the time recorded was 3 min. 39 sec., the calculation would be $\frac{3,600}{219}$ which equals 16.44 miles per hour.

On the Continent

The Continental countries use a different system and one which has much more meaning. In the Continental system the gear represents the distance the cycle will travel in metres for one revolution of the pedals—there is no need to multiply by π as in the English system.

To convert an English gear to the Continental system, multiply by 8 and divide by 100, i.e., to change a gear of 72in. to its Continental equivalent, the following calculation is required: $\frac{72}{1} \times \frac{8}{100} = 5.76$ (the machine will travel 5.76 metres for one revolution of the cranks.

Conversely, to convert a Continental gear to English, multiply it by 100 and divide by 8. For instance, a gear 4.97 multiplied by 100 = 497 and divided by 8 = 62.1 in.

Crank Length

In none of the foregoing calculations has the length of crank been taken into consideration. A little thought and a glance at Fig. 2, will show that a 65in. gear with 6½in. cranks is not the same as a 65in. gear with 7in. cranks. What really counts is the ratio between the distance travelled in a circular path by the feet and the distance travelled in a straight line by the bicycle. It will be clear from the sketch that the longer crank, in effect, lowers the gear, or, if it suits the rider's physique, makes it easier for him to turn the gear. A 65in. gear with 6½in. cranks is as hard to turn as 70in. with 7in. cranks.

Servicing Your Hub Brake

ONE cause of an inefficient hub brake is oil on the linings and this can be caused by the oil drainage hole being choked with dirt. In this case new linings will be required and when they are fitted make sure that the drainage hole is cleaned out.

Worn linings will also have the same effect of inefficient brake action, and again the only solution is replacement. Sometimes, however, the fault is only incorrect adjustment. In this case, the adjusting nuts should be tightened until it can be felt that the linings are just touching the brake drum and then slackened off until they just clear.

Sometimes it may be noticed that the brake is jerky in its action and this can only be caused by a hub drum which has been pulled out of truth. This probably occurred when the wheel was being built or when it was trued and normally only necessitates retruing with a spoke key.

The source of squealing in a hub brake is usually in the lining itself and may be due either to a loose rivet or the front edge of the lining not being tapered off, causing the lining to vibrate. In the first case the head of the rivets in the lining should be supported on a piece of rod in the vice and the projecting tail of the rivet burred over with a hammer and punch. In the second case the lining must be removed and then replaced correctly. One other cause of a squealing brake is a brake arm clip which has worked loose; here, of course, the remedy is obvious.

Finally, knocking or clicking noises may be caused either by loose hub shell rivets or a scored brake drum surface. The remedy here is to replace the hub shell.

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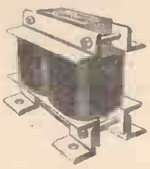

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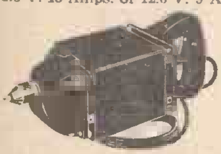

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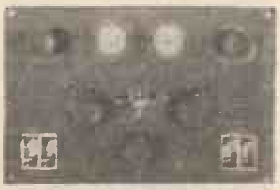

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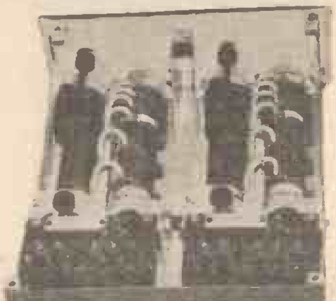

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